APPENDIX C

U.S. COAST GUARD'S WATERWAYS SUITABILITY REPORT

APPENDIX C

U.S. Coast Guard's Waterways Suitability Report

The Coast Guard issued its Waterways Suitability Report (WSR) for the Proposed Broadwater Liquefied Natural Gas Facility on September 21, 2006. The Cost Guard also filed the document with FERC, and it is available in the Broadwater Docket (CP06-054-000).

This appendix to the EIS includes the Coast Guard's summary letter, the complete text of the publicly available portion of the report, and Appendix G to the WSR (ESI maps). The WSR includes the following technical appendices that are not provided in this appendix to the EIS:

- Appendix A - Broadwater Correspondence
- Appendix B - Final PAWSA Report
- Appendix C - Letter Categorization Totals
- Appendix D - Broadwater Filter
- Appendix E - Monthly AIS Data
- Appendix F - Buoy Data
- Appendix H - Safety Risk Assessment
- Appendix I - FSRU Navigational Equipment and Personnel Requirements

U.S. Department of Homeland Security
United States Coast Guard

Commander
United States Coast Guard
Sector Long Island Sound

120 Woodward Ave.
New Haven, CT 06512
Staff Symbol: Prevention
Phone: (203) 468-4444
Fax: (203) 468-4443

16613
September 21, 2006

Coast Guard Report on the Broadwater Energy LNG Proposal

The Coast Guard Captain of the Port for Long Island Sound has completed an assessment of the safety and security issues for the Broadwater Liquefied Natural Gas (LNG) facility proposed for Long Island Sound. The Coast Guard position is to neither support nor oppose this proposal but, rather, to provide an objective analysis of the navigational safety and maritime security issues associated with the Broadwater Energy LNG proposal. As the lead federal agency responsible for waterway safety and maritime security, the Coast Guard's recommendation is based solely on an objective assessment of whether the waterway is suitable with respect to navigation safety and maritime security for LNG marine traffic and the operation of the proposed facility. This assessment is based on the Coast Guard's statutory authority provided by the Ports and Waterways Safety Act (33 U.S.C. §§ 1221 *et seq.*) and the Maritime Transportation Security Act of 2002.

The Federal Energy Regulatory Commission (FERC) is the lead federal agency responsible for determining whether or not the Broadwater proposal will be licensed. As such, this Coast Guard assessment is not an approval or disapproval of the Broadwater proposal. There are many other issues beyond the scope of this assessment that FERC will address through the development of an Environmental Impact Statement (EIS), required under the National Environmental Policy Act (NEPA). FERC's review process and contact information are available at the FERC website, http://www.ferc.gov/for-citizens/for-citizens.asp.

The Coast Guard will provide this assessment (called the Waterway Suitability Report) to FERC for inclusion in the draft EIS. This report will also be posted on the Sector Long Island Sound public information web page at www.uscg.mil/d1/units/seclis/public.html. Certain portions of the report are restricted as Sensitive Security Information (SSI), governed under Title 49, Code of Federal Regulations (CFR) 1520.

This assessment and report took over a year to complete and is based on an analytic and objective assessment of potential risks to navigation safety and maritime security associated with the proposed Broadwater Energy project. The assessment included input from a Harbor Safety Working Group comprised of approximately 30 representatives of commercial, recreational and government waterway users as well as state and local agencies with responsibilities related to waterway safety. It also included input from a Sub Committee of the Long Island Sound Area Maritime Security Committee that included approximately 20 representatives of federal, state and local agencies with responsibilities related to maritime security. Extensive public input was also received through written comments that were submitted to the Coast Guard's docket for this project and during public scoping meetings that were held with FERC.

Coast Guard Report on the Broadwater Energy LNG Proposal

Background, key points, and conclusions of the report are summarized in this letter. Detailed discussion and analysis is contained in the text of the full Waterway Suitability Report.

Background:

- Broadwater Energy is proposing to build a floating storage and regasification unit (FSRU) in Long Island Sound. The FSRU would measure approximately 1,215 feet in length, 200 feet in width, and would rise approximately 80 feet above the water line to the deck. The FSRU's draft would be approximately 40 feet. The entire cargo containment system of the FSRU is protected by a double hull.

- The FSRU itself would have 8 LNG tanks, each having an approximate volume of 44,850 m^3, for a total net storage capacity of 350,000 m^3. The LNG would be maintained at a temperature of minus 260° F and at a normal operating pressure of 1-3 pounds per square inch (psi), closely approximating atmospheric pressure. No mechanical means of refrigeration would be required.

- The FSRU would be secured via a Yoke Mooring System (YMS) attached to a stationary tower structure secured to the seabed, housing a sendout pipeline. The YMS is designed to allow the FSRU to pivot or weathervane around the tower. The FSRU would have a single berth on its starboard side to accommodate LNG tankers for off-loading LNG.

- As proposed, LNG would be delivered to the FSRU by 2 to 3 LNG tankers per week with cargo capacities ranging from 125,000 m^3 to 250,000 m^3.

- The location where Broadwater Energy has proposed to construct and operate the FSRU is in state waters. Therefore, the lead federal agency for this project is the Federal Energy and Regulatory Commission (FERC). As the lead federal agency, FERC is responsible for making the decision whether to license the project. In accordance with an interagency agreement, the Coast Guard is a cooperating agency and is responsible for providing input regarding navigation safety and maritime security to FERC as part of the environmental review process required by the National Environmental Policy Act (NEPA, *see* 42 U.S.C. §§ 4321 - 4370).

- The LNG carriers for the proposed project will transit waters under the jurisdiction of the state of New York, and in some cases may transit the waters under the jurisdiction of the states of Connecticut and Rhode Island.

Key Points:

- Long Island Sound is a mixed use waterway. Recreational, commercial, naval and fishing boats share this estuary of national significance.

- Typically 450 foreign flagged vessels per year call on ports in Long Island Sound. In addition, approximately 4000-7000 domestic commercial vessels transit Long Island Sound each year. The addition of the proposed LNG tankers transiting to the FSRU would increase foreign flagged vessel traffic volume by 20-30%. The overall increase of commercial vessel traffic in Long Island Sound would be less than 1%.

- There are currently no known, credible threats against the proposed Broadwater Energy facility. However, it should be noted that the threat environment changes and that some threats may be unknown. If the project is approved by FERC, periodic threat assessments must be conducted to ensure the security measures in place are appropriate.
- Over the approximately 45 years since the shipment of LNG began, more the 33,000 LNG carrier voyages have taken place. Eight marine incidents worldwide have resulted in LNG spills. No cargo fires on LNG carriers have occurred.
- The proposed location of the FSRU (approximately 10.2 miles from Connecticut and 9.2 miles from New York) has a number of significant safety and security benefits, including reducing threat and public safety consequences since it would be remote from population centers, and protection from open ocean sea conditions. However, the remote location also creates some challenges since it would require that a law enforcement presence be projected to the center of the Long Island Sound.
- The principle characteristic of the consequences of a large open air release of LNG due to an accident or an attack is a fire, not an explosion. LNG fires are very intense and are of short duration, e.g., on the order of an hour. The analysis of consequences was based on the findings in the Sandia National Laboratories Report SAND 2004-6258: Guidance on Risk Analysis and Safety Implications of a Large Liquefied Natural Gas (LNG) Spill over water. The Sandia Report can be found at http://www.fossil.energy.gov/programs/oilgas/storage/lng/sandia_lng_1204.pdf#search=%22Sandia%20LNG%20Report%22.
- None of the hazard zones identified in the Sandia Report (Zone 1, Zone 2, or Zone 3) around the FSRU would impact any population centers due to their distance from land. Neither hazard Zone 1 nor Zone 2 for the next generation LNG tanker would impact land along the proposed transit route. Hazard Zone 3 (unignited vapor cloud) could impact land along limited portions of the proposed transit route.
- The purpose of a safety/security zone is two-fold: to reduce risks to the public by limiting access to the areas of highest consequences should an LNG fire occur; and, to provide a security perimeter to protect the FSRU and LNG tankers.
- The proposed safety/security zone around the FSRU is a circle centered on the mooring tower with a radius of 1210 yards (equal to an area of 1.48 square miles). Long Island Sound is approximately 1320 square miles (an area that is by comparison nearly the size of Long Island, which is 1379 square miles). The area covered by the proposed safety/security zone is approximately 0.12% of the total area of Long Island Sound.
- The proposed safety/security zone around the LNG tanker while in transit in Long Island Sound would extend 2 nautical miles in front of, 1 nautical mile behind, and 750 yards to either side of the LNG tanker. The safety/security zone would move with the LNG

tanker. At a typical LNG tanker speed of 12 knots, it would take the entire zone approximately 15 minutes to pass a given point.

- The Race is a critical waterway connecting Block Island Sound and Long Island Sound used for national defense, commerce, and recreation. The impacts on other waterway users of a moving safety and security zone, if implemented, around LNG tankers could be managed.
- Additional resources would be needed to mitigate safety and security risks associated with the Broadwater LNG project, if approved. The most probable security regime would consist of a mix of federal (including Coast Guard), state, and local law enforcement. If state and local law enforcement agencies are involved, they would also require additional resources. In the event that state and local law enforcement agencies are involved, these agencies and Broadwater Energy would be responsible for brokering a cost sharing agreement.
- Additional marine firefighting resources would be required to mitigate fire risks associated with the Broadwater LNG project, if approved. Existing marine firefighting capability in Long Island Sound is inadequate.

Conclusion of the Coast Guard Waterway Suitability Report:

Based on Coast Guard policy guidance, the Captain of the Port can generally make one of three conclusions regarding the suitability of a waterway to support LNG marine traffic. The first is that the waterway is suitable without the implementation of additional measures. The second is that the waterway is unsuitable. The third is that to make the waterway suitable, additional measures are necessary to responsibly manage risks to navigation safety or maritime security associated with LNG marine traffic and the operation of the FSRU.

Based on the results of this assessment of potential risks to navigation safety and maritime security associated with Broadwater Energy's proposal, the Coast Guard has determined that to make the waters of Block Island Sound and Long Island Sound suitable for LNG vessel traffic and the operation of the proposed FSRU, additional measures would be necessary to responsibly manage the safety and security risks associated with the proposed project.

The Waterway Suitability Report includes a series of risk management strategies that the Coast Guard has determined would be necessary as additional measures to responsibly manage risks to navigation safety and security risks associated with the proposed Broadwater LNG project. These management strategies include both measures designed to reduce risk by reducing the potential that an accident or terrorist attack may be attempted as well as measures designed to reduce the potential consequences if there was a large release of LNG from either the proposed FSRU or an LNG tanker.

Next Steps:

FERC will issue a draft Environmental Impact Statement (DEIS) that includes the Coast Guard's Waterway Suitability Report. FERC's DEIS will address the full spectrum of environmental impacts associated with the proposed project. Following public comment, which may include a series of public meetings, FERC will issue a final EIS (FEIS). Based on the FEIS, FERC will make a licensing decision. Questions regarding these actions should be directed to FERC at 1-866-208-3372 or Email: customer@ferc.gov.

Following the issuance of the FEIS, the Coast Guard Captain of the Port (COTP) Long Island Sound will issue a Letter of Recommendation (LOR) in accordance with 33 C.F.R. § 127.009 to Broadwater Energy and the appropriate federal, state and local agencies. The LOR will be an official determination regarding the suitability or unsuitability of Long Island Sound with respect to navigation safety and security to support the proposed FSRU and associated LNG tanker traffic. The LOR, which will be based on this Waterway Suitability Report, will not be issued until after the NEPA process has been completed.

If the proposed project is licensed by FERC and constructed by Broadwater Energy, the Coast Guard will have continuing involvement in the project, including review and approval of security plans, active participation in the emergency response planning process required the Energy Policy Act (EPACT) of 2005, implementation and overall coordination of enforcement of safety/security zones, and oversight of appropriate navigation standards.

P.J. Boynton
Captain, US Coast Guard
Captain of the Port, Long Island Sound

U.S. Department of
Homeland Security

United States
Coast Guard

U.S. COAST GUARD CAPTAIN OF THE PORT LONG ISLAND SOUND WATERWAYS SUITABILITY REPORT FOR THE PROPOSED BROADWATER LIQUEFIED NATURAL GAS FACILITY

Released on:
September 21, 2006

1 Introduction

This document constitutes the United States Coast Guard (USCG) Captain of the Port Long Island Sound's (COTP Long Island Sound)[1] Waterways Suitability Report for the proposed Broadwater Liquefied Natural Gas (LNG) Facility. This Waterways Suitability Report (WSR or Report) meets the intent of paragraph 6.b.[2] of U.S. Coast Guard Navigation and Vessel Inspection Circular (NVIC) 05-05.[3] NVIC 05-05 establishes Coast Guard policy for assessing the suitability of a waterway to support LNG carrier traffic. This Report was compiled from several resources, some of which have been provided by the applicant, including the Application filed with the Federal Energy Regulatory Commission (FERC) and information provided via correspondence from Broadwater Energy directly to COTP Long Island Sound.[4]

1.1 Role of the USCG Captain of the Port Long Island Sound

COTP Long Island Sound received a Letter of Intent (LOI) in accordance with Title 33 Code of Federal Regulations (CFR), section 127.007 from Broadwater Energy on November 9, 2004. That LOI, which was subsequently amended on April 26, 2005,[5] notified the COTP Long Island Sound that Broadwater Energy, a joint development of Shell US Gas & Power, LLC and TransCanada PipeLines USA, Ltd., intends to construct and own an offshore liquefied natural gas (LNG) terminal and sendout pipeline near the center of Long Island Sound in New York State waters.

Before construction of the offshore structure - technically termed a "Floating Storage and Regasification Unit" (FSRU) - can commence, the proposed Broadwater Energy LNG facility must receive regulatory approval to proceed from several federal and state agencies. FERC is the lead federal agency responsible for licensing LNG facilities located on shore and within state waters under Section 3 of the Natural Gas Act.[6] FERC is responsible for conducting an appropriate study under the National Environmental Policy Act (NEPA).[7] FERC conducts environmental, safety, and security review of LNG

[1] COTP, Long Island Sound's Area of Responsibility is defined in 33 CFR, § 3.05-35.
[2] Paragraph 6.b. of NVIC 05-05, *Guidance on Assessing the Suitability of a Waterway for Liquefied Natural Gas (LNG) Marine Traffic*, addresses that for applicants with applications under FERC review, that FERC, on a case-by-case basis, and in consultation with the Coast Guard, will review the need for an applicant to complete a Waterways Suitability Assessment outlined in the NVIC. See Section 1.2 for a discussion of how this Report follows the guidance provided in NVIC 5-05. NVIC 5-05 can be found on the U.S. Coast Guard Sector Long Island Sound website at http://www.uscg.mil/d1/units/seclis/broadwater/broadwater.html.
[3] NVIC issued by the Coast Guard are intended as guidance to the Coast Guard and maritime community; they are not regulations and therefore do not impose requirements upon the maritime community or industry.
[4] See Appendix A, which contains a compilation of all correspondence between the Coast Guard and Broadwater. Correspondence containing Sensitive Security Information and Critical Energy Infrastructure Information is not contained in the Public version of the WSR.
[5] Broadwater's LOI and Amended Letter of Intent are provided in Appendix A.
[6] 15 U.S.C. § 717 et seq.
[7] NEPA, 42 U.S.C. §§ 4321-4370(d).

plants and related pipeline facilities, and as the lead federal agency for the process of authorizing the siting, construction, and operation of such facilities, prepares the overall NEPA documentation.[8] In accordance with an Interagency Agreement between FERC and the Coast Guard,[9] the Coast Guard is a cooperating agency with FERC under the NEPA process, and will be providing input to FERC throughout the licensing process.

The USCG exercises regulatory authority over LNG facilities which affect the safety and security of port areas and navigable waters under Executive Order 10173, the Magnuson Act,[10] the Ports and Waterways Safety Act of 1972, as amended,[11] and the Maritime Transportation Security Act of 2002.[12] The USCG is responsible for matters related to navigation safety, vessel engineering and safety standards, and all matters pertaining to the security of facilities or equipment located in or adjacent to navigable waters. The USCG also has authority for LNG facility security plan review, approval and compliance verification as provided in Title 33 CFR, Part 105, and siting as it pertains to the management of vessel traffic in and around the LNG facility.

1.2 USCG Waterways Suitability Report, Safety and Security Assessments, and Letter of Recommendation

In accordance with the FERC/USCG Interagency Agreement the Coast Guard is a cooperating agency throughout FERC's NEPA review process for proposed LNG facilities. Through this process, the Coast Guard provides its expertise in matters related to navigation safety, vessel engineering and safety standards, and port security associated with proposed LNG facilities.[13] Other issues such as environmental impacts and alternatives are addressed by FERC through the NEPA review process. The Coast Guard COTP Long Island Sound also has a regulatory responsibility regarding the LNG carriers transiting the waterway: in accordance with NVIC 05-05 the Coast Guard will provide FERC a recommendation in accordance with 33 CFR §127.009 regarding the suitability of the waterway to support LNG carrier traffic and FSRU operations. This Report supports the Letter of Recommendation being submitted by COTP Long Island Sound to FERC for safety and security issues.

This Report contains an analysis of potential navigation safety and maritime security risks associated with the proposed facility and LNG carrier transits on the waters of Block Island Sound and Long Island Sound. This Report also contains a discussion of

[8] 18 CFR, Part 380.
[9] Interagency Agreement among the Federal Energy Regulatory Commission, United States Coast Guard, and Research and Special Programs Administration for the Safety and Security Review of Waterfront Import/Export Liquefied Natural Gas Facilities, effective 10 Feb 2004. A copy of the Interagency Agreement is available at http://www.uscg.mil/d1/units/seclis/broadwater/broadwater.html. Hereafter FERC/USCG Interagency Agreement.
[10] 50 U.S.C. § 191.
[11] 33 U.S.C. § 1221, *et seq*.
[12] 46 U.S.C. § 701.
[13] FERC/USCG Interagency Agreement, p. 2. Vessel engineering and safety standards are addressed in Section 1.2.1.

strategies for managing potential risks associated with the proposed project. Broadwater Energy was approved by FERC to proceed with the Pre-Filing process with FERC in November 2004.[14] Coast Guard policy and required actions by the applicant, the Coast Guard and FERC with respect to proposed LNG facilities are outlined in NVIC 05-05. Because the application process and LOI was received prior to the issuance of NVIC 05-05, COTP Long Island Sound initiated a review of this proposal in accordance with the guidance in 33 CFR, Part 127 prior to NVIC 05-05's effective date. COTP Long Island Sound is therefore conducting this WSR in accordance with paragraph 6.b.1 of NVIC 05-05. COTP Long Island Sound has required Broadwater to provide information that is consistent with what would have been provided in a Waterway Suitability Assessment.[15] This Report was compiled from several resources, including information provided from Broadwater; its application to FERC, dated January 30, 2006; and the associated Resource Reports.[16]

1.2.1 FSRU and Yoke Mooring System Design Review

The proposed Broadwater Energy FSRU incorporates all of the design and engineering components of an LNG import facility, e.g., LNG processing equipment, as well as those of an offshore marine facility, e.g., the yoke mooring tower. It also incorporates features that are similar to an LNG carrier, e.g., a hull with internal LNG cargo tanks. Whereas some of these areas fall within FERC's area of expertise, others fall within the Coast Guard's. There are also areas where the expertise of both agencies overlaps. Therefore, as provided for by the FERC/USCG Interagency Agreement, both agencies are participating in the review and approval of the design of the proposed FSRU and the yoke mooring system.

The division of agency responsibilities was worked out over the course of several meetings involving appropriate staff from FERC and the Coast Guard. In general, the division of responsibility for reviewing the design of the proposed FSRU and its components, which includes the yoke mooring system, is summarized in Table 1-1.

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[14] The FERC pre-filing process is available at http://www.ferc.gov/help/processes/flow/lng-1.asp.

[15] NVIC 05-05, Enclosure (2).

[16] Resource Reports contain environmental documentation required in accordance with NEPA and must accompany applications to FERC for the licensing of a project regulated under the Natural Gas Act. Title 18 CFR § 380.12 requires the submittal of 13 different Resource Reports, each analyzing the project's projected effects on various aspects of the environment, including Water Use and Quality, Air and Noise Quality, and Land Use, Recreation, and Aesthetics. *See* 18 CFR, Part 380. Two sets of Resource Reports for Broadwater were used as references for this Report: the Resource Reports accompanying the main project application, and that providing information regarding the Onshore Facilities. These are respectively labeled "Resource Reports" and "Onshore Facilities Resource Reports."

Table 1-1: FERC and Coast Guard Areas of Responsibility

FERC	Coast Guard	FERC and Coast Guard
• Review LNG pumps and vaporization systems • Review LNG process piping systems and vessels • Review LNG process instrumentation and controls • Review LNG process electrical equipment • Review other equipment normally reviewed for an on-shore terminal	• Provide recommendation to FERC re approval for selection of classification society or third party design agent[17] • Assess the design basis for the FSRU • Conduct oversight review of the proposed structural design • Conduct oversight review of the proposed structural design of the yoke mooring system	• Review of general arrangement and equipment layout • Review LNG storage tank design and construction • Review of relief and venting systems • Review of emergency shutdown systems • Review of LNG spill containment systems • Review of hazard detection and control systems

Authority for the review of the design and engineering of the Broadwater Energy proposal is based on FERC's statutory authorities and responsibilities rather than exercising the Coast Guard's own statutory authority in 46 U.S.C. § 3306 to approve vessel plans. Therefore, the Coast Guard will advise FERC regarding the adequacy of the design information submitted by Broadwater Energy. As appropriate, the Coast Guard, acting under the authority in 33 U.S.C. §§ 1221 *et seq.* will also inform FERC of design and construction-related issues that are identified as part of the safety and security assessments of the proposed project. In either instance, the Coast Guard will work with FERC to ensure that the concerns raised are adequately addressed.

Because the proposed project involves the integration of different components, a critical input for the regulatory review and approval of the proposed design is the process for selecting appropriate design and construction standards. The application Broadwater Energy filed with FERC on January 30, 2006 for the proposed project did not include sufficient information regarding this issue. FERC and the Coast Guard determined that the information provided by Broadwater Energy in its application was not sufficient to proceed with a detailed engineering review. Based on information provided by Broadwater Energy in a supplemental filing on March 14, 2006, FERC and the Coast Guard were able to initiate the engineering review. As this review proceeded, it became apparent that additional information regarding the process for selecting design and construction standards was required. FERC and the Coast Guard issued a data request to Broadwater Energy on May 5, 2006 requesting this information. During a review of the information provided by Broadwater Energy during the Cryogenic Technical Conference conducted in Port Jefferson, New York on June 6, 2006, it was determined that this critical process had not been defined with sufficient detail for FERC and the Coast Guard to complete the initial engineering review of the proposed project. A subsequent joint data request was issued on June 20, 2006. Broadwater Energy filed the information that was requested with FERC and the Coast Guard on August 15, 2006.

[17] The third party design agent would work on behalf of FERC and the Coast Guard to review design plans for the proposed FSRU and its systems, including the yoke mooring tower. FERC, with assistance from the Coast Guard, is currently reviewing Broadwater Energy's nomination of the American Bureau of Shipping to serve as the third party for this project.

1.2.2 Ports and Waterways Safety Assessment

A Ports and Waterways Safety Assessment (PAWSA) conducted in May 2005 provided a baseline for analysis of navigational safety concerns for Long Island Sound.[18] A PAWSA is a systematic assessment designed to identify major waterway safety hazards, estimate risk levels, and evaluate potential mitigation measures to reduce risk for a waterway. Long Island Sound and its approaches were considered in the PAWSA. The PAWSA helped highlight several risk areas that need to be addressed for Long Island Sound, including: traffic congestion; waterways mix; visibility (e.g. fog); and waterways configuration, specifically at The Race. The PAWSA covered all navigational safety concerns for Long Island Sound, including those that could be anticipated if the proposed Broadwater facility is constructed. While not focused on the Broadwater proposal, the PAWSA provided a baseline for our subsequent analysis of the Broadwater proposal, as well as for addressing other navigational concerns within Long Island Sound.

1.2.3 Safety and Security Working Groups

Waterways users and stakeholders, as well as members of the public have also contributed to the information contained in both the safety and security assessments, Sections 4 and 5 of this Report. As part of its assessment of the safety and security of this project, the Coast Guard COTP Long Island Sound has convened safety and security working groups. For each of these working groups, a balanced group of individuals, from both New York and Connecticut were chosen to ensure that concerns of both sides of Long Island Sound were considered. None of the participants were asked to 'vote' or otherwise indicate whether the Broadwater Energy proposal should be approved. Rather participants were relied upon to provide input based on their expertise and perspective to provide a more thorough assessment of potential risks to navigation safety and port security associated with the proposed project as well as potential mitigation measures.

1.2.3.1 *Harbor Safety Working Group*

The COTP Long Island Sound formed a Harbor Safety Working Group (HSWG) composed of waterways users and other stakeholders. The HSWG met initially as a whole in December 2005, and the consultation process has included subsequent collaboration with members. Participants included representatives from the following:

- U.S. Coast Guard
- Reinauer Transportation Companies
- Moran Towing

[18] The Long Island Sound PAWSA report is provided as Appendix B of this Report.

- Connecticut Department of Environmental Protection, Boating Advisory Council
- Connecticut Lobsterman's Association
- Connecticut Shellfisherman's Association
- Fire Marshal, Town of Riverhead
- New Haven Fire Department
- Bridgeport-Port Jefferson Steamboat Company
- Cross Sound Ferry Services, Inc.
- Connecticut and New York licensed marine pilots
- New York State Park Police
- National Oceanic and Atmospheric Administration, Navigation Manager, Northeast
- High Speed Ferry Task Force
- Keyspan Energy
- Citizens Campaign for the Environment
- U.S. Power Squadron District 3
- Vessel HELCAT II and the National Party Boat Owner's Alliance
- Connecticut Harbor Management Association
- Town of Brookhaven Harbor Master
- Connecticut Department of Environmental Protection, Boating Division
- Bay Constables, Brookhaven, New York
- U.S. Navy Commander Sub Group Two
- EPA Long Island Sound Study, Citizens Advisory Committee
- Nassau County
- Suffolk County Fire and Rescue
- The Huntington Yacht Club
- The Riverhead Police Department

This Working Group was formed to review the safety risk assessment compiled by the COTP Long Island Sound and to help evaluate proposed risk mitigation measures. Specifically, participants were asked to assign scores to the safety risk assessment, and their input validated the risk mitigation measures recommended by COTP Long Island Sound. The safety risk assessment and risk mitigation measures are discussed in more detail in Section 4 of this Report.

1.2.3.2 *Security Assessment*

The Coast Guard has conducted its security assessment in conjunction with a Sub Committee of the Area Maritime Security Committee.[19] This Sub Committee included representatives of the following:

[19] Requirements for forming an Area Maritime Security Committee, it's composition and responsibilities are found at 33 CFR §§ 103.300, 103.305, and 103.310, respectively.

- U.S. Coast Guard
- U.S. Department of Homeland Security (Infrastructure Protection)
- Customs and Border Protection (CBP)
- Federal Bureau of Investigation (FBI)
- Transportation Security Administration (TSA)
- U.S. Navy
- New York Office of Homeland Security
- New York Department of Naval and Military Affairs
- Connecticut Department of Emergency Management and Homeland Security
- Connecticut Department of Environmental Protection
- Connecticut National Guard Bureau
- Nassau County Police Department
- Nassau County Office of Emergency Management
- Suffolk County Fire and Emergency Services
- Riverhead Police Department
- Southold Police Department
- City of New Haven Fire Department
- City of New London
- Cross Sound Ferry Services, Inc.
- Bridgeport & Port Jefferson Steamboat Co.

This Report will not identify specific security mitigation measures, nor divulge any other information that could compromise security measures for the proposed facility. That information is considered Sensitive Security Information (SSI) in accordance with 49 U.S.C. § 114(s) and 49 CFR, Part 1520 as it discusses potential vulnerabilities or operational security measures for the proposed facility; the specific information has been provided to FERC as part of the supplementary Record to this WSR.[20] Members of the AMSC Sub Committee had “need to know” as defined by 49 C.F.R. §1520.11, and were granted access to SSI material related to the security assessment.

1.3 Public Comments/Public Participation

The public has also had significant input into this Report. COTP Long Island Sound held a total of four public meetings in conjunction with FERC, two in Connecticut and two on Long Island, New York.[21] COTP Long Island Sound has attended numerous open houses and public information sessions held by both the applicant and information sessions held by local groups and environmental organizations. COTP Long Island Sound has also considered over 2,400 comment letters received from members of the public, local,

[20] *See* 49 CFR § 1520.5
[21] The transcripts of the public meetings can be found on the Coast Guard Docket USCG-2005-21863 or on the Coast Guard Sector Long Island Sound website at http://www.uscg.mil/d1/units/seclis.

county, state and federal elected officials, non-profit organizations, environmental groups, and local, county and state agencies.[22]

Some comments received addressed navigation safety and maritime security. For example, these comments addressed concern for the hazard to navigation that a structure in the middle of Long Island Sound would potentially create; concern for how severe weather might impact the FSRU; and the potential for terrorist threats to vessels and FSRU. These comments were considered in our evaluation of this proposal where relevant. In addition, comments were received that were not relevant to our evaluation of the navigation safety and maritime security of the proposed project. For example, these comments included concerns regarding the following: the general health of Long Island Sound; opposition to industrialization of Long Island Sound; potential negative environmental impact; potential negative impact to the environment for fish, shellfish and lobster and resultant negative impact to commercial fishermen; limiting public access on Long Island Sound; and several expressing general opposition to the proposal without indicating specific areas of concern. These comments are not related to navigational safety and maritime security, which is the subject of this report. However, these comments were still placed in the public docket. In addition, the Coast Guard has conducted significant outreach with local and state agencies and concerned citizens groups including, for example, the State of Connecticut Long Island Sound Liquefied Natural Gas Task Force, among others.[23]

1.4 Thermal Radiation Analysis and Hazard Zones

1.4.1 Overview

LNG is natural gas that has been cooled to its liquid state at atmospheric pressure to a temperature of minus 260 degrees Fahrenheit (ºF). LNG is transported at ambient pressures. [24] LNG is a cryogenic liquid that is flammable when it becomes a gas. It is not explosive in an open atmosphere, such as what would be the case in the event of a large spill on water. Therefore, a breach of an LNG carrier hull would not cause an explosion, but might result in a fire if there is the right concentration of LNG vapor in the air (5-15% concentration) and a source of ignition. Unlike petroleum product spills from vessels, which if ignited can result in a fire of potentially long duration, e.g., hours or days; LNG fires are very intense and are of short duration, e.g., less than an hour. If

[22] Comment Letters have been included in the Coast Guard Docket for the Letter of Recommendation, Docket Number USCG-2005-21863, which can be accessed at: http://dms.dot.gov/search/searchFormSimple.cfm. A summary of the categories of letters received can be found in Appendix C.
[23] http://www.ctlng.state.ct.us/.
[24] Sandia National Laboratories Report SAND2004-6258: *Guidance on Risk Analysis and Safety Implications of a Large Liquefied Natural Gas (LNG) Spill Over Water*, 2004, p. 28. The Sandia Report is available on the Sector LIS website provided in the FERC/USCG Interagency Agreement

LNG spills and vaporizes in the presence of an ignition source, a fire could result and would burn back toward the source of the spill.

An important consideration for assessing the suitability of Block Island Sound and Long Island Sound for LNG carrier traffic as well as the suitability of the proposed location of the Broadwater Energy FSRU is establishing the size of the hazard zones associated with a large release of LNG. In accordance with NVIC 05-05, the criteria used by Sandia National Labs to define the outer limits of the three hazard zones discussed in their report, *Guidance on Risk Analysis and Safety Implications of a Large Liquefied Natural Gas (LNG) Spill Over Water,*[25] were applied for assessing potential risks associated with the proposed Broadwater Energy proposal. These criteria are listed in Table 1-2. The criterion used to define the outer limits of Zone 1 and Zone 2 is incident heat flux, i.e., thermal radiation that would be expected from an intense LNG vapor fire. Within Zone 1, the thermal radiation can cause serious injuries or significant damage to structures. Within Zone 2, thermal radiation can cause injuries or some damage to structures. The outer limit of Zone 3 is defined based on the lower flammability limit of LNG vapor, i.e., when the concentrations of natural gas and oxygen does not have enough fuel to burn. Within all three zones, the level of risk is reduced as the distance from the source increases.

Table 1-2: Definition of Hazard Zone Boundaries

Zone	Criteria (10 minute exposure time)	Basis
Zone 1	37.5 kW/m^{2*}	High potential for major injuries or significant damage to structures
Zone 2	5 kW/m^2	Potential for injuries and some property damage
Zone 3	Lower flammability limit (5%)	Outer limit where LNG vapor can be ignited

Source: Sandia Report, p. 38
Note: *Kilowatts per square meter

The size of the three hazard zones reported in the Sandia Report are based on large releases of LNG from LNG carriers with individual tank capacities of approximately 25,000 m^3 of LNG.[26] This size tank is typical for LNG carriers currently in service, which have a total capacity of approximately 138,000 – 144,000 m^3. For the purposes of calculating the distances for Zone 1 and Zone 2, it was assumed that 12,500 m^3 of LNG was spilled and that the initial height of the liquid, i.e., liquid head, in the tank was 15 m above the breach, which was assumed to be at the waterline. Zone 3 is based on a simultaneous release from three tanks (12,500 m^3 per tank) without an ignition source. In each instance a nominal breach of 5 m^2 was used.

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[25] Sandia National Laboratories Report SAND2004-6258: *Guidance on Risk Analysis and Safety Implications of a Large Liquefied Natural Gas (LNG) Spill Over Water*, 2004, p. 28. The Sandia Report is available on the Sector LIS website provided in the FERC/USCG Interagency Agreement

[26] Sandia National Laboratories Report SAND2004-6258: *Guidance on Risk Analysis and Safety Implications of a Large Liquefied Natural Gas (LNG) Spill Over Water*, 2004, p. 141. The Sandia Report is available on the Sector LIS website provided in the FERC/USCG Interagency Agreement.

1.4.2 Project Modeling – Hazard Zones 1 and 2

Relevant parameters to the hazard zone analysis for the typical LNG carriers currently in service, which were the subject of the modeling conducted by Sandia National Laboratories, the Broadwater FSRU, and 250,000 m^3 LNG carriers are contained in Table 1-3.

Table 1-3: Tank Capacities and Potential Spill Volumes

Input	Sandia	Broadwater FSRU	250,000 m^3 LNG Carrier
Tank Volume (m^3)	25,000	44,850	42,000
Volume released (m^3)	12,500	35,560	27,300
LNG Liquid Head (m)	15	21	20.3
Draft – fully loaded (m)	Not specified	12.3	12
Breach Size (m^2)	5	5	5

Source: Sandia Report, p. 141 and DNV Report 70014347, p. 7

It should be noted that Det Norske Veritas (DNV) Consulting, on behalf of Broadwater Energy, conducted a comparison of the thickness and material strength of outer and inner hull plating as well as the distance between the outer and inner hulls of the FSRU and 250,000 m^3 LNG carriers to establish that a breach with a nominal size of 5 m^2 was applicable to both.[27] Based on this comparison, it was determined that a nominal breach of 5 m^2 is conservative for both the proposed FSRU and 250,000 m^3 LNG carrier.

DNV Consulting, using a model different than that used by Sandia National Laboratories, calculated distances to the 37.5 kw/m^2 (Zone 1) and 5 kw/m^2 (Zone 2) thermal flux level exposures on behalf of Broadwater Energy. The results of these calculations, as well as the Sandia National Laboratories Zones 1 and 2 are included in Table 1.-4.

Table 1-4: Hazard Zone Distances

	Distance to 37.5 kW/m^2	Distance to 5 kW/m^2
Baseline (Sandia)	500 m	1600 m
Broadwater FSRU		
0.353 kg/m^2/s	498 m	1211 m
0.128 kg/m^2/s	629 m	1344 m
250,000 m^3 LNG Carrier		
0.353 kg/m^2/s	495 m	1202 m
0.128 kg/m^2/s	624 m	1335 m

Source: Sandia Report, p. x and DNV Report 70014347, pp. 6-7

The first set of distances shown for the proposed Broadwater FSRU and a 250,000 m^3 LNG carrier are based on a burn rate of 0.353 kg/m^2/s; the second set is based on a burn rate of 0.128 kg/m^2/s, which is the burn rate used by Sandia National Laboratories. For

[27] DNV Consulting, Broadwater LNG: Response to U.S. Coast Guard Letter Dated December 21, 2005, Report for TransCanada Pipelines Limited, Report No.: 70014347, Rev., 1 dated 13 February 2006, pp. 2-5, The report is available as part of the U.S. Coast Guard's docket for this project (Docket No. USCG-2005-21863) or in Appendix A. Hereafter DNV Report 70014347.

both the FSRU and a 250,000 m^3 LNG carrier, the size of Zone 1 decreases with a higher burn rate. This result is consistent with what would be expected since for a given spill volume a slower burn rate will permit a larger pool to form on the waters surface. Because the natural gas vapor burns at the edge of the pool where the mixture of natural gas and oxygen is within the upper and lower flammable limits,[28] LNG spilling from a tank will form a pool on the water's surface.

The results calculated by the DNV model using the slower burn rate (0.128 $kg/m^2/s$) yielded a Zone 1 that is greater for 250,000 m^3 LNG carriers and the FSRU than what was calculated by Sandia National Laboratories for a typical LNG carrier currently in service. However, the DNV model yielded a Zone 2 that is smaller for 250,000 m^3 LNG carriers and the FSRU than what was calculated by Sandia National Laboratories. As the Zone 2 size calculated by this method is smaller than expected, additional modeling was conducted to validate this counter intuitive result.

FERC conducted modeling using the values in Table 1-2 and employed a methodology based on the ABSG Study, *Consequence Assessment Methods for Incidents Involving Releases from Liquefied Natural Gas Carriers*.[29] The modeling conducted by FERC calculated the distances to the 37.5 kW/m^2 and the 5 kW/m^2 thermal flux levels for the nominal case identified by Sandia, a 250,000 m^3 LNG carrier, and the proposed 350,000 m^3 FSRU. These results are shown in Table 1-5.

Table 1-5: FERC Hazard Zone Calculations

Simulation	Distance to 37.5 kW/m^2	Increase from Baseline (scaling factor)	Distance to 5 kW/m^2	Increase from Baseline (scaling factor)
Baseline (Sandia)	421 m	--	1166 m	--
Broadwater FSRU	567 m	35%	1378 m	18%
250,000 m^3 LNG Carrier	555 m	32%	1350 m	16%

The FERC analysis determined that Zone 1 for the proposed Broadwater FSRU and 250,000 m^3 LNG carriers should be approximately 32 – 35 percent larger than what was established by Sandia. Similarly, the FERC analysis determined that Zone 2 should be approximately 16 – 18 percent larger. These values are consistent with the Sandia National Laboratories' conclusion that the Zone 1 and Zone 2 hazard ranges for larger spills are not expected to increase more than 20 – 30 percent over those included in their report, i.e., 500 m and 1600 m.[30]

Adjusted hazard zone sizes were calculated by scaling up from the Sandia National Laboratory baseline hazard zone sizes (500 and 1600 meters) using the scaling factors in Table 1-5. These results are shown in Table 1-6.

[28] For natural gas this range is typically between 15 percent (upper flammable limit, or UFL) and 5 percent (lower flammable limit, or LFL).
[29] ABSG Consulting, Inc,: *Consequence Assessment Methods for Incidents Involving Releases from Liquefied Natural Gas Carriers, study conducted for the Federal Energy Regulatory Commission under contract number FERC04C40196; May 13,* 2004.
[30] Sandia Report, p. 15.

Table 1-6: Adjusted Hazard Zone Distances

Simulation	Dist to 37.5kW/m^2		Dist to 5kW/m^2	
Baseline (Sandia)	500 m	546 yds	1600 m	1750 yds
Broadwater FSRU	673 m	736 yds	1891 m	2068 yds
250,000 m^3 LNG Carrier	659 m	721 yds	1852 m	2025 yds

1.4.3 Project Modeling – Hazard Zone 3

As discussed in Section 1.4.1, in accordance with the Sandia Report and NVIC 05-05, hazard Zone 3 is based on the simultaneous release of LNG from three tanks without being ignited. The size of the zone is established by calculating the distance the vapor cloud could travel before the lower flammability limit (LFL) is reached. The modeling conducted by Sandia National Laboratories was based on a total release of 37,500 m^3 of LNG, or 12,500 m^3 per tank. Based on the modeling conducted, Sandia National Laboratories established the size of Zone 3 to be 3,500 m from the source of the LNG release.

DNV Consulting conducted dispersion modeling for both the proposed FSRU and a 250,000 m^3 LNG carrier. The modeling was based on the values in Table 1-3. Unlike the modeling conducted by Sandia National Laboratories, which was based on a release from three tanks, the DNV Consulting modeling was based on a release from only one tank from either the FSRU (35,560 m^3) or the LNG carrier (27,300 m^3). Based on the modeling conducted by DNV Consulting for Broadwater Energy, the dispersion distance was 3,320 m for a release of LNG from the FSRU and 3,290 m from a 250,000 m^3 LNG carrier.[31]

FERC conducted modeling to establish the dispersion distance for a vapor cloud resulting from a simultaneous release of LNG from three tanks from either the FSRU (106,680 m^3) or the LNG carrier (81,900 m^3). The inputs for this modeling are from Table 1-2. FERC calculated the dispersion distance as 8,260 yards for a release from the FSRU and 7,544 yards from a 250,000 m^3 LNG carrier. The atmospheric conditions used for calculating these zones are the worst case, i.e., calm winds (approximately 5 mph) with a very stable atmosphere. The dispersion distance would be reduced with an increase in wind speed or less stable atmospheric conditions.

1.4.4 Project Hazard Zone Sizes

The hazard zones that will be used to assess the potential impacts of potential LNG releases resulting from either navigation safety accidents or terrorist attacks against the proposed Broadwater FSRU or an LNG carrier transiting the waters of Block Island Sound or Long Island Sound are based on the results of the modeling conducted by DNV Consulting for Broadwater Energy as well as the modeling conducted by FERC. The size of each of the hazard zones as well as those from the Sandia Report that each of the

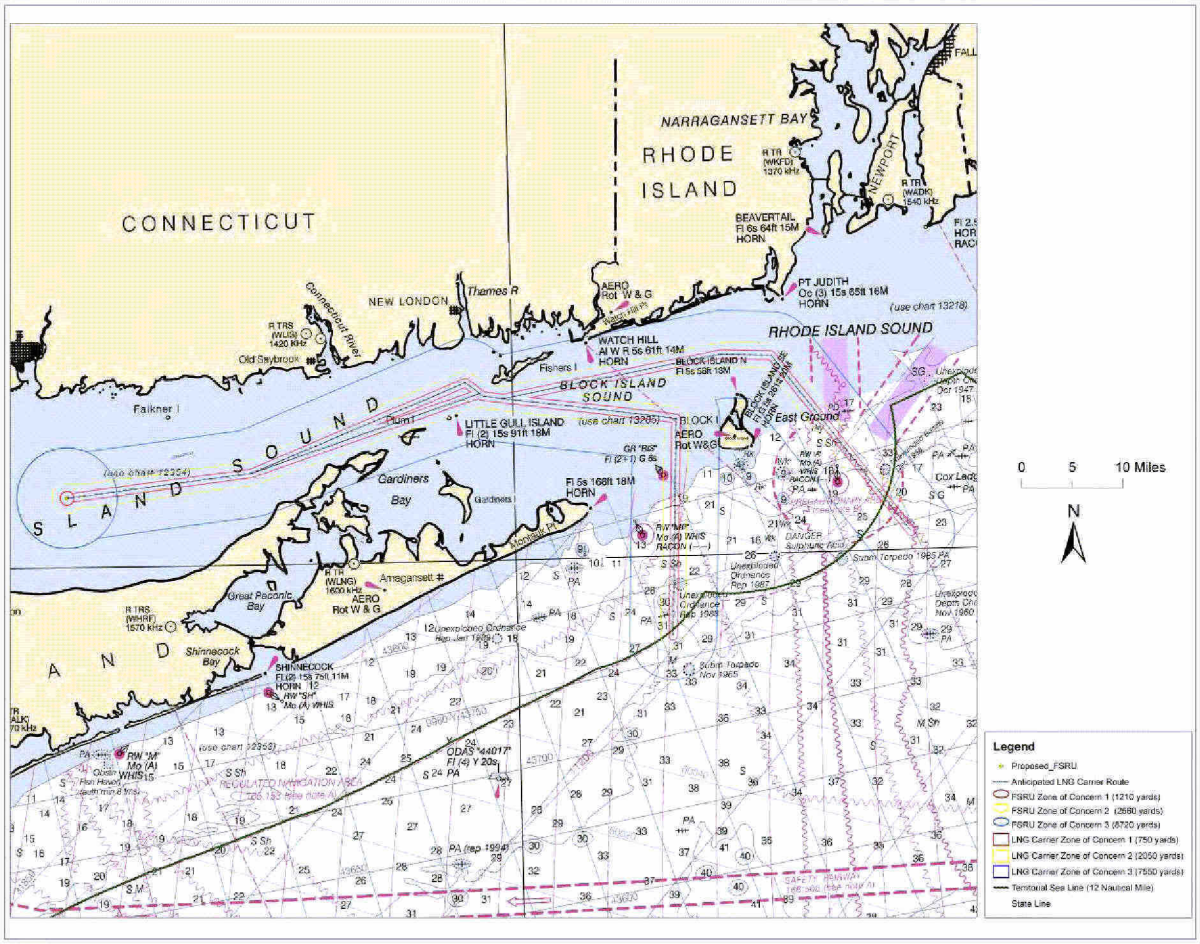
[31] DNV Report 70014347, p. 9.

hazard zones is based, are shown in Table 1-3. Hazard Zone 1 for the Broadwater FSRU and 250,000 m^3 LNG carrier is 37 percent larger than the baseline established in the Sandia Report. Zone 2 for the Broadwater FSRU is 20 percent larger than the baseline established in the Sandia Report. Zone 2 for the 250,000 m^3 LNG carrier is 17 percent larger than the baseline. Hazard Zone 3 for the proposed FSRU is 114 percent larger than the baseline in the Sandia Report. Zone 3 for the 250,000 m^3 LNG carrier is 95 percent larger. Figure 1-1 depicts the hazard Zones along the LNG carrier anticipated transit route and around the FSRU.

Table 1-3: Hazard Zones Broadwater Energy Project

	Zone 1 (37.5 kW/m²)		**Zone 2 (5 kW/m²)**		**Zone 3 (Lower Flammability Limit)**	
Sandia	500 m	546 yds	1600 m	1750 yds	3500 m	2.2 miles
Broadwater FSRU		750 yds		2100 yds		4.7 miles
250,000 m^3 LNG Carrier		750 yds		2050 yds		4.3 miles

Figure 1-1 - LNG Carrier Anticipated Transit Route and Hazard Zones



1.5 Coast Guard Regulatory Role With Respect to an Approved Facility

If approved and constructed, the Coast Guard COTP Long Island Sound would continue to exercise oversight of the safety and security of this proposed facility. The FSRU would be considered an offshore structure, and, as such, would be regulated as a facility by the Coast Guard in the same manner as a similar shore side facility.[32] As a facility, the FSRU would be required to comply with regulatory and statutory requirements for facility operations, environmental and operational safety, and security.

The Coast Guard would regulate the FSRU for navigation and waterways safety purposes under the Ports and Waterways Safety Act (PAWSA), 33 U.S.C 1225, and 33 C.F.R 156,

[32] Although the proposed FSRU has many vessel like characteristics, it has been determined that for regulatory purposes it is a facility. This basis for this determination is outlined in a decision memo issued by the U.S. Coast Guard Headquarters Office of Maritime and International Law dated December 20, 2004.

160, 127 and 165. For security purposes the following regulations would apply: PWSA section 1226; the Marine Transportation Security Act, 46 U.S.C. Chapter 701; and 33 C.F.R. Part 105, Subchapter H.

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

2 Waterway Characterization

If approved, the proposed facility would be located in the waters of Long Island Sound. LNG carrier transits, however, would impact the waters and port areas not only of Long Island Sound but also the approaches thereto, including Rhode Island Sound, Block Island Sound and Montauk Channel. Portions of Block Island Sound and Rhode Island Sound are within the COTP Providence's Area of Responsibility.[33]

Along the LNG carrier transit route, vessels would transit in international waters, the territorial sea,[34] in internal[35] and state waters.[36] The location of vessels in these areas determines applicable laws and regulations. Vessels transiting through Rhode Island Sound, Block Island Sound and Montauk Channel would pass through the territorial sea of the United States as well as state waters. When operating in waters east of the COLREGS demarcation line, mariners are required to comply with the International Regulations for Preventing Collisions at Sea of 1972, or COLREGS.[37]

Long Island Sound consists of 1,320 square miles and is surrounded by approximately 600 miles of coast line. Even though Long Island Sound is over 20 miles wide at its widest point, the Sound consists entirely of internal waters of the United States: specifically, it consists of New York or Connecticut State waters. As inland waters, Long Island Sound, inland of the COLREGS demarcation line at the Race, is governed by the Inland Navigation Rules, and vessels transiting Long Island Sound are required to comply with those regulations.[38] The Sound has two natural exits: to the east, The Race connects Long Island Sound to Block Island Sound and the Atlantic; and to the west, through the East River into the Port of New York and New Jersey.

Long Island Sound is a thoroughfare for commercial vessels enroute and departing from the Port of New York and New Jersey for ports north and east of the Race, and receives over 2,300 vessel arrivals annually at ports within the Sound. Traffic patterns within Long Island Sound are discussed in more detail in Section 2.2.2.

2.1 LNG Carrier Transit Route Summary

Anticipated transit routes for LNG carriers supplying the proposed Broadwater facility are depicted in Figures 2-1 and 2-2.[39] To facilitate detailed study in this Report, the anticipated LNG

[33] The COTP Providence's Area of Responsibility is defined in 33 CFR § 3.05-20. For those areas impacted which are outside of the COTP Long Island Sound Zone, the Captain of the Port, Providence, Rhode Island, was consulted to ensure a detailed analysis along all portions of the transit route.
[34] 33 CFR § 2.22
[35] *See* U.S. v. Maine, 469 U.S. 504 (1985). Title 33 CFR § 2.24 defines internal waters as waters shoreward of the territorial sea baseline. These are also defined as inland waters in 33 CFR § 2.26.
[36] Waters over which individual states have jurisdiction extend 3 nautical miles from mean low water.
[37] 33 CFR § 80.155b.
[38] 33 U.S.C. § 2071; See also 33 CFR Subpart E, (Parts 84-90) Annexes and Interpretive Rules to the Inland Navigation Rules.
[39] COTP Long Island Sound asked Connecticut and New York licensed marine pilots to provide the anticipated routes of LNG carrier traffic as they would pilot the vessels to the proposed FSRU location.

carrier routes to and from the FSRU have been segmented into eight waterways segments as follows:

- Territorial sea entry to Point Judith Pilot Station;
- Territorial sea entry to Montauk Point Pilot Station;
- Point Judith Pilot Station to The Race;
- Montauk Point Pilot Station to The Race;
- The Race;
- Eastern Long Island Sound;
- Central Long Island Sound;
- Western Long Island Sound.

As described more specifically in Section 3.2, each of these eight areas are examined for several aspects, including: the anticipated transit route for LNG carriers; waterways attributes along the route including weather; port characterization within the route segment and density and character of marine traffic; zones of concern as defined in the Sandia Study; sensitive environmental areas; and population density. Information general to all areas of the LNG carrier anticipated transit route is outlined in this section; information applicable to a specific transit segment is contained in Section 3.2 of this Report.

Figure 2-1 – Anticipated LNG carrier transit route – Block Island Sound, Montauk Channel and The Race

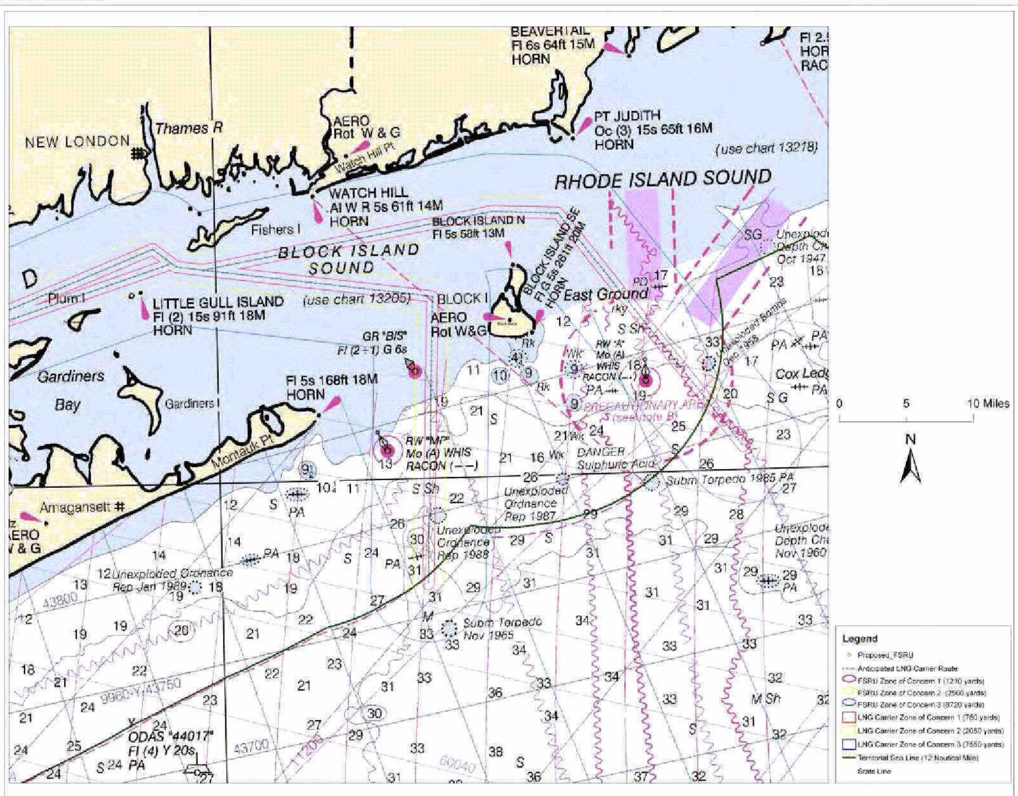
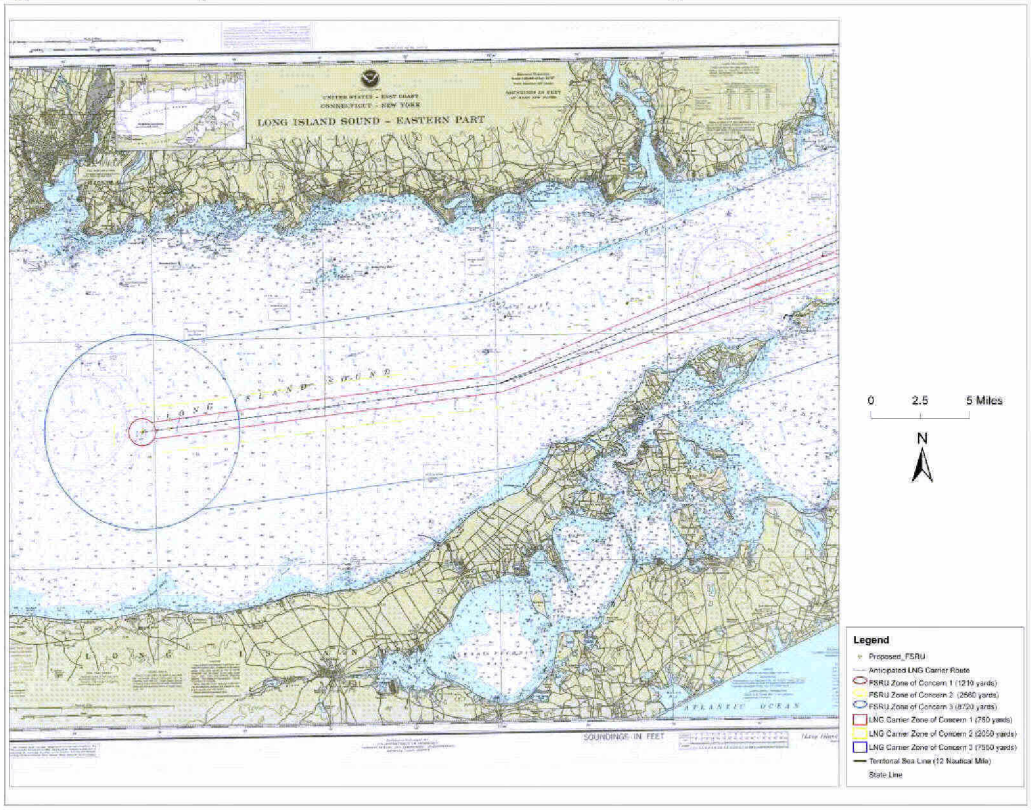


Figure 2-2 Anticipated LNG carrier transit route – Long Island Sound



2.2 Port Activity

The entire transit route, including Long Island and Block Island Sounds (LIS and BIS, respectively), can be categorized as multiple use waterways. LIS and BIS experience significant and diverse commercial traffic and are heavily used by recreational vessels. Analysis of the amount, type, and patterns of both commercial and recreational vessel traffic was undertaken to help forecast potential impacts to waterway usage and traffic flow and to inform the size and configuration of any safety and security zones that may need to be established around the facility. Figures 2-3 and 2-4 depict the anticipated LNG carrier transit route and proposed FSRU location in relation to port areas, as well as other port activity, such as ferry routes.

Figure 2-3 Anticipated LNG carrier transit route in proximity to other port activity

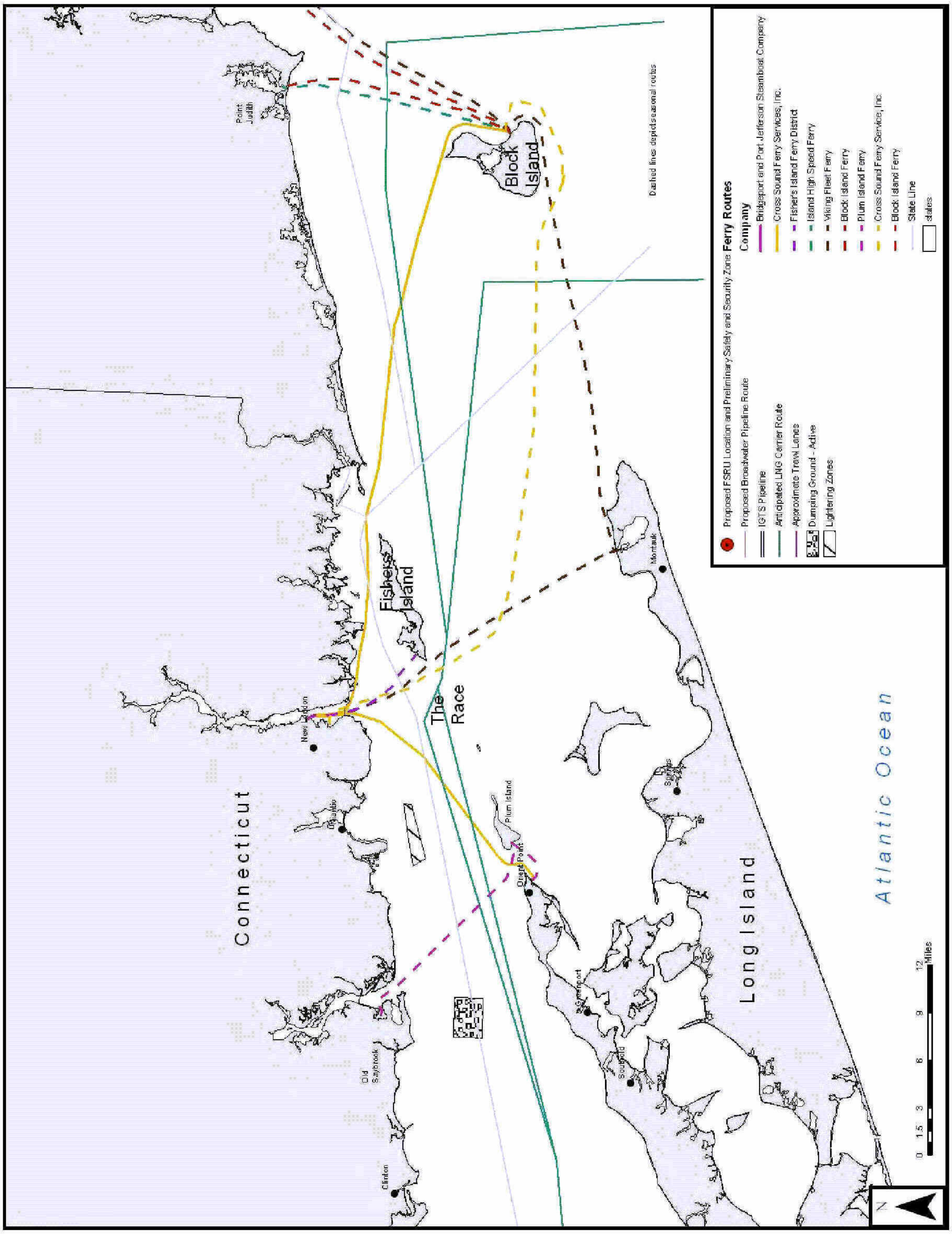


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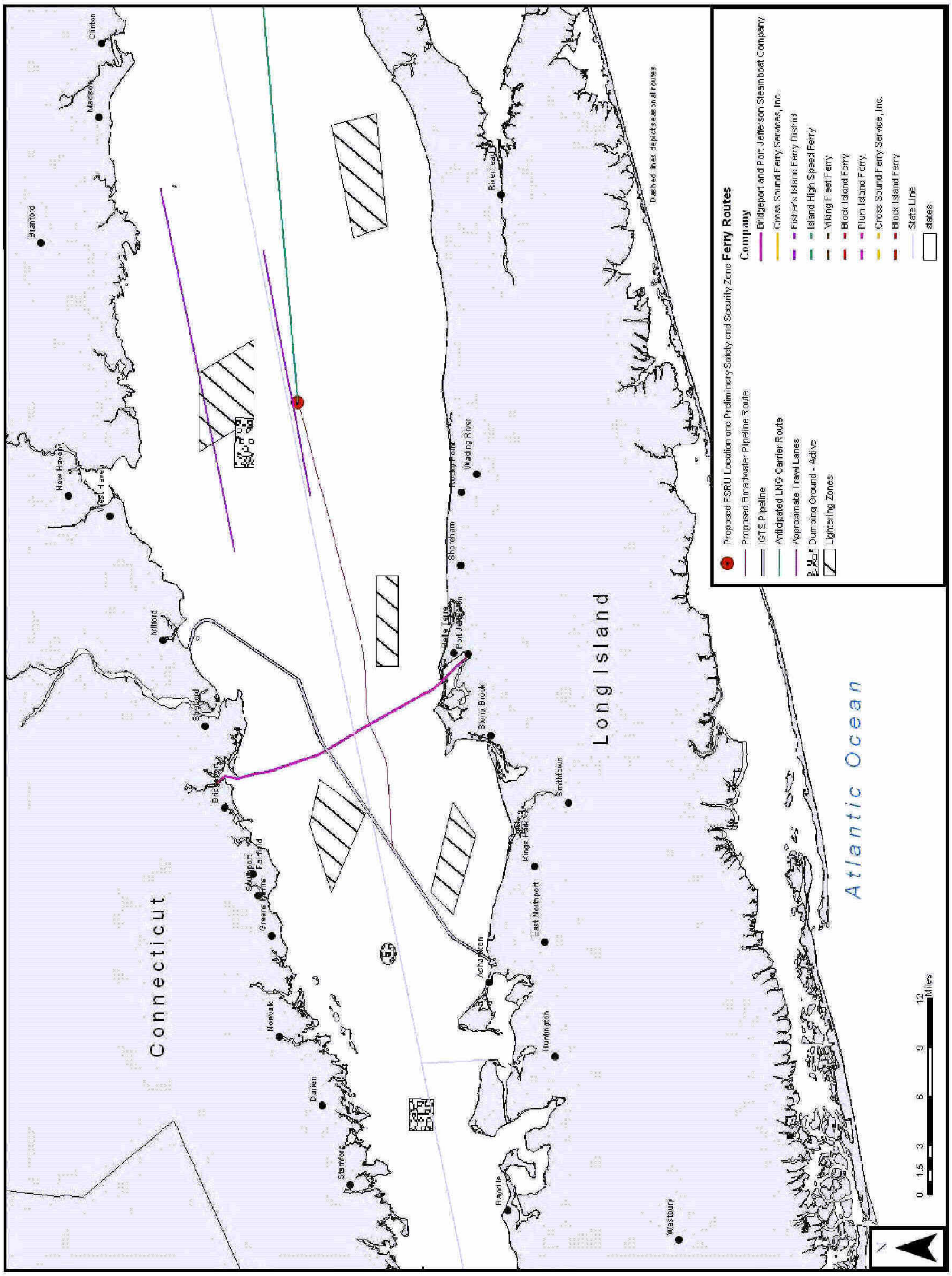
Figure 2-4 Anticipated LNG Carrier transit route in proximity to port activity



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2.2.1 Commercial Vessel Traffic

Vessel traffic in Long Island Sound consists of tug and barge combinations, bulk carriers, general dry cargo, passenger ships, refrigerated tank ships, tank vessels, towing vessels, naval vessels (including submarines), other government vessels, ferries, commercial fishing vessels, charter fishing and tour boats, and recreational vessels. Commercial vessels transiting both LIS and BLS can be destined for ports in Connecticut and Long Island as well as other ports in New England, New York and New Jersey.

As outlined in Table 2-1, for the years 2003 through 2005, ports within Long Island Sound experienced an average of 2,300 commercial vessel arrivals per year. For those years, there was an average of approximately 462 foreign-flagged vessels arrivals annually at port facilities within Long Island Sound located in both Connecticut and on
the north shore of Long Island. These vessels take one of two routes into Long Island Sound; either north of Block Island, or through Montauk Channel to the west of Block Island and then through The Race. Additionally, for the years 2003-2005, there was an average of 1,840 U.S .flagged vessel arrivals annually at ports in Long Island Sound, consisting primarily tug and barge combinations. These vessels arrive from both the eastern entrances and the western end of the sound.

Table 2-1: 2003-2005 Long Island Sound vessel arrival data

	2003		2004		2005	
Vessel Type	**U.S.**	**Foreign**	**U.S.**	**Foreign**	**U.S.**	**Foreign**
Barge	1131	28	1438	63	1779	112
Bulk Carrier		105		116	1	
Fishing Vessel	3		5		1	1
General Dry Cargo Ship		39	3	70	10	54
Miscellaneous Vessel	1	3	3		8	
Passenger Ship	79	1	97	3	140	
Refrigerated Cargo Ship		62		33		56
Recreational	4		2	4	1	44
RO-RO Cargo Ship	1	1			1	2
Tank Ship	200	228	225	184	225	166
Towing Vessel	16		30	1	71	2
Other	17	3	12		17	6
Total	**1452**	**470**	**1815**	**474**	**2254**	**443**
Year Totals	**1922**		**2289**		**2697**	

Source: Coast Guard MISLE (Marine Information for Safety and Law Enforcement) Analysis and Reporting System (MARS);
Note: Appendix D details the process which was used to derive the arrival information.

In addition to the vessel arrival numbers detailed above, it is estimated that 2,000 to 4,000 additional transits occur each year through Long Island Sound that are not destined for a port in

Connecticut or on the north shore of Long Island.[40] In addition, United States naval vessels, including submarines, and other government vessels, including U.S. Coast Guard cutters and small boats, National Oceanographic and Atmospheric Administration (NOAA) survey vessels, and the Connecticut state survey vessel also frequently transit Long Island Sound. Commercial fishing operations are prevalent along the extent of the transit route and include trawlers, lobstermen and shell fishermen. Shellfishermen generally operate close to shore;[41] lobstermen and trawlers may operate throughout Long Island and Block Island Sounds. Commercial fishing vessels homeported along the transit route also transit these areas to fish offshore in the waters of the Atlantic Ocean.

Numerous commercial ferry routes either cross or operate along the anticipated LNG carrier transit route. These include two commercial ferry operations that operate between Connecticut and Long Island. In eastern Long Island Sound, Cross Sound Ferry Services provides year round passenger and vehicle service between New London and Orient Point. This ferry service operates traditional vehicle and passenger ferries, as well as a high speed passenger-only ferry along this route, averaging approximately 50 crossings per day throughout the year.[42] This service offers peak season schedule of 58 transits per day. These ferries have a capacity between 150 and 1,000 passengers, and 22 and 110 vehicles per ferry. As outlined in Table 2-2, for the years 2003-2005, this ferry service carried an average of 506,667 vehicles and 1,333,333 passengers per year. In western Long Island Sound, the Bridgeport-Port Jefferson Steamship Company operates passenger and vehicle service between Bridgeport, Connecticut and Port Jefferson, New York. This ferry makes a minimum of 22 crossings per day and a maximum of 32 crossings per day throughout the year. As outlined in Table 2-2, this ferry route averages 1,200,000 passengers per year, and 500,000 vehicles carried per year.

The importance of cross-Long Island Sound ferry routes for regional transportation was evident on September 11, 2001, when these ferry routes functioned as key transportation links for Long Island due to the attacks on the World Trade Center. On that day, Cross Sound Ferry carried 3,140 passengers and 1,423 vehicles, and operated until 1 a.m. on September 12, 2001 to assist vehicles and passengers transiting these routes. This was a significant increase in average daily passenger and vehicle counts. In addition, ,the Bridgeport-Port Jefferson Ferry carried approximately 3,300 passengers and 1,941 vehicles on September 11, 2001, compared to 900 vehicles on September 10, 2001

In addition to the cross-Long Island Sound routes, there are also several ferries from Connecticut, Long Island and Rhode Island that provide passenger only or passenger and vehicle service to Block Island. A summary of ferry operations impacting the length of the anticipated transit route is provided in Table 2-2. Ferry operations impacting each of the transit segments are discussed as relevant in Section 3.2.

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[40] See Section 2.2.2.2.1. The volume of through-traffic in Long Island Sound is not well documented; this estimate based on information provided by vessel operators suggests there may be 2000-4000 through-transits per year. An initial analysis using AIS data from 2005 indicated that there were 1,607 through-transits of Long Island Sound; this number only includes AIS-equipped vessels. Based on the methodology used, this number is considered to be conservative.

[41] The Connecticut Department of Agriculture, Bureau of Aquaculture, generally leases shellfish beds in waters up to 45 feet deep; some shellfish beds in Connecticut extend to water depths of up to 50 feet. Personal communication with David Carey, Director, Bureau of Aquaculture, May 24, 2006.

[42] Cross Sound Ferry Letter to Entrix dated November 14, 2005.

Several vessels operate along the length of the transit route that carry passengers for hire. These range from small passenger vessels acting as day charters for fishing, area tours or dinner cruises, to cruise ships. In addition, numerous military and government vessels utilize Long Island Sound and the approaches thereto.

Increased commercial vessel use of Long Island Sound is expected based on port growth, proposals to ship containers via barge from the Port of New York to Connecticut and other New England ports to alleviate traffic on I-95, and ongoing consideration of additional ferry routes on Long Island Sound, including proposed high speed ferry service to and from New York City.

Table 2-2 Ferry Route Summary

Ferry Service Name	Ferry Route	Passengers	Vehicles	Max. Number of Daily Transits	Minimum Number of Daily Transits
Cross Sound Ferry Services, Inc.	New London – Orient Point (including high speed SEA JET)	1,333,333	506,667	58	20
New London to Block Island High Speed Ferry	New London- Block Island*	132,500	N/a	10	8
Bridgeport Port Jefferson Steamship Co.	Bridgeport CT to Port Jefferson, NY	1,200,000	500,000	32	22
Plum Island Ferry	Old Saybrook, CT – Plum Island	50,927	N/a	16	6
	Orient Point, NY – Plum Island	66,007	3,016	24	18
Fisher's Island Ferry	New London – Fisher's Island*	159,142	46,929	26	8*
Viking Fleet†	New London – Montauk	452	N/a	4	4
	Montauk to Block Island	8,700	N/a	10	4
	Montauk to Martha's Vineyard**	149	N/a	1	1
	New Bedford to Block Island***	N/a	N/a	6	2
Point Judith to Block Island High Speed Ferry††	Point Judith, RI to Old Harbor, Block Island	66,605	N/a	12	6
Interstate Navigation	Point Judith to Old Harbor, BI	520,000	64,000	18	2
	Block Island to Newport- July– September	6,500	N/a	2	2

* Seasonal ferry service
** Special trip directly from Montauk to Martha's Vineyard once annually. Passenger count based on capacity of vessel, the STARSHIP.
*** New ferry route anticipated for 2006 summer season
† Annual passenger counts for 2005 season.
†† Schedule based on new 2006 schedule; 2005 schedule had greater number of transits.

2.2.1.1 *Commercial Vessel Size and Tonnage*

Generally, foreign flagged commercial vessels calling at Long Island Sound ports range in length from 500 to 902 feet. Deep draft vessels transiting the Sound that exceed 800 feet in length are generally those carrying liquid petroleum products or coal. Barge lengths range between 200 and 500 feet for typical tug and barge combinations transporting petroleum products on Long Island Sound. Table 2-3 depicts a breakdown of vessel lengths for 2003-2005 vessel arrivals for Long Island Sound. Tables 2-4 and 2-5 provide a more detailed description of vessels greater than 700 feet in length.

Table 2-3: 2003-2005 Long Island Sound Commercial Vessel Arrivals sorted by length

Vessel Length (feet)	Number of Vessels Foreign	Number Vessels US
<100	32	178
100-200	189	473
200-300	20	2365
300-400	109	1479
400-500	154	1032
500-600	345	15
600-700	316	25
700-800	197	29
800-900	79	0
900<	2	0
No length listed:	23	17
Total	1466	5613

Source: Coast Guard MISLE (Marine Information for
Safety and Law Enforcement) Analysis and Reporting System (MARS).
Note: The process for determining vessel arrival data is outlined in Appendix D.

Table 2-4: 2003-2005 Long Island Sound Barge Arrivals sorted by Length

Barge Length (feet)	Number
<100	5
100-200	22
200-300	119
300-400	126
400-500	71
500-600	2
600-700	8
700-800	2
800-900	0
900<	0
Total	355

Source: Coast Guard MISLE (Marine Information for
Safety and Law Enforcement) Analysis and Reporting System (MARS).
Note: The process for determining vessel arrival data is outlined in Appendix D.

Table 2-5: 2003-2005 Long Island Sound Vessel Arrivals, length greater than 700-feet, sorted by type

Ship Type	US	Foreign
Barge	1	0
Bulk Carrier	0	64
General Dry Cargo Ship	0	2
Passenger Ship	0	3
Ro-Ro Cargo Ship	2	0
Tank Ship	25	209
Total	28	278

Source: Coast Guard MISLE (Marine Information for
Safety and Law Enforcement) Analysis and Reporting System (MARS). The process for determining vessel arrival data is outlined in Appendix D.
Note: RO –RO stands for Roll on-Roll off cargo ship.

In addition, numerous larger vessels operate routinely on Long Island Sound. This includes the two major ferry companies providing vessel and passenger service between Connecticut and Long Island. Of the eight vessels in the Cross Sound Ferry Services fleet, five have overall lengths greater than 240 feet, with the largest vessel, the CAPE HENLOPEN, measuring 327 feet[43] and 1,505 Long Tons (lightship displacement)[44]. The three vessels in the Bridgeport Port

[43] The five vessels in Cross Sound Ferry's fleet are: the JOHN H., with a length of 240 feet; the SUSAN ANNE, with a length of 250 feet; the NEW LONDON, with a length of 260 feet; the MARY ELLEN, with a length of 260 feet; and the CAPE HENLOPEN, with a length of 327 feet.
[44] One long ton is 2,000 pounds. Lightship displacement is defined as the displacement of a ship when fully equipped and ready to proceed to sea, but with no crew, passengers, stores, fuel, water, or cargo on board. Lightship displacement is typically measured in tons.

Jefferson Steamboat Company fleet measure between 261 and 294 feet for overall length, with the largest vessel, the GRAND REPUBLIC measuring 294 feet with a displacement tonnage of 1,416.7 Long Tons (lightship displacement).[45]

2.2.2 Traffic Flow in Long Island Sound and approaches

There are no formally designated traffic separation schemes or traffic lanes in Long Island Sound or Block Island Sound.[46] Long Island Sound, Block Island Sound, Rhode Island Sound and Montauk Channel are not established as Vessel Traffic Service areas.[47]

From Buzzards Bay to The Race, a Recommended Vessel Route was added to NOAA charts for this area in April 2004.[48] This Recommended Vessel Route, while not a formally designated International Maritime Organization routing measure, identifies the preferred transit areas for deep draft vessels, including tug and barge combinations transiting between Buzzards Bay or Narragansett Bay and Long Island Sound. Additionally, commercial fishermen including lobstermen and trawlers frequent this area from ports in southeastern Connecticut and Rhode Island. The majority of commercial traffic transiting this area, not destined to or departing from Block Island or Newport, generally follow the Recommended Vessel Route.

Within Long Island Sound, standard traffic patterns for commercial vessels have developed, based in large part upon natural features and obstructions, marked by navigational aids, and mariner experience. Obstructions such as rock shoal areas are marked with navigational aids maintained by the Coast Guard. Overall, traffic flow in Long Island Sound runs in an east-west direction down the central portion of Long Island Sound. North-south traffic patterns exist from the general routes to the major ports, as well as cross-Sound traffic servicing the offshore platforms in Riverhead and Northport, New York. Outside of Long Island Sound, running up to and through The Race, there is a Recommended Vessel Route for deep draft vessels and tug-barge combinations. Weather can also factor into the decision of a vessel master to transit along a more northerly or southerly route in the Sound, with vessels favoring one coast or another dependent on the prevailing winds, taking advantage of the lee the land affords. Because there are no restrictions regarding vessels anchoring within Long Island Sound, vessels may be found anchored anywhere within the Sound, based upon bottom conditions and obstructions. Ocean-

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[45] The three vessels in the Bridgeport-Port Jefferson Fleet are: the PARK CITY, with a length of 261.2 feet; the PT BARNUM, with a length of 290.3 feet; and the GRAND REPUBLIC, with an overall length of 294 feet.

[46] Generally, traffic separation schemes are designated by the International Maritime Organization per Regulation 10, Ships' Routeing, of the Convention for Safety of Life at Sea (SOLAS) V/74.

[47] The purpose of a Vessel Traffic Service (VTS) is to provide active monitoring and navigational advice for vessels in particularly confined and busy waterways. The Coast Guard maintains nine Vessel Traffic Centers (VTC). The closest VTC to the Assessment area is VTC New York, established at 33 CFR § 161.25; VTC New York does not encompass the waters of Long Island Sound. The Authority for a VTS is found in the Ports and Waterways Safety Act, 33 U.S.C. §1221, et seq., and regulations implemented there under, 33 CFR Part 161. A Vessel Movement Reporting System was recently proposed by the Coast Guard for Buzzards Bay. See 71 Federal Register 15649.

[48] The Recommended Vessel Route is not mandatory, but NOAA charts and other publications request that deep draft commercial vessels (including tugs and barges) are requested to follow the designated routes at the Master's Discretion. Vessels are not required to remain inside the route nor are fishermen required to keep fishing gear outside the route. The Recommended Vessel Route was established on NOAA navigational charts per recommendation of the Commander, First Coast Guard District, in April 2004.

going vessels tend to utilize one of the six lightering zones established by Coast Guard COTP Policy Letter, discussed in Section 2.3.2 infra, as anchorages. As also discussed in Section 2.3.2, these lightering zone areas are being proposed as formal anchorage grounds by regulation within Long Island Sound. Restrictions on anchoring do exist in some harbor areas.[49]

2.2.2.1 *Automated Identification System Data*

As part of this Report, Automated Identification System (AIS) data from calendar year 2005 was analyzed for vessels that transited the anticipated LNG carrier transit route, namely in Block Island Sound, including Montauk Channel, The Race and within Long Island Sound. Under Coast Guard regulations, several classes of commercial vessels, detailed in Section 2.3.1, are required to be equipped with operable AIS[50] equipment. AIS automatically broadcasts vessel and voyage-related information that is received by other AIS equipped ships and shore stations. This includes such information as vessel name, position, course and speed.[51]

The following vessels are required to have a properly installed, operational, type approved Automated Identification System (AIS):

- Self-propelled vessels of 65-feet or more in length (other than passenger and fishing vessels) in commercial service and on an international voyage;
- Passenger vessels of 150 GT or more;
- Tankers, regardless of tonnage;
- Vessels, other than passenger vessels or tankers, of 300 GT or more.

When navigating in an area in which there is a Vessel Traffic Service (VTS) the following vessels are required to have an AIS:

- Self-propelled vessels of 65 feet or more in length in commercial service, other than fishing vessels and passenger vessels certificated to carry less than 151 passengers-for-hire;
- Towing vessels of 26 feet or more in length, and more than 600 horsepower, in commercial service;
- Passenger vessels certificated to carry more than 150 passengers for hire. [52]

2.2.2.2 *AIS vessel transit data analysis*

As noted above, AIS data for 2005 was analyzed to portray the transit patterns in Block Island Sound, Montauk Channel, The Race and Long Island Sound, and their proximity in relation to the FSRU. From this analysis, vessel routes were plotted. The data provided by analysis of AIS

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[49] For example, see section 3.2-6, discussing anchorage restrictions in New London Harbor.
[50] Automatic Identification System requirements are prescribed in 33 CFR § 164.46
[51] For more information regarding AIS, See 68 Federal Register 39353 and 68 Federal Register 60559, which implemented carriage requirements, as well as the U.S. Coast Guard Navigation Center website at http://www.navcen.uscg.gov/enav/ais/default.htm.
[52] 33 CFR §164.46.

data facilitated an analysis of current traffic patterns of commercial vessels for the study area, and specifically relative to the proposed location of the FSRU. The vessel tracks are shown in Figure 2-5. The vessel tracks displayed in Figure 2-6 represent a sample based on AIS vessel data for a single day during each month of 2005; data sampled was from the 5th day of each month.

In addition to having an understanding of the relative usage, a density plot was developed using a one nautical mile by one nautical mile grid overlay of the study area. The density is a function of the number of transmissions received from AIS units. Each transmission represents a single position of a single vessel. AIS transmission can occur approximately every 5 seconds to 3 minutes. As a density, while this cannot estimate the number of vessels, it is a relative indicator of usage of the area. The density plots are shown in Figure 2-7. In order to evaluate whether there were any seasonal differences, density plots were developed for each month in 2005. This examination indicated that there was not a significant month by month variation. Density plots for each month of 2005 are provided in Appendix E.

Figure 2-5 AIS Vessel Tracks and Density Plot – Block Island Sound and The Race

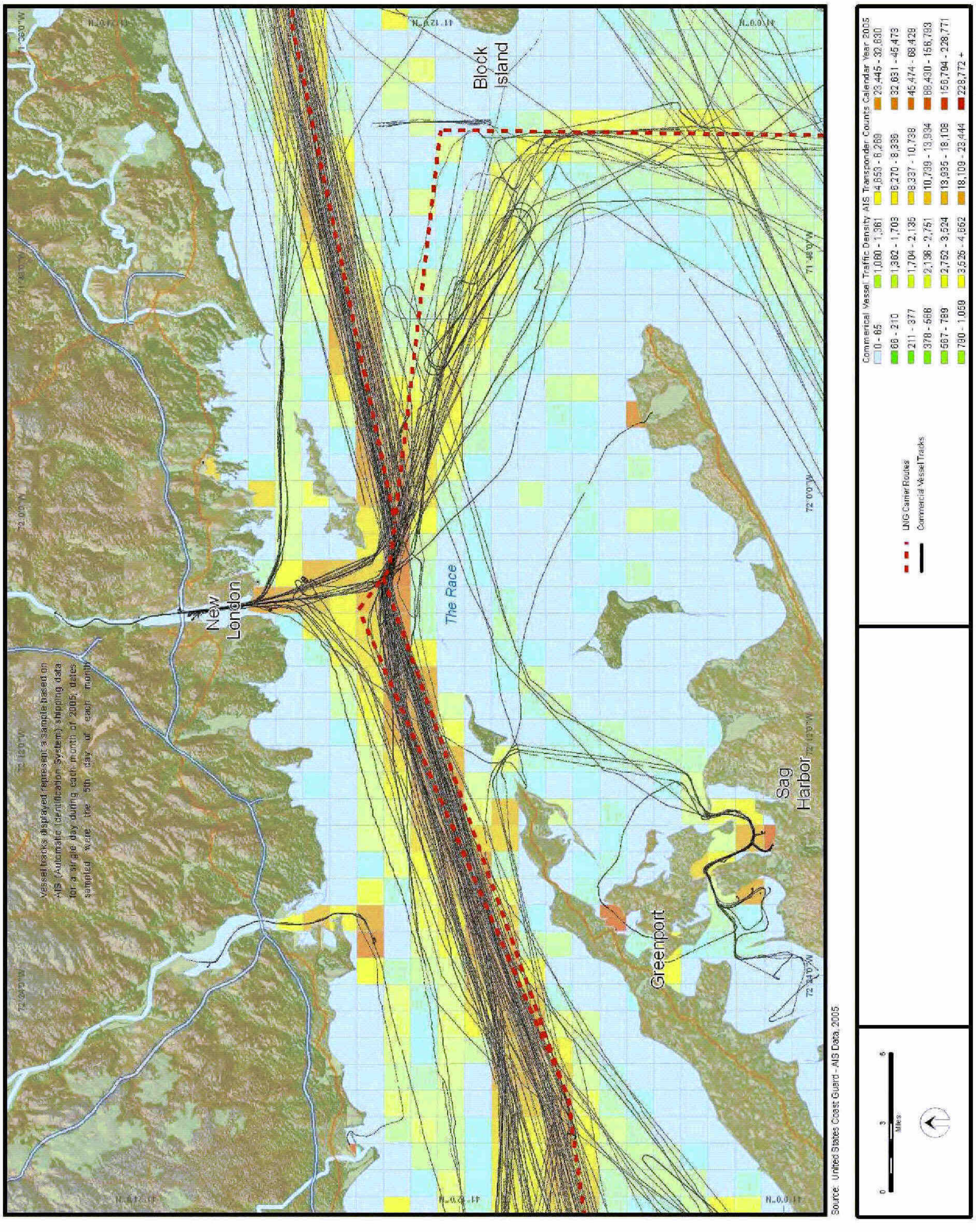

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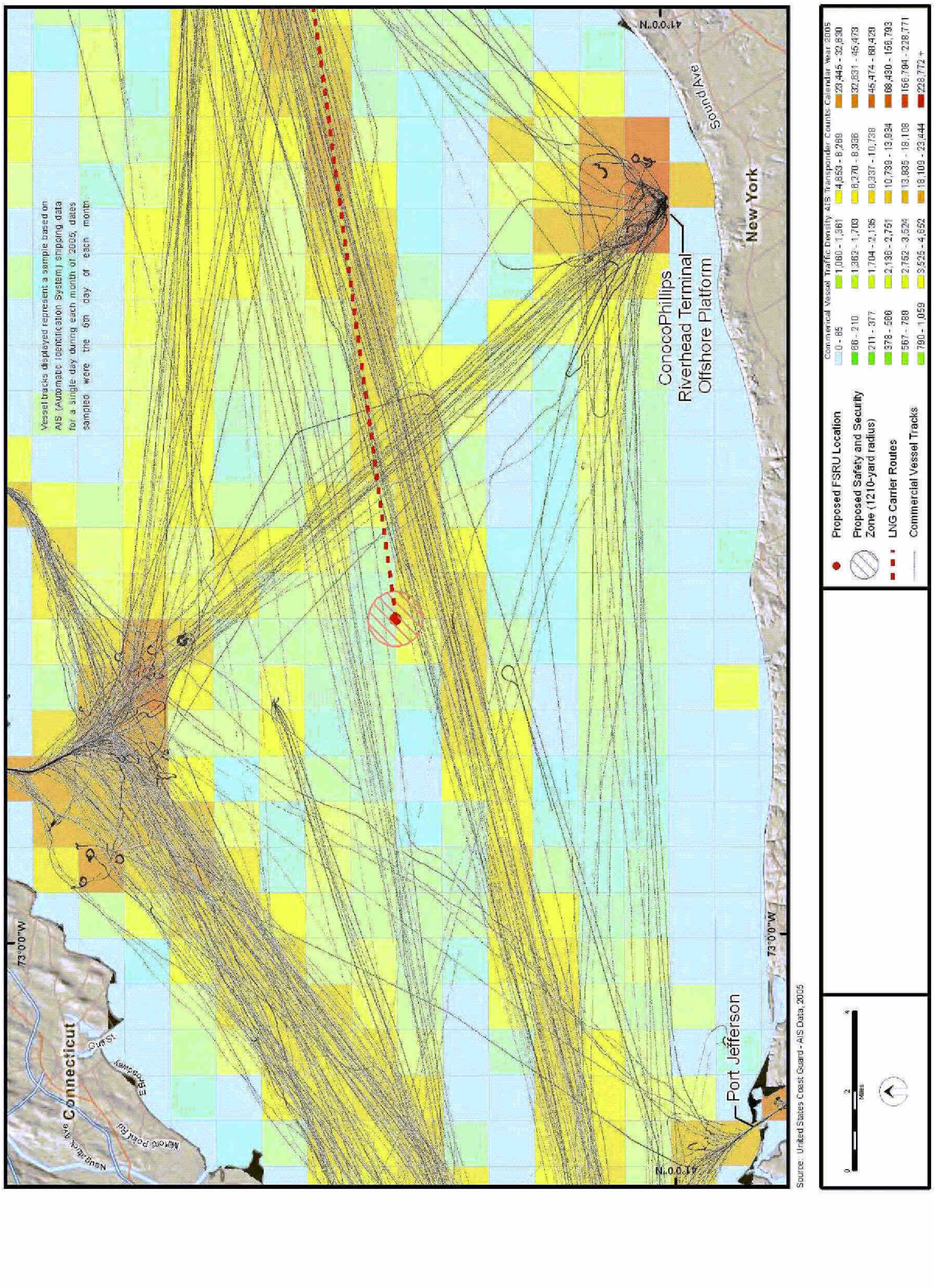
Figure 2-6 AIS Vessel Tracks and Density Plot – Long Island Sound



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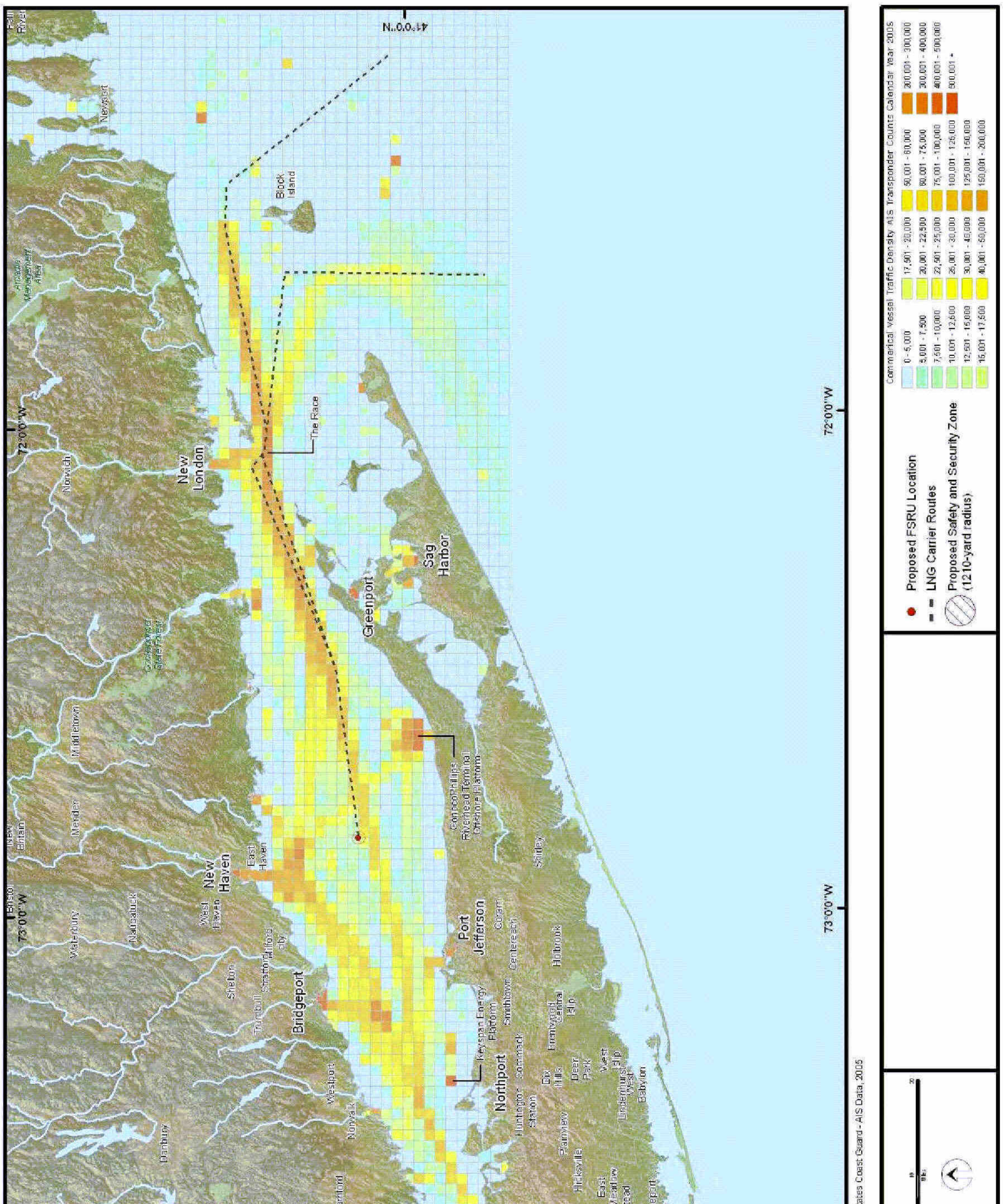

Figure 2-7 AIS Vessel Traffic Density Plot – Block Island Sound, Long Island Sound and The Race

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2.2.2.2.1 2005 Through-transits for Long Island Sound

Volume of through-traffic is not well documented. An estimate based on information provided by vessel operators suggests there may be 2000-4000 through-transits per year. An initial analysis using AIS data from 2005 indicated that there were 1,607 through-transits of Long Island Sound for AIS equipped vessels. Based on the methodology used, this number is considered to be conservative. The methodology for determining through-transits using AIS data is contained in Appendix F.

To determine the number of through-transits using AIS data, a box was created in the center of Long Island Sound which recorded all vessels passing though it. This box was defined by the following coordinates, beginning in the northwest corner and running clockwise as follows: 41° 8' 60" N, 72° 52' 48"W; 41° 8' 60" N, 72° 52' 12"W, 41° 2' 60" N, 72° 52' 48"W; and 41° 2' 60" N, 72° 52' 12"W. Any vessel that had an arrival at one of the Long Island Sound ports on the day that it passed through the "box" defined above that day was removed from the list. The resulting list represents an approximation of the number of through-transits.

2.2.2.3 *Vessel Transit Proximity to the FSRU*

Based on the analysis of vessel transits, it is evident that the proposed location of the FSRU is in the vicinity of a commercial vessel thoroughfare. There is a concentration of commercial vessel traffic in the following areas relative to the proposed location of the FSRU. First, there is a predominance of east–west transits to the south of the proposed location. Much of this east-west traffic is either through traffic, transiting to or from the Port of New York, or is heading towards Bridgeport, CT or Port Jefferson, NY. In addition, there is a concentration of north-south traffic to the east of the proposed facility. The majority of this traffic is tug and barge traffic transiting to or from the Riverhead Offshore Platform.

2.2.3 Recreational Boating and Marine Events

There is a large recreational boating community in New York, Connecticut and Rhode Island. As such, recreational boating usage of Long Island Sound and Block Island Sound is significant. Recreational boating is well distributed along both shores in Long Island Sound, and marinas are found along both coasts, attesting to the large recreational boating community in Connecticut and New York. Similarly, the Rhode Island coast and Block Island have significant seasonal recreational boating activity.

2.2.3.1 *Recreational Boating Population*

There are approximately 180,000 registered recreational vessels statewide in Connecticut;[53] Suffolk County, New York, has approximately 80,000 registered recreational vessels; [54] and

[53] Long Island Sound PAWSA Report, Appendix B, p. 17.
[54] Long Island Sound PAWSA Report, Appendix B, p. 17.

Rhode Island has approximately 43,000 registered recreational vessels.[55] In general, the majority of recreational boating occurs within 3 miles of the shore. Heavier concentrations of recreational boating occur in western Long Island Sound, and near more dense population centers and popular summer vacation locations such as Point Judith and Block Island, Rhode Island, New London, Old Saybrook and Branford, Connecticut, and Port Jefferson and Greenport, NY. In addition, The Race is frequented by heavy concentrations of recreational fishermen throughout the boating season, generally running from the middle of May through the middle of October. Recreational vessels also operate throughout Long Island Sound, including the central Sound.

2.2.3.2 *Marine Events*

Marine events, including, but not limited to fireworks events, regattas, marine parades, power boat races and charity swimming events, occur throughout Long Island Sound and Block Island Sound. These generally occur close to shore, but larger sailing events and power boat races can often be held in or transit through central Long Island Sound, cross Long Island Sound, run out through The Race, and even continue through Block Island Sound and around Block Island. The following list is a selection of the larger events which may impact the entire length or more than one segment of the anticipated LNG carrier transit route, or more than one transit segment; it is not intended to be an all-inclusive list of events on Long Island or Block Island Sounds:

<u>Storm Trysail Club Memorial Day Weekend Block Island Race</u>: This 185 mile race, which has been run for 60 years, begins in Stamford, Connecticut on the Friday of Memorial Day Weekend. Approximately 80-100 yachts race east towards and through The Race, round Block Island in a clockwise direction, and then return to Stamford.

<u>Stamford Yacht Club's Vineyard Race</u>: This 283 mile event begins off Stamford Connecticut's Shippan Point the Friday afternoon before Labor Day and heads east through the Sound, transiting The Race or Plum Gut, proceeding along the Rhode Island shore past Point Judith, to the entrance of Buzzards Bay (rounding the Buzzard's Bay Light Tower), then returning to Long Island Sound and Stamford by way of the south side of Block Island. In 2005, this race had 51 participating boats.

<u>Block Island Race Week</u>: This racing event is held every year in June, with larger events held in odd numbered years, and smaller events in even numbered years. Odd year events, which will take place next in 2007, consist of several hundred participating vessels ranging in size from 24 feet to 70 feet. As this is hosted by Storm Trysail Club of Stamford, CT, many participants transit from Long Island to this event. Races are held throughout the week. Racing areas are generally held within 3.5 to 4.5 miles west and northwest of Block Island. In addition, the final race of this event circumnavigates Block

[55] Narragansett Bay PAWSA Report, p. 16, available at the Coast Guard Navigation Center website at http://www.navcen.uscg.gov/mwv/projects/pawsa/PAWSA_FinalReports.htm.

Island. Races held in even years are smaller events with approximately 100 participating vessels.

Around Long Island Regatta: This race is generally held the last week in July, and lasts approximately 2 ½ days. Beginning off the south shore of Long Island in the Rockaways, participants transit eastward along the Long Island coast, around Montauk Point, through Plum Gut or The Race, and then proceed west to Glen Cove, New York located on the western end of the north shore of Long Island. This Regatta averages approximately 100 participating vessels over 24 feet, with some participating vessels greater than 100 feet. For 2006, this Regatta is scheduled to begin on July 27, 2006.

Off Soundings Spring Race Series: The Off Soundings Club of Madison, Connecticut sponsors this annual two day race series attracting between 120-150 boats the second weekend in June. The participants race from Watch Hill to Block Island on Friday, and again in the vicinity of (often around) Block Island on Saturday.

Off Soundings Fall Race Series: The fall series takes place in mid-September and attracts a somewhat larger field, anywhere from 150-170 boats participating, with yachts ranging from 24 feet to 60 feet. The Friday race is from New London to Gardiner's Bay via The Race or Plum Gut; Saturday features multiple races of various courses inside Gardiner's Bay.

Duck Island Yacht Club: This 45 – 55 NM overnight race from Westbrook to Block Island takes place the second Friday night in August. The 2005 race included about a dozen participants.

Stamford Denmark Friendship Race: Annual event held in September, consisting of two courses involving a total of approximately 150 boats, ranging in size from 20 to 66 feet, participants run triangular courses starting in the vicinity of the Twenty-six Foot Spot Lighted Bell Buoy 32A[56] located in the middle of the Sound south of Stamford; the legs of the courses are anywhere from 8 to 18 miles depending on the weather and wind conditions.

Newport to Bermuda Race: This event is held every other year, in even numbered years. This event impacts the initial segment of the LNG carrier anticipated transit route as participants transit from Newport, RI in Narragansett Sound southeast to Bermuda. Approximately 75 boats transit from locations within Long Island Sound. In 2006, approximately 300 participants are expected for this event.

Manhassett Bay Gold Cup: An annual power boat event sponsored by the National Power Boat Association. This event is organized as a "poker run", an event in which participants collect playing cards at each of the waypoints of the event, compiling a hand of poker; prizes are generally distributed based on the best "hand". The 2006 event is scheduled for June 22, 2006; 75 vessels ranging in size from 18 to 75 feet are expected to

[56] LLNR 21380

participate. This event runs between New Rochelle, NY harbor and Bridgeport, CT with 5 waypoints at harbors in between.

Glen Cove Hi-stakes Poker and Radar Run: An annual power boat event sponsored by the National Power Boat Association. As described above, this is organized as a poker run. In 2006, this event is scheduled for August 26, 2006; 65 vessels ranging in size from 18 to 75 feet are expected to participate. This event runs between Glen Cove, Long Island and Bridgeport Connecticut, with 4 way points along the route.

As noted, the events listed above constitute only a small portion of the Marine Events held on Long Island and Block Island Sounds. New events impacting the transit area occur every year. For example, power boat races are growing in popularity and frequency on Long Island Sound. An event new for 2006 is scheduled for Connecticut, Long Island Sound and Block Island Sound. The tentative route for this one day event is from Old Saybrook, CT, across Long Island Sound and through Plum Gut to Greenport, Long Island, New York, then to New Harbor, Block Island, then transiting west through The Race, and then up the Thames River to American Wharf Marina at Mohegan Sun Casino. Entries in this event are limited to 100 vessels, but several more craft are expected as observers, or unofficial participants.

Marine events that may impact only one particular segment of the anticipated LNG carrier transit route will be discussed for the respective segments in Section 3.2 of this report. The breakdown of events permitted by COTP Long Island Sound in 2004 and 2005 that impact The Race, Eastern, Central and Western Long Island Sound are outlined in Tables 2-5 and 2-6.

Table 2-5: 2004 COTP Long Island Sound Marine Events

Event Type	The Race	ELIS*	CLIS**	WLIS***
Regatta	0	6	1	8
Fireworks	0	12	4	14
Boat Race	0	14	2	14
Boat Parade	0	2	1	2
Poker Run	0	1	0	2
River Glow	0	2	0	0
Swim	0	1	0	5
Totals	**0**	**38**	**8**	**45**

* Eastern Long Island Sound, as defined in section 3.2.6.
** Central Long Island Sound, as defined in section 3.2.7.
*** Western Long Island Sound, as defined in section 3.2.8.

Table 2-6: 2005 COTP Long Island Sound Marine Events

Event Type	The Race	ELIS*	CLIS**	WLIS***
Regatta	1	8	1	12
Fireworks	0	11	4	18
Boat Race	0	13	2	11
Boat Parade	0	2	0	1
Poker Run	0	1	0	2
River Glow	0	1	0	0
Swim	0	1	0	3
Totals	**1**	**37**	**7**	**47**

* Eastern Long Island Sound, as defined in section 3.2.6.
** Central Long Island Sound, as defined in section 3.2.7.
*** Western Long Island Sound, as defined in section 3.2.8.

2.2.4 Regulated Facilities

The Coast Guard regulates various types of facilities to maintain safety, security and environmental compliance. Table 2-7 outlines the types of facilities within Long Island Sound[57] that are regulated by the Coast Guard. As of the date of this report, there are thirty- four (34) marine transfer facilities on Long Island Sound. These facilities are subject to annual exams to ensure compliance with environmental and safety regulations, and to ensure accurate record keeping for training and testing of facility equipment (including pipes, hoses, fire equipment and response gear). The authority for conducting such examinations is primarily contained in 33 CFR Part 154 and Part 156, which address the actual transfer of oil and hazardous materials.

Additionally, there are also facilities, including the marine transfer facilities discussed above, that are subject to the requirements of the Maritime Transportation Security Act (MTSA) of 2002. Regulations implemented in accordance with MTSA are contained in 33 CFR, Subchapter H, Part 105. Under these regulations the Coast Guard conducts annual verification of conformance with the regulations; the Coast Guard also conducts unannounced spot checks to ensure compliance. Under the Part 105 regulations, facilities regularly conduct exercises and drills of their security plan. There are 47 facilities on Long Island Sound subject to MTSA regulations.

Block Island Sound and Narragansett Bay has similar diversity in facility types. Port and facility information for Narragansett Bay and Block Island Sound is discussed in Sections 3.2.1 and 3.2.3 infra.

[57] This table only covers those regulated facilities on Long Island Sound. It does not encompass the entirety of the facilities located in COTP Long Island Sound Zone, or those located in Block Island Sound.

Table 2-7: Regulated facilities in Long Island Sound

	Facility Type			
	Marine Oil Facility	**Passenger Terminal**	**Waterfront Facility**	**Waterfront & Passenger Terminal**
Eastern LIS Total	**9**	**6**	**0**	**1**
Deep River	-	1	-	-
Fishers Island	-	1	-	-
Gales Ferry	1	-	-	-
Groton	2	-	-	-
Haddam	-	1	-	-
Hartford	1	-	-	-
Middletown	1	-	-	-
New London	1	2	-	1
Orient Point	-	1	-	-
Portland	1	-	-	-
Uncasville	1	-	-	-
Wethersfield	1	-	-	-
Central LIS[58] Total	**1**	**0**	**0**	**0**
Riverhead	1	-	-	-
Western LIS Total	**24**	**4**	**2**	**0**
Bridgeport	2	1	-	-
Devon	1	-	-	-
Greenwich	-	2	-	-
New Haven	8	-	1	-
Northport	1	-	-	-
Oyster Bay	1	-	-	-
Port Chester	1	-	-	-
Port Jefferson	2	1	-	-
South Norwalk	2	-	-	-
Stratford	6	-	1	-
Totals	**34**	**10**	**2**	**1**

[58]Central LIS is defined in Section 3.2.7.

2.3 Regulatory requirements for vessel operation and transit within COTP Long Island Sound Zone

There are numerous regulatory requirements imposed on vessels; some apply to all vessels operating in U.S. waters, some apply to certain classes of vessels, such as cargo or tank vessels operating in U.S. waters, and some are unique to the COTP Long Island Sound Zone. The requirements applicable to all vessels are discussed herein; regulations specific to LNG carrier are highlighted where there are additional or unique regulatory requirements.

2.3.1 Regulations generally applicable in U.S. Waters

Prior to receiving approval to enter U.S. waters, foreign vessels must meet a number of requirements prescribed by international conventions[59] and U.S. laws and regulations governing vessel security, safety and environmental compliance. The scope of regulatory enforcement under the authority of the U.S. Coast Guard Captain of the Port includes but is not limited to the following: General authority for maritime enforcement of U.S. laws, 14 United States Code (U.S.C.) 89; the Ports and Waterways Safety Act (PAWSA) of 1972; the Port and Tanker Safety Act (PTSA) of 1978; the Oil Pollution Act of 1990 (OPA 90); and the Maritime Transportation Security Act of 2002 (MTSA).

2.3.1.1 *Advance Notice of Arrival*

All U.S. and foreign vessels bound for or departing from ports or places in the U.S. must submit an Advance Notice of Arrival (ANOA) to the National Vessel Movement Center.[60] ANOAs must be submitted at least 96 hours prior to entering a port or place of destination or, if the voyage time for the vessel is less than 96 hours, the ANOA must be submitted at least 24 hours in advance. These notices are forwarded to the office of the COTP zone in which the vessel will arrive. Prior to receiving approval to enter U.S. waters, all foreign vessels must meet a number of requirements prescribed by international convention and U.S. laws and regulations governing vessel security, safety and environmental compliance. An example of this process and the associated timeline is depicted in Figure 2-8.

Upon receiving a request for entry into a U.S. port through the ANOA process, the cognizant COTP has the ability to conduct reviews of the vessel's history with regards to safety, law enforcement and previously collected intelligence data. The decision process for authorizing the vessel's entry into the port is conducted and a formal entry or denial decision is made. Action can be taken to mitigate any potential risk that the vessel may pose to the port. The COTP has several operational tools that can be utilized to initiate action on the pending vessel.

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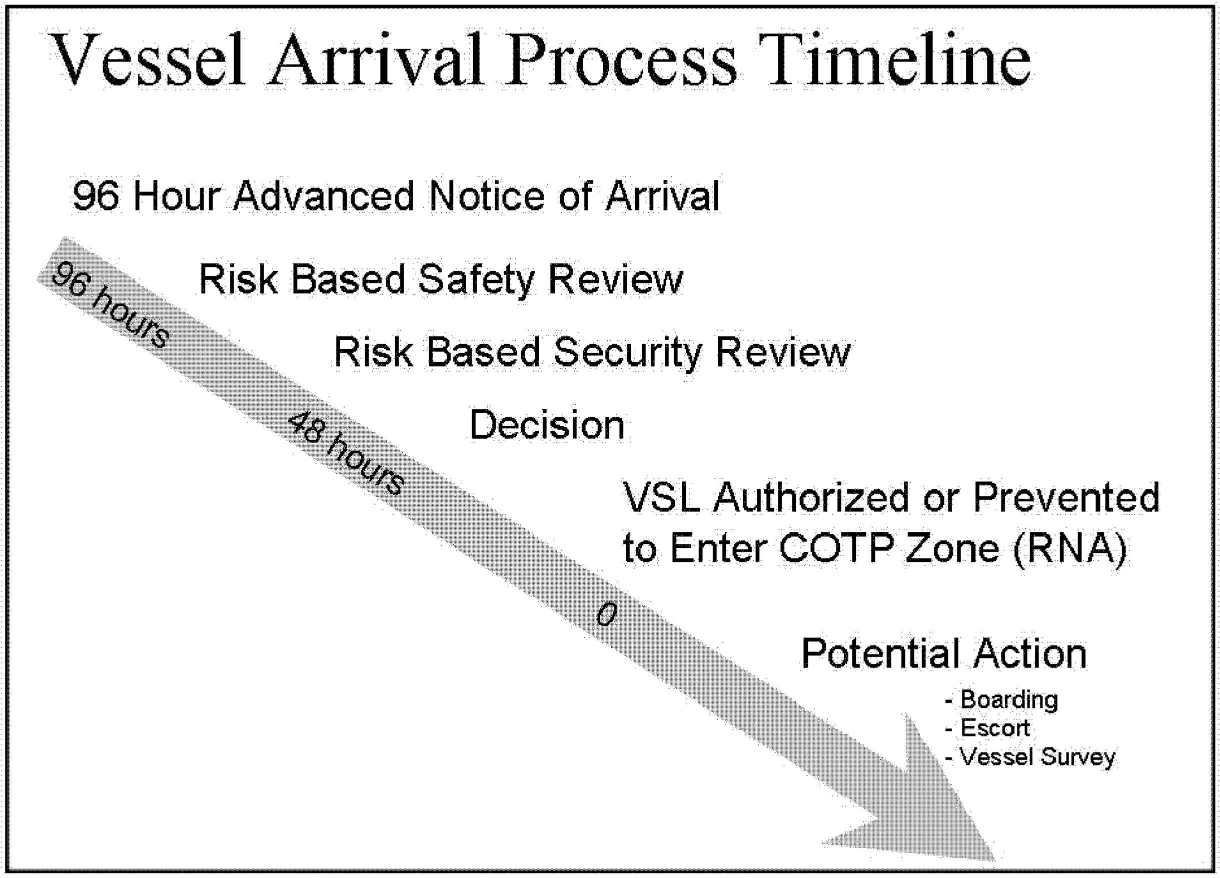
[59] International Convention for the Safety of Life at Sea (SOLAS), International Convention on Load Lines 1966 (ICLL); International Convention for the Prevention of Pollution from Ships 73/78 (MARPOL); the International Convention on Standards and Watchkeeping for Seafarers, 1978, as amended in 1995 (STCW 1995); and International Labor Organization Convention No. 147, the Convention Concerning Minimum Standards in Merchant Ships (ILO 147)).
[60] See 33 CFR Part 160, Subpart C.

Figure 2-8 - Vessel Arrival Process Timeline



2.3.1.1.1 Port State Control Program

Through its Port State Control (PSC) Program, the Coast Guard verifies that foreign flagged vessels operating in U.S. waters comply with applicable international conventions, U.S. laws and regulations. This program ensures that vessels meet security, safety and environmental compliance standards. Any foreign flagged vessel entering U.S. waters is subject to boarding and examination by Coast Guard boarding teams to verify compliance with the laws and regulations. Vessels non-compliant with relevant conventions, law or regulations may be subject to certain action under the authority of either the Coast Guard Captain of the Port (COTP) or the Coast Guard Officer in Charge of Marine Inspection (OCMI)[61] to ensure compliance, including: requesting appropriate information; requiring the immediate or future correction of deficiencies; detaining the vessel; or allowing the vessel to proceed to another port for repairs.

[61] The authority of the Officer in Charge of Marine Inspection (OCMI) is defined in 33 CFR §1.01-20.

2.3.1.2 *Vessel Security Plans*

In December 2002, the International Ship and Post Facility Security Code (ISPS) and the Maritime Transportation Security Act of 2002 (MTSA 2002) required vessels to have in place vessel security plans for foreign flagged vessels or for U.S. flagged ships. All LNG carriers, as well as other cargo vessels 300 gross tons and larger, and ports servicing those regulated vessels, must adhere to the IMO and SOLAS standards. Tank vessels entering U.S. waters have additional requirements to those addressed above under the PSC program.

2.3.1.3 *Tank Vessel Exams*

As required by 46 U.S.C. §3714, each foreign tank vessel shall undergo a full safety examination at its initial U.S. port of call and at least annually thereafter. This annual examination is referred to as a Tank Vessel Exam (TVE). Title 46 U.S.C. §3711 requires that the Coast Guard to issue a Certificate of Compliance to each foreign tank vessel that is valid for 24 months. The Coast Guard has determined that a TVE letter will be issued to tank vessels carrying oil and oil products every 12 months and a Certificate of Compliance will be issued to chemical and gas carriers every 24 months with an annual mid-period exam. Title 46 CFR §154.1802 requires that all vessels as defined below have: (1) an IMO Certificate issued by the flag administration that is endorsed with the name of the cargo that it is allowed to carry, and (2) a Certificate of Compliance (COC) issued by the U.S. Coast Guard *endorsed* with the name of the cargo that it is allowed to carry. A Subchapter O Endorsement (SOE) is a document issued by the U.S. Coast Guard to meet the endorsement requirement of 46 CFR §154.1802. The SOE allows the foreign flag vessel to carry products listed on the vessel's Certificate of Fitness in U.S. waters.

Any foreign flag self-propelled vessel that has on board bulk liquefied gases as cargo, cargo residue, or vapor and wishes to operate that vessel on the navigable waters of the United States must have a Certificate of Compliance with a Subchapter O Endorsement. This includes all LNG carriers.

2.3.1.4 *Naval Vessel Protective Zones*

Naval vessel protective zones (NVPZ) exist within 500-yards of any U.S. naval vessel that is greater than 100-feet in length overall, at all times in the navigable waters of the United States. NVPZs were established to provide for the safety or security of these U.S. Naval vessels.[62] While within the zone, vessels are required to operate at a minimum speed necessary to maintain safe course, unless required to maintain speed by the Navigation Rules, and may not enter within 100-yards of the naval vessels.[63]

2.3.2 Regulations Unique to COTP Long Island Sound Zone

A COTP Long Island Sound Zone-wide Regulated Navigation Area (RNA), located at 33 CFR §165.153, exists out to twelve nautical miles from the territorial sea baseline. This RNA imposes requirements on vessels, dependent upon their size, last port of call, whether they are transiting

[62] 33 CFR §§165.2015 and 165.2025.
[63] 33 CFR §165.2025 (d).

to a port within the COTP Long Island Sound Zone or merely in innocent passage, and where they are operating. The RNA imposes inspection and authorization requirements by the COTP prior to vessels entering within three nautical miles from the territorial sea baseline.[64] Additionally, vessels over 1,600 gross tons operating in the RNA within three nautical miles must receive authorization from the COTP prior to transiting or any intentional vessel movements, including shifting berths, departing anchorage, or getting underway from a mooring.[65] This regulated navigation area also imposes a no-entry area for vessels greater than 300 gross tons within a 1200-yard radius of ferries and a no-entry area for all vessels within 100-yards of a vessel engaged in commercial service.[66] For both, entry is permitted if the express prior authorization of the ferry vessel licensed operator, licensed master, COTP or designated COTP on-scene representative is obtained.

Several safety and security zones exist within the COTP Long Island Sound Zone. These include zones surrounding the Naval Submarine Base, New London, Connecticut,[67] General Dynamics Electric Boat Shipyard, Dominion Millstone Nuclear Power Plant, and surrounding all anchored Coast Guard vessels.[68] In addition, safety and security zones have been proposed surrounding the Northport and Riverhead Offshore Platforms. Safety zones are also imposed for several fireworks events in the COTP Long Island Sound area of responsibility.[69]

Six Lightering Zones exist within Long Island Sound; these areas are designated by Captain of the Port Policy letter 03-99, and not by regulation.[70] As shown in Figures 2-3 and 2-4, these lightering zones are located off of Niantic, New Haven, and Bridgeport, Connecticut and off of Riverhead, Northport and Port Jefferson, New York.[71] COTP Long Island Sound is in the process of establishing these areas as formal anchorage grounds and lightering zones in accordance with Coast Guard regulations in 33 CFR Parts 110 and 156, respectively. This process is independent of the Broadwater proposal; anchorage grounds and lightering zones are being developed to provide for general navigation safety, security and environmental protection.

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[64] 33 CFR §§165.153(d)(3) and (4), respectively. The following vessels are exempted from the vessel inspection and authorization requirements: vessels operating exclusively within the Long Island Sound Marine Inspection and COTP Zone, vessels on a single voyage which depart from and return to the same port or place within the RNA, all towing vessels engaged in coastwise trade, vessels in innocent passage not bound for a port or place subject to the jurisdiction of the united states, and all vessels not engaged in commercial service whose last port of call was in the United States. These requirements are in addition to Notice of Arrival Requirements for U.S. Ports outlined In 33 CFR 160, Subpart C, outlined in Section 2.3 above.

[65] 33 CFR §165.153(d)(5).

[66] *Commercial service* is defined in 33 CFR §165.153(c) as, "any type of trade or business involving the transportation of goods or individuals, except service performed by a combatant vessel."

[67] 33 CFR §165.140 (a)(2)

[68] 33 CFR §165.154(a)(2).

[69] Safety Zones for annual events exist at 33 CFR 165.151, and special local regulations exist for fireworks events at 33 CFR 100.114. Temporary zones may also be established to protect the boating public for non-reoccurring events.

[70] COTP Long Island Sound Policy Letter 03/99 of 16 July 2006.

[71] The coordinates for the lightering zones are discussed where applicable in Section 3.2 infra.

2.3.3 State Pilotage Requirements

Foreign and American vessels under register transiting to ports or places within Long Island Sound must utilize a New York or Connecticut licensed marine pilot while transiting Long Island Sound.[72] Pilotage on Long Island Sound is concurrent between the states of New York and Connecticut.[73] Marine pilots must embark and disembark vessels at one of two designated pilot boarding stations: the Point Judith Pilot Station located at 41°17'N, 071°30.5'W, or the Montauk Point Pilot Station, located at 41° 02' N, 071° 42'W.[74] Point Judith Pilot Station is considered the primary pilot boarding station for New York Licensed Marine Pilots; Montauk Pilot Boarding Station is considered an alternate boarding station.[75] Vessel draft and weather conditions limit use of the Montauk pilot station by pilots licensed by both Connecticut and New York: vessels with a draft in excess of 38' may not be piloted through Montauk Channel; and pilotage requirements for CT and NY prohibit use of Montauk Channel if weather conditions, sea state and vessel traffic "pose a threat to the safety of any person, vessel, prudent navigation, or safety of the environment."[76] Broadwater has indicated that the same pilot that boards the LNG carrier for transit to the FSRU will complete the docking and undocking operations at the FSRU and will remain onboard throughout the discharge operation.[77]

2.3.4 Regulatory requirements specific to LNG carriers

LNG carriers supplying the FSRU would likely be foreign flagged vessels, or vessels that are of foreign registry. The carriers used to import LNG to the proposed Broadwater facility would be constructed and operated in accordance with International Maritime Organization's Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk, the SOLAS, and Title 46 CFR, Part 154, which contain the United States safety standards for vessels carrying bulk LNG. Foreign flag LNG ships are required to possess a valid IMO Certificate of Fitness and a Coast Guard Certificate of Compliance with an endorsement that the vessel is in compliance with 46 CFR, Subchapter O.

[72] See Reg. Conn. Agencies §15-15a-16(a).
[73] Reg. Conn. Agencies §15-15d.
[74] State of Connecticut Department of Transportation Notice, Mandated Pilot Boarding and Disembarking Stations, dtd March 1, 2005; Board of Commissioners of Pilots of the State of New York, Policy and Procedure Memorandum No. 042302 dated 30 April 2002. When necessary to ensure safe passage of a vessel, Pilots may board or disembark a vessel in the following locations: south or east of Pilot Station Point Judith and outside of the waters of the State of Rhode Island; or south of the Montauk Point Pilot Station. See State of Connecticut Notice dtd March 1, 2005.
[75] Board of Commissioners of Pilots of the State of New York, Policy and Procedure Memorandum No. 042302 dtd 30 April 2002.
[76] Board of Commissioners of Pilots of the State of New York, Policy and Procedure Memorandum No. 042302 dtd 30 April 2002.
[77] Resource Report 1, p. 1-71.

2.4 Weather

Generally, in Long Island Sound weather is most favorable from mid-May to mid-October, when the most common hazards are thunderstorms and fog. Weather is generally favorable for recreational vessels during June, July and August. Fog is most likely in spring and early summer. Heavy fog is encountered about 10-12 percent of the time from April to August. Winter winds are mostly out of the west through north, but gale force winds[78] blow less than five (5) percent of the time due to these waters being somewhat sheltered.[79] Historic hurricane data for this area is discussed in Section 2.4.2.

It is important to note the significant differences that can exist within Long Island Sound, which provides protected waters for vessels, versus Block Island Sound, Montauk Channel and Rhode Island Sound, which are exposed waters and, overall, experience greater wind velocities and more turbulent weather conditions and wave height. Weather conditions unique to each portion of the transit area are discussed as applicable for each of the transit segments in Section 3.2.

The waters of Block Island Sound and Rhode Island Sound are open waters and experience weather conditions similar to those in the open ocean. Land influences the weather only at the northern edge of the Block Island Sound, with a northerly wind. Winds from all other directions have ample time to increase in strength and the Sound can be as turbulent as any water off the coast. In Block Island Sound, generally, winds averaging 16-17 knots are common in the winter. Gale force winds occur up to 5 % of the time in the winter and are generally from the west and northwest. The average wind speed throughout the year is 15 knots, but the mean is 17 knots in the winter, when gale force winds are frequent. Seas built by winds from the southeast through southwest are usually highest since there is no land to interfere with the fetch. Seas of 10 feet (3 meters) or more are likely 5 to 7 percent of the time in the winter.[80] The cold waters of Block Island Sound result in more frequent fog in the summer months than Narragansett Bay or Buzzards Bay to the north; fog can be 2-3 times more prevalent in Block Island Sound than in those areas. The usual duration of a fog is from 4 to 12 hours. In the early fall most of the tropical storms moving up the coast affect Block Island to some extent. Since 1871, 13 storms have come within 25 miles of Block Island. The most recent was Hurricane Bob in August 1991. The center of Hurricane Bob passed about 10 miles to the west of the island with 85 knot winds.[81] Hurricane data for the area is addressed in more detail in Section 2.4.2.

2.4.1 Ice Formation in Long Island Sound

Vessel transits in Long Island Sound and The Race can be affected by ice formation during winter months. In ordinary winters, floating and pack ice exists in Long Island Sound. While this can impede navigation, the ice formation is generally of low risk to commercial vessel

[78] Gale force winds are winds with speeds between 39 to 54 miles per hour (34 to 47 knots).
[79] National Oceanic and Atmospheric Administration, Office of Coast Survey, Coast Pilot 2, 35th Edition Chapter 8, p. 290.. Hereafter, Coast Pilot,
[80] Coast Pilot p. 264-5.
[81] Coast Pilot p. 265.

transit. In severe winters, ice may have significant impact on traffic other than ocean going vessels.[82]

Drift ice, which is formed principally along the northern shore of Long Island Sound under the influence of the prevailing northerly winds, drifts across to the southern side and accumulates there, massing into large fields, and remains until removed by southerly winds, which drive it back to the northerly shore. In ordinary winters, ice generally forms in the western end of the Sound as far east as Eaton's Neck.

Northeasterly winds force the ice westward and cause formations heavy enough to prevent the passage of vessels of every description until the ice is removed by westerly winds. These winds carry the ice eastward and, if of long duration, drive it through The Race into Block Island Sound.

2.4.1.1 *Freezing of Long Island Sound*

There is evidence that substantial portions of Long Island Sound have frozen, significantly impacting vessel transits. Although unable to locate historical records confirming ice formation across the Sound, as part of this Report, COTP Long Island Sound surveyed commercial operators with extensive histories of operation on the Sound, to determine the extent of ice formation. From the mariner information, it is apparent that large portions of Long Island Sound have indeed frozen over sufficiently to impede vessel traffic.

In 1977, from the first week in January through the second week of February, most of Long Island Sound was frozen over. The waters at Execution Rock on the western end of the Sound were solid ice. Commercial deep draft vessel traffic was not impeded in the Sound as the shipping lanes remained open, but operation in the harbors was limited strictly to daylight. Riverhead Platform was inaccessible by tankers or barges due to the pressure created by ice pushing on vessels, making mooring exceptionally difficult and causing mooring lines to break once vessels were moored up. Lighted aids to navigation in the sound were off station or missing, and were extinguished; ice buoys replaced buoys for navigation. Ice was 2-3 feet thick in certain portions of the Sound.

During the winter of 1967-68, the Port Jefferson to Bridgeport ferry was unable to transit out of Port Jefferson Harbor due to ice that extended out past the entrance to the harbor to a thickness where a crew was able to conduct welding operations on one of the Port Jefferson ferries from the ice. Also that year, there was heavy pack ice between the Connecticut River and the Thames River, causing difficulty of passage for commercial vessels. That same winter, Gardiners Bay, Long Island, froze completely across.[83] During the winter of 1917 to 1918, cars were apparently driven across the Sound in the vicinity of Port Jefferson, NY.[84]

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[82] Coast Pilot p. 290.
[83] Information obtained from Brad Glass, operator of HELCAT II, Groton, Connecticut.
[84] Information obtained from Fred Hall , Bridgeport -Port Jefferson Steamship Company.

Historic data also indicates that, during the winter of 1779-1780, "Long Island Sound was almost completely clogged with ice, and people were able to cross from Long Island to the vicinity of Stamford" Connecticut for several days, and that people were able to cross other areas of the western Sound, including from Connecticut to Lloyd's Neck, Long Island.[85]

2.4.2 Hurricane Data

Per National Hurricane Center Data provided in Table 2-8 below, between the years 1851 and 2004, twelve hurricanes have made direct landfall in New York. As noted in Table 2-8, six of these hurricanes were a Category 1, one was a Category 2, and five were Category 3 hurricanes. No Category 4 or 5 hurricanes have ever made landfall in the study area.

As noted above and in Table 2-8, a total of twelve hurricanes have made landfall in the study area. While not making landfall, high winds and storm surge from several hurricanes and tropical storms have also impacted Long Island Sound. According to National Weather Center data, forty tropical cyclones have affected southern New England since 1936; 16 were tropical storms, and 24 were hurricanes.[86] With any hurricane or tropical storm event, Long Island Sound can be impacted by several weather factors, including sustained winds, wind gusts and storm surge. Hurricanes that have impacted the Long Island Sound area have produced notable sustained winds, wind gusts and storm surge. For example, during Hurricane Bob in 1991, peak wind gusts were recorded at 125 miles per hour. During the Great Hurricane of 1938, the hurricane produced storm tides of 14 to 18 feet across most of the Connecticut Coast, with 18 to 25 foot tides beginning in New London and running east.

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[85] Newsday.com article, "F*rozen Ducks in the Kitchen, Nations at war shiver through the Northeast's hard winter of 1779-80* by George De Wan, citing David M. Ludlum, "Early American Winters: 1604-1820", at http://www.newsday.com/community/guide/lihistory/ny-history-hs424a,0,6567872.story?coll=ny-lihistory-navigation.

[86] Southern *New England Tropical Storms and Hurricanes, A Ninety-eight Year Summary 1909-1997*, by David R. Vallee and Michael R. Dion, National Weather Service, Taunton, MA.

Table 2-8_Hurricane direct hits on the mainland U.S. coastline and for individual states 1851-2004 by Saffir/Simpson category.

Area	Category Number					All (1-5)	Major (3-5)
	1	2	3	4	5		
U.S. (Texas to Maine)	109	72	71	18	3	273	92
Texas	23	17	12	7	0	59	19
(North)	12	6	3	4	0	25	7
(Central)	7	5	2	2	0	16	4
(South)	9	5	7	1	0	22	8
Louisiana	17	14	13	4	1	49	18
Mississippi	2	5	7	0	1	15	8
Alabama	11	5	6	0	0	22	6
Florida	43	32	27	6	2	110	35
(Northwest)	27	16	12	0	0	55	12
(Northeast)	13	8	1	0	0	22	1
(Southwest)	16	8	7	4	1	36	12
(Southeast)	13	13	11	3	1	41	15
Georgia	12	5	2	1	0	20	3
South Carolina	19	6	4	2	0	31	6
North Carolina	21	13	11	1	0	46	12
Virginia	9	2	1	0	0	12	1
Maryland	1	1	0	0	0	2	0
Delaware	2	0	0	0	0	2	0
New Jersey	2	0	0	0	0	2	0
Pennsylvania	1	0	0	0	0	1	0
New York	6	1	5	0	0	12	5
Connecticut	4	3	3	0	0	10	3
Rhode Island	3	2	4	0	0	9	4
Massachusetts	5	2	3	0	0	10	3
New Hampshire	1	1	0	0	0	2	0
Maine	5	1	0	0	0	6	0

Source: NOAA Technical Memorandum NWS TPC-4:THE DEADLIEST, COSTLIEST, AND MOST INTENSE UNITED STATES HURRICANES FROM 1851 TO 2004 (AND OTHER FREQUENTLY REQUESTED HURRICANE FACTS) by Eric S. Blake, Jerry D. Jarrell(retired) and Edward N. Rappaport NOAA/NWS/ Tropical Prediction Center Miami, Florida Christopher W. Landsea NOAA/AOML/Hurricane Research Division Miami, Florida

Table 2-9 Hurricane Categories

CATEGORY	WIND SPEED (mph)	STORM SURGE
1	74-95	4-5 feet
2	96-110	6-8 feet
3	111-130	9-12 feet
4	131-155	13-18 feet
5	156 or greater	More Than 18 feet

Source: Saffir/Simpson category index, a description of which is available at the National Weather Service National Hurricane Center website at: http://www.nhc.noaa.gov/aboutsshs.shtml.

3 Characterization of LNG Facility and LNG Carrier Route

3.1 LNG Facility

The information regarding the proposed facility detailed in this Section was derived from Broadwater's Application to FERC, supporting Resource Reports filed with the application, as well as information provided directly to the COTP Long Island Sound by Broadwater[87].

Broadwater Energy is proposing to build a floating storage and regasification unit (FSRU) in Long Island Sound. The FSRU would be supplied by LNG vessels, which will transit to Long Island Sound from foreign ports. The FSRU will be designed to receive, store, and regasify LNG at an average throughput of 1.0 billion cubic feet per day (bcf/d) and will be capable of delivering a peak throughput of 1.25 bcf/d. As proposed, the FSRU would deliver the regasified LNG to the existing natural gas pipeline system via a subsea interconnection to the Iroquois Gas Transmission system pipeline. Aspects of the proposal that could impact marine safety and security if approved and constructed are highlighted below. A detailed description of the project is available through the Application and Resource Reports filed by the applicant, available on the FERC website at http://www.ferc.gov/for-citizens/for-citizens.asp.

3.1.1 Proposed Floating Storage and Regasification Unit (FSRU)

The proposed LNG facility will consist of a floating storage and regasification unit (FSRU). The steel hull of the FSRU would measure approximately 1,215 feet (370 meters [m]) in length, 200-feet (60 m) in width, and would rise approximately 80- feet (25 m) above the water line to the deck. The FSRU's draft would be approximately 40-feet (12 m). The freeboard and mean draft of the FSRU would generally not vary throughout operating conditions. This would be achieved by using ballast to maintain the FSRU's trim, stability and draft. The FSRU will be designed to accommodate storage of approximately 8 billion cubic feet (bcf) (350,000 cubic meters [m^3]) of LNG, with base vaporization capabilities of 1.0 bcf/d using a closed-loop shell and tube (STV) vaporization system. The anticipated displacement tonnage of the FSRU would be 266,048 tonnes.[88] The FSRU will be a vessel-shaped, double hulled facility, built specifically to transfer, store and regasify LNG. The entire cargo containment system of the FSRU is protected by a double hull: the double hull design is similar to that of an LNG carrier; the double hull is applicable to the flat bottom, sides and upper/trunk decks of the FSRU.[89] All LNG storage will be integrated into the hull of the facility, with some process equipment located on its deck.

As proposed, LNG would be delivered to the FSRU in LNG carriers with cargo capacities ranging from 125,000 m^3 to 250,000 m^3. As proposed, 2 to 3 LNG carriers per week would deliver LNG to the FSRU. The FSRU would be equipped on its starboard side with berthing and

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[87] Broadwater's Application and accompanying Resource Reports submitted to FERC provide a detailed description of the proposed project. These can be found at the FERC website at http://www.ferc.gov/for-citizens/for-citizens.asp. FERC/USCG Interagency Agreement
[88] DNV Report no. 70014347 dtd 13 Feb 2006
[89] Resource Report 1, Section 1.3.2.1.

unloading facilities for a single LNG carrier. The berth can accommodate one LNG carrier in the range of 125,000 - 250,000 m^3 at a time. Characteristics of LNG vessels that may supply the FSRU if constructed are discussed in Section 3.1.4 below.

The FSRU itself will have 8 LNG tanks, each having an approximate volume of 44,850 m^3, for a total net storage capacity of 350,000 m^3. The LNG will be maintained at a temperature of minus 260° F and at a normal operating pressure of 1-3 pounds per square inch (psi), closely approximating atmospheric pressure. No mechanical means of refrigeration will be required because the LNG is refrigerated (liquefied) at the sending site and transported in thermally insulated LNG carrier cargo tanks. The main components of the containment system are more specifically detailed in Resource Report 1, section 1.3.2.5.1. All LNG storage will be integrated into the hull of the facility, with some process equipment located on the deck of the facility.

The FSRU will be secured in place in Long Island Sound via a Yoke Mooring System (YMS) attached to a stationary tower structure that is secured to the seabed which houses the sendout pipeline. The YMS is described in Section 4.3.5 infra. The YMS also is designed to allow the FSRU to orient in response to the prevailing wind, wave, and current conditions, that is, it will be able to pivot or weathervane around the tower.[90] The FSRU will be non-propelled; however, it will be equipped with electrically powered azimuth stern thrusters to maintain a constant heading when LNG carriers are mooring at or getting underway from the FSRU.[91] In addition, the FSRU will have a single berth on its starboard side to accommodate LNG carriers for off-loading of LNG. Living quarters to accommodate approximately 30 permanent and 30 temporary crew members will be installed on the facility aft of the LNG storage and containment area.

3.1.2 Location of FSRU

The proposed location of the FSRU is in central Long Island Sound. The yoke mooring tower is proposed to be located at approximate location 41° 06' 02.870" North Longitude, 72° 50' 44.56" West Latitude,[92] approximately 9.2 miles due north of Long Island, and approximately 8.9 miles from Herod Point in Wading River, Town of Riverhead, Suffolk County, Long Island, New York, and approximately 10.2 miles south of Johnson Point, Branford, Connecticut. The proposed location is in New York state waters, approximately 0.5 miles south of Connecticut state waters.[93] The proposed location is in the Town of Riverhead, Suffolk County, New York.[94] Figures 2-2 and 2-3 supra show the proximity of the FSRU to port areas.

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[90] See Resource Reports 1 and 11.
[91] Resource Report 1, p. 1-15.
[92] Broadwater Amendment to Letter of Intent to COTP Long Island Sound dated April 26, 2005.
[93] Connecticut Special Laws Volume 8, pp. 377-8, Jan. 1880; New York Rev. Stat. 1882, Vol.1, p. 136; U.S. Congressional acceptance, Feb 26 1881, 21 Stat. L. 351.
[94] *See* 1881 N.Y. Laws 695, §2 states: "The boundary lines of the several towns in the counties of Queens and Suffolk that adjoin Long Island Sound are hereby extended northwardly into Long Island Sound at right angles to the general trend of the coast at their several respective points, until they intersect the boundary line between the states of New York and Connecticut as lately established by the commissioners of the said states, and confirmed by the respective legislatures thereof." In a letter dated September 9, 2005, Coast Guard COTP Long Island Sound has requested clarification from the Attorney General of New York verifying that the FSRU would be located in Suffolk County. COTP Long Island Sound has not yet received a response from the New York Attorney General regarding this matter.

3.1.2.1 *Waterway attributes at the proposed location*

The proposed location is in approximately 90 feet of water in Central Long Island Sound. The tidal range at the location averages approximately 5.9 feet, with a spring range of 6.8 feet.[95] There are no charted natural obstructions near the FSRU; the closest natural obstruction is at Stratford Shoal Middle Ground, a natural rock ledge area, which is approximately 13.7 miles west southwest of the proposed location. Additionally, the Central Long Island Sound Dredged Material Disposal Site is 2.8 miles northwest of the proposed FSRU location.[96] Because of its location in the central sound, there are no manmade obstructions such as bridges which affect FSRU operations, or transits of LNG vessels to the FSRU. The most obvious obstruction to the FSRU is from other vessels transiting the Sound. The proximity of vessel transit to the FSRU is discussed in section 2.3 above. The proposed location within Central Long Island Sound offers natural protection from conditions on the high seas, and sea conditions are generally calmer than those encountered off the south shore of Long Island and within Block Island Sound. Currents at the proposed location average 0.8 knots on the ebb, and 1.0 knots on the flood. The ebb sets in an east-southeasterly direction; the flood in a west –southwesterly direction. An underwater cable is located approximately 3.8 miles to the east of the proposed FSRU location.

3.1.2.2 *Weather at Proposed Location*

Generally, in Long Island Sound weather is most favorable from mid-May to mid-October, when the most common hazards are thunderstorms and fog. Weather is generally favorable during June, July and August. Fog is most likely in spring and early summer. Heavy fog is encountered about 10-12 percent of the time from April to August. Winter winds are mostly out of the west through north, but gales blow less than five (5) percent of the time due to these waters being generally sheltered.[97] Historic hurricane data for this area is discussed in Section 2.4.2.

The University of Connecticut, Department of Marine Sciences maintains several weather buoys within Long Island Sound. The closest of these to the proposed FSRU location is National Data Buoy Center Station 44039, Central Long Island Sound, located at position 41°8'15" N, 72°39'18" W. This is approximately 10.4 miles east northeast of the proposed FSRU location discussed supra in Section 3.1.2.[98] Weather buoy data for the Central Long Island Sound Buoy for the years 2004 and 2005 is listed in Table 3.1-1. As noted in this Table, for this location, winds averaged over the two years at 5.0 and 6.4 m/s, 11.2 and 14.4 mph. Wind gusts averaged at 11.2 and 18.1 m/s and 30.5 and 40.4 mph. The maximum wind gust for 2004 was 30.5 mph in December 2004, and in 2005, it was measured at 58.8 mph, occurring both in October and December. Winds averaged out of the south–southwest (that is, winds blowing towards the north-northeast).

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[95] Ranges for Branford Harbor obtained from *National Oceanic and Atmospheric Administration Tidal Station Locations and Ranges*.
[96] Information regarding the Central Long Island Sound Dredged Material Disposal Site is available at http://www.epa.gov/ne/eco/lisdreg/.
[97] Coast Pilot, Ch. 8, p. 290.
[98] Meteorological data for the Central Sound Station is described at http://www.ndbc.noaa.gov/measdes.shtml#stdmet

3.1.2.3 *Density and Character of Marine Traffic*

Section 2.2 generally discusses the character of marine traffic within Long Island Sound. Section 2.2.2.2 discusses commercial vessel tracks and density derived from AIS data for 2005. As discussed in that Section, a predominance of east –west traffic transits to the south of the proposed location. Much of this east-west traffic is either through traffic, utilizing Long Island Sound as a thoroughfare to or from the Port of New York/New Jersey, or is heading towards Bridgeport, CT, Port Jefferson or Northport, New York. In addition, there is a concentration of traffic running from north-south located to the east of the proposed facility. The majority of this traffic is tug and barge traffic transiting to or from the Riverhead Offshore Platform. Section 2.2.3 discusses the character of recreational marine traffic on Long Island Sound. The highest density of recreational boating is generally within 2.3 to 3.5 miles of the shore of both coasts on Long Island Sound. [99] Similarly, most marine events are also held close to shore. There are few marine events that are held in proximity to the proposed location of the FSRU. Some larger sailing regattas and power boat races transit through the center of the Sound. These are outlined in Section 2.2.3.2.

[99] Long Island Sound PAWSA Report, p.17.

Table 3.1-1 National Data Buoy Center Station 44039, Central Long Island Sound summary of data

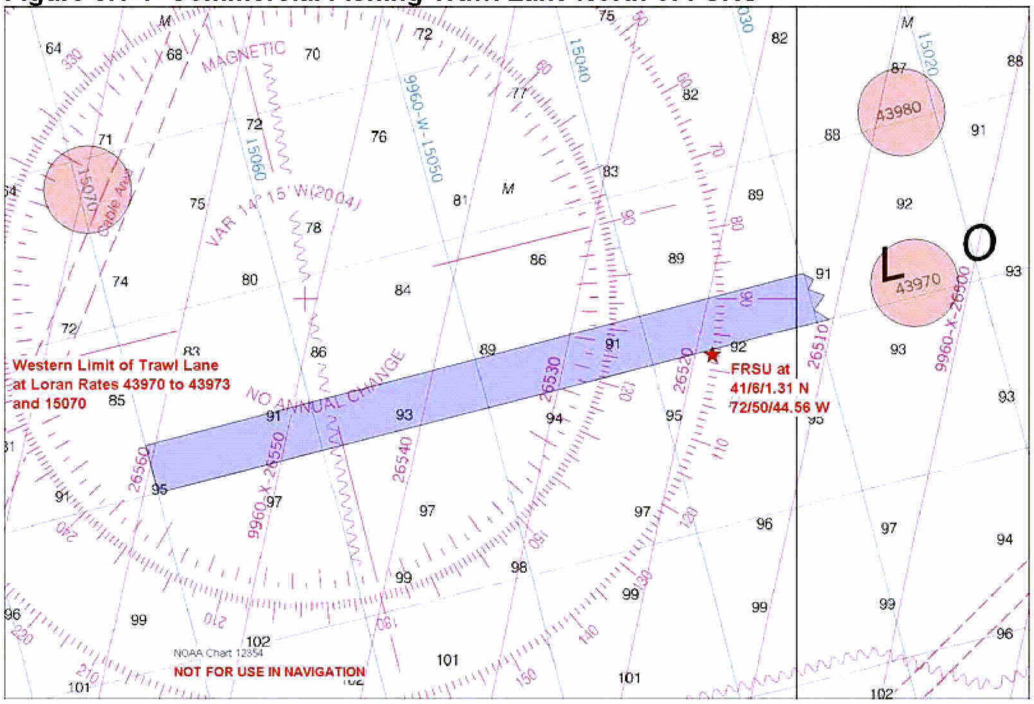
2004	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr Ave
Wind Direction (°T)													
Average	245.0	243.4	178.1	180.1	171.4	201.4	187.4	195.5	170.8	230.4		217.1	**201.9**
Wind Speed													
Average (m/s)	4.7	5.8	5.2	4.7	4.0	4.0	4.3	4.6	5.1	5.6		6.9	**5.0**
Maximum (m/s)	7.2	13.9	13.4	16.0	13.4	11.8	14.9	12.4	15.4	14.4		17.0	**13.6**
Average (mph)	10.4	12.9	11.6	10.5	8.9	8.9	9.7	10.3	11.4	12.6		15.5	**11.2**
Maximum (mph)	16.1	31.1	30.0	35.8	30.0	26.4	33.3	27.7	34.4	32.2		38.0	**30.5**
Wind Gust													
Average (m/s)												8.0	**8.0**
Maximum (m/s)												18.0	**18.0**
Average (mph)												17.9	**17.9**
Maximum (mph)												40.3	**40.3**
Dew Point													
Average	11.7	-5.7	-1.3	3.2	10.7	14.0	18.2	17.7	15.6	10.1		-4.2	**8.2**
Minimum	9.7	-27.3	-27.3	-27.3	-27.3	3.7	12.9	7.8	-27.3	-1.1		-17.5	**-11.0**
Maximum	13.7	3.0	8.5	11.9	17.2	21.3	22.5	22.9	22.0	16.6		11.3	**15.5**
Air Temperature													
Average (°C)		0.1	2.6	6.9	13.0	17.4	21.3	21.3	20.1	15.7		1.1	**11.9**
Minimum (°C)		-8.9	-4.4	-0.8	6.7	10.4	17.1	15.4	13.2	10.2		-11.3	**4.8**
Maximum (°C)		6.3	9.4	14.9	21.8	23.6	26.0	26.2	25.1	21.1		12.9	**18.7**
Average (°F)		32.2	36.7	44.3	55.5	63.3	70.3	70.3	68.1	60.3		34.0	**53.5**
Minimum (°F)		16.0	24.1	30.6	44.1	50.7	62.8	59.7	55.8	50.4		11.7	**40.6**
Maximum (°F)		43.3	48.9	58.8	71.2	74.5	78.8	79.2	77.2	70.0		55.2	**65.7**
Surface Temperature													
Average (°C)	5.4						22.1	22.6	22.2	19.8		6.6	**16.5**
Minimum (°C)	5.2						20.1	21.0	20.8	12.5		5.1	**14.1**
Maximum (°C)	5.6						24.0	25.5	25.5	21.4		8.8	**18.5**
Average (°F)	41.7						71.8	72.7	71.9	67.7		43.9	**61.6**
Minimum (°F)	41.4						68.2	69.8	69.4	54.5		41.2	**57.4**
Maximum (°F)	42.1						75.2	77.9	77.9	70.5		47.8	**65.2**
Wave Height													
Average (m)	0.4	0.5	0.4	0.4	0.3	0.2	0.3	0.3	0.4	0.4		0.6	**0.4**
Maximum (m)	0.6	1.7	1.6	1.5	1.0	1.0	1.3	0.9	1.7	1.0		1.5	**1.3**
Average (ft)	1.3	1.5	1.4	1.2	0.9	0.8	1.0	1.0	1.2	1.4		2.0	**1.2**
Maximum (ft)	2.0	5.6	5.2	4.9	3.3	3.3	4.3	3.0	5.6	3.3		4.9	**4.1**
Dominant Wave Period (s)													
Average	4.0	3.5	3.7	3.4	3.1	3.1	3.1	3.0	3.3	3.2		3.8	**3.4**
Minimum	4.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		2.0	**2.2**
Maximum	4.0	13.0	12.0	12.0	5.0	11.0	10.0	5.0	6.0	6.0		6.0	**8.2**
Pressure (mbar)													
Average												1022.1	**1022.1**
Minimum												1001.5	**1001.5**
Maximum												1035.8	**1035.8**

2005	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr Ave
Wind Direction (°T)													
Average	181.7	196.7	186.0	183.9	170.8	202.1	215.0	188.5		213.1	247.4	245.4	**202.8**
Wind Speed													
Average (m/s)	6.6	4.4	3.8	4.9	4.7	3.7	4.0	3.7		7.2	6.4	7.0	**5.1**
Maximum (m/s)	17.0	13.4	12.9	16.0	14.4	10.3	15.4	13.9		16.0	12.4	14.4	**14.2**
Average (mph)	14.8	9.9	8.6	10.9	10.6	8.3	9.0	8.3		16.2	14.3	15.6	**11.5**
Maximum (mph)	38.0	30.0	28.9	35.8	32.2	23.0	34.4	31.1		35.8	27.7	32.2	**31.7**
Wind Gust													
Average (m/s)	7.9	5.1	4.4	5.7	5.6	4.5	4.9	4.5		9.9	8.6	9.7	**6.4**
Maximum (m/s)	19.6	15.4	14.9	19.0	17.0	9.8	15.4	11.3		26.3	23.7	26.3	**18.1**
Average (mph)	17.7	11.5	9.8	12.7	12.5	10.0	10.9	10.0		22.2	19.3	21.8	**14.4**
Maximum (mph)	43.8	34.4	33.3	42.5	38.0	21.9	34.4	25.3		58.8	53.0	58.8	**40.4**
Dew Point													
Average	-5.1	-2.7	0.1	3.4	6.9	15.8	18.6	19.1		5.5	6.7	-2.6	**6.0**
Minimum	-21.5	-12.7	-8.4	-8.8	-8.4	0.0	0.0	0.0		-2.4	-6.2	-15.2	**-7.6**
Maximum	11.9	5.2	8.0	11.8	12.5	20.9	23.4	24.5		14.7	15.2	11.3	**14.5**
Air Temperature													
Average (°C)	-0.7	1.4	3.1	7.7	10.8	18.9	22.6	23.3		11.1	12.0	2.4	**10.2**
Minimum (°C)	-14.4	-3.6	0.0	0.0	6.5	13.8	16.2	17.3		4.7	2.4	-8.4	**3.1**
Maximum (°C)	13.1	7.8	8.5	16.4	16.9	26.9	27.6	28.5		19.3	18.0	11.5	**17.7**
Average (°F)	30.8	34.5	37.5	45.8	51.5	66.0	72.7	73.9		52.0	53.6	36.2	**50.4**
Minimum (°F)	6.1	25.5	32.0	32.0	43.7	56.8	61.2	63.1		40.5	36.3	16.9	**37.6**
Maximum (°F)	55.6	46.0	47.3	61.5	62.4	80.4	81.7	83.3		66.7	64.4	52.7	**63.8**
Surface Temperature													
Average (°C)	3.9	1.5	2.5	6.5	10.8	18.9	22.5	24.1		16.5	13.8	7.8	**11.7**
Minimum (°C)	1.1	0.7	1.2	2.8	8.3	14.2	17.5	21.5		13.9	12.4	5.2	**9.0**
Maximum (°C)	5.6	3.0	4.5	10.1	14.7	22.6	26.7	32.2		18.7	15.3	10.9	**14.9**
Average (°F)	39.1	34.6	36.4	43.6	51.5	65.9	72.5	75.3		61.7	56.9	46.1	**53.1**
Minimum (°F)	34.0	33.3	34.2	37.0	46.9	57.6	63.5	70.7		57.0	54.3	41.4	**48.2**
Maximum (°F)	42.1	37.4	40.1	50.2	58.5	72.7	80.1	90.0		65.7	59.5	51.6	**58.9**
Wave Height													
Average (m)	0.6	0.4	0.2	0.4	0.3	0.3	0.3	0.2		0.6	0.6	0.6	**0.4**
Maximum (m)	2.0	1.4	1.4	2.0	1.5	0.9	1.4	0.8		1.9	1.4	2.0	**1.5**
Average (ft)	1.8	1.2	0.8	1.2	1.1	0.9	1.0	0.8		2.0	1.8	2.1	**1.3**
Maximum (ft)	6.6	4.6	4.6	6.6	4.9	3.0	4.6	2.6		6.2	4.6	6.6	**5.0**
Dominant Wave Period (s)													
Average	3.6	3.9	3.3	3.4	3.4	3.1	3.2	2.8		3.7	3.6	3.9	**3.4**
Minimum	2.0	2.0	2.0	2.0	0.0	2.0	2.0	2.0		2.0	2.0	2.0	**1.8**
Maximum	7.0	6.0	6.0	6.0	8.0	10.0	6.0	5.0		6.0	7.0	7.0	**6.7**
Pressure (mbar)													
Average	1022.6	1016.3	1015.5	1013.6	1010.4	1014.5	1015.3	1017.0		1013.4	1019.3	1014.7	**1015.7**
Minimum	993.9	995.0	994.5	991.5	0.4	1001.0	1006.1	1000.0		991.4	1000.4	988.1	**905.7**
Maximum	1041.8	1034.8	1024.9	1036.6	1034.5	1025.4	1024.9	1024.2		1028.5	1029.9	1038.7	**1031.3**

International System of Units: (blue shading)
US Standard Units: (yellow shading)

3.1.2.3.1 Commercial Fishing Trawl Lanes

Figure 3.1-1 Commercial Fishing Trawl Lane North of FSRU



In the early 1980's as part of a cooperative effort between lobstermen and commercial trawlers, an agreement was reached between these fishing communities on Long Island Sound to establish two areas specifically reserved for commercial trawling. As such, no lobster traps are set in these trawl lanes. One of these trawl lanes is located approximately 61 yards north of the proposed FSRU location. This trawl lane, located in New York State waters, is identified according to Loran C lines, specifically beginning at Loran C line15070 east for approximately 15 miles, running between Loran C lines 43970 and 43973. This represents a width of approximately 810 yards (0.46 statute miles). The location of the trawl lanes is depicted in Figure 3.1-1. The second trawl lane is located in Connecticut State waters, running between Loran C lines 44009 to 44012. These lanes run approximately 2.3 to 5.4 miles offshore between Guilford, and Milford, Connecticut. The location of this trawl lane is depicted in Figures 2-3.

Very few commercial trawl fishing vessels utilize these lanes. It is estimated that at most 6 trawlers utilize these lanes; generally, fishing occurs in summer, primarily during the month of August.[100]

3.1.3 Onshore Facilities

As proposed, Broadwater has indicated that both temporary and permanent onshore facilities will be required during construction and operation of the proposed Broadwater LNG Facility.[101]

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[100] Personal communication with Nick Crismale, Connecticut Lobsterman's Association.

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During construction of the pipeline from the FSRU to its connection with the Iroquois Gas Transmission System, temporary space on the shore and dock space will be required by the Broadwater contractor. This would be used primarily for laying out pipeline to be used for the pipelaying operations, as well as for shuttling personnel and supplies to the project site.[102] Barges would be used for transporting the pipe from Newark, Jersey to the installation location; the vessel type for personnel transport has not been specified.[103] Broadwater has indicated that existing dockage space in Port Jefferson or Greenport, New York would be used for berthing vessels engaged in pipe laying installation and for personnel transport.

Permanent onshore facilities will include office space, warehousing, and a facility with waterfront access. These facilities will be located within existing marine facilities that are operated by others. Waterfront facilities would primarily be used for tug mooring, personnel transfer and materials transfer.[104] If constructed, Broadwater's operations would require a facility for the transfer of equipment, consumables and personnel between the shore and boats for transport to and from the FSRU. [105] Shore side facility would include mooring locations for marine support craft, including tugboats required for escort for LNG vessels, a supply boat or barge, if the tugs cannot be utilized, and crew boats for personnel transfers which will likely occur on a weekly basis.[106] The waterfront facility will require berthing for up to four tugs, measuring 30 meters long by 10 meter beam and 4 meter draft.

In correspondence with the COTP Long Island Sound, Broadwater indicated that if only a shared facility is available, Broadwater will have dedicated security measures in place for its activities.[107] The waterfront facility will be equipped to provide security inspection and secure storage of all materials being transferred offshore. A security system will also be implemented to ensure that only authorized personnel, equipment etc. are transferred from Shore to the FSRU. Broadwater has indicated that security measures will include: inspection of credentials and/or goods, secure waiting areas and storage, secure moorings for supply craft/tugs, and physical security monitoring during shore facility operations. [108]

At this time, Broadwater has not specified where the shore side facilities will be, but has identified Port Jefferson and Greenport New York as potential locations with the necessary infrastructure to provide marine access necessary for the shore side support facilities.[109]

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[101] Onshore Facilities Resource Report 1, Section 1.1, p. 1-2; Broadwater letter to COTP Long Island Sound dtd 25 Jan. 2006. See Appendix A.

[102] Onshore Facilities Resource Report 1, Section 1.1.1. A space of approximately 10 acres will be required to store the pipe used for the pipeline. From the storage area, the pipe will be loaded onto barges, transported to the project area, and directly offloaded to the lay barge.

[103] Onshore Facilities Resource Report 1, Section 1.1.1.

[104] Onshore Facilities Resource Report 1, Section 1.1.2.

[105] Onshore Facilities Resource Report 1, Section 1.1, p. 3; Broadwater letter to COTP Long Island Sound dtd 25 Jan. 2006. See Appendix A.

[106] Onshore Facilities Resource Report 1, Section 1.1.2.1. Jan 25, 2006 letter, Onshore Facilities Resource Report 1, Section 1.1, p. 3; Broadwater letter to COTP Long Island Sound dtd 25 Jan. 2006. See Appendix A. . Tug boat proposed characteristics are discussed in Section 4.6.1.3 of this Report.

[107] Onshore Facilities Resource Report 1, Section 1.1, p. 2; Broadwater letter to COTP Long Island Sound dtd 25 Jan. 2006. See Appendix A.

[108] Onshore Facilities Resource Report 1, Section 1.1.2.1.

[109] Onshore Facilities Resource Report 1, Section 1.1.2.

Office accommodations for the support of the offshore activities would also be located onshore to provide support for normal FSRU operations. This office will also function as the emergency response and communications center for the FSRU.[110] Additionally, an onshore warehouse would also be necessary for supply of spares, special tools and equipment. This could be located on the waterfront but could also be located inland.

If constructed, traffic in this area of the Sound between Port Jefferson or Greenport and the FSRU would therefore increase: tug traffic to support LNG vessel operations would transit to and from the facility at least twice per week.

According to Broadwater, support craft designated for Broadwater FSRU would be for the sole use of the facility, although at Broadwater's management's discretion, support craft may be allowed to perform other activities when appropriate. Voice and data communication capability will link the on shore support facilities to the FSRU.

3.1.3.1 *Marine Services Contractor*

As proposed, marine support function will be a contracted-for service by Broadwater.[111] Broadwater has indicated that the Marine Services Contractor will likely perform the waterfront functions associated with the marine support facilities. These include providing the following functions: tug services; supply boat or barge services for normal supplies and equipment; crew boat for personnel transfers; moorings for the marine support craft;

3.1.4 LNG vessel characteristics and frequency of deliveries to the facility

Broadwater Energy has not specified the LNG supply sources for the proposed Broadwater LNG facility, but has indicated that it will come from a portfolio of the existing export facilities.[112]

Imported LNG could be obtained from the current 20 LNG export terminals in operation around the world and delivered by LNG vessels to the proposed FSRU, or others that may be developed.[113] Exporting countries presently include Egypt, Algeria, Nigeria, Angola, Trinidad, and Norway, Australia, Brunei, Indonesia, Malaysia, Oman, Qatar, and United Arab Emirates.

A fleet of approximately 150 specially designed LNG carriers are currently being used worldwide to transport natural gas. These are generally either Moss spherical tankers or prismatic, membrane lined cargo tanks. Each design consists of an outer hull, an inner hull, and a cargo containment system. This double hull design increases the integrity of the hull system and provides additional protection in the event of a collision or grounding. Over the

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110 Onshore Facilities Resource Report 1, Section 1.1.2, p. 1.5; Broadwater 25 Jan 2006 letter, Onshore Facilities Resource Report 1, Section 1.1, p. 4; Broadwater letter to COTP Long Island Sound dtd 25 Jan. 2006. See Appendix A.

111 Broadwater 25 Jan 2006 letter, Onshore Facilities Resource Report 1, Section 1.1, p. 1; Broadwater letter to COTP Long Island Sound dtd 25 Jan. 2006. See Appendix A.

112 Resource Report 11, Section 11.2, p. 11-6.

113 Resource Report 11, Section 11.2.2.

approximately 45 years since the shipment of LNG began in vessels, more than 33,000 LNG carrier voyages have taken place. Transport of LNG in vessels has an excellent safety record: only eight marine incidents worldwide have resulted in LNG spills, some with damage. No cargo fires have occurred.[114]

LNG is natural gas that has been cooled to its liquid state at atmospheric pressure to a temperature of minus 260 degrees Fahrenheit (ºF). LNG is transported at ambient pressures.[115] LNG is a cryogenic liquid that is flammable when it becomes a gas. It is not explosive in an open atmosphere, such as what would be the case in the event of a large spill on water. Therefore, a breach of an LNG carrier hull would not cause an explosion, but might result in a fire if there is the right concentration of LNG vapor in the air (5-15% concentration) and a source of ignition. Unlike petroleum product spills from vessels, which if ignited can result in a fire of potentially long duration, e.g., hours or days; LNG fires are very intense and are of short duration, e.g., less than an hour. If LNG spills and vaporizes in the presence of an ignition source, a fire could result and would burn back toward the source of the spill.

The proposed frequency of LNG shipments to the terminal would be 2-3 times per week, on average.[116] The total duration for operations from transit beginning at the Point Judith Pilot Station, discharging cargo, and ending with disembarking the pilot at Point Judith is expected to take approximately 40 hours per LNG carrier.[117] At a transit speed ranging between 12 and 15 knots, from Point Judith Pilot Boarding Station to the proposed location of the FSRU, a distance of approximately 69.1 miles, transit would take between approximately 5 to 6 hours. The remainder of the time would be spent berthing, deberthing and conducting cargo operations, approximately 25 to 30 hours. The applicability and size of moving safety and security zones around the LNG vessels to the portions of the LNG vessel transit route is discussed in Section 4.6. and in Section 5 of this Report.

3.1.4.1 *Vessel Characteristics*

The proposed Broadwater LNG terminal will be designed to accept LNG carriers with capacities between 125,000 cubic meters (m^3) and 250,000 m^3 of LNG. The actual vessel sizes expected to supply the Broadwater facility has not been determined.[118] The dimensions of 125,000 m^3 and 250,000 m^3 LNG carriers are set forth in Table 3.1-2.

[114] Sandia Report, Section 2.1.2, p. 28. See also http://www.coltoncompany.com/shipbldg/worldsbldg/gas/lngcaccidents.htm (accessed August 22, 2006). There was one incident that was the result of a fire equipment malfunction; this occurred when the fixed fire fighting system in the engine room was being serviced.
[115] Sandia National Laboratories Report SAND2004-6258: *Guidance on Risk Analysis and Safety Implications of a Large Liquefied Natural Gas (LNG) Spill Over Water*, 2004, p. 28. The Sandia Report is available on the Sector LIS website provided in the FERC/USCG Interagency Agreement
[116] Resource Report 1, Section 1.1, p. 1-1.
[117] See November 1, 2005 Broadwater letter to COTP Long Island Sound, p. 1
[118] Resource Report 1, Section 1.6.1.

Table 3.1-2 – LNG Carrier Dimensions

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

Source: Broadwater Energy response to U.S. Coast Guard Request of October 5, 2005, dtd 1 Nov 2005, p. 1. Note: Corrections were made for ballast draft for the 250,000 m^3 carrier capacity; in Broadwater's submission, the draft in feet was provided as 33, in meters as 30. The meters value was corrected to 10.

Table 3.1-3 – LNG Carrier Displacement Tonnage

Carrier Capacity	125,000 m^3	145,700 m^3	216,000 m^3	235,000 m^3
Displacement (tonnage)	99130	116,941	151599	178247

Source: DNV Report 70014347, p. 3.

3.1.4.2 *Operational limits for LNG Vessels*

Based on modeling conducted for LNG vessel operations at the proposed FSRU, Broadwater has proposed that operations can be safely conducted under the following weather conditions:

Table 3.1-4 Summary of Operational Limits

Operational Limit	Significant Wave Height		Current Velocity		Wind Velocity	
Approach Limits	2 m	6.6 ft	0.9 kts	1.5 mph	33 kts	38 ft/sec
Side-by-side mooring limits	3 m	9.8 ft	0.9 kts	1.5 mph	39 kts	45 ft/sec
Departure limits	2 m	6.6 ft	0.9 kts	1.5 mph	33 kts	38 ft/sec

Source: Broadwater Energy Response to U.S. Coast Guard dtd Nov. 1, 2005, p.7.

3.2 LNG Carrier Route Analysis

As discussed in Section 2.1 above, the LNG carrier transit route is segmented into eight areas to facilitate detailed analysis. The eight segments are:

- Territorial sea entry to Point Judith Pilot Station;
- Territorial sea entry to Montauk Point Pilot Station;
- Point Judith Pilot Station to The Race;
- Montauk Point Pilot Station to The Race;
- The Race;
- Eastern Long Island Sound;
- Central Long Island Sound;
- Western Long Island Sound.

Each of these eight segments will evaluate several criteria, described in more detail below, including the following: transit route; waterways attributes along the route, including unique weather conditions, if applicable; port characterization within the route segment; density and character of marine traffic; hazard zones; identification of sensitive environmental areas; and population density. These sections will be discussed in each route segment, and will contain the information discussed below. These eight segments are identified as much as possible by reference to coordinates, or a longitudinal reference. All coordinates given are in North American Datum 1983.

Transit Route

The anticipated LNG carrier transit route for each of the 8 transit segments are described for each of the anticipated routes. Distances from land areas along the transit route are provided. All distances discussed are provided in statute miles; all coordinates herein are North American Datum 1983.

Waterways Attributes

This section will discuss water depths, obstructions, currents, and natural obstructions, including reefs, rocks and sandbars, for each of the segments of the transit areas. Generally, obstructions such as rock shoal areas are marked with navigational aids maintained by the Coast Guard. Generally, there are no manmade obstructions such as bridges or locks that impact the transit route.

Weather

Weather common to the entirety of the LNG transit route was discussed in Section 2.4 supra. Weather factors unique to a specific segment of the transit route will be discussed in the relevant section for that segment.

Port Characterization

As described generally in Section 2 of this Report, the Port Characterization for each segment discusses the facilities located with the segment and vessel usage, as well as any anticipated changes in port activity along the length of the transit route. This section also discusses the marine traffic type and density in the particular zone and particularly in proximity to the anticipated transit routes. There can be potential conflict between larger marine events and commercial transits and the type and number of marine events along the transit route are also discussed with particular emphasis on those events that may impact the transit route. Events which occur close to shore, and not in proximity of the anticipated transit route, will be discussed generally.

Population Density and Structures

Following the guidance of Enclosure (2) to NVIC 05-05, this section characterizes the population densities of shore side communities along the LNG carrier anticipated transit route as follows: “High” if the population density is greater than 9,000 persons per square mile; “Medium” if it is between 1,000-9,000 persons per square mile; or "Low" if the density is less than 1,000 persons per square mile. In accordance with NVIC 05-05, each segment of the transit route also makes note of important structures within those communities; important structures includes locations such as industrial, commercial, residential, city centers, and military installations, schools, hospitals, and cultural centers. Population data was obtained from the United States Census Data for the year 2000. Local seasonal population data in several areas were obtained through local emergency management officials.

Sensitive Environmental Areas

NVIC 05-05 requires identification of sensitive environmental areas.[119] The NVIC also recommends that the characterization include the information listed in 33 CFR §127.007 and 127.009. Section 127.007 requires identification of environmentally sensitive areas within a 25 kilometer (15.5 mile) radius of the facility.[120] To identify the environmental resources present along the anticipated transit route and within the prescribed radius of the prospective location of the FSRU, the subsection for each segment of the route contains a table referencing the appropriate Environmental Sensitivity Index (ESI) Maps.[121] These ESI maps are included in Appendix G. In addition, following the definition of environmentally sensitive areas in 33 CFR, Part 127, the subsection for each segment of the transit route contains a second table listing the public parks and recreation areas, wildlife and waterfowl refuges, historic sites, fishing grounds, wetlands, other areas deemed to be of high value to fish and wildlife resources, and other protected areas; these tables note the distance to each from the anticipated transit route.

Thermal Radiation Hazard Zone impact on land along Transit routes

The thermal radiation hazard zones used for the analysis of the transit route segments are discussed in Section 1.4 supra. As detailed in that Section, the hazard zones used in the evaluation of the Broadwater proposal are as follows in Table 3.2-1:

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[119] NVIC 05-05, Enclosure (2), p. 3.

[120] 33 CFR § 127.005 defines "environmentally sensitive areas" as including "public parks and recreation areas, wildlife and waterfowl refuges, fishing grounds, wetlands, other areas deemed to be of high value to fish and wildlife resources, historic sites, and other protected areas." 33 CFR § 127.005.

[121] The ESI Maps serve as primary references for the U.S. Coast Guard in fulfilling its responsibilities for marine environmental protection under various federal statutes. These maps were not prepared exclusively for this project; rather, they are representative of a much larger set of such maps covering coastal environments around the country that have been prepared and maintained since the early 1980s for this purpose by Research Planning Institute, Inc., of Columbia, South Carolina, under contract the NOAA Office of Response and Restoration, Hazardous Materials Response Division. Three different sets of ESI Maps are referenced in this section; two sets, those for the states of Connecticut and Rhode Island, are available in electronic form (.pdf file format) and online at http://www.edc.uri.edu/riesi/, and are on file in electronic form and hard copy at the office of the COTP, Long Island Sound. Those two sets were published in October, 2001. The third set, which covers the shoreline and near-shore waters of Long Island are, is available only in hard copy, and is on file at COTP Long Island Sound. This set was published in 1985. All the ESI maps are a compilation of three types of information provided by scientists and other personnel from various federal and state government agencies and non-profit institutions: shoreline habitat characterization; sensitive biological resources; and human-use resources. The shoreline habitat information was gathered during low-altitude overflights and ground surveys by experienced coastal geologists, while biological information was collected, compiled, and reviewed with the assistance of biologists and resource managers.

Table 3.2-1 – Hazard Zones for Broadwater Energy Project

	Hazard Zone 1		Hazard Zone 2		Hazard Zone 3	
	Yards	Miles	Yards	Miles	Yards	Miles
Broadwater FSRU	0-750	~0.5	750-2100	~0.5 - ~1.2	2100- 8260	~1 – 4.7
LNG Carrier	0- 750	~0.5	750-2050	~0.5 – ~1.2	2050- 7550	~1 – 4.3

Each of the route segments herein will discuss the impact of these hazard zones to land areas along the carrier vessel transit route.

As discussed more in depth in each of the segments below, no land areas along the LNG carrier transit route would fall within Hazard Zone 1. No areas of land fall within Hazard Zone 2. Extending out to 4.3 miles from LNG carriers, Hazard Zone 3 would overlap the following land areas: The northern tip of Block Island, Rhode Island; the southern tip of Weekapaug Point, Westerly, Rhode Island; the southern tip of Watch Hill, Rhode Island; all of Fisher's Island, NY; all of Plum Island, New York, the northeastern most third of the North Fork of eastern Long Island, and a portion of Goshen Point straddling the City of New London, and the town of Waterford. As the FSRU is located in the central Sound, none of the hazards zones surrounding the FSRU would overlap any portion of land.

3.2.1 Territorial sea to Point Judith Pilot Station

If the Broadwater proposal is approved and the FSRU constructed, it is likely that the LNG carriers that would supply the FSRU with LNG would be foreign-flagged. Foreign flagged vessels transiting to ports or places within Long Island Sound must utilize a New York or Connecticut licensed marine pilot while transiting Long Island Sound, which consists entirely of State waters.[122] Marine pilots must embark and disembark vessels at one of two designated pilot boarding stations. Consequently, the LNG carriers must utilize one of the two pilot stations: Point Judith Pilot Station is located at 41°17'N, 071°30.5'W, approximately 5.2 miles south-southeast of Point Judith, Rhode Island; Montauk Point Pilot Station is located at 41° 02' N, 071° 42'W, approximately 8.9 miles southeast of Montauk, New York, and 3.45 miles due east of the MP buoy.

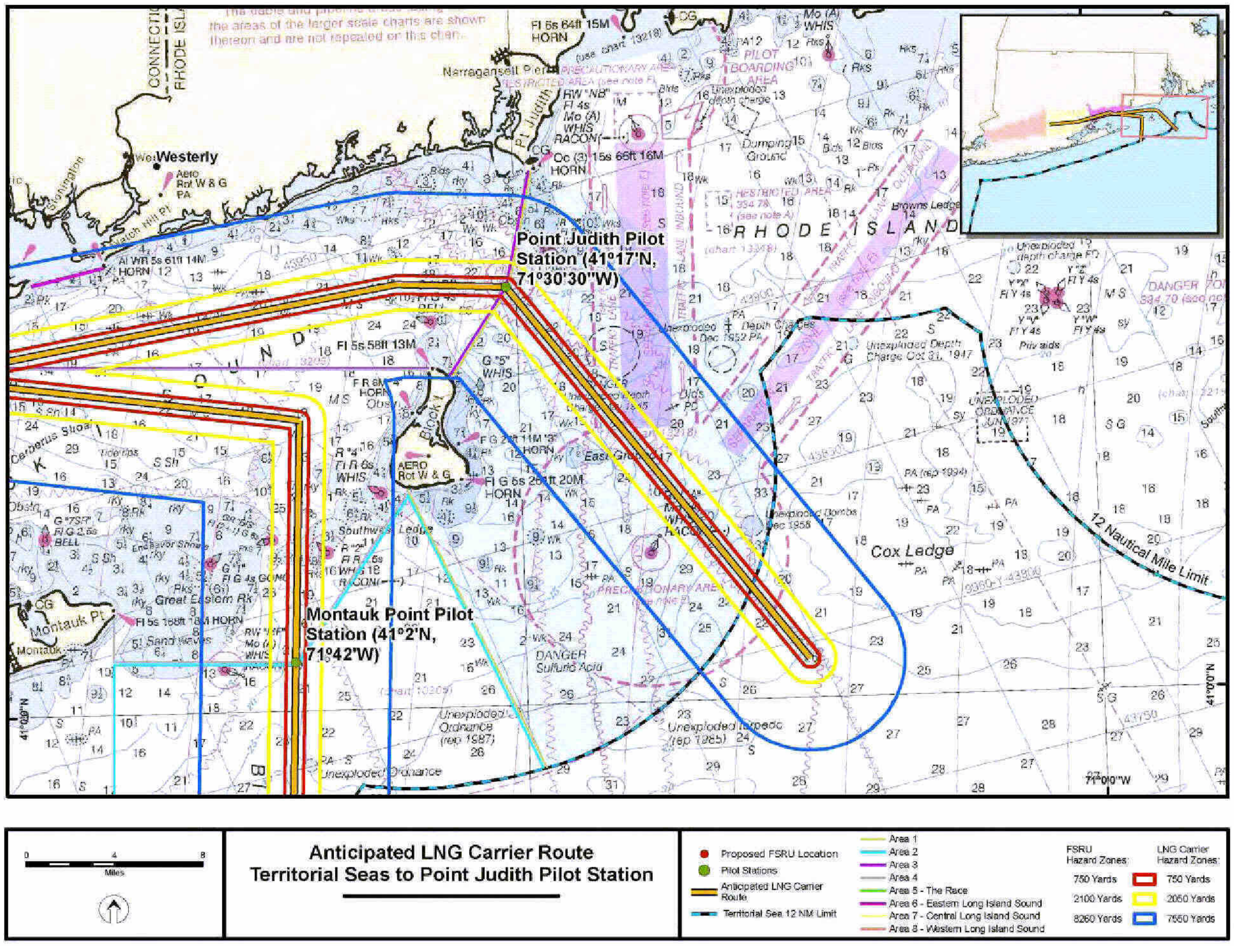
Pilot Station Point Judith is the principal pilot station utilized by deep draft vessels entering or departing Long Island Sound on the eastern end of the Sound. Vessel draft and weather conditions limit use of the Montauk Point Pilot Station by pilots: piloting of vessels with a draft in excess of 38 feet is not permitted through Montauk Channel. Additionally, Montauk Channel may not be used by pilots when weather and sea state "pose a threat to the safety of any person, vessel, prudent navigation or safety of the environment."[123] Connecticut and New York State pilotage requirements are discussed in more detail in Section 2.3.3 supra.

[122] *See* U.S. v. Maine, 469 U.S. 504 (1985).
[123] *See* NY Board of Commissioners of Pilots Memo of 30 April 2002, p. 1.

3.2.1.1 *Transit route*

The anticipated LNG carrier transit route from the territorial seas to the Point Judith Pilot Boarding Station is depicted in Figure 3.2-1. LNG carriers utilizing the Point Judith Pilot Station would generally enter the territorial sea southeast of Block Island, Rhode Island and would proceed northwesterly to the Point Judith Pilot Station. Pilot Station Point Judith is located outside of Rhode Island State waters, approximately 5.3 miles south of Point Judith, Rhode Island, and approximately 5.2 miles northeast of Block Island. Carriers utilizing this route would transit through Rhode Island Sound to the east of Block Island. Depending on the point of origin or transit route, carriers may cross the Traffic Separation Scheme (TSS) for Narragansett Bay or the Precautionary Area south of this TSS, discussed below in Section 3.2.1.2.1. This portion of the transit route is located within the Providence Captain of the Port Zone.

Figure 3.2--1- Anticipated LNG carrier transit route- Territorial Sea to Point Judith Pilot Station



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3.2.1.1.1 Waterway attributes

Water depths and other waterway restrictions are generally not a concern for LNG carriers transiting this area. Southeast of Block Island, depths are generally greater than 100-feet, with the exception of some shallower depth areas approximately 5.8 miles east of Block Island with reduced depths down to 46-feet; these areas are identified on National Oceanic and Atmospheric Administration navigational charts for the area. Depths at the Pilot Station are greater than 100-feet, and can accommodate deep draft vessels of any draft. There is a large rocky area north-north-east of the Pilot Station, beginning approximately 2.6 miles from the Pilot Station, as it is designated on navigational charts. These rock ledge areas reduce depths to as low as 44-feet, and are denoted well on navigational charts of the area;[124] U.S. Coast Guard maintained buoys also warn mariners of these shallower depths.

The confluence of tidal currents in the Point Judith area can make transiting in the vicinity of Point Judith rough. The mean range of tide throughout Block Island Sound varies from about 3 feet at Point Judith to 2 feet at Montauk Point. The tidal currents throughout Block Island Sound have considerable velocities: the greatest velocities occur in the vicinity of The Race and in the entrances between Montauk Point, Block Island and Point Judith. In the vicinity of the Point Judith Pilot Station, the flood current runs in a west-south-westerly direction averaging approximately 0.8 knots, the ebb in a east-north-easterly direction, averaging approximately 0.7 knots.[125]

Traffic Separation Scheme (TSS) Narragansett Bay is located east and southeast of the Pilot Boarding area. This TSS is composed of directed traffic lanes, each with one-way inbound and outbound traffic lanes separated by a defined traffic separation zone, and two precautionary areas, one at the southern end and the other at the northern end of the separation scheme. This Scheme is recommended for use by vessels approaching Narragansett Bay

3.2.1.1.2 Weather

The waters of Block Island Sound and Rhode Island Sound are open waters and experience weather conditions similar to those in the open ocean. In Block Island Sound, generally, winds averaging 16-17 knots are common in the winter. Gale force winds[126] occur up to 5 % of the time in the winter and are generally from the west and northwest. The average wind speed throughout the year is 15 knots, but the mean is 17 knots in the winter, when gale force winds are frequent. The usual duration of a fog is from 4 to 12 hours. In the entrance and approaches to Narragansett Bay, fogs are more prevalent from April to October. In the early fall most of the tropical storms moving up the coast affect Block Island to some extent. Since 1871, 13 storms have come within 25 miles of Block Island. The most recent was Hurricane Bob in August 1991. The center of Hurricane Bob passed about 10 miles to the west of the island with 85 knot winds.[127]

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[124] NOAA Chart 13218.
[125] Embassy Guide p. 45 citing NOAA Tidal current diagram for Long Island Sound.
[126] Gale force winds are winds with speeds between 39 to 54 miles per hour (34 to 47 knots)
[127] Coast Pilot, p. 265.

3.2.1.2 *Port Characterization*

Transit of LNG carriers from the territorial sea to the Point Judith Pilot Station does not enter a specific port area. However, the transit is close to the entrance to Narragansett Bay. As discussed in Section 2.2, this area generally is a multiple use waterway. Facilities within Narragansett Bay to which commercial vessels may be transiting along the LNG carrier anticipated transit route are varied.

3.2.1.2.1 Density and character of marine traffic

The waters of Block Island Sound between Point Judith and Block Island experience high traffic density and multiple uses. Block Island Sound is a link for waterborne commerce between Cape Cod and Long Island Sound. Heavy recreational traffic and commercial traffic, including deep draft, tug and barge and commercial fishing vessels, utilize this waterway. Commercial traffic includes tug and petroleum barge combinations, bulk carries, general dry cargo ships, and tank ships. Narragansett Bay is a multiple use waterway, hosting commercial deep draft, tug and barge, commercial fishing, commercial cruise ships and small passenger vessels, and recreational/pleasure craft.

Significant tug and barge traffic carrying petroleum products and deeper draft tank vessels transit from the bays and sounds west to Long Island Sound. Tug and barge traffic transiting from these northern ports via Long Island Sound to the Port of New York also utilize this route. Traffic Separation Scheme (TSS) Narragansett Bay is located east and southeast of the Pilot Boarding area. This TSS is composed of directed traffic lanes, each with one-way inbound and outbound traffic lanes separated by a defined traffic separation zone, and two precautionary areas, one at the southern end and the other at the northern end of the traffic lanes/separation zones. This Scheme is recommended for use by vessels approaching Narragansett Bay.

As indicated in Section 3.2.1, the Pilot Boarding Station is approximately 2.6 miles from the Narragansett Bay Outbound Traffic Lane. The majority of the deep draft vessels, including tug and barge traffic, transiting between Buzzards Bay or Narragansett Bay and Long Island Sound generally follow a Recommended Vessel Route, added to NOAA charts for this area in April 2004.[128] This Route is recommended on NOAA charts for deep draft commercial vessels and tug-barge combinations entering and departing Rhode Island Sound, Narragansett Bay, and Buzzards Bay. The Route passes through the northern portion of the Pilot Boarding area denoted on NOAA charts.[129] Additionally, commercial fishermen including lobstermen and trawlers frequent this area from ports in southeastern Connecticut and Rhode Island. The majority of commercial traffic transiting this area, not destined to or from Block Island or Newport, utilizes this Recommended Vessel Route.

Point Judith serves as a homeport for approximately 40 commercial fishing vessels.

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[128] The Recommended Vessel Route is not mandatory, but NOAA charts and other publications request that deep draft commercial vessels (including tugs and barges) follow the designated routes at the Master's Discretion. Vessels are not required to remain inside the route nor are fishermen required to keep fishing gear outside the route.

[129] NOAA Chart 13205.

3.2.1.2.2 Marine Events and Seasonal Usage

As discussed above, there is significant seasonal usage of Block Island Sound by recreational and pleasure craft in the waters surrounding Block Island as well as between Block Island and the Rhode Island mainland. Narragansett Bay, and, in particular, Newport, Rhode Island located on the southern end of the Bay, attracts significant seasonal usage and hosts numerous large scale sailing events each year. The waters of Block Island Sound however, host numerous large scale marine events. There are several annual sailing events which occur around Block Island which occur in the vicinity of the LNG carrier anticipated transit route. Several large scale sailing events impact this portion of the transit route; these are discussed in Section 2.2.2 supra. Racing events and regattas held in the Block Island or Newport often attract numerous participants from the Connecticut and Long Island areas.

Recreational vessel traffic is significant within the area between Point Judith and Block Island. "The Gap" between Rhode Island coast and Block Island is a popular location for recreational fishing and charter fishing,

In the summer season, Block Island itself attracts significant recreational vessel traffic. This includes pleasure craft participating in organized marine events. Marine events that impact the entire transit route for LNG carrier traffic are discussed in Section 2.2.3.2.

In addition, there are seasonal increases in commercial ferries running to Block Island between the months of May and October. These ferries transit to one of two harbors on Block Island: New Harbor, located on the western side of the Island within the Great Salt Pond, and Old Harbor, located on the western side of the Island. There are three ferry routes that cross this portion of the LNG carrier transit route: (1) year round passenger and vehicle service from Galilee (Point Judith) Rhode Island to Old Harbor, Block Island offered by Interstate Navigation; this ferry service increases the number of transits during the summer season; (2) seasonal high speed passenger service between Point Judith and Old Harbor, Block Island; (3) and seasonal service between Old Harbor, Block Island and Newport, consisting of one round trip, or two transits, per day. A fourth seasonal ferry service between New London and Block Island is discussed in Section 3.2.3.2.2. In total, all four ferry routes to Block Island service over 3-4 million passengers annually; passenger volume is higher in the summer months. The details of these routes are outlined in Table 2-2 supra.

3.2.1.3 *Population density and important structures*

As LNG carriers reach the Point Judith Pilot Station at the end of this segment, they would be approximately 5.2 miles from Point Judith, located in the town of Narragansett, Rhode Island. Narragansett's has a medium population density per NVIC 05-05, with a year-round population density of 1,157 persons per square mile; the population increases over a third during the summer months.[130] Narragansett has one elementary school, a middle school, and a high school, as well as a public library. It is also home to the University of Rhode Island's Graduate School of Oceanography, on the University's Bay Campus. Other important structures include the State

[130] Telephone conversation with Judy Christofaro, Narragansett Fire Dept (May 22, 2006).

Pier at Galilee, Rhode Island, located at Point Judith, used by the Point Judith-Block Island Ferry.

The town of New Shoreham, which occupies the entire 9.7 square miles of Block Island, has a year-round population of just slightly over a thousand people or a low density per NVIC 5-05 of slightly over 100 persons per square mile. The summer resident population increases to 10,000, which puts it in the Medium population density category per NVIC 05-05. A peak summer day can bring an additional 10,000 visitors, [131] increasing the island population to 20,000, or a density to 2,060 persons per square mile. Significant structures on Block Island include the Block Island Medical Center, a K-12 school, and the historic Block Island North Lighthouse and Block Island Southeast Light, which are both over 100 years old. Ferries servicing the Island offload passengers both in Old Harbor on the western side of the Island, and in New Harbor, located in the Great Salt Pond. There is also a general aviation airport on the island, near its center.

3.2.1.4 *Zones of concern*

As depicted in Figure 3.2-1, none of the three defined Hazard Zones identified in Section 3.2 supra would impact land along this portion of the anticipated LNG carrier transit route.

3.2.1.5 *Sensitive Environmental Areas*

The environmental attributes and resources of the southeastern shore of Rhode Island and the shoreline of Block Island, and present in Rhode Island Sound and Block Island Sound, are identified and mapped on the four (4) Environmental Sensitivity Index (ESI) maps listed in Table 3.2-2 below.

Table 3.2-2: Environmental Sensitivity Index Maps for Territorial Sea to Point Judith Pilot Station

Map ID	Map name
RI – 8 (October, 2001)	Sakonnet Point, RI area
RI – 7 (October, 2001)	Newport, RI area
RI – 6 (October, 2001)	Narragansett Pier, RI area
RI – 4 (October, 2001)	Block Island, RI

[131] Telephone conversation with Paul Dean, Corporal, New Shoreham Police Dept. (May 22, 2006).

Public parks and recreation areas and wildlife refuges along this segment of the anticipated carrier transit route include the areas listed in Table 3.2-3.

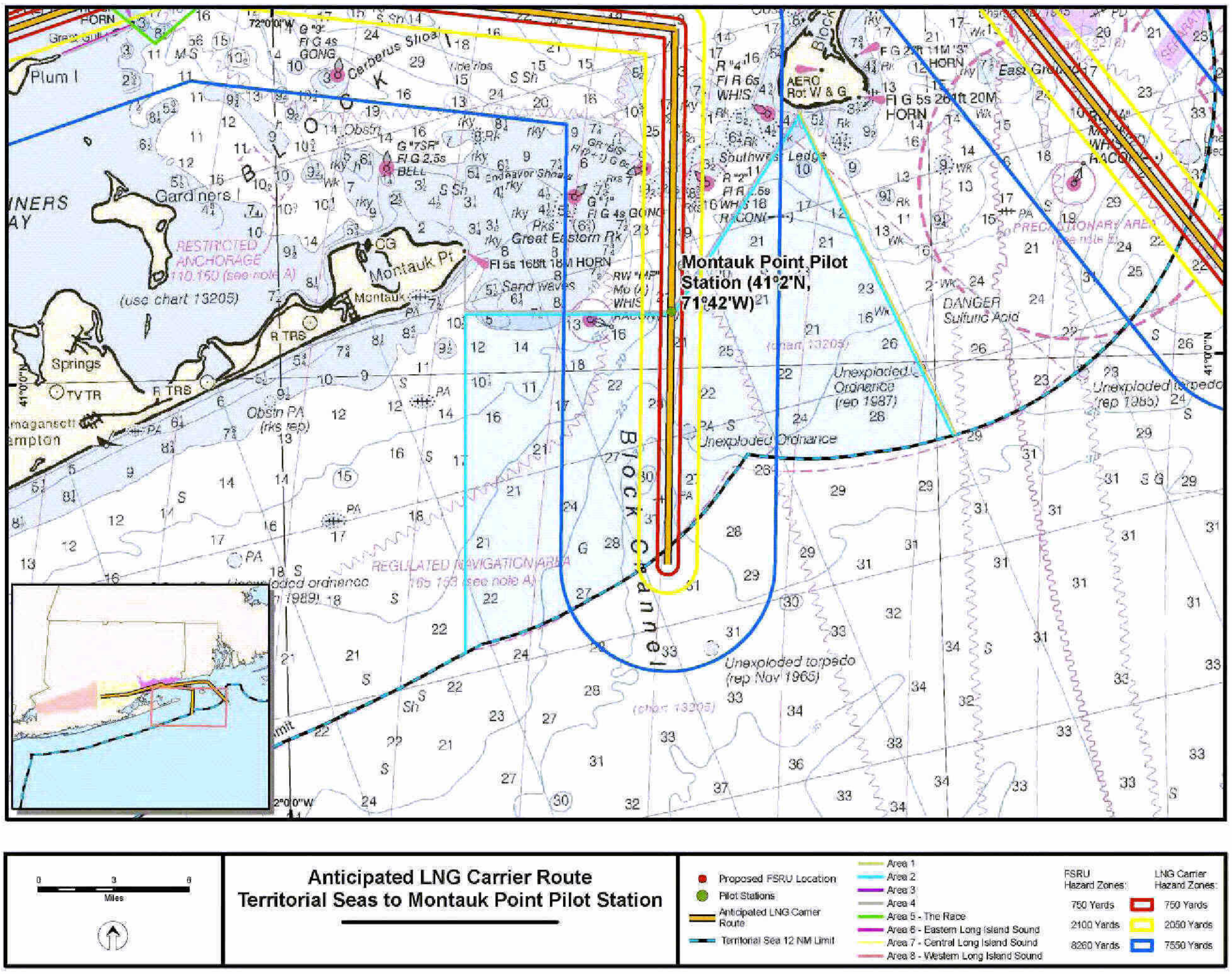
Table 3.2-3: Public Parks and Wildlife Refuges for Territorial Sea to Point Judith Pilot Station

Name	Distance from anticipated transit route (Miles)
Mainland	
Brenton Point State Park	10.6
Beaver Tail State Park	10.4
John H. Chafee at Pettaquamscutt Cove NWR	13.8
Scarborough State Beach	7.6
Point Judith State Park	5.3
Fisherman's Memorial State Park	6.0
Roger W. Wheeler Memorial Beach	5.7
Block Island	
Block Island National Wildlife Refuge	3.6
Mohegan Bluffs Scenic Natural Area	8.3

3.2.2 Territorial sea entry to Montauk Point Pilot Station

Section 3.2.1 supra discusses state pilotage requirements, including when transits are restricted, applicable to the Montauk Point Pilot Station.

Figure 3.2-2 – LNG carrier anticipated transit route – Territorial sea to Montauk Point Pilot Station



3.2.2.1 *Transit route*

As depicted on Figure 3.2-2, LNG carriers utilizing the Montauk Point Pilot Station would typically enter the territorial sea southwest of Block Island, Rhode Island, and would transit east of Long Island, New York to the Montauk Point Pilot Station.[132] The Pilot Station is located approximately 11.5 miles southeast of Montauk Point, and approximately 9.4 miles southwest of Lewis Point, Block Island, Rhode Island;[133] those locations are the closest points of land to which the LNG carriers approach along this portion of the transit route.

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[132] See section 2.3.1, for details regarding the New York and Connecticut State pilotage requirements.
[133] The States of Connecticut and New York have designated the Montauk Point Pilot station as position 41°-02' N, 071°-42W.

3.2.2.1.1 Waterway attributes

Generally, the transit to the Montauk Pilot Station presents few waterways restrictions. Water depths from the limits of the territorial sea to the pilot station run at depths in excess of 128 feet. The only notable waterways obstructions for this area of transit are other vessels transiting in the same vicinity as the LNG carriers; there are no depths or underwater obstructions due to the nature of the route being in open ocean waters.

3.2.2.1.2 Weather Conditions

Weather conditions are discussed in Section 2.4 of this report. The National Oceanic and Atmospheric Administration (NOAA) maintains several weather monitoring stations in Long Island, Block Island Sound, and Rhode Island Sound. Weather data for the southern approach to Long Island Sound, via Montauk Channel, is recorded by National Data Buoy Center Station 44017, located approximately 23 miles south of Montauk Point. At Station 44017, over the three year period from 2003-2005, winds averaged 6.75 m/s or 15.1 mph. Wind gusts averaged 8.2 m/s or 18.4 mph. The maximum wind gust over that three year period was measured at 28.9 m/s or 64.6 mph, in March of 2005. The average wind direction was out of the south–southwest from approximately 194°T (that is, blowing toward the north-northeast). This data is contained in Appendix F.

3.2.2.2 *Port characterization*

Because the majority of this portion of the transit route is in open waters, there are no major ports that are directly affected by the transit of LNG carriers to the Montauk Pilot Station. The closest small port that this comes within proximity to is Montauk New York.[134]

3.2.2.2.1 Density and character of marine traffic

This area experiences high traffic density and multiple uses. Montauk Channel is commonly used by ocean-going vessels with drafts less than 38 feet,[135] commercial fishing, and military vessels, including U.S. Naval vessels, including submarines, U.S. Coast Guard patrol boats, and NOAA survey vessels.

3.2.2.2.2 Marine Events and seasonal use of waterway

Offshore areas are infrequently used for marine events, the exception being offshore fishing events usage of this area or seasonal use of the waterway. See Section 2.2.3.2, which outlines marine events which impact this portion of the transit route.

3.2.2.3 *Population density and important structures*

The population density of Block Island and its important structures are discussed in Section 3.2.1.3 supra. The population density of Montauk, New York and important structures are discussed in Section 3.2.3.3 supra.

[134] Port activity in Montauk, NY is discussed in Section 3.2.2.1 of this Report.
[135] *See* Section 2.4.4 of this Report, discussing State Pilotage requirements.

3.2.2.4 *Zones of Concern*

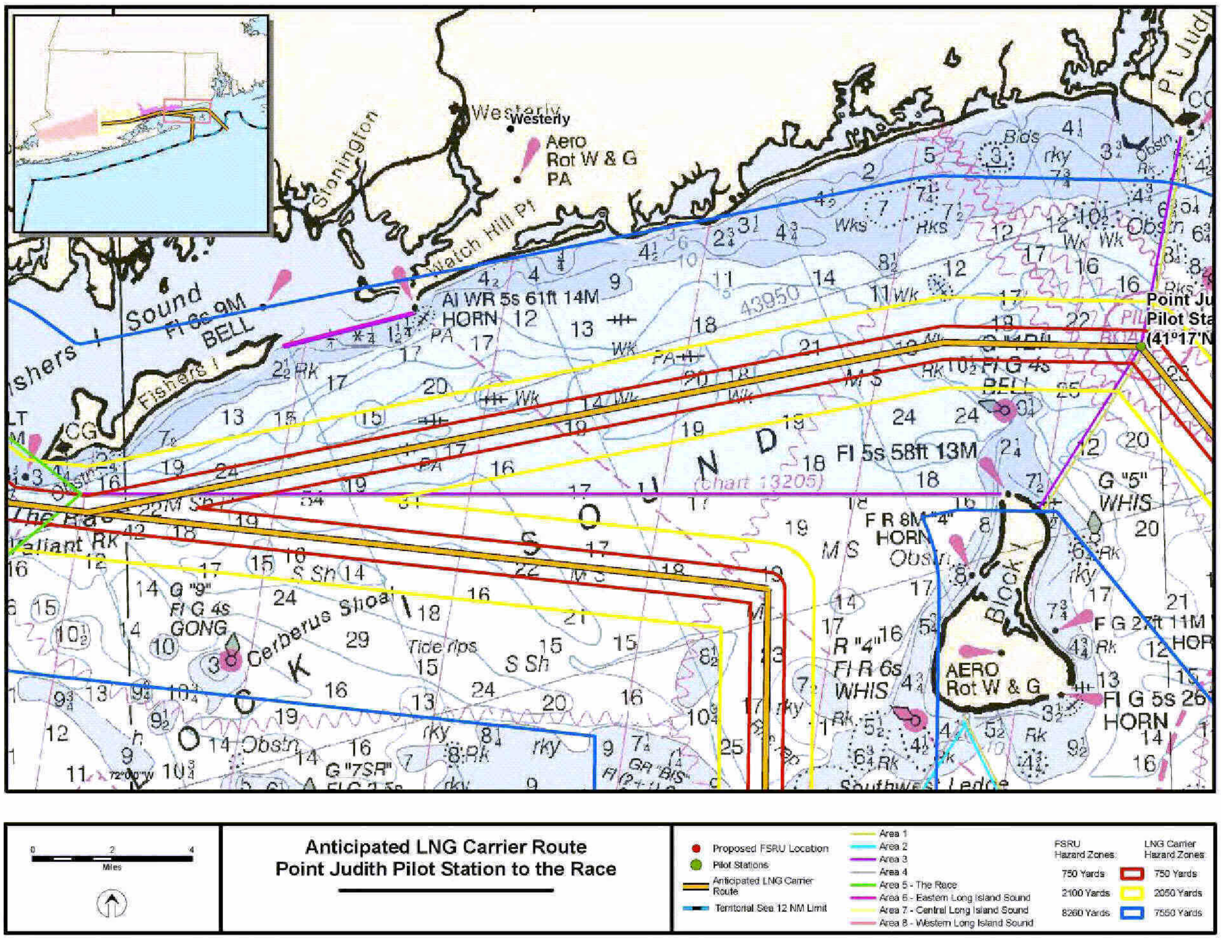
None of the three hazard zones identified in section 3.2 supra along this portion of the transit route overlap with land.

3.2.2.5 *Sensitive environmental areas*

The environmental attributes and resources of Block Island are discussed in Section 3.2.1.5 supra; those of Montauk, New York are discussed in 3.2.4.5.

3.2.3 Point Judith Pilot Station to The Race

Figure 3.2- 3 – Transit Route and Hazard Zones – PT Judith Pilot Station to The Race



3.2.3.1 *Transit route*

As depicted in Figure 3.2-3, LNG carriers would transit from the Point Judith Pilot Boarding Area to The Race in a westerly direction north of Block Island, along the coast of Rhode Island. Along this route, LNG carriers would pass approximately 3.8 miles north of Sandy Point, Block Island, and would transit at an approximate distance of 3.8 miles from Watch Hill, Rhode Island. They would then turn to a southwesterly route toward The Race along the southern side of Fishers Island, New York to the entrance to The Race. This anticipated route would take LNG carriers approximately 3.6 miles south of East Point, Fishers Island, New York, and approximately 1.4 miles from Wilderness Point on Fishers Island. The total distance of transit from the Point Judith Pilot Boarding area to The Race is approximately 29.5 miles. The transit of LNG carriers would generally follow the Recommended Vessel Route for Deep Draft vessels running from Buzzards Bay to The Race.[136]

3.2.3.1.1 Waterway attributes

Along this portion of the transit route, and the waters of central Block Island Sound are deep enough to accommodate vessels of the greatest depth. Water depths only become restrictive a maximum of 1.7 miles from shore along the Rhode Island coast, averaging 1.15 miles from shore, and approximately 0.5 to 1.15 miles along Fishers Island. The entrance to Fishers Island Sound between Watch Hill and East Point, Fishers Island, becomes restrictive for transit approximately 2.4 miles from the transit route, with depths dropping off dramatically and rocky areas with least depths of 2 feet[137] in some areas. These rocky areas are marked with Coast Guard aids to navigation. This portion of the transit route is approximately 4.3 miles from Cerberus Shoal to the South. Generally, the flood sets in a westward direction in Block Island Sound, and the ebb eastward. In the middle of the passage between Point Judith and Block Island, the velocity of the current averages approximately 0.8 knots on the flood and 0.7 knots on the ebb tide. Proceeding west along the transit route, the current velocity increases with a flood of 1.4 knots and an ebb of 0.8 knots. South of Fishers Island, the current increases with the flood setting in a southwesterly direction averaging 2.1 knots, and the ebb sets northeasterly averaging 1.9 knots.

3.2.3.1.2 Weather

The weather discussed in Section 3.2.1.1.2 for Block Island Sound is applicable to this portion of the transit route.

3.2.3.2 *Port Characterization*

There are no major port areas along this portion of the transit route. Shore side facilities generally service recreational vessels, and some commercial fishing vessels. Although this area indirectly affects vessel traffic destined for ports within Long Island Sound and those vessels transiting between the ports of New York and New Jersey and northern ports, port characterizations for those areas will be discussed herein in Sections 3.2.6 through 3.2.8. While there is a commercial fishing fleet home ported in Point Judith, Rhode Island, there are no large

[136] *See* Section 3.2.1.2.1
[137] Charted depths are for mean low water.

fish processing facilities; this area serves as a trans-shipment fishing facility. From Point Judith running west to the Connecticut state border, there are no facilities located along the coastline. Generally, the marine infrastructure along this area services recreational vessels. Block Island's marine infrastructure also service recreational vessels. The exception being the two commercial ferry facilities located in Old Harbor on the western side of Block Island and at New Harbor, in the Great Salt Pond on the Eastern side of Block Island. There are no facilities located on Block Island. Similarly, Fishers Island has no regulated facilities. There is one passenger ferry terminal located in Silver Eel Cove on the northern side of the Island.

3.2.3.2.1 Density and character of marine traffic

The description of marine traffic in section 3.2.1.2.1 is equally reflective of the density and character of traffic in the Block Island Sound segment of this portion of the LNG carrier transit route.

3.2.3.2.2 Marine Events and seasonal use of waterway

Marine events along this portion of the transit route are generally held close to shore. Larger sailing events are discussed in Section 2.2.3.2.

An additional seasonal ferry crosses this portion of the route, running from New London to Block Island. This high speed passenger service makes between 8 to 10 transits daily and operates generally from Memorial Day weekend at the end of May to Columbus Day weekend in the middle of October. For the years 2004 and 2005, this ferry averaged 132,500 passengers annually and. Its transit route takes it from New London, Connecticut, through The Race between Valiant Rock Lighted Whistle Buoy and Race Rock Light, north of Block Island into Old Harbor, Block Island, located on the western side of Block Island.

3.2.3.3 *Population density and structures*

East of the town of Narragansett, Rhode Island, the south shore of Rhode Island is comprised primarily of the towns of South Kingstown, Charlestown, and Westerly. The year round population density of each of these towns is considered low per NVIC 05-05. Population densities for each of these areas increase during the summer months; the increase is concentrated along the coast. South Kingstown's year-round density of 489 persons per square mile is estimated to increase by one third during the summer.[138] South Kingstown is home to the University of Rhode Island's main campus, which adds a daily commuter population of 10,000 students and 3,000 faculty and staff to its 4,000 resident students. The town has 3 public elementary schools, a middle, and a high school, three branches of the public library, as well as the South County Hospital. Charlestown's population density of 213 persons per square mile can increase three-fold on a peak summer weekend.[139] Charlestown Elementary School is the only school located in the town; there is also a town library. The year-round population of the town of Westerly, Rhode Island is 23,000, a density of 763 persons per square mile. Westerly's population nearly doubles during the summer, classifying it as a medium population density per NVIC 05-05. In addition, numerous public beaches in the Westerly area can swell the daytime

[138] Telephone conversation with Vincent Murray, South Kingstown, RI Planning Director (May 24, 2006).
[139] Telephone conversation with John Rookwood, Charlestown, RI Emergency Management Director (May 22, 2006).

population to as much as 100,000 on a peak summer day.[140] Important structures in Westerly include the Westerly Hospital, the Westerly Town Hall and Westerly Public Library as well as several elementary schools, a middle school, and a high school.

3.2.3.4 *Zones of Concern*

As noted above, the LNG carrier's transit through this segment would begin at approximately 5.5 miles south of Point Judith, Rhode Island between Rhode Island and Block Island, along the Rhode Island coast, and along the south shore of Fishers Island, New York. No areas along this portion of the transit route would fall within Hazard Zones 1 or 2. The tip of Weekapaug Point, in Westerly, Rhode Island, approximately 4.3 miles from the transit route, the tip of Watch Hill, Rhode Island, approximately 3.8 miles from the transit route, and all of Fishers Island would fall within Hazard Zone 3. The Hazard Zones for this segment of the transit route are depicted in Figure 3.2-3 above.

3.2.3.5 *Sensitive environmental areas*

The environmental attributes and resources along the south shore of Rhode Island and present in Block Island Sound are identified and mapped on the four (4) Environmental Sensitivity Index (ESI) maps listed in Table 3.2-4 below.

Table 3.2-4: Environmental Sensitivity Index Maps for Point Judith Pilot Station to the Race

Map ID	Map name
RI – 5 (October, 2001)	Kingston, RI
RI – 3 (October, 2001)	Quonochontaug, RI
RI – 2 (October, 2001)	Watch Hill, RI-CT
RI – 1 (October, 2001)	Mystic, CT – N.Y. – R.I.

Public parks and recreation areas and wildlife refuges along this segment of the anticipated LNG carrier transit route include the areas listed in Table 3.2-5.

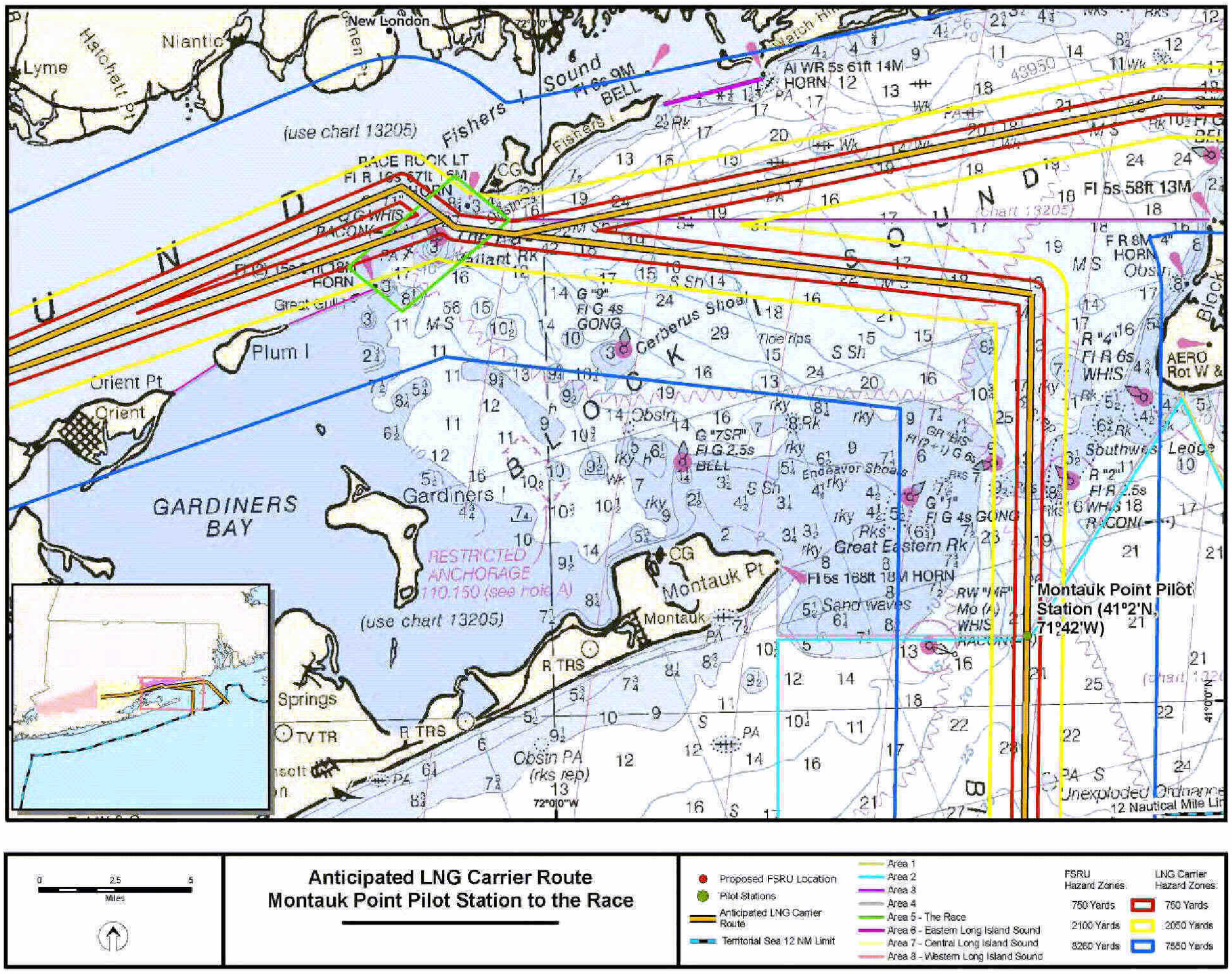
Table 3.2-5: Public Parks and Wildlife Refuges for Point Judith Pilot Station to the Race

Name	Distance from anticipated transit route (Miles)
Salty Brine State Beach	6.0
East Matunuck State Beach	6.1
Trustom Pond National Wildlife Refuge	6.1
Charleston Breachway	5.6
Ninigret National Wildlife Refuge	6.0
Quonochontaug Conservation Area	4.6
East Beach State Beach	5.4
Misquamicut State Beach	4.5
Barn Island State Park and Wildlife Management Area	6.9

[140] Telephone conversation with Larry Steadman, Westerly, RI Emergency Dispatcher (May 23, 2006).

3.2.4 Montauk Point Pilot Station to an area 1.15 Miles west of The Race

Figure 3.2-4 – Transit Route and Hazard Zones – PT Judith Pilot Station to The Race



3.2.4.1 *Transit route*

LNG carriers would transit from the Montauk Point Pilot Station north through Montauk Channel, defined as area between the Southwest Ledge Lighted Whistle Buoy 2[141] and the Block Island Sound Entrance Obstruction Lighted Buoy BIS buoy.[142] This area is over 2.3 miles wide. Vessels would transit approximately 1.3 miles east of the BIS buoy. Shallow areas run northeastward and north of the ledge. Vessels will transit approximately due north then would turn when west of Grace Point, Block Island, passing approximately 4.5 miles from Southwest

[141] Southwest Ledge Lighted Whistle Buoy 2, LLNR 650.

[142] Block Island Sound South Entrance Obstruction Lighted Buoy BIS, LLNR 19845. See State of Connecticut Mandated Pilot Boarding and Disembarking Stations Notice dated March 1, 2005.

Point, Block Island. Vessels would then turn to a west-north course to The Race, passing approximately 1.4 miles from the southern portion of Fishers Island. This transit route would take LNG carriers approximately 3.1 miles north of Cerberus Shoal, which has a least depth of 19-feet. The transit distance for this segment is approximately 28.9 miles. The waterways attributes, port characterization, population density and environmental attributes of Fishers Island and Fishers Island Sound are discussed in Section 3.2.6.

3.2.4.1.1 Waterway attributes

The depths in this area are generally shallower than those at Point Judith Pilot Station and north of Block Island. Water depths in Montauk Channel impose restrictions for usage of the pilot station. This route may not be used by vessels with a draft exceeding 38 feet.[143] Areas restricted due to underwater obstructions are marked by federal aids to navigation.

This transit would bring LNG carriers between two extensive ledge areas: Southwest Ledge and Endeavour Shoals. Southwest Ledge, located 6.3 miles west-southwestward of Block Island Southeast Light, has a least known depth of 21 feet, and is marked on its southwest side by Southwest Ledge Lighted Whistle Buoy 2. Rocky patches with least depths of 27 and 29 feet extend 1.7 miles northeastward from the ledge. Endeavour Shoals is located approximately 3.6 miles from the transit route, with a least depth of 19 feet. Other rock and ledge areas are located south of Endeavour Shoals, beginning approximately 6.2 miles at Phelps ledge, with a least depth of 19 feet. Shoal or ledge areas run from Endeavour Shoals west to Montauk, NY.

In the passage between Block Island and Montauk, the current velocity is 1.5 knots on the flood and 1.9 knots on the ebb. Approximately 1.4 miles eastward of Montauk Point, the flood sets 346°, ebb 162°, with a velocity of 2.8 knots.

3.2.4.1.2 Weather

Weather information contained in Sections 2.4 and 3.2.1.1.2 supra for Block Island Sound is applicable to this portion of the transit route analysis. Additionally, data from weather monitoring equipment located in Montauk, NY, NOAA National Data Buoy Center Weather Station MTKN6, is included in the tables in Appendix F.

3.2.4.2 *Port Characterization*

This portion of the transit route has little in terms of port infrastructure. Port infrastructure for Block Island and Fishers Island is discussed in Section 3.2.3.2 supra. Montauk, New York, located on easternmost end of the south fork of Long Island, has dock facilities for between 5-10 commercial fishing vessels. In addition, numerous small passenger vessels operate out of Montauk, as discussed in Section 3.2.4.2.1 below.

3.2.4.2.1 Density and character of marine traffic

As with other segments along the anticipated LNG carrier transit route, Montauk Channel and northern Block Island Sound are multiple use waterways. Vessels transiting the area include tug

[143] New York and Connecticut State Pilot regulations restrict pilots from operating vessels through this area with drafts greater than 38 feet.

and barge combinations, deep draft vessels transiting to or from Long Island Sound, military vessels including Naval submarines, Coast Guard and NOAA survey vessels Montauk Harbor homeports between 5 and 10 commercial fishing vessels. These mainly fish for scallops offshore.

3.2.4.2.2 Marine Events and seasonal use of waterway

As with other portions of the transit route, the majority of marine events, consisting of fireworks events and sailing regattas, are held close to shore. Several larger scale sailing events pass through or are held in this portion of the transit route. These are discussed in Section 2.2.3.2 supra. Seasonal recreational usage along this portion of the transit route occurs mainly close to shore, and in Gardiner's Bay. Additionally, recreational transits and recreational fishing in the vicinity of The Race increase substantially in the summer months.

Two commercial ferries operate seasonally within this portion of the transit route. The first route runs from Montauk Harbor, Long Island, New York, to New Harbor (Great Salt Pond), Block Island. The second operates from Montauk Harbor to New London. The Montauk to Block Island Route operates generally from May to October, with vessel transits ranging between 4 to 10 transits per day. In 2005, this route carried approximately 8,700 passengers. The Montauk to New London Route operates generally only Fridays and Sundays between the end of May to the beginning of September, with 4 transits each day. In 2005, this route carried 452 passengers. There is also limited ferry service between Montauk and Martha's Vineyard; this is a special trip conducted once annually. A summary of Ferry information is contained in Table 2-2.

3.2.4.3 *Population density and important structures*

The village of Montauk, New York, located on the South fork of the eastern end of Long Island, has a year-round population of 3,851 at a density of 220 persons per square mile, or a low population density per NVIC 05-05. The population of this area is estimated to triple during the summer months.[144] Significant structures in Montauk include the 100 foot historic Montauk Point Lighthouse, at 210 years the oldest lighthouse in New York State, as well as the historic Montauk Playhouse which serves as a community center. There is also a K-8 school.

Orient, NY, which occupies the north fork of the eastern end of Long Island, has a year-round population of 709, at a density of 139 persons per square mile. Although the population increases by approximately 2 ½ times during the summer months,[145] it remains low density per NVIC 05-05. Important structures within Orient include Oyster Pond Elementary School, the 107 year old Orient Point Light, and the Cross-Sound ferry terminal, which may have as many as 58 ferry arrivals and departures per day.

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144 Telephone conversation, Cathy McCormick, Suffolk County Supervisors Office (May 23, 2006).
145 Telephone conversation, Carlisle Cochran, Town of Southold Police Chief (May 23, 2006).

3.2.4.4 *Zones of Concern*

There are no land areas along this portion of the LNG carrier anticipated transit route that would fall within Hazard Zones 1 and 2. Portions of the shoreline of western Block Island and all of Fishers Island falls with Hazard Zone 3. The Hazard Zones for this portion of the anticipated transit route are depicted in Figure 3.2-4 above.

3.2.4.5 *Sensitive environmental areas*

The environmental attributes and resources in the vicinity of Montauk Point are identified and mapped on Environmental Sensitivity Index (ESI) Map LI – 29 (1985), Montauk Point, NY. ,along the eastern end of Long Island north of Montauk Point, the environmental attributes and resources are identified and mapped on the two (2) Environmental Sensitivity Index (ESI) maps listed in Table 3.2-6 below.

Table 3.2-6: Environmental Sensitivity Index Maps for Montauk Point Pilot Station to the Race

Map ID	Map name
LI – 28 (1985)	Gardiners Island East, NY
LI – 26 (1985)	Plum Island, NY - CT

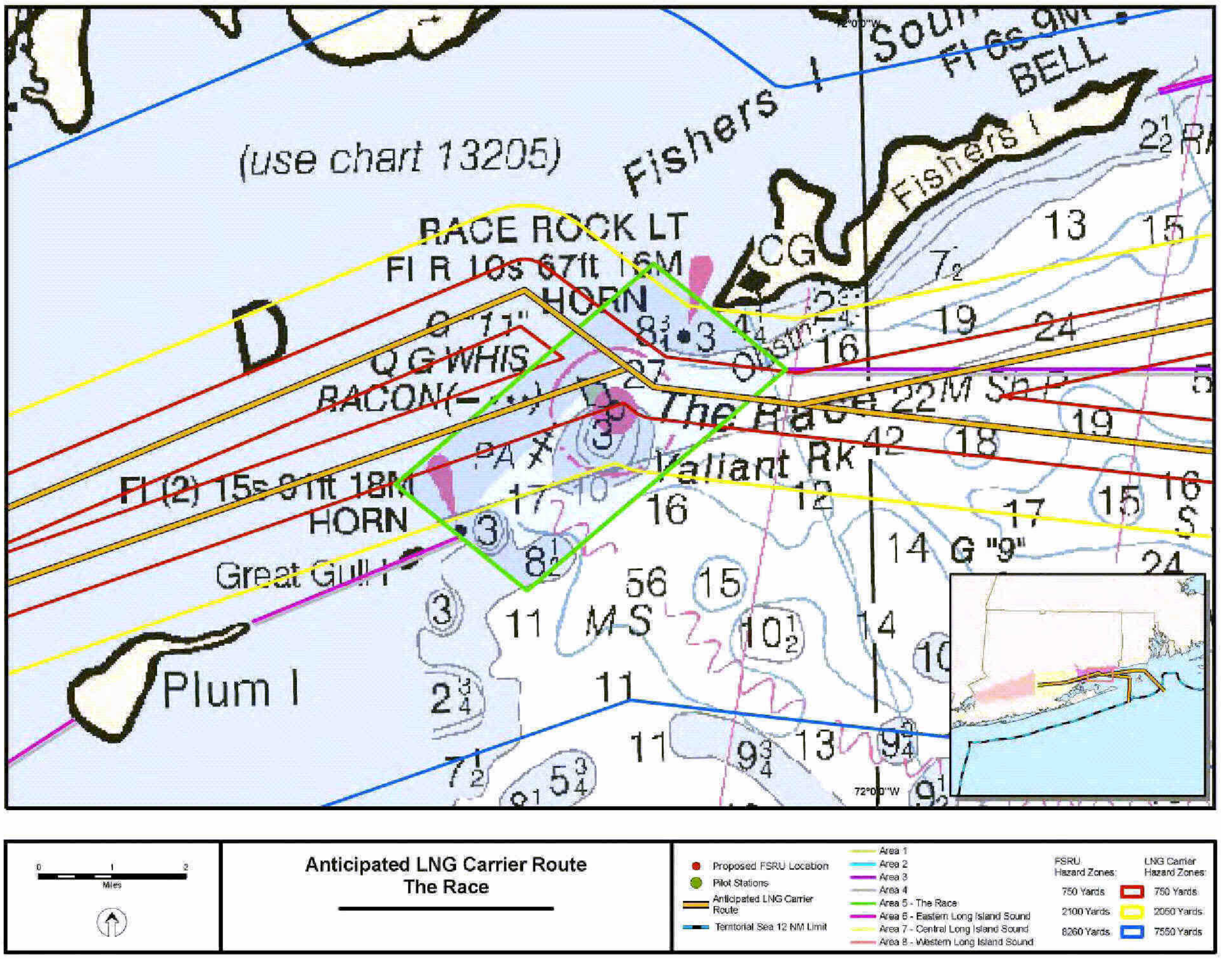
Montauk Point State Park covers approximately 724 acres of the east end of the South fork of Long Island. Within this segment of the anticipated LNG carrier transit route, the most significant public park or recreation area is Orient Beach State Park on Orient Point, Long Island. It is located approximately 11.5 miles from the anticipated transit route of LNG carriers as they approach The Race.

3.2.5 The Race

The Race is the main entrance to Long Island Sound from the east. The area known as "The Race" is typically defined as the waters between the southwestern tip of Fishers Island, running southwest to Little Gull Island Light.[146] That area is approximately four miles wide. For the purposes of this Report, in order to conduct a focused examination of this area, our area of review will be defined more broadly. As depicted in Figure 3.2-5, this section examines an area 1.15 miles to each side of the COLREGS demarcation line,[147] which runs from Race Point, located at the southwestern tip of Fishers Island, to Little Gull Island. Specifically, the area of study was bounded as follows: beginning at 41° 14' 18" N, 072° 01' 16" W, then running 310 degrees T to 41° 15' 36" N, 072° 03' 17" W, then running in a southwesterly direction to 41° 13' 02" N, 072° 07' 26" W, then running 130 deg T to 41° 11' 44" N, 072° 05' 24" W; and then back to the point of beginning.

[146] LLNR 19830. Coast Pilot, p. 272.
[147] 33 CFR § 80.145.

Figure 3.2-5 – LNG Carrier Anticipated Transit Route and Hazard Zones – The Race



3.2.5.1 *Transit route*

The transit of LNG carriers through The Race will be the most navigationally constrained portion of the vessel transit to and from the FSRU. Although The Race is defined as a larger area by most nautical publications, typically, deep draft vessels transit generally through the 1.4 mile wide area running between Race Rock, marked by Race Rock Light[148] and Valiant Rock, marked by Valiant Rock Lighted Whistle Buoy (LWB).[149] The center of the Recommended Vessel Route running through this portion of The Race is approximately 0.7 miles northeast of Valiant Rock LWB. Due to the configuration of The Race, LNG carriers will likely transit in a northwesterly direction through The Race transiting inbound, and southeasterly on an outbound

[148] LLNR 19815.
[149] LLNR 19825.

BW029440

transit. Under ideal conditions, LNG carriers would transit The Race at speeds between 12 and 15 knots; at this speed, LNG carrier transits through The Race would take approximately 15 minutes.[150] Weather, sea state, and vessel traffic may require reduced vessel speed and resultant increase in transit times through this segment.

3.2.5.1.1 Waterways attributes

Water depths at The Race are extremely deep, with some areas measuring greater than 270-feet . In spite of these depths, The Race is the most navigationally constrained area for a potential LNG carrier's transit: this area is bounded by natural ledge with shallow depths. These obstructions are marked with federal navigational aids, and dictate vessel transit routes. Race Rock, on the northeast side of The Race, is nearly 200-yards in diameter, with a depth of 8 feet. A ridge with at least depth of 25-feet is reported extending about 370-yards south of Race Rock; shallower depths are located just south-south-west of Race Rock. Approximately 380-yards east of Race Rock another ridge, oriented north south, has a least depth of 40-feet. The area between Race Rock and Fishers Island is only suitable for recreational craft.[151]

Valiant Rock, located nearly at the center of The Race, has a least depth of 19-feet and is surrounded by shoal area. The area in the immediate vicinity of Valiant Rock experiences heavy swirls and rips, and is recommended to be avoided by deep-draft vessels and preferably by all vessels.[152] The recommended transit areas for passing north of Valiant Rock is approximately 0.7 miles northeastward of Valiant Rock Lighted Whistle Buoy; through the southern portion of The Race, the recommended transit area is 1.15 miles northeastward of Little Gull Island Light.

In the middle of The Race, the flood sets 295° and the ebb 100°, with average velocities of 2.9 knots and 3.5 knots, respectively. There are always strong rips and swirls in the wake of all broken ground in The Race, except for about one-half hour at slack water. The rips are exceptionally heavy during heavy weather, and especially when a strong wind opposes the current, or the current sets through against a heavy sea.

While the area between Race Rock Light and Valiant Rock is the preferred route for deep draft vessel traffic, the route between Valiant Rock and Little Gull, an area approximately 2.4 miles wide,[153] is frequently used for smaller tankers and tug-barge combinations as an alternate to The Race. This route relieves much of the traffic from the deeper passage between Race Rock Light and Valiant Rock. The passage between Race Rock Light and Valiant Rock is the route that would be utilized by LNG carriers. The least depth of this route is 48 feet, a rock area located just to the eastern side of the COLREGS demarcation line. The recommended transit area between Valiant Rock and Little Gull Island is approximately 1 mile northeastward of Little Gull Island Light.[154] This is also a frequented recreational vessel route and is heavily used by recreational fishing vessels as well as charter fishing vessels. Occasionally, the ferries running

[150] November 1, 2005 Letter from Broadwater to COTP Long Island Sound, p. 11.
[151] Coast Pilot, p. 270.
[152] Coast Pilot, p. 270.
[153] This distance represents the distance between Valiant Rock Lighted Whistle Buoy and C"1" buoy , LLNR 19840.
[154] Coast Pilot, p. 270.

between Orient Point, New York and New London, Connecticut, discussed infra in Section 3.2.6.2.1, will also utilize this route if conditions in Plum Gut prohibit safe transit.

The waters located between Plum Island and Little Gull Island, known as the Sluiceway, is not considered a possible alternate route for commercial traffic. This waterway has several known dangers and a very irregular bottom. This area is generally regarded as hazardous for transit without local knowledge.[155]

Plum Gut, located between Orient Point and Plum Island, is also an alternate passage for smaller vessels and recreational boaters to Gardiner's Bay and Block Island Sound from Long Island Sound, but caution is recommended when using this passage. The overall width of the Gut is approximately 0.8 miles wide, with a deep water central area of 0.35 miles wide. The Gut has several rock areas with depths down to 17 to 19 feet.[156] Tidal currents set through the Gut with great velocity. Velocities of the current on flood are 3.5 knots, and on ebb are 4.3 knots. Heavy tide rips occur. A countercurrent normally develops along the north shore of Plum Island during the flood.

For smaller vessels and some shallow draft or tug and barge combinations, Fishers Island Sound can serve as an alternate route to The Race. Watch Hill Passage is the principal entrance to Fishers Island Sound from the east. The least depth in this passage is 13 feet, with a transit area of approximately 150 yards to the northeast of this buoy. Rock areas are dispersed throughout Fishers Island Sound reducing depths in some locations to as little as 6 feet in the center of the Sound, with reduced depths closer to shore. Vessels transiting to Stonington, Mystic, and Noank, Connecticut, must transit through Fishers Island Sound.

3.2.5.1.2 Weather

Tidal currents at The Race have an influence on the movements of ice during the winter. Large quantities of floe ice usually pass through The Race during the ebb, especially if the wind is westerly. During severe ice seasons, this floe ice can cause some obstruction in Block Island Sound and around Montauk Point. These obstructions are the most extensive around the middle of February.

3.2.5.2 *Port Characterization*

Because of the narrow focus of The Race for this Report, there are no port facilities or distinct port areas discussed within this segment of the transit route.

3.2.5.2.1 Density and character of marine traffic:

There is considerable traffic through this area, as this is the main entrance into Long island Sound from the east, and the primary route used by deep draft traffic entering and exiting Long Island Sound. As discussed in Section 3.2.5.1.1 supra, the route between Valiant Rock and Little Gull relieves much of the traffic from the deeper passage between Race Rock Light and Valiant Rock. The passage between Race Rock Light and Valiant Rock is the route that would be

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[155] Need chart reference if warning listed on chart.

[156] Coast Pilot, , p. 273

utilized by LNG carriers. This area is a mixed use area: commercial deep draft, tug and barge traffic, commercial ferry, charter fishing boats, recreational vessels. Military vessels also utilize The Race, including U.S. Navy submarines transiting to and from the Naval Submarine Base New London in Groton, Connecticut, as well as Coast Guard cutters and smallboats, and NOAA vessels. During the summer months, from May to October, high speed passenger ferry service between New London to Block Island operates 8-10 transits daily of The Race. Seasonal use of The Race can vary drastically, with significant recreational fishing and commercial charter fishing presence during the summer months, typically between May and October. Commercial lobstermen also frequently transit and set lobster pots within this area.

3.2.5.2.2 Marine Events and seasonal use of waterway

There is limited use by The Race for Marine events. Generally, these consist of sailing regattas and races, which occur primarily between spring and early fall, which transit the Race as part of a race route. These are discussed in Section 2.2 supra. The route through The Race for several of these events is not specified, and participating vessels, which have shallow drafts, may utilize the area between Valiant Rock and Little Gull, or even Plum Gut.[157]

3.2.5.3 *Population density and important structures*

LNG carriers transiting The Race will pass within 1.4 miles of Fishers Island, NY. The Island has a year-round population of between 275 and 300 people, which rises to approximately 6,000 during peak summer weekends.[158] With a land area of just 4.1 square miles, the population density during the year is 73 persons per square mile, a low population density per NVIC 05-05; during the summer, the population density is approximately 1,463, or a medium population density per NVIC 05-05 during summer peaks. Fishers Island has a community school that serves between 50-60 students pre-K through 12th grade, as well as a public library. The Fishers Island Ferry District operates a ferry terminal on the northern side of the Island, in Silver Eel Cove.

3.2.5.4 *Zones of Concern*

No land areas along this portion of the transit route would be impacted by Hazard Zones 1 or 2. As shown in Figure 3.2-5, all of Fishers Island, New York would fall within Hazard Zone 3.

3.2.5.5 *Sensitive environmental areas*

The environmental attributes and resources of Fishers Island and its surrounding water bodies, Fishers Island Sound and Block Island Sound, are identified and mapped on the two (2) Environmental Sensitivity Index (ESI) maps listed in Table 3.2-7 below.

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[157] Plum Gut runs between Plum Island and Orient Point New York.
[158] Telephone conversation with Joseph Curto Trooper, NY State Police (May 23, 2006)

Table 3.2-7: Environmental Sensitivity Index Maps for the Race

Map ID	Map name
CT – 22 (October, 2001)	New London, CT
CT – 24 (October, 2001)	Mystic, CT – N.Y. – R.I.

Public parks and recreation areas and wildlife refuges along this segment of the anticipated LNG carriers transit route include the areas listed in Table 3.2-8.

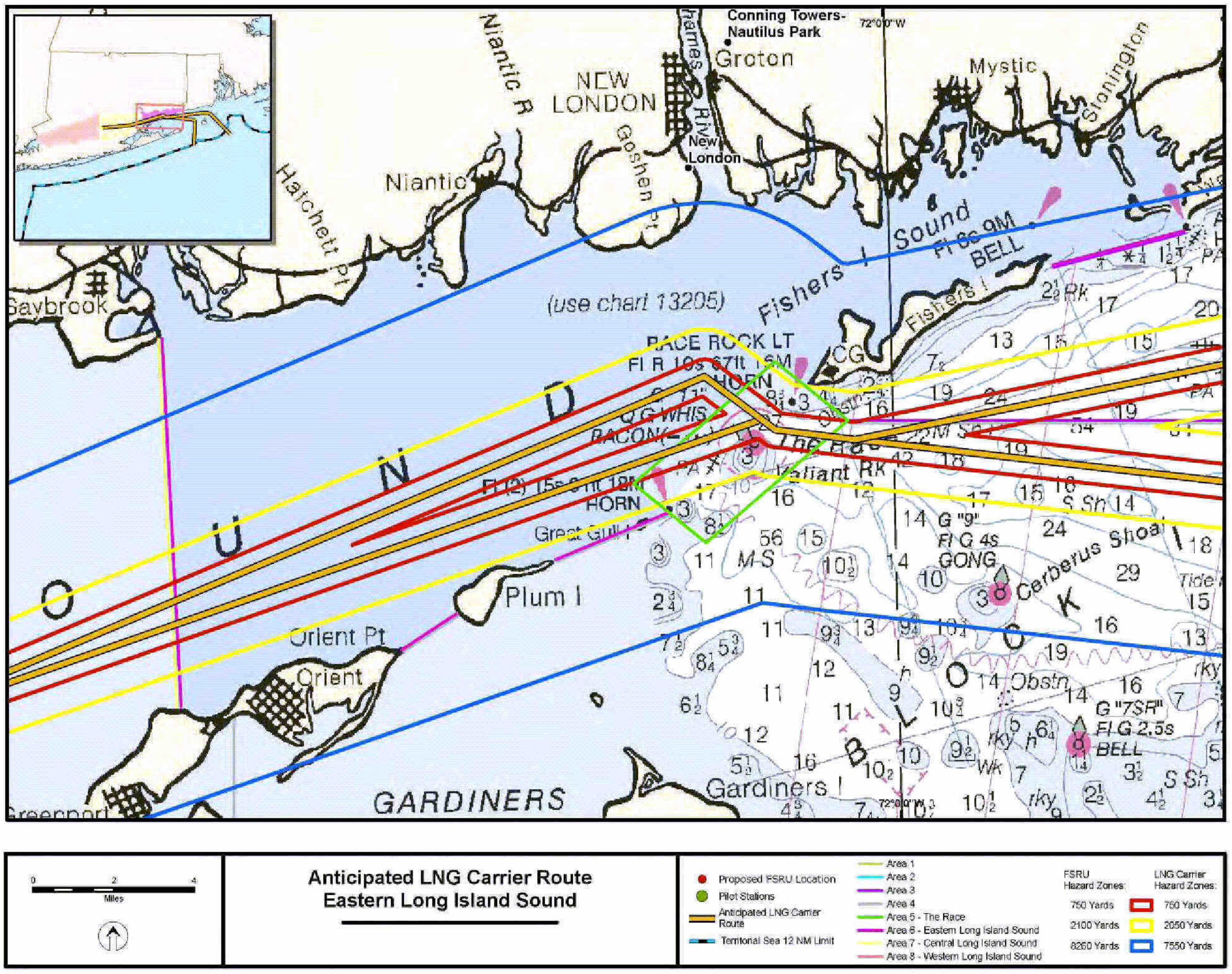
Table 3.2-8: Public Parks and Wildlife Refuges for the Race

Name	Distance from anticipated transit route (Miles)
Eastern Point Beach	4.8
Esker Point Park Beach	5.5

3.2.6 Eastern Long Island Sound

This area examines the waters between The Race, as defined in Section 3.2.5, above and West Longitude 072° 20.5', which runs approximately between Lynde Point, Old Saybrook, CT and an area just west of Rocky Point, in East Marion, Long Island, New York. Information discussed in this transit segment includes the Connecticut River up to Hartford, Connecticut, Fishers Island Sound, and Fishers Island, Plum Island, and Orient Point, New York.

Figure 3.2-6 –Anticipated LNG Carrier transit route – Eastern Long Island Sound



3.2.6.1 *Transit route*

After passing through The Race on a northwesterly heading, LNG carriers would generally then turn to a west –southwesterly course approximately 0.2 to 2.2 miles northwest of the COLREGS Demarcation Line.[159] Vessels would then transit along a west-southwesterly course along the mid- Sound, either immediately north or south of the Plum Island Lighted Whistle Buoy PI[160]. This places the transit route approximately 4.3 miles from a more northerly route to Black Point in Niantic, CT, and approx 1.8 miles from a more southerly route from Mulford Point in Orient, Long Island. LNG carriers would transit approximately 1.6 miles from the eastern end of Plum Island; the closest approach to Plum Island on the anticipated route of the LNG carriers is 1.3 miles. In Eastern Long Island Sound, LNG carriers would pass approximately 5 miles from the

[159] 33 CFR 80.155b.
[160] LLNR 21080.

Dominion Millstone Nuclear Power Plant, located in Waterford, Connecticut. The western edge of this transit route is bound by a line running between Rocky Point, East Marion, Long Island, NY and Lynde Point, Old Saybrook, CT. The anticipated transit route would run approximately 1.8 miles from Rocky Point, and would pass approximately 6.6 miles from the southernmost point of land at Lynde Point, Old Saybrook. Based upon an assessment of vessel traffic conditions by the pilot and vessel's master, it is possible that LNG carriers may pass into Connecticut State waters along this portion of the transit route. State borders are not portrayed on navigational charts and will not be part of decision making analysis of a pilot determining the safest route to navigate a vessel.

3.2.6.1.1 Waterway attributes

As is consistent with other portions of the route, other than other vessel traffic, navigational obstructions are few. The Plum Island Lighted Whistle Buoy[161] marks safe water along the portion of the central Sound; vessels generally transit north or south of the Plum Island Buoy. There are no manmade obstructions. Water depths through this area are favorable for deep draft vessel traffic. Reefs north of this portion of the transit route reduce depths substantially. This includes Bartlett reef, 2 miles north of the anticipated transit route, with reduced depths down to as low as 3 feet. Long Sand Shoal runs south of Lynde Point, Connecticut west to Westbrook Harbor, with reduced depths as low as 4 feet. The anticipated transit route would run approximately 4.3 miles from Long Sand Shoal

Vessels in New London Harbor or the approaches thereto may only anchor in designated anchorage grounds.[162] Several Anchorage Grounds have been established in and just outside of the mouth of the Thames River. The closest anchorage ground to the transit route for the LNG carriers is Anchorage F in New London Harbor, which is reserved for use of naval vessels, and is approximately 1.3 miles from the LNG carrier anticipated transit route. The U.S. Navy maintains the navigational channel in the Thames River; the channel is maintained to a depth of 40 feet.[163] A former army dumping ground exists immediately south of the mouth of the Thames River. This dumping ground is no longer used, but is marked with navigational aids to advise mariners of the location.[164]

As noted in section 3.2.6.1. above, LNG vessels would transit approximately 5 miles from Millstone Point, which is the location of the Dominion Millstone Nuclear Power Plant in Waterford, Connecticut. This is outside Hazard Zones 1, 2 and 3. The waters entering Niantic Bay and Jordan's Cove approaching Millstone Point drop off from the generally deep waters of the Sound to depths of 24 feet approximately 0.9 miles south of Millstone Point. Bartlett Reef, with reduced depths to 2 feet, is located approximately 0.6 miles to the southeast of Millstone Point. While the channel between Bartlett reef and the mainland of Niantic has locations with depths to as high as 51 feet, the area between Bartlett Reef and Goshen Point are generally impassible to deep draft traffic with drafts greater than 27 feet.

[161] LLNR 21080.
[162] 33 CFR 110.147.
[163] Coast Pilot, p. 293.
[164] New London Dumping Ground Lighted Buoy NDA, LLNR 21830 (maintained by the U.S. Army); and Dumping Ground Lighted Buoy NL, LLNR 21785.

Additionally, if the facility is approved and constructed, LNG vessels would pass within 1.3 miles of Plum Island, which houses the U.S. Department of Agriculture Animal Disease Center. Depths north of Plum Island become shallow enough to prevent deep draft vessel traffic from approaching closer than 0.5 miles. From the east, depths approaching Plum Island are more restrictive, with depths of 27 feet or less approximately 2.3 miles east of Plum Island. To the south and southeast or far side of Plum Island from the carrier route, depths are favorable for deep draft vessels from 0.2 to 0.9 miles from the shore.

As discussed in Section 2.3.2, the COTP Long Island Sound has designated an area south of Niantic as one of six lightering zones for Long Island Sound.[165] This area is located southwest of Black Point in Niantic. The southeastern most boundary of this lightering area is approximately 1.5 miles from the LNG vessel anticipated transit route. Lightering operations are infrequently conducted in this location; when conducted, these are petroleum products.

3.2.6.1.2 Weather

Weather for the Sound is as discussed generally for Long Island Sound in Section 2.4 herein. Weather data for Eastern Long Island Sound is recorded on the National Weather Data Buoy Center Station LDLC3 located on Ledge Light, provided in Appendix F.

3.2.6.2 *Port Characterization and activity*

The area characterized herein as Eastern Long Island Sound includes port facilities in both Connecticut and on Long Island, New York.

In Connecticut, this area includes the port of Groton and New London, Uncasville, and Gales Ferry, all with facilities on the Thames River. Facilities are located on both sides of the Thames River. Commodities handled in the port of Groton and New London include petroleum products, forest products, chemical products, general break-bulk cargo, project cargo and heavy lift cargo. This segment also includes the Connecticut River, which has facilities located on the River up to Hartford. Numerous barge-handling facilities are situated on the Connecticut River between Old Saybrook and Hartford, located approximately 52 miles north of Old Saybrook. The river is used to transport commodities such as petroleum, asphalt and coal.
In New York, this transit segment includes all of Fishers Island, New York, Fishers Island Sound, Plum Island and the eastern portion of the north fork of Long Island, including Orient Point, located in the Town of Southold, NY.

Facilities located in this area include nine marine oil transfer facilities, one waterfront facility that is also approved as a passenger facility, and six regulated passenger terminals. Products received by the facilities include refined petroleum products (#2 Oil, #6 Oil, Home Heating Oil, Kerosene), Asphalt, Styrene, Sulfuric Acid, Caustic Soda, lumber and copper. The passenger terminals, located in New London, Fishers Island, Orient Point, and Old Saybrook, Connecticut service several ferry routes, discussed in Section 3.2.6.2.1.

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165 The following geographical positions represent the four corners of the Niantic Lightering Zone (clockwise from northwestern most corner: 41°15.6'N, 072 13.6'W; 41°16.3'N, 072°10.4'W;41°15.4'N, 072°10.1'W; 41°14.7'N, 072°13.2'W.

There are several government facilities and contractors located adjacent to this transit segment. The U.S. Naval Submarine base New London is located on the Thames River in Groton, Connecticut, north of the I-95 Gold Star highway bridge. This submarine base is home port to 18 nuclear attack submarines.[166] General Dynamics Electric Boat, a government contractor that builds and services nuclear submarines, is also located in Groton, Connecticut, on the eastern side of the Thames River south of the I-95 Gold Star highway bridge. Coast Guard Station New London is located on the Thames River. The United States Department of Homeland Security, Department of Agriculture owns and operates the Plum Island Animal Disease Center on Plum Island, New York. Public Access to Plum Island is prohibited; access is restricted to employees or authorized guests and contractors of the Animal Disease Center. Two ferry routes provide transportation to and from the Animal Disease Center from Old Saybrook, CT and Orient Point, New York; these are discussed in more detail in Section 3.2.6.2.1 of this Report.

Table 3.2-9: Facilities in Eastern Long Island Sound Regulated by the U.S. Coast Guard

	Facility Types			
	Marine Oil Facility	Passenger Terminal	Waterfront Facility	Waterfront & Passenger Terminal
Eastern LIS Total # of Facilities	**9**	**6**	**0**	**1**
Deep River	-	1	-	-
Fishers Island	-	1	-	-
Gales Ferry	1	-	-	-
Groton	2	-	-	-
Haddam	-	1	-	-
Hartford	1	-	-	-
Middletown	1	-	-	-
New London	1	2	-	1
Orient Point	-	1	-	-
Portland	1	-	-	-
Uncasville	1	-	-	-
Wethersfield	1	-	-	-

Source: Coast Guard MISLE (Marine Information for Safety and Law Enforcement) Analysis and Reporting System (MARS).

3.2.6.2.1 Density and character of marine traffic

Marine traffic in Eastern Long Island Sound is diverse, with unique usages not found in other portions of the anticipated LNG carrier transit route. As in other segments of the transit route, this is a multiple use waterway: commercial tankers, dry cargo vessels, tugs and barges. Products carried include petroleum products, dry cargo including lumber and copper, and barges carrying styrene.[167] Commercial vessels share this waterway with significant recreational traffic

[166] 14 LOS ANGELES Class; 3 SEAWOLF Class; and 1 VIRGINIA Class submarines. State of Connecticut Economic Impact Analysis *The Contribution of the Groton Naval Sub Base and the Electric Boat Company to the Economies of Connecticut and Southeastern Connecticut* dated May 3, 2005, p. 7.
[167] These barges transit to Dow Chemical in Gales Ferry.

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as well as unique military traffic transiting to and from Naval Submarine Base New London in Groton, Connecticut. Fishers Island Sound is a particularly densely populated recreational boating area. Mystic Seaport, located on the Mystic River, in Mystic, Connecticut, attracts numerous recreational craft and hosts several small scale marine events, including rowing events and boat parades.

In the past 4 years, cruise ships have begun making port calls in New London, Connecticut. In 2002, there was one Cruise Ship visit; none occurred in 2003; in 2004, there were 4 cruise ships arrivals in New London, two were port calls, and for two New London served as a point of embarkation and debarkation. In 2005, there were no port calls. While these vessels formerly used the pier at Fort Trumbull State Park, they now moor at State Pier in New London. The one scheduled visit for 2006, which occurred on May 5, 2006, was for the M/V MAASDAM, a 719-foot vessel certificated to carry 2,100 persons on board, consisting of 1,498 passengers and 602 crew. The Deadweight Tonnage for the MAASDAM is 6,749. In 2007, two port calls of the M/S MAASDAM are currently scheduled, one in May and the second in October. The State of Connecticut, through the Connecticut Cruise Ship Task Force, has been promoting New London as a port of call for cruise ships, and an increase in future visits for cruise ship port calls is anticipated.

Table 3.2-10 Eastern Long Island Sound Vessel Arrivals

Port	2003		2004		2005	
	U.S.	Foreign	U.S.	Foreign	U.S.	Foreign
Gales Ferry	2					
Groton/New London	104	32	122	60	191	61
Hay	3					
Middletown	7					
Montville	6					
Norwich	1					
Plum Island	1					
ELIS Total	**124**	**32**	**122**	**60**	**191**	**61**

Source: Coast Guard MISLE (Marine Information for Safety and Law Enforcement) Analysis and Reporting System (MARS).

Passenger Ferry Operations

There are six passenger ferry routes operating within this area,[168] consisting of five commercial ferry routes, and one ferry operated by the federal government. Table 2.2 outlines the ferry services and the number of passengers and vehicles carried. The four commercial ferry routes are:

(1) Cross Sound Ferry, providing year round passenger and vehicle service between Orient Point, New York and New London, CT;

[168] In addition, two seasonal passenger and vehicle ferries operate across the Connecticut River in two locations: between Chester and Hadlyme, and between the towns of Glastonbury and Rocky Hill.

(2) Fishers Island Ferry, operated by the Fishers Island Ferry District, with passenger and vehicle service between New London and Fishers Island;
(3) Seasonal high speed passenger service between Block Island and New London;
(4) Seasonal ferry service from New London, CT to Montauk, New York.

Details regarding the New London to Block Island Ferry service are discussed in Section 3.2.3.2.2 supra. The New London to Montauk seasonal ferry is discussed in section 3.2.4.2.2 supra. The remainder of the ferry routes are described below.

The largest ferry route potentially impacted by the Broadwater proposal is the Cross Sound Ferry, providing year round passenger and vehicle service between New London and Orient Point. This ferry service operates traditional vehicle and passenger ferries, as well as a high speed passenger ferry along this route. Averaging approximately 50 ferry crossings per day throughout the year this service offers peak season schedule of 58 transits per day for the combined services. These ferries have a capacity between 150-1,000 passengers, and 22-110 vehicles per ferry. As outlined in Table 2.2, for the years 2003-2005, this ferry service carried an average of 506,667 vehicles and 1.333 million passengers annually.[169]

A second ferry service also operates across Long Island Sound running from Old Saybrook, Connecticut to Plum Island, New York.[170] Plum Island is the home to the Plum Island Animal Disease Center, discussed in section 3.2.6.2 supra. There is another ferry service between Plum Island and Orient Point, New York that serves employees, guests and contractors of the Animal Disease Center. Between 2003 and 2005, the average annual number of passengers carried between Old Saybrook and Plum Island was 50, 927 passengers; between Orient Point and Plum Island, 66,007 passengers and 3,016 vehicles.

Fishers Island Ferry runs between City Pier in New London and Silver Eel Cove on Fishers Island, New York, an island consisting mainly of residential properties. This ferry service averages approximately 8-14 transits per day throughout the year, with increased transits during the summer months ranging from 10 to 16 transits per day. Peak service for holidays can increase transits to 26 per day. Between 2003 and 2005, Fishers Island Ferry carried an average of 159,142 passengers and 46,929 vehicles.[171] This ferry route does not cross the anticipated LNG vessel transit route.

Commercial Fishing operations

There is a small commercial fishing presence home ported in New London of approximately 6-8 commercial fishing vessels. Several vessels discharge their catch in New London. A larger fleet of fishing vessels work out of Stonington, Connecticut, with approximately 25 vessels homeported there. These include trawlers and scallopers, which generally operate offshore. These vessels generally transit out to sea to fishing grounds through Watch Hill Passage. Several

[169] Letter from Cross Sound Ferry Services, Inc. to ENTRIX, Inc. dtd November 14, 2005.
[170] The Plum Island Ferry is a private ferry run by the US Department of Agriculture Plum Island Research Facility.
[171] In 2003, there were 152,632 Passengers, 40,397 automobiles, and 5,832 trucks; in 2004, 162,298 passengers, 40,548 automobiles, and 6,229 trucks; and in 2005, 162,495 passengers, 40,388 automobiles, and 7,394 trucks. Source: e-mail dated 5 April 2006 from Thomas Doherty, Manager, Fishers Island Ferry District.

inshore areas, and out into Long Island Sound up to depths of 45-feet are designated as shellfish beds by the State of Connecticut and are leased to commercial shellfishermen. Commercial lobstermen operate throughout this area.

There are also numerous vessels along this portion of the transit route that operate as charter boats for deep sea fishing. These vessels operate throughout the year.

3.2.6.2.2 Marine Events and seasonal usage of the waterway

In addition to those events outlined in Section 2.2.3.2 supra, Eastern Long Island Sound hosts numerous small scale marine events throughout the year, primarily during the summer months. The majority of these events are held within close proximity to the shore or, within Fishers Island Sound, on the Connecticut River, the Thames River, or the Mystic River. The State of Connecticut Department of Environmental Protection Boating Division also permits events held in Connecticut waters. These primarily consist of fishing tournaments taking place on the Connecticut River. One notable event along this portion of the transit route is the Thames River Mashantucket Pequot Fireworks held annually on the Saturday after the July 4th holiday.[172] This event is promoted as the largest fireworks event in New England, attracting hundreds of spectator craft.

3.2.6.3 *Population density and important structures*

The shoreline of Eastern Long Island Sound comprises the Connecticut towns of Groton (which includes the separately incorporated City of Groton), Waterford, East Lyme, and Old Lyme, the City of New London, Connecticut, and the Long Island town of Southold. After passing through the Race and turning west-southwestward to complete their transit to the FSRU, LNG carriers will pass between 3.45 to 4.6 miles from the cities of New London and Groton and the towns of Groton and Waterford, Connecticut. Both the town of Groton and City of Groton's population densities also qualify as medium per NVIC 05-05 at 1,275 and 3,226 persons per square mile, respectively. New London has a medium population density per NVIC 05-05, with a population of 4,636 persons per square mile. Immediately to the west, Waterford has a low population density per NVIC 05-05, with a population of 585 persons per square mile. East Lyme and Old Lyme, which are west of Waterford, have a low population density per NVIC 05-05[173], with population densities of 532 and 321 persons per square mile, respectively. Although these areas experience a summer season increase in population densities, the increase in population density does not rise above the low population density characterization per NVIC 05-05.

Important structures in this urban section of coastline include the Groton-New London Airport, the University of Connecticut Avery Point campus, the Lawrence and Memorial Hospital in New London, the United States Coast Guard Academy, the campuses of Connecticut College and Mitchell College, the New London Ferry Terminal and Amtrak Station, the I-95 Gold Star Bridge and a railroad bridge (a vital link in Amtrak's Northeast Corridor) spanning the Thames River, the General Dynamics Electric Boat Corporation submarine construction and repair facility in Groton, the Groton Naval Submarine Base, office, research and manufacturing facilities of Pfizer Corporation in both Groton and New London, and the Millstone Nuclear

[172] A permanent safety zone for this event is promulgated at 33 CFR § 165.151(a)(10)
[173] Online at http://www.oldlyme-ct.gov/Pages/OldLymeCT_WebDocs/about

Power Plant in Waterford. The town of Groton has eight elementary schools, three middle schools, and two high schools, along with a public Library. The City of New London features five elementary schools, one middle school, and one high school. The town of Waterford has six elementary schools, one middle school, and one high school, as well as a public Library, and East Lyme has three elementary schools, one middle school, and one high school, along with a Community Center/Library complex. Old Lyme is part of the Lyme-Old Lyme Regional District #18, which consists of three elementary schools, a middle school, and high school. The town is also home to the Lyme Academy College of Fine Arts, the Old Lyme-Phoebe Griffin Noyes Library, and the Florence Griswold Museum.

Orient, NY, which occupies the north fork of the eastern end of Long Island, has a year-round population of 709 and a population density of 139 persons per square mile. Although the population increases by approximately 2 ½ times during the summer months, it remains low density per NVIC 05-05.[174] Important structures within Orient include Oyster Pond Elementary School, the 107 year old Orient Point Light, and the Cross-Sound ferry terminal, which may have as many as 58 ferry arrivals and departures per day.

The Town of Southold, NY, which includes the incorporated village of Greenport, covers approximately 54 square miles of the North fork. The Town of Southold has a population of 20,599, and a low in population density per NVIC 05-05 with 385 persons per square mile. The population density within the Village of Greenport is a medium density per NVIC 05-05 of 2,143 persons per square mile. Although the population of the North fork roughly doubles during the summer months, the region overall – with the exception of Greenport - remains categorized as a low population density per NVIC 05-05.[175] Greenport has a hospital and a K-12 school, while the hamlet of Southhold has a two-building school complex for grades K-12. Further east, the village of Cutchogue has East Cutchogue Elementary, while the village of Mattituck has a grade 7-12 School. The Southold Free Library and the museum/library/archives of the Southold Historical Society are important cultural centers.

3.2.6.4 *Zones of Concern*

No areas of land along this portion of the transit route fall within Hazard Zones 1 and 2. The following areas of land fall within Hazard Zone 3: all of Plum Island , New York; all of Orient, New York, and the Northeastern portion of the town of Southold, New York; land in Connecticut within Hazard Zone 3 include southern potions of New London, including Goshen Point, and southern portions of Waterford bordering Jordan's Cove. These hazard zones are depicted on Figure 3.2-6 supra.

[174] Telephone conversation with Carlisle Cochran , Police Chief, Town of Southold (on May 23, 2006).
[175] Telephone conversation with Carlisle Cochran , Police Chief, Town of Southold (on May 23, 2006).

3.2.6.5 *Sensitive Environmental Areas*

The environmental attributes and resources along the eastern end of Long Island north of Montauk Point are identified and mapped on the two (2) Environmental Sensitivity Index (ESI) maps listed in Table 3.2-6 below.

Table 3.2-6: Environmental Sensitivity Index Maps for Montauk Point Pilot Station to the Race

Map ID	Map name
LI – 28 (1985)	Gardiners Island East, NY
LI – 26 (1985)	Plum Island, NY - CT

Within this segment of the anticipated LNG vessel transit route, the most significant public park or recreation area is Orient Beach State Park on Orient Point, Long Island.

The environmental attributes and resources of Eastern Long Island Sound are identified and mapped on the four (4) Environmental Sensitivity Index (ESI) maps listed in Table 3.2-11 below.

Table 3.2-11: Environmental Sensitivity Index maps for Eastern Long Island Sound

Map ID	Map name
CT – 21 (October, 2001)	Niantic, CT
CT – 15 (October, 2001)	Old Lyme, CT
LI – 23 (1985)	Orient, NY - CT
LI – 20 (1985)	Southold, NY

Public parks and recreation areas and wildlife refuges along this segment of the anticipated LNG vessel transit route include the areas listed in Table 3.2-12.

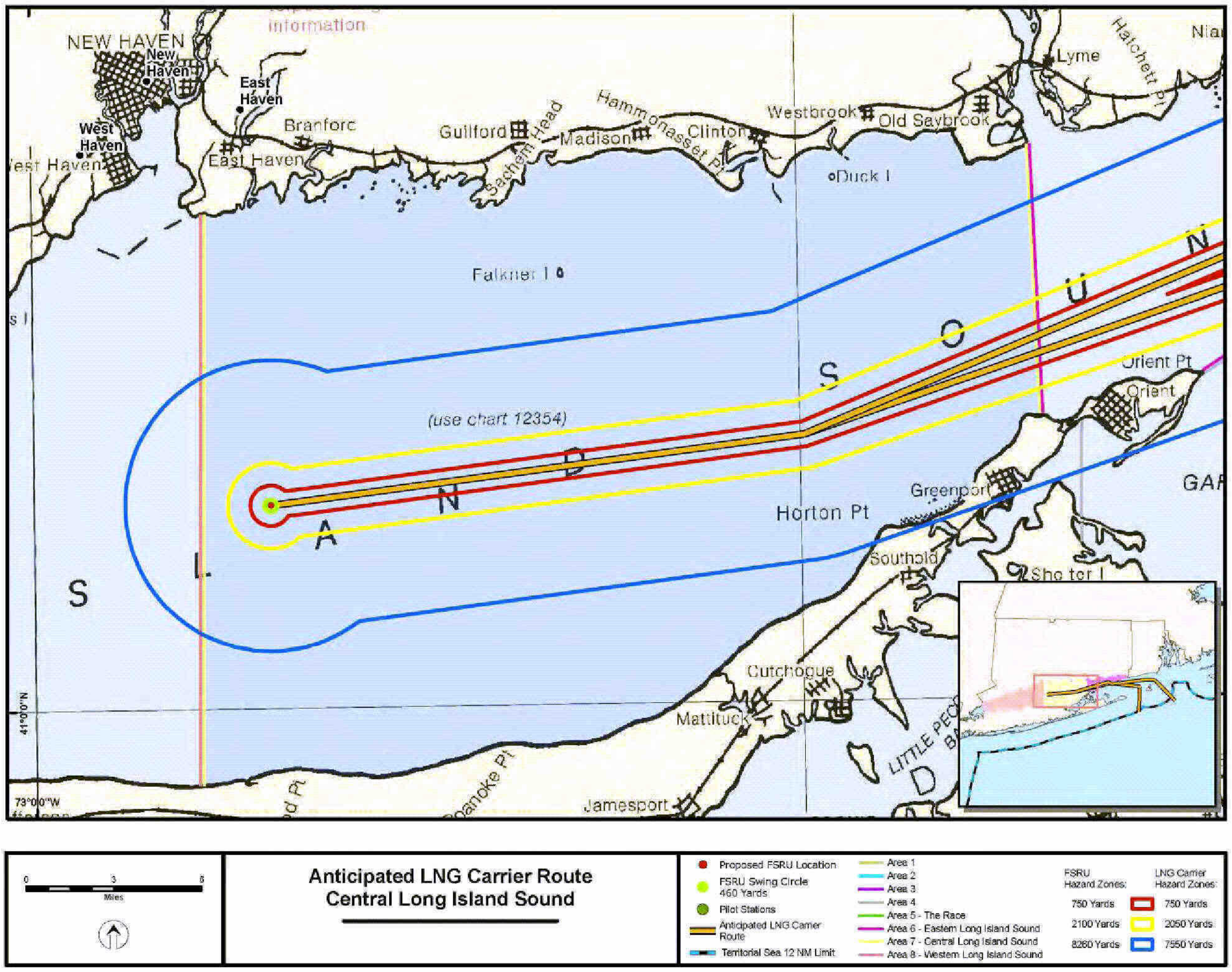
Table 3.2-12: Public Parks and Wildlife Refuges for Eastern Long Island Sound

Name	Distance from anticipated transit route (Miles)
Connecticut	
Bluff Point State Park and Coastal Reserve	6.6
Fort Griswold Battlefield State Park	6.9
Fort Trumbull State Park	6.5
Ocean Beach Park	3.6
Harkness Memorial State Park	3.0
Rocky Neck State Park	5.9
Great Island Wildlife Management Area	6.9
Ragged Rock Creek Marsh Wildlife Area	7.2
South Cove Wildlife Area	6.1
Plum Bank Marsh Wildlife Area	6.4
Long Island	
Orient Point State Park	3.7

3.2.7 Central Long Island Sound

This area consists of waters of Long Island Sound between West Longitude 072° 20.5' and West longitude 072° 53.4', representing an area from the western side of the Connecticut River to approximately 2.3 miles west of the proposed location for the FSRU.

Figure 3.2-7 – Anticipated LNG carrier transit route – Central Long Island Sound



3.2.7.1 *Transit route*

LNG vessels transiting to the FSRU would likely transit along Central Long Island Sound on a west-south-westerly course to the FSRU. LNG vessels would transit along this portion of the transit route 4.3 miles south of Long Sand Shoal, and south of the Cornfield Lighted Whistle

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Buoy CF. [176] Proceeding west, their transit would take them approximately 3.1 miles south of Six Mile Reef, and approximately 1.7 miles south of the Twenty Eight Foot Shoal (TE) Buoy. Continuing along this route, LNG vessels would pass approximately 7.6 miles north of Mattituck Inlet, 3.7 miles north of the northeast corner of the Riverhead COTP designated lightering zone, and approximately 7 miles north of the Riverhead Offshore Platform. LNG vessels would then transit approximately 6 miles south of Falkners Island. LNG vessels would arrive at the FSRU for offloading; the location of the FSRU is discussed in Section 3.1.2 supra.

3.2.7.1.1 Waterway attributes

Obstructions along this portion of the transit route are few and are marked by navigational aids maintained by the Coast Guard. These consist mainly of shoal and reef areas. The mid sound is marked by the Cornfield Lighted Whistle Buoy CF, a Morse Alpha buoy marking good water. Obstructions in this portion of the transit route include Long Sand Shoal, a 28-foot least depth shoal area marked by the TE Buoy, Six Mile Reef, Faulkner's Island, and the Riverhead Platform; distances to these are discussed in section 3.2.7.1 supra.

As discussed in Section 2.3.2, the COTP Long Island Sound has designated an area north east of Riverhead, New York, and approximately 1.8 miles north of the Riverhead Offshore Platform as a lightering zone. The lightering zone, discussed more in Section 3.2.7.2 infra, is 3.7 miles from the anticipated transit route of the LNG vessels, and approximately 8.3 miles southeast of the proposed location of the FSRU.[177] Lightering operations are infrequently conducted in this location; when conducted, petroleum products are lightered. This area is frequently used as an anchorage vessels waiting to conduct transfer operations at the Riverhead Offshore Platform.

A lightering area also exists of New Haven, southeast of the New Haven breakwater.[178] The southern boundary of the lightering zone is approximately 3 miles north of the proposed FSRU location. In 2005, the New Haven lightering zone experienced increased activity with usage of the zone for lightering gasoline from tankers to barges, which deliver the product to terminals in New Haven.

In 2005, the Central Long Island Sound Dredged Material Disposal area was federally designated to receive dredge spoils.[179] This disposal area is approximately 2.8 miles northwest of the proposed location of the FSRU.

3.2.7.1.2 Weather

Weather for Long Island Sound is noted in Section 2.4. Weather for the Central Sound is also discussed in Section 3.1.2.2 and Table 3.1-1.

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[176] LLNR 21140.

[177] The following geographical positions represent the four corners of the Riverhead Lightering Zone (clockwise beginning at the northwestern most corner: 41° 3.0'N, 072°42.0'W; 41°04.0'N, 072°36.0'W; 41°02.0'N, 072°35.4'W; 41°01.4'N, 072°41.4'W).

[178] The following geographical positions represent the four corners of the New Haven Lightering Zone (clockwise beginning at the northwestern most corner: 41°11.2'N, 072°53.1'W; 41°11.5'N, 072°49.4'W; 41°08.6'N, 072°47.4'W; 41°08.6'N, 072°51.4'W).

[179] The Central Long Island Sound Dredged Material Disposal Area covers a 6.86 km² (2 nmi²) area and is centered at 41° 08.905' N, 72° 53.073' W (NAD 83). More information regarding this disposal area can be found at http://www.epa.gov/NE/eco/lisdreg/eis.html.

3.2.7.2 *Port Characterization and Activity*

This portion of the transit route has considerably less port infrastructure than either Eastern or Western Long Island Sound. The only facility regulated by the Coast Guard in this area is a marine oil facility approximately 1.15 miles offshore of Riverhead, Long Island, New York. The Marine oil transfer facilities include an offshore platform off the town of Riverhead, New York on Long Island.[180] This facility handles refined petroleum products, including #2 Oil, #6 Oil, Diesel, Home Heating Oil and gasoline. Tankers awaiting to transfer petroleum products at the Riverhead platform utilize the designated Riverhead lightering zone northeast of the platform as an anchorage.

3.2.7.2.1 Density and character of marine traffic

Consistent with the rest of the anticipated LNG transit route, this is a multiple use waterway as discussed in Section 2.2 supra.

Table 3.2-13 Central Long Island Sound Vessel Arrivals

Port	2003		2004		2005	
	U.S.	Foreign	U.S.	Foreign	U.S.	Foreign
Long Island Sound	111	4	126	9	207	31
Mattituck	1					
Riverhead	133	51	169	84	231	48
Riverhead Anchorage	9	4	1	2	3	4
Wethersfield	1					
Total	**255**	**59**	**296**	**95**	**441**	**83**

Source: Coast Guard MISLE (Marine Information for Safety and Law Enforcement) Analysis and Reporting System (MARS).

3.2.7.2.2 Marine Events and seasonal use of waterway

Marine events in Central Long Island Sound are generally discussed in Section 2.2.3.2 supra. Tables 2-5 and 2-6 outline the marine events held in Central Long Island Sound for the years 2004 and 2005.

3.2.7.3 *Population density and important structures*

The Connecticut shoreline stretching from Old Saybrook to Branford is an area of low population density per NVIC 05-05. Branford, CT has a medium population density per NVIC 05-05, with a population density of 1,305 persons per square mile. The New Haven area,

[180] The Conoco Philps Riverhead Offshore Platform is located approximately one nautical mile north of the shoreline of Riverhead, New York, in approximate position 41°00.0' N, 072°38.8'W. A permanent safety zone exists at 33 CFR §165.155 while Liquefied Petroleum Gas (LPG) vessels are conducting transfer operations at the Riverhead Platform. Although the Platform remains capable of receiving LPG, it currently does not receive LPG vessels, and has not received LPG for several years. The safety zone is, therefore, not currently enforced.

including East Haven, is considerably more dense, with New Haven's population density of 6,558 persons per square mile, and East Haven's population density at 2,298 persons per square mile, both falling within a medium population per NVIC 05-05. Development along the shoreline from Old Saybrook to Branford is typically limited to marinas and residential areas. Old Saybrook has one elementary, one middle, and one high school, along with the Acton Public Library.

Westbrook also has a single elementary along with one middle and one high school, and a public library. Madison has three elementary schools, a lower and upper middle school, and a high school, and the E.C. Scranton Memorial Library. Clinton has two elementary schools, a middle school, a high school, and the Henry Carter Hull Library. Branford has three elementary schools, an intermediate school, a high school, and the James Blackstone Memorial Library.

The metropolitan area comprising East Haven, New Haven, and West Haven, which surrounds New Haven harbor, features quite a few important structures, including: the PSEG New Haven Harbor Electric Generating Station ; a number of marine terminals that compose the Port of New Haven; the I-95 Quinnipiac River Bridge, the Tomlinson Bridge, as well as several other fixed and moveable bridges key to transportation in this area; the downtown New Haven business district including New Haven City Hall, the Yale-New Haven hospital; the campus of Yale University; and the headquarters of the New Haven *Register*. The two municipalities have numerous public schools, public libraries, and cultural institutions.

On the southern shore of the Sound, the town of Riverhead's total population of nearly 27,000 people is spread out over 67 square miles of land area, yielding a low density per NVIC 05-05 of only slightly over 400 persons per square mile. However, over 10,000 people are concentrated in Riverhead, which serves as the county seat for Suffolk County, at the somewhat higher density of nearly 700 persons square mile. Structures along the shoreline are typically limited to residential and marinas, with the exception of two offshore petroleum transfer platforms, one at Riverhead and the other at Northport, Long Island. The Riverhead School District comprises 4 elementary schools, a lower and upper middle school, and a high school. The Riverhead Free Library, Suffolk County Community College – Eastern Campus, the Suffolk County Historical Society, and Railroad Museum of Long Island are important cultural centers.

3.2.7.4 *Zones of Concern*

There are no land areas within this segment of the transit route that fall within Hazard Zones 1 and 2. Portions of the North Fork of Long Island from Horton Point, east, encompassing portions of the Town of Southhold, including Greenport, New York, fall within Hazard Zone 3. These Hazard Zones are shown in Figure 3.2-7 supra.

3.2.7.5 *Sensitive environmental areas*

The environmental attributes and resources of Central Long Island Sound are identified and mapped on the ten (10) Environmental Sensitivity Index (ESI) maps listed in Table 3.2-14 below.

Table 3.2-14: Environmental Sensitivity Index maps for Central Long Island Sound

Map ID	Map name
CT – 14 (October, 2001)	Niantic, CT
CT – 13 (October, 2001)	Old Lyme, CT
CT – 12 (October, 2001)	Guilford, CT
CT – 11 (October, 2001)	Branford, CT
CT – 10 (October, 2001)	New Haven, CT
CT – 9 (October, 2001)	Woodmont, CT
LI – 17 (1985)	Mattituck Hills, NY
LI – 32 (1985)	Riverhead, NY
LI – 33 (1985)	Wading River, NY
LI – 34 (1985)	Middle Island, NY

Public parks and recreation areas and wildlife refuges along this segment of the anticipated LNG vessel transit route include the areas listed in Table 3.2-15.

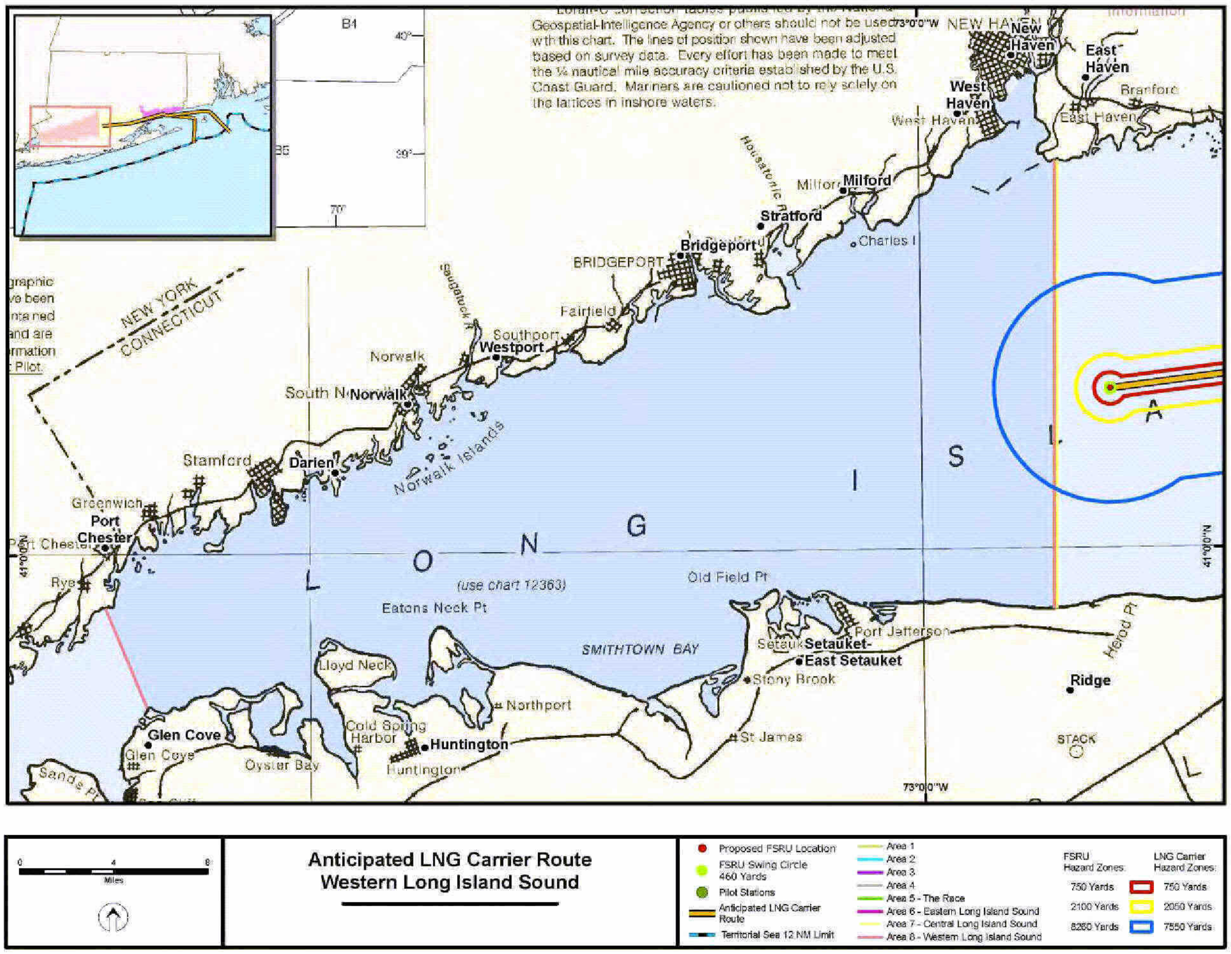
Table 3.2-15: Public Parks and Wildlife Refuges for Central Long Island Sound

Name	Distance from transit route (Miles)
Connecticut	
Hammock River Marsh Wildlife Area	9.7
Hammonasset Natural Area Preserve	7.8
Hammonasset Beach State Park	9.7
East River Wildlife Area	10.4
Great Harbor Wildlife Management Area	9.9
Pine Orchard Marsh Wildlife Area	10.9
Pawson Park Marsh Wildlife Area	11.0
Stewart B. McKinney National Wildlife Refuge (has 8 units along 60 mi. of CT coastline)	9.2
Long Island	
Jamesport State Park and Preserve	8.6
Wildwood State Park	9.5

3.2.8 Western Long Island Sound

For purposes herein, Western Long Island Sound is considered as the area approximately 2.3 miles west of the FSRU, West Longitude 072° 53.4' to the western boundary of the COTP, Long Island Sound Area of Responsibility on Long Island Sound, specifically bounded as follows: beginning on Long Island, New York at position 40°52.5'N, 73°37.2'W running northwest to the south shore of Manursing Island at 40°58'N, 73°40'W. This area includes the Ports of New Haven, Bridgeport, Port Jefferson, Norwalk and Stamford.

Figure 3.2-8 – Anticipated LNG carrier transit route – Western Long Island Sound



3.2.8.1 *Transit route*

This segment is not part of the transit route for LNG vessels supplying the FSRU. Although this area will not constitute part of the transit route for the FSRU, it is within an approximately 25 kilometer (15.5 nautical mile) radius of the proposed location of the FSRU and LNG vessel traffic.[181] Vessels transiting to ports or places within Western Long Island Sound may potentially be affected by FSRU operations or LNG vessel transits. Additionally, this area will be impacted during construction of the pipeline if the FSRU is approved and constructed.

[181] 33 CFR 127.007.

3.2.8.2 *Port Characterization*

This area encompasses two moderate sized ports, and several smaller port areas. This segment includes the port of New Haven, Bridgeport, Stamford, Norwalk and Greenwich, CT. On Long Island, this includes Port Jefferson and Oyster Bay, New York.

As shown in Table 3.2-16, facilities in this segment area include 24 marine oil transfer facilities, one general cargo facility, and four passenger terminals. The port of New Haven is located in central southern Connecticut at the head of New Haven Harbor and includes facilities on New Haven Harbor and the Mill and Quinnipiac Rivers. Products received by the facilities in this port area include refined petroleum products (#2 Oil, #6 Oil, Gasoline, Jet Fuel, Home Heating Oil, Kerosene), Styrene, Rock Salt, Scrape Metal, Metal, Lumber and Cement. Two petroleum facilities in New Haven, Magellan Midstream Partners, LP and Motiva Enterprises, are part of the strategic oil reserve for the northeast region of the United States.[182]

The Buckeye Pipeline, a multi-product pipeline, begins in New Haven and connects with petroleum terminals in Connecticut and Massachusetts. This provides jet fuel to two military facilities, including the Air National Guard facility at Bradley International Airport in Windsor Locks, Connecticut, as well as the Westover Airforce Base in Westover, Massachusetts.

Recently, lightering of gasoline began to occur on a more regular basis and is expected to continue in the New Haven designated lightering area, located southeast of the New Haven Breakwater.[183]

The port of Bridgeport is located in south central Connecticut, west of New Haven. For purposes herein, the port of Bridgeport includes the City of Bridgeport, Stratford and Devon, including the Housatonic River. Facilities located in this port area include eight marine oil transfer facilities, one general cargo facility, and one passenger terminal. Products received by these facilities include tropical fruit, mostly bananas and plantains, refined Petroleum Products (#2 Oil, #6 Oil, Gasoline, Home Heating Oil), Waste Oil, asphalt, coal, and fruit. The passenger terminal, located in Bridgeport, services vehicle and passenger ferries which run between Bridgeport and Port Jefferson, New York, discussed in further detail in Section 3.2.8.2.1 below.

Lightering of coal occurs almost continuously off of Bridgeport in and area designated as a lightering area by the COTP.[184] Barges deliver most of the lightered coal to a power generation

[182] Because roughly 69 percent, or 5.3 million, of the U.S. households that use heating oil to heat their homes reside in the Northeast region of the country - making the Northeast area especially vulnerable to fuel oil disruptions. The Northeast Strategic Oil Reserve was created in 2000 to create a buffer large enough to allow commercial companies to compensate for interruptions in supply or severe winter weather, but not so large as to dissuade suppliers from responding to increasing prices as a sign that more supply is needed. The Strategic Oil reserve for the Northeast is authorized by the Energy Policy and Conservation Act of 2000. The Northeast Home Heating Oil Reserve has 2 million barrels of emergency fuel stocks stored at commercial tank farms. More information is available at the Department of Energy's website: http://www.fossil.energy.gov/programs/reserves/heatingoil/

[183] 33 CFR 127.007.

[184] The following geographical positions represent the four corners of the Bridgeport Lightering Zone (clockwise beginning at the northwestern most corner: 41° 05.5'N, 073°13.5'W; 41°05.0'N, 073°11.0'W; 41°02.5'N, 073°12.3W; 41° 04.0'N, 073°16.5'W).

facility in Bridgeport, CT; occasionally, barges deliver coal to the Port of New Jersey through the East River

The port of Stamford is located in southwestern Connecticut west of Bridgeport. This area includes, for discussion herein, Stamford, Norwalk, and Greenwich Connecticut, and Port Chester, New York and includes the Norwalk and Mianus Rivers in Connecticut. Located within this area are four Marine Oil Transfer facilities and two passenger terminals.[185] Stamford itself has one commercial oil terminal that accepts barge traffic only. The majority of vessel traffic here is recreational. Products received by the facilities are mainly refined petroleum Products (#2 Oil, #6 Oil, Diesel, Home Heating Oil) and aggregate material.

Although the Long Island portion of this transit segment is much less industrialized than Connecticut, there is still notable port infrastructure. The north shore of Long Island includes the areas of Oyster Bay, Port Jefferson, and Northport. Port Jefferson hosts marine oil transfer facilities as well as an energy generation facility. Off of Northport, Keyspan Energy operates an offshore Marine oil transfer facilities approximately 1.7 miles north of Northport, Long Island, NY.[186] Vessels waiting to conduct transfer operation at the facility frequently utilize the Northport COTP designated lightering zone as an anchorage grounds.[187] This facility handles refined Petroleum Products, including #2 Oil, #6 Oil, Diesel, Home Heating Oil and gasoline.

As discussed in Section 3.2.8.2.1, passenger terminals in Port Jefferson, NY and in Bridgeport, Connecticut service passenger and vehicle ferries running between Port Jefferson NY and Bridgeport Connecticut.

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185 Greenwich Town Ferry and the Great Captain Ilse Ferry.

186 The Keyspan Northport Offshore Platform is located approximately 1.7 miles north of the shoreline of Northport, New York, in position 40°57.3'N, 73°20.5'W.

187 The following geographical positions represent the four corners of the Northport Lightering Zone (clockwise beginning at the northwestern most corner: 40° 58.8'N, 073°16.5'W; 40°57.7'N, 073°11.7'W; 40°56.5'N, 073°13.5W; 40° 57.6'N, 073°18.2'W).

Table 3.2-16: Facilities in Western Long Island Sound

	Facility Types			
	Marine Oil Facility	Passenger Terminal	Waterfront Facility	Waterfront & Passenger Terminal
Western LIS Total	**24**	**4**	**2**	**0**
Bridgeport	2	1	-	-
Devon	1	-	-	-
Greenwich	-	2	-	-
New Haven	8	-	1	-
Northport	1	-	-	-
Oyster Bay	1	-	-	-
Port Chester	1	-	-	-
Port Jefferson	2	1	-	-
South Norwalk	2	-	-	-
Stratford	6	-	1	-
Totals	**24**	**4**	**2**	**0**

Source: Coast Guard MISLE (Marine Information for Safety and Law Enforcement) Analysis and Reporting System (MARS).

3.2.8.2.1 Density and character of marine traffic

As with the rest of the area covered by this report, Western Long Island Sound is a multiple use waterway. This segment hosts significant commercial vessel traffic to and from the ports of New Haven and Bridgeport, as well as Stamford, Norwalk and Port Jefferson. This includes tug-barge combinations as well as significant deep draft vessel traffic.

Bulk cargo carriers transporting coal, or colliers, arrive at the Bridgeport lightering zone approximately every 10 days. These vessels, with lengths ranging from 700 to 800 feet and a deadweight tonnage of approximately 87,000 tonnes, will transit past the FSRU for inbound and outbound transits. These vessels are the largest vessels currently entering the COTP Long Island Sound zone.

The Bridgeport-Port Jefferson Ferry provides year-round passenger and vehicle service between Bridgeport, Connecticut and Port Jefferson, New York. This ferry service offers between 22 and 32 crossings per day throughout the year. The three vessels in the Bridgeport-Port Jefferson Steamboat Company's fleet each have a passenger capacity of approximately 1000 and a vehicle capacity of between 90 and 120 vehicles. As outlined in Table 2.2, for the years 2003-2005, this ferry service carried an average of 500,000 vehicles and 1.2 million passengers annually. The LNG carrier anticipated transit route would not cross this ferry route

Commercial fishermen operate throughout western Long Island Sound, including mainly shellfishermen and lobstermen. Commercial fishermen homeport in Mattituck Inlet and Oyster Bay, New York.

Additional commercial passenger ferries have been proposed for western Long Island Sound. Proposals include routes for ferries running from New Haven to Port Jefferson, and Greenwich to LaGuardia Airport in New York have been discussed. It is unknown when these may commence operations.

Container feeder barge service is proposed for Bridgeport, CT. This service is intended to have barges bring containers from the Port of New York/New Jersey through the East River into Bridgeport, Connecticut, where the containers would be offloaded and transported further by tractor trailer. This service was proposed to reduce traffic density on the I-95 corridor. The expected start date of this service is unknown.

Table 3.2-17: Central Long Island Sound Vessel Arrivals

Port	2003		2004		2005	
	U.S.	Foreign	U.S.	Foreign	U.S.	Foreign
Bridgeport	186	94	267	84	271	78
Bridgeport Anchorage	3	10	1	15	2	17
Cold Spring Harbor	11					
Greenport	1					
Hempstead					6	
Milford	4					
New Haven	327	235	536	192	656	190
New Haven Anchorage	13	23			1	2
Northport	43	14	32	20	69	6
Northport Anchorage	7				3	1
Norwalk	9					
Oyster Bay	133		173		121	1
Port Jefferson	278	3	330	8	426	2
Stamford	58		58		67	2
Total	**1073**	**379**	**1397**	**319**	**1622**	**299**

Source: Coast Guard MISLE (Marine Information for Safety and Law Enforcement) Analysis and Reporting System (MARS).

3.2.8.2.2 Marine Events and Seasonal Usage

As discussed in Section 2.2.3.2, there are several larger marine events which occur in this area. As with other portions of both Long Island and Block Island Sounds, there are numerous smaller scale marine events which are held in this area, some of which are permitted by the Coast Guard in accordance with 33 CFR Part 100. The number of events permitted by the Coast Guard from 2003 -2005 for western Long Island Sound are listed in Tables 2-5 and 2-6 supra.

3.2.8.3 *Population density and important structures*

The City of West Haven and the towns of Milford, Stratford and the City of Bridgeport are among the municipalities located in this portion of the analysis. The population of each of these municipalities is classified as medium per NVIC 05-05. The City of West Haven has a population of 52,630, and a population density of 4,832 persons per square mile. Milford's population density is less than half of neighboring West Haven's at 2,271 persons per square mile. The population density is slightly higher in Stratford, to approximately 2,850 persons per square mile. The City of Bridgeport, the largest city in Connecticut, has a population density of 8,721persons per square mile. Important structures along the shoreline in these jurisdictions include: the downtown Bridgeport business district, Bridgeport City Hall, the Harbor Yard Ballpark and Arena, the PSEG Bridgeport Harbor Electric Generating Station, and the Bridgeport and Port Jefferson Steamboat Company's ferry terminal. The three municipalities also have numerous public schools, public libraries, and cultural institutions.

Across the Sound on Long Island, the incorporated villages of Northport, at nearly 3,300 persons per square mile and Port Jefferson, to the east, at just under 2,700 persons per square mile, are both classified as a medium population density per NVIC 05-05. Important structures include the Bridgeport & Port Jefferson Steamboat Company's ferry terminal in Port Jefferson, the Port Jefferson Free Library and the elementary school, middle school, and high school of the Port Jefferson School District. The campus of the State University of New York at Stony Brook is approximately 4.5 miles southwest of the village of Port Jefferson. Port Jefferson also features two hospitals, the John T. Mather Memorial Hospital and St. Charles Hospital and Rehabilitation Center. Important structures in the village of Northport include the Historical Society Museum, Village Hall, and Public Library. The Northport-East Northport School District includes six elementary schools, one middle school, and one high school.

3.2.8.4 *Zones of Concern*

There are no land areas within this segment that fall within any of hazard zones for LNG carriers or for the proposed FSRU.

3.2.8.5 *Sensitive Environmental Areas*

The environmental attributes and resources of Western Long Island Sound are identified and mapped on the five (5) Environmental Sensitivity Index (ESI) maps listed in Table 3.2-18 below.

Table 3.2-18: Environmental Sensitivity Index maps for Western Long Island Sound

Map ID	Map name
CT – 7 (October, 2001)	Milford, CT
CT – 6 (October, 2001)	Bridgeport, CT
LI – 35 (1985)	Port Jefferson NY
LI – 36 (1985)	St. James, NY
LI – 37 (1985)	Northport, NY

Public parks and recreation areas and wildlife refuges in Western Long Island Sound include the areas listed in Table 3.2-19:

Table 3.2-19: Public parks and wildlife refuges for Western Long Island Sound

Name	Distance from LNG vessel anticipated transit route (Miles)
Connecticut	
Silver Sands State Park Reservation	13.2
Smith-Hubbell Wildlife Refuge	14.4
Wheeler Wildlife Management Area	15.0
Long Island	
None within 15 mi. of the proposed FSRU	

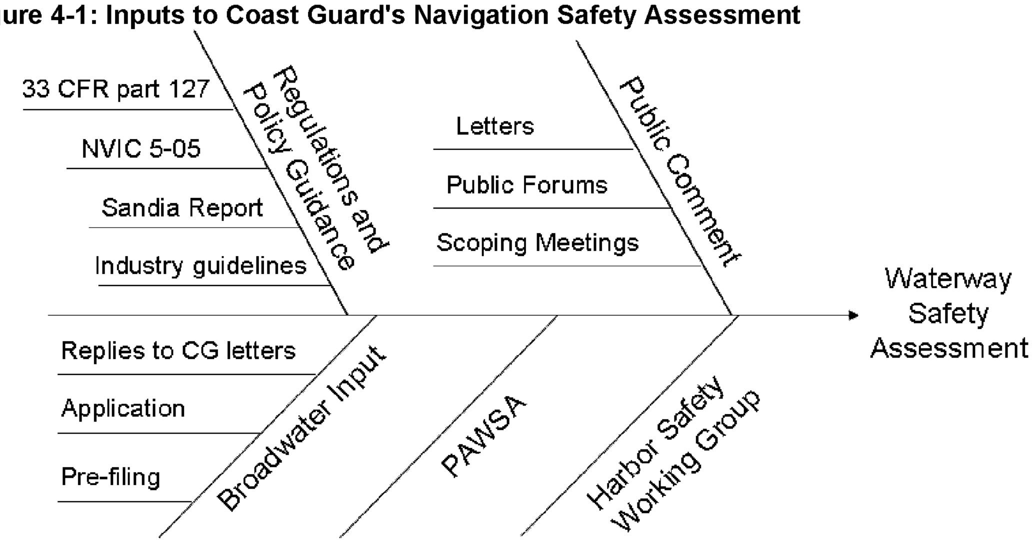
4 Safety Assessment

4.1 Overview

The focus of the navigation safety assessment was potential navigation-related incidents associated with the construction and operation of the FSRU in central Long Island Sound as well as the transport of LNG on the waters of Block Island Sound and Long Island Sound. The intent of the assessment was to determine whether these waterways could safely accommodate the FSRU at the location proposed by Broadwater Energy and support LNG carrier traffic with or without mitigation measures that might be required to ensure the safety of navigation if the Broadwater proposal is approved.

The safety assessment was not a singular event. Rather, it was an extended process that drew upon a variety of different inputs. The most significant inputs to the Coast Guard's navigation safety assessment are shown in Figure 4-1. Both the PAWSA and the Harbor Safety Working Group also provided additional opportunities for public input since participants included approximately 30 representatives from various commercial and recreational waterway users (See Section 1.2.3).

Figure 4-1: Inputs to Coast Guard's Navigation Safety Assessment



Currently, LNG is not transported by water on either Block Island Sound or Long Island Sound. If the FSRU is approved and constructed, as discussed in Section 3.1, Broadwater Energy has stated that approximately 2 – 3 LNG carriers a week (104 – 156 per year) would call at the facility.[188] This represents an approximate 20 to 30 percent increase in average annual number of foreign-flagged vessel arrivals and a less than one percent increase in the overall number of

[188] See Broadwater Energy Letter of Intent dated November 9. 2004.

commercial vessels on Long Island Sound. In addition to an increase in vessel arrivals, there would also be an increase in vessel traffic on the Sound due to the movements of support vessels between the on-shore support facility and the FSRU as well as the movements of tugs needed to assist LNG carriers. However, the overall increase in commercial vessels would still be less than one percent. It is also expected, based on experience in other U.S. ports that receive LNG carriers, that there would also be increased movements of Coast Guard vessels engaged in safety and security operations necessitated by the movement of LNG carriers and the presence of the FSRU.[189] Although the potential introduction of LNG carriers would result in a significant increase in the number of foreign-flag vessels transiting the waters of Block Island Sound and Long Island Sound, even when the support vessel movements are taken into account, there would not be any appreciable increase in the overall volume of commercial vessel traffic on either waterway.

The safety record associated with the maritime transport of LNG is very good.[190] However, it is also noted that the Society of International Gas Tanker and Terminal Operators (SIGTTO) has stated that "the paramount objective in managing LNG shipping operations in port areas is the elimination of any credible risk of a tanker's containment system being breached."[191] As discussed in Section 2, Block Island Sound and Long Island Sound are not traditional port areas, e.g., the Port of New Haven or Port Jefferson. Rather, they are thoroughfares that are used by significant numbers of commercial vessels while also supporting large numbers of recreational vessels. Eastern Long Island Sound, The Race and Block Island Sound are also critical for national defense. A particular challenge for this assessment was evaluating the potential impact on navigation safety associated with locating a fixed structure, e.g., the proposed FSRU, in a thoroughfare used by a wide variety of waterway users.

Potential risks to navigation safety during the construction of the mooring tower, laying of the pipeline or while the FSRU is being towed through Block Island Sound or Long Island Sound were not addressed because they are outside the scope of the assessment as defined by NVIC 5-05. It should be noted that these activities would not be dissimilar to operations associated with the installation of the Cross Sound Cable or Iroquois pipeline. If Broadwater Energy's application is approved and the facility is constructed, any potential risks to navigation safety would be identified and addressed by the Coast Guard before these operations would be allowed to be conducted.

4.2 Risk Assessment

In order to conduct a systematic assessment of the potential risks to navigation safety associated with the proposed project, a risk assessment was conducted using the Preliminary Risk Assessment technique described in the Coast Guard's Risk Based Decision Making

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[189] See Sections 2.2.2 and 2.2.3 for a discussion of vessel traffic on Block Island Sound and Long Island Sound.
[190] Sandia Report, p. 43.
[191] The Society of International Gas Tanker and Terminal Operators, LNG Operations in Port Areas: Essential Best Practices for the Industry, London: Witherbys Publishing (2003), p. 4.

Guidelines.[192] This technique was used because it provides a systematic means of evaluating and comparing risks associated with a number of different accident scenarios. The assessment involved:

- Identifying credible threats to navigation safety associated with the Broadwater Energy proposal;
- Identifying where these threats might exist, e.g., a portion of the LNG carrier's transit route or in the vicinity of the proposed FSRU;
- Identifying potential vulnerabilities, i.e., risk factors, that could contribute to causing a navigation safety related accident;
- Identifying the potential likelihood and consequences of an accident if it did occur; and,
- Identifying potential measures that could be implemented to manage the potential risk by either reducing the likelihood that an accident might occur or by reducing the consequences in the event an accident did occur.

4.2.1 Identification of Potential Threats to Navigation Safety

Based in part on the Sandia Report,[193] as well as information provided by Broadwater and input from the public, navigation safety related events associated with Broadwater Energy's proposal that pose a threat to safety were identified. These included:

- Collisions involving LNG carriers;
- Allisions[194] with the FSRU involving either LNG carriers or other vessels;
- Allisions with structures other than the FSRU involving LNG carriers;
- Groundings involving LNG carriers;
- Failure of the yoke mooring system and the FSRU being set adrift;
- Collisions involving small commercial vessels and / or recreational vessels while clearing The Race in advance of a LNG carrier transit; and,
- Collisions involving large commercial vessels transiting in the vicinity of the FSRU.

These events can be grouped into two general categories. The first are those that could be expected to result in a breach of the LNG containment of either the FSRU or an LNG carrier. This group includes all of the events in which either the FSRU or an LNG carrier is directly involved. The second group includes those events for which either the proposed location of the FSRU or the movement of LNG carriers is a contributing factor. Although these events would not result in a breach of the cargo containment on either the FSRU or an LNG carrier, they could potentially result in damage or loss of other vessels, passengers or crew on those vessels being injured or killed, or potential damage to the marine environment.

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[192] The Coast Guard's Risk Based Decision Making Guidelines are available at http://www.uscg.mil/hq/g-m/risk/e-guidelines/rbdm.htm.

[193] Sandia Lab Report. p. 43-44.

[194] Allisions are defined as accidents in which a moving vessel strikes an object or other vessel that is not moving.

4.2.2 Location

Understanding where on the waterway an event might reasonably be expected to occur is important for identifying potential factors that could contribute to the event, the likelihood that a particular event may occur, and for the development of appropriate mitigation measures if it is determined during the assessment process that measures currently in place are not sufficient to manage the identified risk. For the purpose of this assessment, the areas discussed in Section 3.2 will be used to describe the location.

4.2.3 Risk Factors

For this assessment, risk factors are waterway characteristics that may contribute to or cause an event. Risk factors identified as potentially contributing to navigation safety related events that could potentially result in a breach of the cargo containment on the FSRU or an LNG carrier, or that could contribute to a navigation safety related event associated with the proposed location of the FSRU or the movement of LNG carriers were grouped using the categories used in the PAWSA (See Section 1.2.2). This was done to help prioritize risk factors that would most likely require additional mitigation measures if the Broadwater FSRU is approved and constructed. A detailed discussion of the risk factors based on the results of the PAWSA is in Section 4.4.

4.2.4 Likelihood

The likelihood that each event would result in one of three ranges of consequences was assessed using the scores shown in Table 4-1. The likelihood scores, which are based on guidance in the Coast Guard's Risk Based Decision Making Guidelines, were selected to provide a time horizon for evaluating the potential that a particular event could occur. This was necessary since a statistical analysis of marine casualty data for Block Island Sound and Long Island Sound yields little useful information due to the low number of recorded marine casualties. The descriptions in Table 4.1 are used in Section 4.3 to describe the likelihood that a potential navigation safety accident scenario might occur.

Table 4-1: Likelihood Scores

Score	Description
5	May occur more than once a year
4	May occur once every 1 – 10 years
3	May occur once every 10 – 50 years
2	May occur once every 50 – 100 years
1	May occur once in 100 or more years

Based on Coast Guard Risk Based Decision Making Guidelines, Vol. 3

4.2.5 Consequences

The consequences of the identified events are defined in terms of their potential impact on navigation safety, economics or port operations, and national defense. The definition of each category is shown in Table 4-2. It is not necessary for all of the criteria in each impact area to be met in order for the potential consequences of an event to be evaluated as being minor, moderate or major. Similarly, if a significant number of criteria for a particular category might be met, the consequences of an event could be evaluated as meeting the next higher category. The terms minor, moderate and major are used in Section 4.3 to provide a general description of the consequences associated with a particular navigation safety accident.

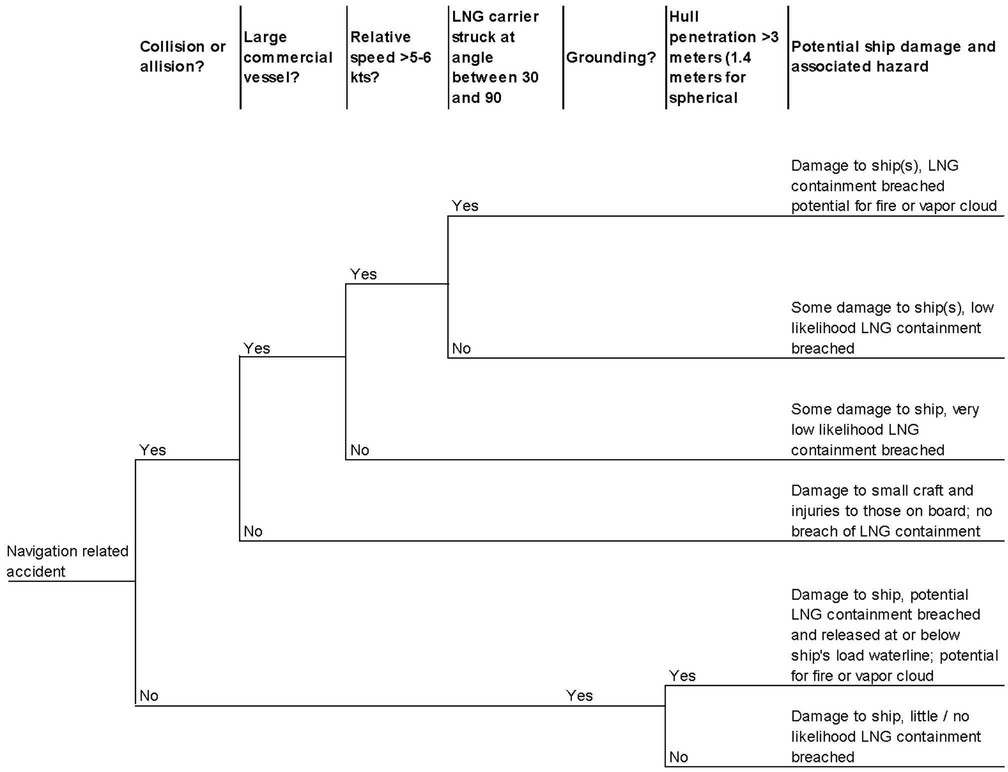
Table 4-2: Consequence Categories

Consequence Category	Safety Impact	Economic / Port Operations Impact	National Defense Impact
Minor	Injuries that require more than first aid, i.e. may require hospitalization or result in lost work days Low risk of LNG release	FSRU sustains some structural damage; vessel seaworthy but requires some temporary repairs; or, port operations delayed	Naval unit transits delayed less than 6 hours
Moderate	Injuries that may result in permanent disability Medium risk of LNG release	FSRU sustains significant structural damage; vessel not seaworthy; port operations disrupted up to 24 hours	Naval unit transits are delayed more than 6 but less than 12 hours
Major	One or more deaths High risk of LNG release	FSRU must be rebuilt; vessel declared total constructive loss; port operations disrupted for more than 24 hours	Naval unit transits delayed more than 12 hours

Based on Coast Guard Risk Based Decision Making Guidelines, Vol. 3

The event tree shown in Figure 4-2, which is based on the Sandia Report, was used to assist with evaluating the potential consequences of the navigation safety accident scenarios that could result in a release of LNG. As is evident based on the event tree, only if a number of certain conditions exist at the time of an accident is there a reasonable potential for the LNG containment of either the proposed FSRU or an LNG carrier to be breached.

Figure 4-2: Event Tree - Accidental LNG Cargo Tank Breach



Based on Sandia National Laboratories Report, *Guidance on Risk Analysis and Safety Implications of a Large Liquefied Natural Gas (LNG) Spill Over Water*

4.2.6 Risk Index Number

A risk index number (RIN) was calculated based on the likelihood and consequence scores.[195] The RIN is used to rank potential events and determine which potentially pose the greatest risk to navigation safety. This is a dimensionless number that was calculated using the formula $RIN = \frac{10^{L1} + 10^{2L2} + 10^{3L3}}{1110}$, where *L1* is the likelihood score for an event with minor consequences, *L2* is the likelihood score for an event with moderate consequences, and *L3* is the likelihood score for an event with major consequences. As is evident, although the RIN is a function of all consequences, it is weighted so that low probability, high consequence events are the most significant component of this value.

[195] Based on The Coast Guard's Risk Based Decision Making Guidelines, Vol. 3, Chap 4.

4.3 Navigation Safety Accident Scenarios

The Coast Guard completed an initial risk assessment of the navigation safety accident scenarios that could result in a breach of the LNG containment on either the proposed FSRU or an LNG carrier. This was presented to a Harbor Safety Working Group convened specifically for that purpose. Following the PAWSA model, this Working Group consisted of over 30 individuals representing a cross section of waterway users, including marine pilots, tug and barge operators, commercial fishermen, recreational boaters, the U.S. Navy and NOAA. Also participating were representatives from fire and emergency service departments. After being provided an overview of navigation safety related events that could reasonably be expected to potentially result in a breach of the LNG containment as well as an assessment of risk factors that could contribute to or cause an event to occur, the participants were divided into 15 groups and asked to critically review the initial risk assessment.

The review consisted of validating the navigation safety related events, potential areas on Block Island Sound or Long Island Sound where it might occur, the associated risk factors and the likelihood scores that were identified during the preliminary risk assessment. The teams were asked to add other events they thought were credible, or to delete those they felt were not credible.[196] In addition, the teams were asked to add or delete potential risk factors and to adjust the likelihood scores. The preliminary risk assessment was then updated to include the input from each of the 15 teams. After determining that there was not any significant statistical variation in the scores that were assigned by the individual teams, these scores were averaged and entered into the risk assessment worksheet. The completed risk assessment is in Appendix H.

4.3.1 Collisions involving LNG carriers

For the cargo containment of an LNG carrier to be breached in a collision, the other vessel must have enough kinetic energy to breach both the outer and inner hull of the LNG carrier. The modeling conducted by the Sandia National Laboratory determined that in order to generate enough kinetic energy for both the outer and inner hulls of a typical LNG carrier currently in service to be breached in a collision, the collision must involve another large commercial vessel moving at least 5 – 6 knots and that the angle of the collision would need to be approaching 90 degrees.[197] This information is consistent with information from SIGTTO regarding displacement tonnage[198] and speed of another vessel that could be expected to potentially

[196] Fire was identified very early in the Coast Guard's assessment of the proposed Broadwater Energy project as a potential threat to public safety and was also discussed by the Harbor Safety Working Group. The focus of this section is reducing the potential of a navigation safety related event from occurring and hence reducing the potential for a fire from occurring. Response to a fire due to a release of LNG from either an LNG carrier or the proposed FSRU is one of the issues that would be addressed during the development of the Emergency Response Plan discussed in Section 6 of this report.

[197] Sandia Report, Appendix B. The Sandia Report is based on an LNG carrier with a design capacity of 138,000 m^3 of LNG. *See* Sandia Report, p. 141.

[198] Displacement tonnage, or displacement, is the volume of water measured in tons displaced by a vessel and hence is an approximation of its weight.

penetrate the outer and inner hull of a typical LNG carrier currently in service (see Table 4-3). However, according to SIGTTO, there is some possibility that a high energy collision with an angle of at least 30 degrees could breach the cargo containment of an LNG carrier.[199] Therefore, in order to be conservative, it was assumed for this assessment that collisions with angles between 30 and 90 degrees could potentially result in a breach of the cargo containment.

Table 4-3: Displacement Tonnage and Vessel Speed

Displacement of Impacting Ship (tons)	Impact Speed (knots)	Typical Ship Type
93,000	3.2	Largest tank ship or coal ship calling on Long Island Sound
61,000	4.2	Average freight ship calling on Long Island Sound
20,000	7.3	Small freight ship or large petroleum barge

Source: SIGTTO, LNG Operations in Port Areas, p. 2

In response to a request for information from the Coast Guard, Broadwater Energy conducted modeling to establish the applicability of the hole sizes that were used in the Sandia Report to the Broadwater FSRU and LNG carriers capable of carrying up to 250,000 m^3 of LNG. This modeling assumed that the displacement of the vessel that collided with the LNG carrier was 5,000 tons.[200] It was determined that for LNG carriers with cargo capacities ranging from 145,700 to 216,000 m^3 the outer hull could be breached and the inner hull contacted, and therefore at risk of being breached, if collided with by a vessel with a speed between 3.4 – 4.8 knots.[201] These figures are conservative vis-à-vis the modeling conducted by Sandia National Laboratories, which determined the speed of the other vessel would need to be 5 – 6 knots in order to generate sufficient kinetic energy to breach the LNG containment.[202]

Based on the modeling conducted by Broadwater and Sandia National Laboratories, for the purpose of this assessment it was assumed that there was a risk that the LNG containment could be breached if an LNG carrier was involved in a collision and the following conditions were met:

- The displacement tonnage of the other vessel was greater than 5,000 tons;
- The speed of the other vessel was greater than 3.5 knots;
- The LNG carrier was struck in the cargo block; and,
- The angle of impact was 30 – 90 degrees.

The Sandia Report concluded that if a collision involving a vessel with sufficient kinetic energy to breach both the inner and outer hulls of the LNG carrier, the resulting breach could range from

[199] SIGTTO, *LNG Operations in Port Areas*, p. 2.
[200] DNV Consulting, Broadwater LNG: Response to U.S. Coast Guard Letter Dated December 21, 2005, Report for TransCanada Pipelines Limited, Report No.: 70014347, Rev., 1 dated 13 February 2006, p. 4. Report is available as part of the U.S. Coast Guard's docket for this project (Docket No. USCG-2005-21863). It should be noted that the displacement of the largest ferries operated by Cross Sound Ferries is less than 5,000 tons. Hereafter DNV Report 70014347.
[201] DNV Report 70014347, p. 4.
[202] Sandia Report, p. 43.

5 – 10 m^2.[203] However, it was also concluded that if the two ships remained joined, which is not uncommon in a collision involving larger vessels, the effective hole would be approximately 1 m^2 and that the overall potential for a large release of LNG due to a collision was low. The results of the modeling conducted by Broadwater indicate that larger LNG carriers may potentially be able to absorb twice the energy of LNG carriers currently in service before the inner hull is contacted.[204] The implication is that the conclusions of the Sandia Report are conservative with respect to the potential breach size of the LNG containment for LNG carriers with capacities upward of 250,000 m^3 involved in a collision with a large commercial vessel.

Collisions involving LNG carriers could potentially occur at any place along the planned transit route from sea to the location of the proposed FSRU. Based on the discussion above, areas where the likelihood of a collision involving an LNG carrier is the highest are portions of the route that would involve crossing situations with large commercial vessels. On Block Island Sound and Long Island Sound, this is most likely to occur where the LNG carrier would cross ferry routes (See Section 3.2).

It was estimated that if the Broadwater Energy proposal is approved and constructed, there is the potential that a collision involving an LNG carrier that would result in minor or moderate consequences could occur once every 10 – 50 years. It was also estimated that such a collision resulting in major consequences could potentially occur once every 50 – 100 years. Because the hazard Zone 1 and Zone 2 do not reach land along the planned transit route, the potential risk to population centers is low.

A scenario that is of particular concern would be a collision involving an LNG carrier and a ferry since the transit route crosses the ferry routes between Point Judith and Block Island, New London and Orient Point, and New London and Block Island. Based on the transit route as described in Section 2.1, neither hazard Zone 1 or Zone 2 includes land (see Figures 2-1 and 2-2) and would not impact any population centers. Therefore, the greatest potential consequences to safety would be to the crew on board the vessels involved in the collision, crews on escort vessels inside Zone 1, and passengers and crew on vessels near the boundary between Zone 1 and Zone 2. The consequences would decrease as the distance from the incident site increased. The highest consequences would be areas of the route where large concentrations of recreational and smaller commercial vessels are common. This includes The Race, Block Island Sound, and Eastern Long Island Sound.

In the event a collision resulted in an LNG release that was not ignited, the resulting vapor cloud could potentially extend up to approximately 4.3 miles (Zone 3) from the LNG carrier. Depending on where along the LNG carrier's transit route the collision occurred, the vapor cloud could potentially cross over Fishers Island, Plum Island or portions of the North Fork of Long Island before dispersing (See Figures 2-1 and 2-2).

[203] Sandia Report, p. 44.
[204] DNV Report 70014347, p. 5.

Risk factors that could contribute to a collision as well as mitigation measures that are currently in place to manage this risk are discussed in Section 4.4. Potential strategies for managing risks associated with collisions involving LNG carriers are discussed in Section 4.6.1. The process for developing a plan to manage potential consequences, including the use of escort tugs, is addressed in Section 6.

4.3.2 Allisions with the FSRU involving either LNG carriers or other vessels

Allisions with the FSRU or an LNG carrier moored at the FSRU are not dissimilar to a collision involving an LNG carrier and another vessel. There are two scenarios that could potentially be expected to occur:

- An allision with the FSRU, or an LNG carrier moored at the FSRU, by a non-LNG carrier transiting Long Island Sound; and,
- An allision with the FSRU by an LNG carrier approaching or getter underway from the FSRU.

As discussed in the load and survivability analysis for the yoke mooring system (see Section 3.1.1 for a description of the yoke mooring system) that was conducted by DNV on behalf of Broadwater Energy,[205] a vessel transiting in the vicinity of the proposed FSRU is more likely to allide with the FSRU than with either the mooring tower or the yoke.[206] Based on the modeling conducted by DNV, it is expected that if a large bulk carrier or tanker allided with the FSRU, most of the resulting force would be absorbed by the FSRU. It is not expected that the mooring would fail. Allisions with the mooring tower and the yoke are discussed in Section 4.3.5.

An allision with the FSRU by a large bulk carrier or tanker could result in a breach of the outer and inner hull of the FSRU and a potential release of LNG. As discussed in Section 1.5, if approved and constructed, the FSRU will be regulated as a facility. However, due to its similarity with an LNG carrier design and operation, it will be constructed according to the same standards as an ocean-going vessel.[207] A third party ship classification society will verify and certify final design and construction.[208] The implication is that insofar as the construction of the FSRU will be similar to an LNG carrier, this type of accident is very similar to a collision involving an LNG carrier. Based on the modeling provided by Broadwater Energy, the FSRU would be able to absorb significantly more energy than the LNG carriers considered in the discussion of collisions involved LNG carriers before the inner hull would be contacted. This is primarily because the distance between the outer and inner hull of the FSRU will be

[205] Broadwater Energy Cryogenic Information Request 2-2 submitted on August 15, 2006 (hereinafter Broadwater Cryogenic Information Request) and DNV Report "Load and Survivability Analysis of the Yoke Mooing System Design for the Broadwater Energy Long Island Sound FSRU Terminal" dated August 14, 2006 (hereinafter DNV Load and Survivability Analysis).
[206] A description of the yoke mooring tower is provide in Section 3.1.1.
[207] Broadwater Energy, Resource Report 11, Section 11.3.2.1.
[208] See American Bureau of Shipping letter forwarded by Broadwater on August 19, 2005 approving of FSRU design in concept.

approximately 4.8 m whereas the corresponding distance for LNG carriers is between 2 – 3 m.[209] The analysis for collisions involving LNG carriers applies also to allisions with LNG carrier moored at the FSRU by a transiting vessel. The implication is that the conclusions of the Sandia Report re breach size are conservative for breaches resulting from an allision.

Although the mooring procedures described in Resource Report 13 that was filed with FERC as part of Broadwater Energy's application are intended to reduce the potential for an LNG carrier to allide with the FSRU while mooring or getting underway from the FSRU, nevertheless there is some potential that such an accident could occur.[210] However, if such an allision did occur it is expected that the LNG carrier would not have sufficient kinetic energy to penetrate both the outer and inner hulls of the FSRU. It is also expected that the angle between the LNG carrier and the FSRU would be less than 30 degrees. Therefore although there is some potential for an LNG carrier to allide with the FSRU, there is very low risk that such an accident would result in the release of LNG.

It was the consensus of the Harbor Safety Working Group that an allision with the FSRU involving an LNG carrier that resulted in minor consequences could potentially occur once every one to ten years. It was also assessed that such an event resulting in moderate consequences could occur once every 50 – 100 years and in major consequences once in 100 or more years.

The proposed location of the FSRU is in close proximity to a traditional thoroughfare used by vessels transiting Long Island Sound (see Figure 2-6). As discussed in Section 3.1.2.3, this includes tankers and colliers, which are some of the largest vessels to transit Long Island Sound, as well as tugs and barges. Therefore, the potential exists for a transiting vessel to allide with the FSRU or with an LNG carrier moored at the FSRU.

The scenario of greatest concern is an allision involving the largest vessels that would reasonably be expected to transit this portion of Long Island Sound. The reason for this is that these vessels would have the greatest kinetic energy and could cause the most significant damage to either the structure of the yoke mooring system or the FSRU. The extent of the damage would depend on where on the structure the force of the allision was centered. It is expected that the extent of the damage to the yoke mooring system as well as the potential for a release of LNG would be related to where on the structure the allision occurred. The potential would be highest the closer the allision was to the forward end of the FSRU and the yoke mooring system.

It was estimated that a non-LNG carrier might allide with the FSRU with minor consequences once every 10 – 50 years and that such an allision would result in moderate or major consequences potentially once every 50 – 100 years. If such allision did occur, the associated risks would extend outward from the location of the proposed FSRU. Based on the modeling conducted, it is not expected that the immediate consequences of a large LNG release due to an allision with the FSRU, or with an LNG carrier while moored to the FSRU, would extend on shore since none of the hazard zones (Zone 1, Zone 2 or Zone 3) reach land (see Figure 2-2).

[209] DNV Report 70014347, p. 3.
[210] Broadwater Energy, Resource Report 13, Appendix 13.6, dated September, 2005. This document is marked Critical Energy Infrastructure Information as provided by FERC regulations.

The most significant consequences to safety are major injuries or death to FSRU personnel and vessel crewmember as well as significant damage to the FSRU, the yoke mooring system and vessels that are inside of hazard Zone 1 or near the boundary between Zone 1 and Zone 2. There is some potential for injuries and damage to vessels within hazard Zone 2. The actual consequences will vary based on the size of the LNG breach, the amount of LNG spilled, the distance from the spill, and the weather conditions when the spill occurred. In the event of a large release of LNG, i.e., three tanks, without an ignition source, the cloud would disperse before reaching land (hazard Zone 3) so population centers would not be impacted.

An additional potential consequence of an allision involving the FSRU or LNG carrier moored at the FSRU is a failure of the yoke mooring system. This will be addressed in Section 4.3.5.

Risk factors that could contribute to an allision are discussed in Section 4.4. Potential strategies for managing risks associated with allision with the proposed FSRU are discussed in Section 4.6.1 and in Section 6. Mitigation measures that could be used to manage potential risks associated with an allision with the FSRU are discussed in Sections 4.6.1 and 4.6.2. The process for developing a plan to manage potential consequences is addressed in Section 6.

4.3.3 Allisions with structures other than the FSRU involving LNG carriers

As discussed in Section 2.1, there are no bridges or other structures adjacent to the route LNG carriers would transit either inbound from sea to the FSRU or outbound from the FSRU to sea. Therefore, the only fixed objects with which LNG carriers could reasonably be expected to have an allision are aids to navigation, e.g., light houses and buoys. Of these, the light houses pose the more significant risk of breaching a large vessel's hull insofar as they are large, fixed structures.

It is estimated that an LNG carrier would potentially allide with either a light house or a buoy in The Race with minor consequences once every 50 – 100 years and with moderate or major consequences once in 100 or more years. Allisions elsewhere along the route that resulted in with minor, moderate or major consequences might potentially occur once every 100 years. If an LNG carrier did have an allision with an aid to navigation, it is likely that the area of impact would be forward of the cargo block and would not result in a breach of the cargo containment. It is also likely that the carrier would go aground and that the primary consequences would be due to the grounding, which is discussed in Section 4.3.4.

The potential consequences of an LNG carrier alliding with structures other than the FSRU will vary depending where along the route it occurred. If an LNG carrier allied with Race Rock light house, hazard Zone 1 would not reach shore. Hazard Zone 2 would include portions of Fishers Island in the vicinity of Race Point. Hazard Zone 3 would include Fishers Island; it would not include the mainland. None of the hazard zones would reach the mainland.

Risk factors that could contribute to an allision are discussed in Section 4.4. Potential strategies for managing risks associated with allisions with structures other than the FSRU are discussed in Section 4.6.1. The process for developing a plan to manage potential consequences, including the use of escort tugs, is addressed in Section 6.

4.3.4 Groundings involving LNG carriers

There is the potential that the cargo containment of an LNG carrier could be breached if the vessel went aground. However, for this to reasonably be expected to occur, the LNG carrier would need to go aground on a rock pinnacle or similar obstruction that is high enough relative to the surrounding bottom to penetrate both the outer and inner hulls. As noted in the Sandia Report, for typical LNG carriers the obstruction would likely need to be at least 3 meters higher than the surrounding sea floor.[211] According to information provided to the Coast Guard by Broadwater Energy, the height of the double bottom on LNG carriers with prismatic tanks expected to call at the FSRU is between 3.2 and 3.4 m. However, it should be noted that the height of the double bottom for LNG carriers with spherical tanks is between 1.4 and 1.6 m.[212] The implication is that there is a higher risk of an LNG release due to a grounding involving an LNG carrier with spherical tanks than from an LNG carrier fitted with membrane tanks.

The Race was the portion of the route where it was determined that the highest risk due to a vessel grounding existed due to the proximity of the route to shoal water. It was estimated that an LNG carrier could potentially go aground in The Race with minor or moderate consequences once every 10 – 50 years. Groundings elsewhere along the route with minor or moderate consequences were considered possible once every 50 – 100 years, and with major consequences once every 100 or more years.

If an LNG carrier went aground in an area where there were obstructions on the bottom that were greater than approximately 3 m in the case of carriers fitted with prismatic tanks and approximately 1 m in the case of carriers with spherical tanks, any breach of the LNG containment that might occur would be below the waterline. LNG would be released into the water until the hydrostatic pressure inside the tank was equal to the hydrostatic pressure of the sea water on the hull. Since LNG is less dense than water, any LNG that was released would rise to the surface and dissipate unless ignited. The implication is that the highest risk would be within Zone 1, but that the potential risk is less than if the LNG carrier had been involved in a collision.

Whether hazard Zone 1 or Zone 2 would reach land depends on where along the planned route the grounding occurred. Hazard Zone 3 would include land in some areas if there was a release due to grounding. The portion of the route closest to shore is in The Race, where it is off the southwestern end of Fishers Island. The actual land areas that would be included in hazard Zone 1 or Zone 2 would depend on the actual location of the grounding.

Risk factors that could contribute to an LNG carrier grounding are discussed in Section 4.4. Potential strategies for managing risks associated with groundings involving LNG carriers are discussed in Section 4.6.1. The process for developing a plan to manage potential consequences, including the use of escort tugs, is addressed in Section 6.

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[211] Sandia Report, p. 43. *See also* SIGTTO, p. 2.
[212] DNV Report 70014347, p. 3.

4.3.5 Failure of the yoke mooring system and the FSRU being set adrift

Due to the proximity of the proposed location of the FSRU to a thoroughfare that is transited by commercial vessels (see Section 2.2.2.3), there is some possibility of an allision with the FSRU or the yoke mooring system if one of these vessels experienced a steering or propulsion failure. Vessels that use this thoroughfare include some of the largest vessels that call at places or ports on Long Island Sound. These include colliers and tankers displacing as much as 90,000 deadweight tons. Although the probability of an allision with the mooring tower or the yoke is considered to be low, the consequences of such an event can include a release of LNG and or a failure of the mooring system.

Based on the load and survivability analysis conducted by DNV, an allision with the yoke would cause the FSRU to break loose from the mooring.[213] An allision with the mooring tower would result in significant damage to the tower and the mooring system; however, it would be capable of continuing to keep the FSRU in position for some period of time.[214] An allision with the FSRU would result in some force being transmitted to the tower and the mooring system; however, it would not be enough to cause the mooring system to fail.[215]

As described in Section 3.1.1, the FSRU would be secured in place in Long Island Sound via a Yoke Mooring System attached to a tower structure that is secured to the seabed. The YMS is attached to a stationary tower structure, which houses the send out pipeline; it also is designed to allow the FSRU to pivot or weathervane around the tower in response to the prevailing wind, wave, and current conditions.

There are currently eight yoke mooring systems in operation worldwide similar to that being proposed for the Broadwater proposal. These yoke moorings are used for Floating Production, Storage and Offloading (FPSO) units, which are used to produce, process, and store hydrocarbon products offshore, such as crude oil. These mooring systems are installed in Southeast Asia (mainly China) and West Africa. Shell currently operates an FPSO with a yoke mooring system off of the coast of Nigeria.[216] This mooring has been in service since December 12, 2002.

Several comments received during the joint scoping meetings held by FERC and the Coast Guard, as well as in letters submitted to the docket, pointed out that many offshore rigs in the Gulf of Mexico failed during Hurricane Katrina and Hurricane Rita. These commentators expressed concern that the yoke mooring system could also potentially fail and that the proposed FSRU would be set adrift on Long Island Sound. Because of the damage that did occur during these hurricanes, the Minerals Management Service (MMS) is reviewing the API RP 2A design standard, which is the design standard Broadwater Energy has proposed to use for designing the fixed portion of the mooring system. To date, this review has not been completed.

[213] DNV Load and Survivability Analysis, p. 3.
[214] Broadwater Cryogenic Information Request, p. 1 of 5 and DNV Load and Survivability Analysis, p. 3.
[215] Broadwater Cryogenic Information Request, p. 1 of 5 and DNV Load and Survivability Analysis, p. 2-3.
[216] Letter from LeBoeuf, Lamb, Greene & MacRae, dated November 1, 2005.

According to Broadwater Energy, the design weather criteria they intend to base the design of the Yoke Mooring System exceeds the 100 year storm, which is the minimum required by the API RP2A standard.[217] The design factor Broadwater Energy intends to use is a one hour average wind speed between 50.2 and 56.8 m/s (approximately 97.6 to 110 knots or 112 to 127 mph).[218] Since the Saffir-Simpson Hurricane scale is based on wind speeds of one minute average duration,[219] the one hour average wind speed must be converted to a one minute average wind speed in order to compare the stated design wind speed with the Saffir-Simpson Hurricane Scale. Using standard gust factor curves[220], Broadwater Energy determined that a one hour average wind speed of 56.8 m/s is equivalent to a one minute average wind speed of 88.5 m/s (approximately 172 knots or 198 mph), which is equivalent to a Category Five hurricane. These figures are shown in Table 4-4. Using a slightly more conservative conversion factor, the Coast Guard Marine Safety Center validated Broadwater Energy's assertion that the stated design wind speed is equivalent to a Category Five hurricane.

Table 4-4: Design Wind Factors

Design Factor	1 Hour Average		1 Minute Average		Equivalent Hurricane
	Meters per second	Miles per hour	Meters per second	Miles per hour	
1:100 Year Storm	41.9	94	65.4	146	Category Four (131 – 155 mph)
Design Case					
Minimum	50.2	112	78.3	175	Category Five (155+ mph)
Maximum	56.8	127	88.5	198	Category Five (155+ mph)

If the mooring did fail and the FSRU was set adrift, there is some potential it could collide with a transiting vessel, be involved in an allision, or go aground. Of these, the most credible scenarios are that the FSRU would be involved in an allision or go aground. This is because the greatest potential for the yoke mooring system to fail would be during heavy weather when other vessels would not be transiting Long Island Sound, which are also the conditions when assist tugs would more than likely not be able to take the FSRU in tow and control its movement.

As discussed in Section 4.3.4, the FSRU would have to go aground on a rock pinnacle or similar obstruction that is high enough relative to the surrounding bottom to penetrate both the outer and inner hulls of the of the FSRU. The distance between the outer and inner hulls on the proposed FSRU will approximately 3.5 m.[221] Based on the draft of the proposed FSRU (approximately 12.3 m or 40 feet) and water depth, if set adrift it could drift within 1 – 2 NM of either the north shore of Long Island or the Connecticut shoreline before going ground. Hazard Zone 1, which is the area of highest potential consequences, would not reach shore. Depending on where the FSRU went aground, hazard Zone 2 could include areas of land. Hazard Zone 3 would also

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[217] Broadwater Energy LLC, Broadwater Energy LLC, Resource Report 11, January 2006, p. 11-22 and "Response to U.S. Coast Guard Letter of February 16, 2006: Codes and Standards Development," March 10, 2006, pp. 3-4.
[218] Broadwater Energy LLC, Resource Report 11, p. 11-26. This is consistent with information provided by Broadwater Energy in Resource Report 13.
[219] See discussion of the Saffir-Simpson Hurricane Scale at http://www.nhc.noaa.gov/aboutsshs.shtml.
[220] Durst, C.S., 1960: Wind Speeds over short periods of time. *Meteor. Mag.*, 89, 181-187.
[221] DNV Report 70014347, p. 3.

include areas of land. The actual area that would be included is dependent on the location where the FSRU went aground.

As discussed in Section 4.3.2, there is some potential that the mooring system could also fail due to an allision with the FSRU, a seismic event, or if a large pack of ice allided with the mooring tower. This later possibility was raised by members of the public during the course of public meetings and public outreach. Several comments alluded to occasions when several of the larger bays and even Long Island Sound froze over to the point where individuals could walk from Connecticut to Long Island.[222] If the mooring failed because of any of these events, it is likely that the FSRU would allide with another structure or go aground rather than colliding with transiting vessels since they would be advised of the FSRU's position while efforts were being made to take it in tow.

The likelihood that the yoke mooring system might fail and the FSRU set adrift with minor, moderate or major consequences was estimated to be possible once every 50 – 100 years. The actual consequences would depend on the cause of the failure, the weather conditions at the time of the failure, whether there was other vessel traffic in the area, and whether the FSRU could be taken in tow before it was involved in a collision, allision or grounding.

Risk factors that could contribute to a failure of the yoke mooring system are discussed in Section 4.4. Potential strategies for managing risks associated with a failure of the yoke mooring system are discussed in Section 4.6.2.1. The process for developing a plan to manage potential consequences is addressed in Section 6.

4.3.6 Collisions involving small commercial vessels and / or recreational vessels

Due to the large concentrations of recreational vessels and small commercial vessels that are common along the route LNG carriers would transit from sea to the FSRU or from the FSRU to sea, there is the potential for them to collide with each other while clearing the channel in advance of an LNG carrier transit. The area where there is the greatest potential of such an accident is The Race. This is due to a number of factors including: this portion of the transit route is where the largest concentrations of recreational vessels and small commercial vessels are found; the strong currents can compromise vessel maneuverability, visibility is frequently limited in fog, and it is the most restricted portion of the route.

Although these events would not result in a breach of the cargo containment on an LNG carrier, they could potentially result in damage or loss of other vessels, passengers or crew on those vessels being injured or killed, or damage to the marine environment. The consequences of these events would be limited to the passengers, crew and vessels involved in the collision.

It was estimated that collisions involving recreational vessels or small commercial vessels clearing The Race prior to an LNG carrier transit with minor or moderate consequences could

[222] See discussion in Section 2.4.1 of ice formation on Long Island Sound.

potentially occur once every 10 – 50 years and that it was possible that such an event with major consequences could occur once every 50 – 100 years.

Risk factors that could contribute to collisions involving recreational vessels or small commercial vessels are discussed in Section 4.4. Potential strategies for managing risks associated with collisions involving recreational vessels or small commercial vessels are discussed in Section 4.6.1. The process for developing a plan to manage potential consequences is addressed in Section 6.

4.3.7 Collisions involving large commercial vessels transiting in the vicinity of the FSRU

Vessels involved in a collision in the vicinity of the FSRU could also potentially drift in the direction of the FSRU if the vessels are not able to proceed under their own propulsion and their drift is not controlled, either by anchoring or by being taken in tow. However, it should be noted that a drifting vessel would more than likely not have sufficient kinetic energy to breach both the outer and inner hulls of the FSRU if one did allide with the FSRU. There is also the potential that a collision could involve one or more vessels transporting petroleum as cargo and could cause a large oil spill and, possibly, a fire. Because petroleum fires on water will spread unless contained using fire boom or foam, such a fire could potentially impact the FSRU.

It was estimated that large commercial vessels being involved in a collision while transiting in the vicinity of the proposed location of the FSRU with minor consequences could potentially occur once every 10 – 50 years and that it was possible that such an event could occur and result in either moderate or major consequences once every 50 – 100 years.

Risk factors that could contribute to collisions involving large commercial vessels transiting in the vicinity of the FSRU are discussed in Section 4.4. Potential strategies for managing risks associated with such collisions are discussed in Section 4.6.1. The process for developing a plan to manage potential consequences, including marine fire fighting tugs, is addressed in Section 6.

4.4 Risk Factors and PAWSA Conclusions

During the evaluation of the navigation safety accident scenarios, it became apparent that a large number of the risk factors during the navigation safety risk assessment were common to many or all of the scenarios considered. The risk factors that were identified for each of the scenarios are included in Appendix H. With the exception of one risk factor associated with a failure of the mooring system, all of the risk factors that were identified during the assessment can be grouped within the following four PAWSA risk categories: vessel conditions, traffic conditions, navigational conditions, and waterway conditions. The risk factors were grouped by PAWSA risk category to facilitate an evaluation of how the potential risks to navigation safety associated with Broadwater Energy's proposal to build and operate an FSRU LNG import might exacerbate existing risks as assessed during the PAWSA.

4.4.1 Risk Factors – Vessel Conditions

The following risk factors that are related to vessel conditions were identified during the risk assessment for the Broadwater proposal:

- Loss of situational awareness;
- Navigational decisions;
- Mechanical / system failure - LNG carrier;
- Mechanical / system failure - other vessels;
- Recreational vessel operator losses situation awareness while clearing channel in advance of LNG carrier transit; and,
- Lack of recreational vessel operator training

These risk factors are not unique to LNG carriers or the proposed location of the FSRU and are also associated with existing vessel traffic on Block Island Sound and Long Island Sound.

Measures that currently are in place to address vessel condition-related risk factors are outlined in the PAWSA report.[223] For commercial vessels these include U.S. and international design and equipment requirements, Coast Guard inspections, U.S. and international merchant mariner licensing and training requirements, and compulsory pilotage. These requirements would be applicable to LNG carriers that would call at the FSRU if the Broadwater Energy proposal is approved. As discussed in Section 2.6.5, LNG carriers would also be required to hold a Certificate of Compliance issued by the Coast Guard. The mitigation measures that are place for recreational vessels would remain in place regardless of whether the Broadwater Energy proposal is approved. Examples of these measures include Connecticut's mandatory recreational boater training requirements, enforcement of recreational boating regulations in New York and Connecticut, as well as U.S. Power Squadron and Coast Guard Auxiliary training course and dockside exams.

During the PAWSA it was determined that the existing mitigation measures that are applicable to deep draft and shallow draft vessels effectively address the risks associated with the quality of these vessels to navigation safety. Given the high quality of LNG carriers and the training requirements for LNG carrier crews, there was consensus that additional mitigation measures related to vessel quality would not be warranted if the Broadwater Energy proposal is approved. However, the PAWSA and members of the Harbor Safety Working Group did highlight that additional resources, e.g., fire boats or tugs with robust fire fighting capabilities, would be required to reduce the consequences of an accident involving an LNG carrier or the FSRU.

Collisions involving recreational vessels at the edge of the shipping lane in the vicinity of The Race are a potential risk to navigation safety that is associated with the movement of LNG carriers. Risk factors that were identified, i.e., training and situational awareness of recreational vessel operators are related to small craft quality. The consensus of the Harbor Safety Working

[223] PAWSA report, pp. 12 – 15. As used in the PAWSA report, deep draft vessel refers to ocean going vessels such as the tankers and freight ships, shallow draft vessel refers to tugs and barges as well as ferries and other inspected passenger vessels that operate on Block Island Sound and Long Island Sound.

Group was that any mitigation measures that might be implemented to reduce the risk of collisions involving recreational vessels should be focused on providing timely information about LNG carrier movements as well as scheduling LNG carrier transits through The Race to avoid times when there would be the highest concentrations of recreational boaters. There was also consensus that Coast Guard escorts of LNG carriers would also help reduce the risk of collisions involving recreational vessels clearing the channel.

4.4.2 Risk Factor – Traffic Conditions

The following risk factors related to traffic conditions were identified during the navigation safety risk assessment for the Broadwater Energy proposal:

- Vessel congestion - recreational and commercial vessels queuing to transit The Race after LNG carrier transit or pushing to transit prior to LNG carrier passage;
- Vessel congestion - commercial and recreational fishing activity;
- Vessel congestion - meeting other vessels (recreational and commercial) transiting through The Race;
- Vessel congestion - sailing regattas;
- Crossing ferry routes;
- Meeting large commercial vessels transiting Block Island Sound and Long Island Sound;
- Crossing routes commonly used by recreational vessels;
- Proposed location of FSRU is in an area of open water;
- Proximity of east/west transit routes to FSRU transited by tankers headed to Northport and tug/tows transiting through the Sound;
- State of tide - different users time activities (through transits, working gear, etc.) around tide;
- Concentrations of smaller vessels at edge of shipping lane;
- Time of year - seasonal variations;
- Vessel traffic approaching Plum Gut; and,
- FSRU creates a 'blind spot' - obstructs visibility.

Of these the only risk factors that are unique to the Broadwater Energy proposal are related to the potential impact on vessel traffic of LNG carriers transiting The Race and the proposed location of the FSRU. However, although the other risk factors are not unique to LNG carriers or the potential presence of the FSRU, if approved the Broadwater Energy proposal would increase the volume of foreign-flagged vessel traffic on Block Island Sound and Long Island Sound by approximately 20 - 30 percent. However, the overall increase in commercial vessel traffic would be less than one percent. The Broadwater Energy proposal would also change the mix of vessel traffic currently found on Block Island Sound and Long Island Sound since it would introduce a new type of vessel on these waters, i.e., LNG carriers.[224]

[224] See Sections 2.2.2 and 2.2.3 and 3.x – 3. x for a discussion of the diversity of commercial and recreational vessels that operate on the waters of Block Island Sound and Long Island Sound.

Measures currently in place to mitigation risks to navigation safety associated with vessel traffic are listed in the PAWSA and would be applicable to LNG carriers as well as vessels supporting the operation of the FSRU.[225] These measures include: compulsory state pilotage, well-defined traffic patterns for commercial vessels and some recreational vessels,[226] permitting and notices of marine events, as well as safety broadcasts,

Given the conclusion of the PAWSA about the potential impacts of LNG carrier movements and the presence of the FSRU, the consensus of the Harbor Safety Working Group was that additional mitigation measures will be required if the Broadwater Energy proposal is approved. In addition, given the potential risks to public safety associated with the release of LNG, there was consensus that a more active system of vessel traffic management for Block Island Sound and Long Island Sound would be warranted insofar as it would enable real-time monitoring of vessel traffic and would allow the Coast Guard to intervene more quickly if a situation was developing that could result in a collision, allision or grounding.

4.4.3 Risk Factors – Navigation Conditions

Navigation condition risk factors that were identified during the navigation safety risk assessment for the Broadwater Energy proposal are:

- Reduced visibility in fog;
- Time of day (day vs. night);
- Time of year;
- Weather conditions; and,
- State of tide / current.

Although none of these risk factors are unique to LNG carrier movements or the location of the FSRU, they do have the potential to exacerbate the potential impact on navigation safety associated with the Broadwater Energy proposal. The effectiveness of mitigation measures that may be required if the Broadwater Energy proposal is approved should not be compromised by the presence of heavy fog as well as reduced visibility due to heavy rain or snow.

4.4.4 Risk Factors – Waterway Conditions

Risk factors associated with waterway conditions that were identified during the risk assessment were:

- The entrance to Long Island Sound is a relatively narrow channel (The Race);
- Proposed location of the FSRU is in an area of open water that historically has been transited by tankers headed to Northport, colliers enroute the Bridgeport anchorage, and tug/tows transiting east/west through the Sound; and,
- Bathymetry in The Race.

[225] PAWSA, pp. 16-20.

[226] Examples of established traffic patterns for recreational vessels include established marine events and regattas as well as popular fishing areas such as The Race, etc.

Based on the estimate that the potential risks associated with an LNG carrier going aground are higher in The Race than anywhere else along the transit route (see Section 4.3.4), if the Broadwater Energy proposal is approved by FERC, any mitigation measures that may be implemented to reduce the risk of an LNG carrier going aground must account for the physical characteristics, e.g., bathymetry, width and current, of The Race. In addition, insofar as the FSRU would be located in an area that is frequently transited by large deep draft vessels as well as tugs and barges, mitigation measures must be implemented to reduce the potential of an allision with the FSRU by a passing vessel, or for non-LNG carriers to collide with one another while transiting the area.

4.5 Results of the Risk Assessment

The ranked results of the assessment of navigation related accidents as determined by the Harbor Safety Working Group are shown in Table 4-5 (the complete worksheet is in Appendix H. Collisions involving LNG carriers in The Race, Block Island Sound and Eastern Long Island Sound, areas that are part of the thoroughfare used by vessels transiting Block Island Sound and Long Island Sound, account for the majority of the potential navigation safety risk associated with the Broadwater Energy proposal. These were followed by collisions involving small craft at the edge of the shipping lane in The Race, allisions with the FSRU and collisions involving non-LNG vessels in the vicinity of the FSRU. Other navigation safety related events deemed to pose a credible risk to navigation safety include a failure of the mooring tower and the FSRU being set adrift, collisions with the pilot boat while pilots are boarding or disembarking the LNG carrier,[227] an LNG carrier going aground while in The Race, a collision involving an LNG carrier while in the vicinity of the pilot station, and collisions involving non-LNG carriers in the vicinity of the proposed FSRU. Although the other events may be credible, the consensus of the Harbor Safety Working Group was that the risk associated with them is very low and that the associated risk would be reduced even further if the mitigation measures discussed in Section 4.6 were implemented. Therefore, it was determined that mitigation measures be developed only for those events that individually accounted for more than one percent of the cumulative risk.

[227] It should be noted that risks associated with pilots boarding or disembarking a vessel is not unique to LNG carriers.

Table 4-5: Ranked Navigation Safety Events

Id.	Event	Portion of Route	Risk Index Number	Percent Cumulative Risk
4	Collision	The Race	11274.61	31.18%
3	Collision	Block Island Sound	6586.25	18.21%
5	Collision (small craft at edge of shipping lane)	The Race	4816.07	13.32%
15	Allision with FSRU by non-LNG carriers transiting in vicinity of FSRU	Waters adjacent to FSRU	3629.14	10.04%
6	Collision	Eastern Long Island Sound	3168.04	8.76%
25	Mooring tower failure / FSRU set adrift	Vicinity of FSRU	2279.80	6.30%
1	Collision (with pilot boat)	Approach to / vicinity of pilot station	1799.70	4.98%
20	Grounding	The Race	1022.30	2.83%
2	Collision	Approach to / vicinity of pilot station	924.43	2.56%
8	Collision	Vicinity of FSRU	591.72	1.64%
7	Collision	Central Long Island Sound	21.01	Less than 1%
16	Allision with FSRU by LNG carriers while mooring or getting underway	Waters adjacent to FSRU	20.65	Less than 1%
21	Grounding	Eastern Long Island Sound	7.62	Less than 1%
19	Grounding	Block Island Sound	5.87	Less than 1%
22	Grounding	Central Long Island Sound	5.85	Less than 1%
12	Allision (with ATON)	The Race	1.80	Less than 1%
18	Grounding	Approach to / vicinity of pilot station	1.06	Less than 1%
10	Allision (with ATON)	Approach to / vicinity of pilot station	1.00	Less than 1%
11	Allision (with ATON)	Block Island Sound	1.00	Less than 1%
13	Allision (with ATON)	Eastern Long Island Sound	1.00	Less than 1%
14	Allision (with ATON)	Central Long Island Sound	1.00	Less than 1%
9	Collision	Western Long Island Sound	0.64	Less than 1%
17	Allision (with ATON)	Western Long Island Sound	0.64	Less than 1%
24	Grounding	Western Long Island Sound	0.41	Less than 1%
23	Grounding	Vicinity of FSRU	0.00	Less than 1%

4.6 Potential Risk Management Strategies

Based on a review of the risk factors identified during this assessment and the PAWSA Report, it was concluded that it will be necessary to implement mitigation measures to effectively manage potential risks to navigation safety if the FERC does approve the proposed Broadwater Energy project and it is constructed and operated. Mitigation measures generally fall into one of two categories: prevention and consequence management. Whereas prevention seeks to avoid an accident, consequence management seeks to reduce the negative impacts when an accident does occur. Although preventing accidents is preferred, insofar as accidents do occur, responsible risk management requires that both types of measures should be implemented if the Broadwater Energy proposal is approved.

To the maximum extent possible, any mitigation measures that are implemented should be consistent with the following assumptions:

- LNG carrier movements shall not delay or otherwise impede the movement of naval vessels;
- Minimize potential to create vessel interactions that require deviation from either the International or Inland Rules of the Road[228];
- Any measures intended to mitigate potential risks to waterway safety should be consistent with current uses of Long Island Sound; and,
- Any potential for imposing the burden of adjusting transit patterns / schedules on non-LNG related traffic, commercial and recreational, should be minimized as much as possible.

Mitigation measures that could potentially be implemented to reduce risks to navigation safety associated with the Broadwater Energy proposal are summarized in Table 4-6. Each of these measures is discussed in the sections that follow.

Table 4-6: Potential Mitigation Measures

Vessel Traffic Management	Design, Construction and Compliance	Consequence Management
• FSRU equipment and manning • LNG carrier transit scheduling and coordination • Assist tugs • Safety zones o Moving zone around LNG carriers o Fixed around FSRU • Vessel traffic routing • Vessel traffic service	• Yoke mooring system design and construction o Redundant design / emergency anchors • FSRU design and construction • Joint USCG / FERC compliance inspections o During construction o In service	• Escort tugs • Coast Guard escort • Marine fire fighting • General emergency response • Safety zones o Moving zone around LNG carriers o Fixed around FSRU

4.6.1 Vessel Traffic Management

As noted in Section 4.4.2, it was the consensus of the Harbor Safety Working Group that mitigation measures should be implemented if the proposed Broadwater Energy project is approved by FERC to ensure that additional risks to navigation safety associated with the proposed FSRU and LNG carriers are effectively managed. Broadwater Energy would be responsible for implementing some of the measures, subject to Coast Guard oversight. However,

[228] The International Rules, i.e., COLREGS, are applicable seaward of the demarcation line, which is located at The Race per 33 C.F.R. § 80.155(b).

because the Coast Guard is the lead agency under federal law for vessel traffic management on the navigable waters of the United States, some of the identified measures would be the responsibility of the Coast Guard.

4.6.1.1 *FSRU equipment and manning*

In order to reduce the potential for another vessel to allide with the FSRU, Broadwater Energy should, subject to verification by the Coast Guard, fit the FSRU with appropriate navigation equipment to assess the potential of a vessel alliding with the FSRU as well as to monitor the FSRU's position and movement around the mooring tower. The FSRU should also be fitted with appropriate lights, sound signals and communications equipment. In addition, the FSRU crew should include a qualified navigation watch. Additionally, the FSRU should be fitted with a pre-rigged emergency towing bridle.

It was considered that the above measures if implemented would have a moderate to significant impact on reducing the potential of an allision with the FSRU. However, it was also recognized that the effectiveness of these measures is directly related to the training and qualifications of the FSRU's navigation watch. It was also recognized that the effectiveness of these measures is limited by the fact that the navigation watch on the FSRU can warn but cannot direct the movement of another if the risk of allision is determined to exist.

4.6.1.2 *LNG carriers*

In order to reduce the potential for navigation safety accidents related to the movement of LNG carriers, it was the consensus of the Harbor Safety Working Group that:

- LNG carrier arrivals and departures should be scheduled to minimize conflicts with other waterway users, with particular emphasis on avoiding transiting The Race during times when use by commercial and recreation fishermen is highest and avoiding interfering with regattas;
- LNG carrier arrivals and departures should be scheduled so that only one LNG carrier is inshore of the pilot stations at any one time;
- Broadwater Energy should provide the Coast Guard with sufficient notice of planned LNG carrier transits to ensure there is not a conflict with U.S. Navy vessel movements;
- Broadwater Energy should provide initial and periodic refresher full mission bridge simulator training for all pilots licensed by either the State of New York or Connecticut who may be responsible for serving as pilot onboard an LNG carrier as provided by pilotage requirements established by either of the two states;[229]

[229] Pilotage of foreign-flag ships and U.S.-flag ships sailing under registry operating on the waters of Long Island Sound is subject to regulation by the States of New York and Connecticut. The assignment of pilots to ships required to comply with state pilotage requirements is managed by a Rotation Administrator in accordance with the MOA between the two states.

- Broadwater Energy should ensure that a pilot licensed by either the State of New York or Connecticut is onboard an LNG carrier throughout the entire discharge operation;[230] and,
- These requirements must be outlined in the Operations Manual required by 33 C.F.R. § 127.305.

It was determined that these measures, if implemented, would have varying impacts on reducing potential safety risks related to vessel traffic. LNG carrier scheduling was considered to have a moderate reduction in risk, whereas simulator training for pilots was considered to have a significant reduction.

4.6.1.3 *Assist tugs*

Broadwater Energy has conducted preliminary berthing simulations to establish requirements for assist tugs. Based on these berthing simulations, Broadwater Energy stated in the application filed with FERC that the tugs would have tractor drives with 5000 hp and a minimum of 60 tons bollard pull would be sufficient for berthing and unberthing operations.[231] Also based on the preliminary berthing simulations, Broadwater Energy has estimated that the number of tugs required for berthing and unberthing of LNG carriers is as shown in Table 4-7.

Table 4-7: Number of Required Assist Tugs

Operation	October – April	May – September
Berthing – Small LNG carriers (138,000 m^3)	3	3
Unberthing – Small LNG carriers (138,000 m^3)	2	2
Berthing – Large LNG carriers (250,000 m^3)	4	3
Unberthing – Large LNG carriers (250,000 m^3)	3	2

It was the consensus of the Harbor Safety Working Group that if the Broadwater Energy FSRU is approved by FERC that:

- A minimum of two assist tugs capable of taking the FSRU in tow in the event the mooring tower fails and the FSRU is set adrift should be within the limits of the safety zone at all times while an LNG carrier is moored at the FSRU;
- That berthing simulations conducted with active New York or Connecticut licensed pilots and witnessed by the Coast Guard should be conducted to establish the minimum number of tugs required for berthing and unberthing operations for LNG carriers by ranges of size as well as to establish the minimum horsepower and bollard pull requirements for the assist tugs; and,

[230] This requirement is consistent with statements made in Broadwater Energy's application to FERC and in a letter to the Coast Guard dated… It is standard practice for state licensed pilots to remain on board tankers at either the Riverhead or Northport platforms during discharge operations.
[231] Resource Report 11, p. 11-43 and Broadwater Energy reply dated November 1, 2005 to Coast Guard COTP Long Island Sound letter of October 5, 2005.

- These requirements should be included in the Operations Manual required by 33 C.F.R. § 127.305.

The effectiveness of assist tugs to reduce risks associated with a failure of the yoke mooring system or an allision with the FSRU was considered moderate except during periods of heavy weather when the tugs could not be on station.

The potential use of escort tugs for some portions of the LNG carrier transit route is discussed in Section 6.3.1.

4.6.1.4 *Safety Zone – LNG Carrier*

The Harbor Safety Working Group recommended the Coast Guard establish and enforce a safety zone that would be in place around LNG carriers while they are underway on the waters of Block Island Sound and Long Island Sound. It was generally agreed the size of the safety zone should not be smaller than the Sandia Zone 1, which is consistent with the guidance provided in NVIC 5-05. There was also agreement that the safety zone should extend sufficiently far ahead of the LNG carrier to reduce the potential for a close quarters situation between an LNG carrier and small craft, e.g., kayaks, in The Race. The Harbor Safety Working Group also raised concerns regarding the potential impact the size of the safety zone could have on vessel traffic, particularly in areas such as The Race. Concern was also raised about the potential impact a moving safety zone would have on sailing regattas such as the Block Island race. These concerns were consistent with comments received during public meetings and written comments submitted to the docket.

There was consensus that the effectiveness of moving safety zones around LNG carriers for reducing risk associated with navigation safety accidents was dependent on whether the safety zone was being actively enforced by a Coast Guard escort. With an escort, the effectiveness was considered moderate. Without an escort to enforce the safety zone, there was consensus that a moving safety zone may result in some reduction of risk. It was also agreed that a safety zone around an LNG career would result in a moderate reduction in risk in the event a navigation safety accident did occur and resulted in a breach of the LNG containment.

Examples of safety zones currently in place around LNG carriers while they are underway in other U.S. ports are:

- Boston Harbor: 2 NM (4000 yards) ahead, 1 NM (2000 yards) astern, and 500 yards on each side;[232]
- Chesapeake Bay: 500 yard radius around the LNG carrier;[233]
- Savannah River: 2 NM (4000 yards) for all vessels greater than 1600 GT and all other vessels must remain clear;[234]

[232] 33 C.F.R. § 165.110(b)(1)
[233] 33 C.F.R. § 165.500(b)
[234] 33 C.F.R. § 165.756(d)(1)

- Lake Charles, LA: 2 NM (4000 yards) ahead, 1 NM (2000 yards) astern, and the width of the ship channel on either side.[235]

Based on guidance provided by NVIC 5-05 and the Sandia Report, the minimum size of the safety zone for LNG carriers should be equivalent to hazard Zone 1, which for 250,000 m^3 LNG carriers is 750 yards (See Section 1.4). Taking the beam of the LNG carrier into account, the safety zone would be a total of approximately 1550 to 1560 yards wide. The channel between Valliant Rock and Race Rock light is approximately 2400 yards. Therefore, assuming an LNG carrier is equidistant between Valliant Rock and Race Rock light, there would be approximately 425 yards on each side of the safety zone where small craft could operate while LNG carriers were transiting through The Race.

The distance the safety zone extends ahead of the LNG carrier should be sufficient to provide small vessels, including kayaks, adequate time to safely clear the channel between Valliant Rock and Race Rock light. It should also be sufficiently large to reduce the risk of collision with other vessels crossing ahead of an LNG carrier. As shown in Table 4-8, a vessel moving at 2 knots would require approximately 12 minutes to transit from the center of the channel to the outer edge of the safety zone. During this same period an LNG carrier moving at 12 to 15 knots would travel approximately 2 to 3 NM. If a small vessel traveling at 2 knots began moving from the center of the channel approximately 12 to 15 minutes before the LNG carrier entered The Race, it would reach the outer edge of the safety zone concurrent with the passage of the LNG carrier. Therefore a safety zone extending 2 NM ahead of the LNG carrier, would provide a small vessel moving at 2 knots adequate time to move from the center of the channel well in advance of the LNG carrier's transit through The Race. This distance also provides adequate separation with vessels that might cross ahead of an LNG carrier, e.g., ferries.

Table 4-8: Time to Clear Channel

Distance from middle of channel to outer edge of safety zone (yards)	Other Vessel's Speed (kts)	Time to Clear Channel (min)	Distance traveled by LNG carrier	
			12 kts	15 kts
775	2	11.6	2.3	2.9
775	5	4.7	0.9	1.2
775	10	2.3	0.5	0.6
775	15	1.6	0.3	0.4

The distance the safety zone extends astern of the LNG carrier should be sufficient to prevent vessels from crossing too close astern as well as to ensure that vessels that may be following astern of the LNG carrier have room to maneuver in the event that the LNG carrier loses steering or propulsion. In keeping with the safety zones established elsewhere, the minimum distance astern should be 1 NM (2000 yards).

[235] 33 C.F.R. § 165.805(b)

Based on the above, the proposed size of the moving safety zone is 2 NM (4000 yards) ahead, 1 NM (2000 yards) astern, and 750 yards on each side of the LNG carriers. Because LNG carriers in service always have some remaining cargo on board to keep the tanks cold, the safety zone should be applicable to all LNG carriers that are not certified as being gas free.[236]

4.6.1.5 *Safety Zone – FSRU*

There was consensus amongst the Harbor Safety Working Group that a safety zone should be established by the Coast Guard around the FSRU. After some discussion of different ways of configuring the safety zone, it was recommended the safety zone be centered on the yoke mooring. It was also recommended that the radius of the safety zone should be equal to the distance from the center of the mooring tower to the aft end of the FSRU plus the distance determined to provide a level of safety equivalent to the Zone 1 described in the Sandia Report. The distance from the center of the mooring tower to the aft end of the FSRU is approximately 460 yards and hazard Zone 1 for the FSRU is 750 yards. Based on this the safety zone around the FSRU would be a circle with a radius of 1210 yards centered on the mooring tower. Given the historical vessel traffic patterns shown in Figure 2-4, the safety zone would require some vessels to transit either more to the north or to the south.

The Harbor Safety Working Group recommended a fixed safety zone over one that moved with the FSRU as it rotated around the mooring tower. The fixed zone was preferred since its location could be shown on navigation charts and its limits could be marked with buoys. The ability to positively communicate the outer limits of the safety zone around the FSRU was considered by the Harbor Safety Working Group to be particularly important for minimizing unintentional incursions into the safety zone. This recommendation is consistent with a concern frequently expressed by members of the public that an unintended incursion into the safety zone could trigger a response by security personnel.

There was consensus that a fixed safety zone around the FSRU would result in a moderate reduction of the potential for an allision with the FSRU as well as for reducing risks to public safety associated with a release of LNG provided the outer limits of the zone was well marked and there were periodic Coast Guard patrols to enforce it.

4.6.1.6 *Vessel Traffic Routing*

To reduce the potential for collisions involving LNG carriers and other large commercial vessels and for allision with the FSRU, the Harbor Safety Working Group suggested that the Coast Guard consider establishing a vessel traffic routing scheme approved by the International Maritime Organization that would include the following components:

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[236] It should be noted that the Lake Charles safety zone is expressly applicable to all LNG carriers that are not gas free, whereas the other regulations do not specify whether they apply to LNG carriers that have discharged all pumpable cargo.

- A one way vessel traffic lane for vessels greater than 300 GT through the waters between Valliant Rock and Race Rock light to prevent vessels meeting in The Race;
- Vessel traffic lanes with a separation zone on the waters of Block Island Sound from both pilot stations to The Race and on the waters of eastern Long Island Sound to establish a minimum closest point of approach between commercial vessel traffic greater than 300 GT meeting on these waters, and to promote separation from commercial fishing and recreational vessel traffic;[237] and,
- Vessel traffic lanes in the vicinity of the FSRU in order to reduce the potential for a collision in this area between non-LNG carriers as well as to reduce the potential for LNG carriers maneuvering while approaching or getting underway from the FSRU to interfere with the safe navigation of other commercial vessels.

Although the potential benefits of vessel traffic routing measures were recognized, there was also concern that such measures could have an undue impact on recreational vessel operators. The basis for this concern is that routing measures could potentially interfere with regattas, particularly those that pass through The Race. Therefore, it was recommended that if vessel traffic routes were established, it would be necessary to account for the volume of recreational and small commercial vessels that transit these waters as well as the routes they generally follow. There was less agreement regarding the potential benefits associated with routing measures in the vicinity of the FSRU, particularly if the safety zone around the FSRU was determined to provide adequate separation between commercial vessels and the FSRU.

Vessel traffic routing was considered to have a moderate effect on reducing risks associated with navigation safety accidents associated with the Broadwater Energy proposal. The consensus of the Harbor Safety Working Group was that routing measures would be more effective in Block Island Sound, The Race and eastern Long Island Sound than elsewhere along the route.

4.6.1.7 *Vessel Traffic Service*

Because the FSRU, if constructed in the location proposed by Broadwater Energy, would be located in a thoroughfare, and because the LNG carriers' transit route would pass through The Race and would cross several ferry routes, the Harbor Safety Working Group recommended that Coast Guard consider establishing a Vessel Traffic Service (VTS) for the waters of Block Island Sound and Long Island Sound. A similar recommendation was made by the PAWSA. A VTS was recognized as providing the Coast Guard with a real time, active means of monitoring vessel traffic on these waters. In addition, it would provide a means for the Coast Guard to quickly and efficiently direct vessel movements as necessary to enforce the vessel traffic routing system or to reduce the potential for a navigation safety related accident. A VTS was also recognized as an effective mechanism for communicating LNG transit information to all waterway users.

If established, a VTS was considered to have a significant effect on reducing risks that could contribute to navigation safety accidents associated with the Broadwater Energy proposal.

[237] These routes would supersede the recommended route that is shown on current editions of chart 13205.

4.6.2 Design and Construction Standards and Compliance Inspections

The design and construction of the FSRU and its associated systems is a primary means of reducing risk associated with navigation safety accidents involving the FSRU. In addition, surveys should be conducted by a third party, e.g., classification society, and operational and structural inspections of the FSRU and the yoke mooring system should be conducted by FERC and the Coast Guard. The purpose of these inspections would be to ensure that if approved and constructed, the Broadwater FSRU is operated in accordance with all applicable regulations and conditions imposed by the FERC license. These inspections would also be required to verify the structural integrity of the FSRU and the yoke mooring system throughout its service life. Specific recommendations are discussed below.

4.6.2.1 *Yoke Mooring System Design and Construction*

Given the importance of the yoke mooring system and that the redundancy is limited to components within the design, the following mitigation measures were recommended by the Harbor Safety Working Group if the Broadwater Energy proposal is approved:

- The design and construction standard should meet or exceed the design and construction requirements in the API RP2A standard for high consequence designs for offshore structures that are accepted by the Minerals Management Service upon completion of their review based on Hurricane Katrina and Hurricane Rita;
- The yoke mooring system should be designed to withstand a Category Five hurricane;[238]
- The design of the yoke mooring system should include all possible redundancies to prevent the FSRU from being set adrift following a potential failure of the mooring regardless of the cause of the failure that take into account, among other things, adverse wind and sea conditions, potential impacts of mishaps onboard the FSRU (e.g. fire, collision damage, etc.), time of day, proximity to shoal waters, and other vessel traffic in the vicinity;
- All plans for the yoke mooring system should be reviewed and approved by a third party prior to being submitted to FERC and the Coast Guard for review and approval;
- A failure modes and effects analysis should be conducted by a third party and reviewed by FERC and the Coast Guard to verify that there is not a single point of failure in the design of the yoke mooring system;
- The yoke mooring system and its components should be subject of third party oversight inspections/surveys throughout construction;
- FERC engineers and Coast Guard marine inspectors should conduct oversight inspections during construction; and,

[238] As discussed in Section 4.3.5, the design basis selected by Broadwater Energy for the yoke mooring system corresponds with a Category Five hurricane.

- Broadwater Energy must report to FERC and the Coast Guard any structural repairs, modifications, or failures of yoke mooring systems owned or operated by Broadwater Energy, Shell, or TransCanada.

The design and construction of the yoke mooring system is considered to have a significant impact on reducing the potential for the mooring to fail and the FSRU to be set adrift. Therefore, verification of the load and survivability analysis should be conducted during the detailed design review. The following points should be addressed as part of this review:

- For different weather conditions, determine for how long could the mooring tower be able to accommodate the anticipated range of forces associated with the attached FSRU and an LNG carrier following an allision with the mooring tower;
- Verify that the results of the detailed geotechnical studies are consistent with the preliminary results upon which the load and survivability analysis was based;
- That the detailed design of the FSRU includes an adequate number of side shell bitts as well as at least two sets of emergency towing equipment;[239] and,
- Verify that the design of the yoke mooring system is sufficient to withstand a Category Five hurricane.

Procedures for offloading LNG from the FSRU to LNG carriers should be addressed in the Emergency Response Plan (See Section 6) as well as the Emergency Manual required by 33 C.F.R. § 127.307. These procedures are required in the event the FSRU must be removed from the mooring.

The potential consequences associated with a release of LNG from the FSRU if the yoke mooring system failed during a hurricane could be reduced by pumping down the LNG on board. Such procedures should be addressed in the Operations Manual required by 33 C.F.R. § 127.305 and the Emergency Response Plan discussed in Section 6.2.

4.6.2.2 *FSRU Design and Construction*

Based on the proposed location of the FSRU, the unit is potentially at risk of being involved in an allision with vessels of sufficient displacement tonnage to establish a credible risk that the LNG containment could be breached and result in a release of LNG. Ensuring the design and construction of the FSRU meets or exceeds the applicable design and construction standards for LNG carriers trading in the United States was considered vital by the Harbor Safety Working Group for ensuring that the structure would be sufficiently robust to minimize the potential for the LNG tanks to be breached due to an allision. It was also considered critical for ensuring that the all vital systems, e.g., life saving, fire fighting, cargo systems, navigation related equipment, etc., are adequate for the intended service. Therefore, the following measures were recommended if the Broadwater Energy proposal is approved by FERC:

[239] Broadwater Cryogenic Information Request 2-2, p. 4 of 5.

- The FSRU should be designed and constructed to meet or exceed all applicable design and construction standards for LNG carriers trading in the United States;[240]
- All plans for the FSRU should be reviewed and approved by a third party prior to being submitted to FERC and the Coast Guard for review and approval;
- The FSRU and its components must be subject of third party oversight inspections/surveys throughout construction; and,
- FERC engineers and Coast Guard marine inspectors shall conduct oversight inspections during construction.

The design and construction of the FSRU are considered to have a significant impact on reducing potential risks associated with navigation safety accidents that could potentially result in a breach of the FSRU's LNG storage tanks. The design and construction of the FSRU are also considered to have a significant impact on reducing the potential consequences of an accident that resulted in a breach of the LNG containment by ensuring the FSRU is fitted with the appropriate life saving and fire fighting systems.

4.6.2.3 *Compliance Inspections*

An effective, thorough inspection regime is vital for reducing the potential of a yoke mooring system failure ensuring that the structural integrity of the yoke mooring system and the FSRU are properly maintained throughout its service life. Compliance inspections are also necessary to ensure that requirements such as those discussed in Section 4.6.1.1 and 4.6.1.3 are maintained. The consensus of the Harbor Safety Working Group was that the inspection regime should:

- Be based on current FERC operational inspection requirements;
- Incorporate Coast Guard inspection requirements for LNG facilities as contained in 33 C.F.R. part 127; and,
- Incorporate regular third party audits as well as structural surveys of the yoke mooring system and the FSRU conducted by FERC and the Coast Guard. Reports and recommendations from all third party audits and inspections shall be provided to FERC and Coast Guard Sector Long Island Sound.

Compliance inspections and structural surveys are considered to have a moderate to significant impact on reducing risk insofar as they would contribute to ensuring continued regulatory compliance and the structural integrity of the FSRU and yoke mooring system throughout their service life.

4.6.3 Consequence Management

Although risk management reduces the potential that an accident will occur, it cannot totally eliminate the possibility that an accident will occur. Therefore, in addition to identifying means

[240] Issues related to the selection of appropriate design and construction standards are discussed in Section 1.2.1.

of reducing the potential that an accident will occur, it is also necessary to identify measures to mitigate the consequences of an accident. Insofar as consequence management is primarily a function of the emergency response planning process and is common to both the navigation safety and the maritime security assessments, mitigation measures intended to mitigate the consequences of navigation accidents (and terrorist attacks) are discussed in Section 6.

4.7 Evaluation of Potential Mitigation Measures

The estimated benefits of the potential mitigation measures for reducing the identified risks to waterway safety associated with the Broadwater Energy proposal were evaluated in order to help determine which of the potential mitigation measures should be recommended to be implemented if the Broadwater Energy proposal is approved by FERC. The values used for this assessment are shown in Table 4-9.

Table 4-9: Benefit Estimation Scale

Estimate of Effectiveness	Description
1	Mitigation results in a negligible reduction of risk if implemented
2	Mitigation results in some reduction of risk if implemented
3	Mitigation results in moderate reduction of risk if implemented
4	Mitigation results in a significant reduction of risk if implemented

The estimated benefits of each of the potential mitigation measures in reducing risks associated with the navigation safety events identified as contributing more than one percent of the cumulative risk associated with the proposed Broadwater Energy project are shown in Table 4-10. In addition to providing a means of comparing the relative effectiveness of a given mitigation measure for reducing potential risks associated with a given navigation safety event vis-à-vis another mitigation measure, this Table also provides a means of:

- Determining whether a given mitigation measure will contribute to reducing potential risks associated with more than one navigation safety event, i.e., that it provides multiple benefits; and,
- Determining the extent to which the identified mitigation measures establish a layered system for reducing potential risks.

The utility of the first point when selecting potential mitigation measures is straightforward: select mitigation measures that would result in the largest potential reduction in risk and that will contribute to reducing risks associated with more than one navigation safety event. The utility of the second point is that it helps to highlight events for which there are limited options as well as those for which the proposed mitigation measures establish a layered system for reducing risks.

A review of Table 4-10 indicates that each of the mitigation measures related to vessel traffic management that were discussed in Section 4.6.1 could reduce the risks associated with multiple navigation safety events and that they also establish a layered system for managing potential risks. Table 4-10 also highlights the importance of ensuring the adequacy of the design and construction of both the proposed FSRU and yoke mooring system for reducing the potential failure of the mooring system due to either an allision by a vessel transiting in the vicinity of the FSRU or due to heavy weather. Final recommendations with respect to mitigation strategies are contained in Section 8 and are based on the mitigation strategy effectiveness evaluation contained in Table 4-10.

Table 4-10: Evaluation of Proposed Mitigation Measures

Event	Portion of Route	Section	Risk Index Number	Percent Cumulative Risk	Vessel Traffic Management							Design, Construction and Compliance		
					FSRU Equipment and Manning	LNG carrier transit scheduling	Assist tugs	Safety zones[1]	Vessel traffic routing	Simulator training for pilots	Vessel traffic service	Yoke Mooring System design and construction	FSRU design and construction	Compliance Inpsections
Collision - LNG carrier	The Race	4.3.1	11274.61	31.18%	NA	3	NA	3	3	4	4	NA	NA	NA
Collision - LNG carrier	Block Island Sound	4.3.1	6586.25	18.21%	NA	2	NA	3	2	4	4	NA	NA	NA
Collision (between small craft at edge of shipping lane)	The Race	4.3.6	4816.07	13.32%	NA	3	NA	1	2	NA	2	NA	NA	NA
Allision with FSRU by non-LNG carriers transiting in vicinty of FSRU	Waters adjacent to FSRU	4.3.2	3629.14	10.04%	4	NA	3	3	2	NA	4	4	4	3
Collision - LNG carrier	Eastern Long Island Sound	4.3.1	3168.04	8.76%	NA	2	NA	3	3	4	4	NA	NA	NA
Mooring tower failure / FSRU set adrift	Vicinity of FSRU	4.3.5	2279.80	6.30%	1	NA	3	NA	NA	NA	NA	4	4	3
Collision - LNG carrier with pilot boat	Approach to / vicinity of pilot station	4.3.1	1799.70	4.98%	NA	NA	NA	NA	NA	3	NA	NA	NA	NA
Grounding - LNG carrier	The Race	4.3.4	1022.30	2.83%	NA	2	NA	2	3	4	3	NA	NA	NA
Collision - LNG carrier	Approach to / vicinity of pilot station	4.3.1	924.43	2.56%	NA	NA	NA	3	2	2	2	NA	NA	NA
Collision - non-LNG carriers	Vicinity of FSRU	4.3.7	591.72	1.64%	2	1	3	1	3	NA	3	NA	NA	NA

Notes:
1 - Assumes with Coast Guard escort for moving safety zone around LNG carrier

5 Security Assessment

5.1 Overview

The focus of the security assessment was to identify potential risks to maritime security on Block Island Sound and Long Island Sound associated with the proposed construction and operation of the Broadwater Energy FSRU in central Long Island Sound as well as the potential transport of LNG on the waters of Block Island Sound and Long Island Sound. Additionally, the security assessment includes recommended measures to mitigate identified risks.

The security assessment was conducted using a Sub Committee of the Long Island Sound Area Maritime Security Committee. As discussed in Section 1.2.3.2, this Sub Committee included representatives from the federal, state and local agencies with responsibilities related to maritime security. It also included representatives from the marine industry.

Neither Broadwater Energy nor their security consultants were members of the AMSC Sub Committee. However, Broadwater Energy was required to provide information that was used by the Sub Committee. This included a Preliminary Project Security Assessment and Overview (PPSAO).[241] The PPSAO presented Broadwater Energy's assessment of potential threats to LNG operations as well as vulnerabilities of the proposed FSRU. The Coast Guard along with representatives from the FBI and U.S. Department of Homeland Security Infrastructure Protection conducted a preliminary review of the PPSAO and required Broadwater Energy to provide additional information before presenting it to the Sub Committee. The members of the Sub Committee then conducted a review of the PPSAO. As a result of this review Broadwater Energy was required to provide additional information in order for the Work Group to proceed with the security assessment.[242] Broadwater Energy was invited to attend a meeting of the Sub Committee to present the additional information that was required and to answer questions from the Sub Committee members. However, Broadwater Energy did not participate in the Sub Committee's assessment of potential risks to maritime security associated with the proposed project.

A portion of the report of the assessment of potential risks to maritime security contains Sensitive Security Information (SSI). Those portions of the report will be provided to FERC and individuals within agencies that have a need to know as provided by 49 C.F.R. part 1520. SSI portions of the report have been redacted in publicly available version.

[241] The PPSAO contains Sensitive Security Information (SSI) as defined by 49 C.F.R. § 1520.5. Access to this document restricted to individuals with a need to know per 49 C.F.R. § 1520.11. All participants in the AMSC Sub Committee's security risk assessment of the Broadwater Energy proposal were required to execute non-disclosure agreements.

[242] The process that was used to review the PPSAO was based on the approach used by the Coast Guard to review and approve vessel and facility security plans that are required by the regulations implementing the Maritime Transportation Security Act of 2002, which are found in 33 C.F.R. Parts 104 and 105.

5.2 Risk Assessment

In order to conduct a systematic assessment of the potential risks to maritime security on Block Island Sound and Long Island Sound associated with the proposed project, a risk assessment was conducted using the Preliminary Risk Assessment technique described in the Coast Guard's Risk Based Decision Making Guidelines.[243] This is the same approach that was used to assess potential risks to waterway safety.

The assessment involved:

- Identifying credible attack scenarios that if they did occur could reasonably be expected to compromise maritime security;
- Identifying where the event could reasonably be expected to potentially occur, i.e., area along the route used by LNG carriers or at the FSRU;
- Identifying the threat, vulnerability and consequences of each particular type of attack; and,
- Identifying potential measures that could be implemented to manage the potential risk by either reducing the likelihood that an accident might occur or by reducing the consequences of a potential attack.

Whereas potential risks to waterway safety are a function of the probability that an event will occur and the consequences if it does, potential risks to security are a function of three factors:

- Threat;
- Vulnerability; and,
- Consequences.

More discussion of this subject is contained in the SSI portion of this report.

5.2.1 Threat

A classified threat assessment was conducted by the Coast Guard Atlantic Area. The results of the assessment indicated there is currently no specific, credible threat against Broadwater energy's proposed FSRU. Based on current terrorist target selection criteria, the FSRU's remote location (distant from population centers and relative inaccessibility by the general public and media) would lessen its attractiveness as a target.

[243] The Risk Based Decision Making Guidelines are available at http://www.uscg.mil/hq/g-m/risk/e-guidelines/rbdm.htm.

A threat assessment is defined as: "A systematic effort to identify and evaluate existing or potential threats to a jurisdiction and its target assets." [244] Due to the difficulty in accurately assessing terrorist capabilities, intentions, and tactics, threat assessments may yield only general information about potential risks. Threat assessments are designed to identify who may initiate an attack and how capable and/or serious they are about attacking a target. It is important to note that threat assessments are, by their nature, perishable and need to be periodically updated.

The threat that a particular type of attack may be attempted against a particular target is established using information about who might intend to initiate an attack, the means as well as how, when and where they may execute a potential attack. Threats may be specific or general in nature. They may also be credible or unsubstantiated. Lastly, threats are dynamic and need to be periodically reevaluated. An implication is that although threat assessments are an extremely important input when evaluating security related risks, it is possible that there are threats that are not known. It is also important to note that the threat to the proposed FSRU can change as a result of geopolitical developments as well as the emergence of new potential terrorist and/or criminal groups or a change in targeting and tactics by existing groups. Therefore, any assessment of threat must be considered perishable and should be revisited as circumstances dictate. If the Broadwater Energy project is approved by FERC, Coast Guard Sector Long Island Sound's Intelligence staff would monitor those factors that may potentially affect threats against the FSRU and would request updated assessments from both regional and national resources as necessary.

Coast Guard Captain of the Port Long Island Sound requested that the Coast Guard's Atlantic Area Intelligence Staff conduct a threat assessment for the proposed Broadwater Energy project. A classified threat assessment was received from the Coast Guard's Atlantic Area Intelligence Staff. This assessment[245] as well as other information available through open and restricted sources was used to establish the current threat environment for the proposed Broadwater Energy FSRU. For the purpose of the risk assessment, potential threats to the Broadwater Energy FSRU were assigned using the values in Table 5-1. There are currently no specific, credible threats against Broadwater Energy's proposal. However, potential mitigation strategies (i.e. security regime with its associated resources) must account for:

- Unknown threats
- A changing threat environment
- Established Coast Guard policy and procedures

[244] U.S. Bureau of Justice Administration, *Assessing and Managing the Terrorism Threat*, 2005, p. 6.
[245] The CG Atlantic Area threat assessment is classified SECRET. Access to this assessment is restricted to individuals who have an appropriate security clearance and have a need to know. A summary conclusion of this assessment is SSI/Law Enforcement Sensitive, and was made available to the members of the AMSC Sub Committee.

Table 5-1: Threat Scores

Score	Description
5	Critical - Existence, capability, and targeting are present; history and intentions may not be
4	High - Existence, capability, history, and intentions are present
3	Medium - Existence, capability, and history are present; intention may not be
2	Low - Existence and capability are present; history may not be
1	Negligible - Existence or capability may not be present

Based on U.S. Bureau of Justice Administration, *Assessing and Managing the Terrorism Threat*, 2005

The current threat environment indicates a primary factor in the selection of targets by a terrorist organization such as al-Qa'ida is whether an attack could result in significant loss of life. Another factor is that the target is readily accessible to the media so that images of the attack can quickly be seen throughout the country and around the world.

There would normally be between 30 and 60 persons on the FSRU and between 20 – 25 crewmembers on an LNG carrier. While an attack against the FSRU or an LNG carrier would possibly result in loss of life, the proposed location is sufficiently remote that hazard Zones 1, 2, or 3 would not affect shoreside population centers. Second, the proposed location of the FSRU is relatively remote given the distance from shore and would not be broadly and readily accessible to the media or public. Based on the above two criteria, the Broadwater Energy FSRU would more than likely not be an attractive terrorist target.

The AMSC Working Group concluded that this assessment was consistent with threat information that was available to them both through open and restricted sources. Insofar as the threat environment is dynamic, this threat assessment should be reviewed and updated as appropriate on an annual basis if FERC approves Broadwater Energy's application to building and operate an FSRU on Long Island Sound.

5.2.2 Vulnerability

A vulnerability assessment is a process that identifies weaknesses in physical structures, personnel protection systems, processes, or other areas that may lead to a security breach, and may suggest options to eliminate or mitigate those weaknesses. For example, a vulnerability assessment might reveal weaknesses in an organization's security systems or unprotected key infrastructure, such as water supplies, bridges, and tunnels.[246]

Assessing the vulnerability of a target requires assessing how the target could be attacked, e.g., vessel-borne improvised explosive devices, internal sabotage, etc. The focus of this part of the assessment is on the design and engineering of the FSRU and its systems as well as the design and engineering of the LNG carriers and their systems. It also requires assessing the impact of potential resource limitations or security measures that either could limit the ability to reduce the

[246] U.S. Coast Guard Navigation and Inspection Circular 9-02, change 2, Enclosure 3, p.2, dtd 27 October 2005.

likelihood that an attack would be considered, or that could potentially prevent or reduce consequences of an attack. Table 5-2 contains the scores that were used. Scores of 2 or 4 were assigned if it was determined that the conditions for neither the higher or lower scores were fully met.

Table 5-2: Vulnerability Scores

Score	Description
1	Negligible - No Coast Guard or other agency resource gaps; facility / vessel operator has adequate security measures in place
2	Low
3	Medium - Some Coast Guard or other agency resource gaps, some gaps in facility / vessel operator's security measures
4	High
5	Critical - Significant Coast Guard or agency resource gaps, facility / vessel operator has inadequate security measures in place

The SSI portion of this report contains detailed information regarding the vulnerabilities associated with the proposed Broadwater Energy project.

It was recognized that the proposed location of the FSRU has both potential benefits and challenges. The benefits include reducing its attractiveness as a potential target because it would be removed from population centers by virtue of its location away from land. There are benefits as well for consequence management in the event of an accident or attack that results in breach of the LNG containment and subsequent release of LNG, because of the proposed location is away from population centers. The challenges created by virtue of the location distant from shore include questions of authority and jurisdiction, private property vs. public trust, and the maritime response to security incidents.

5.2.2.1 Authority and Jurisdiction

The Broadwater Energy FSRU, if approved and constructed as proposed in the application submitted to FERC on January 30, 2006, would be located on the internal waters of the United States in an area that is within the boundaries of the State of New York.[247] In accordance the laws of the State of New York, the FSRU would be located within the Town of Riverhead, Suffolk County.[248]

It is clear that the Coast Guard, subject to the provisions of the National Response Plan,[249] is the lead Federal agency responsible for maritime security related to Broadwater Energy's proposal to build and operate an FSRU for the import of LNG. However, there appears to be a lack of clarity regarding the authority of county and local agencies with responsibilities related to maritime security, including law enforcement and emergency response[250]at the intended location

[247] *See United States v. Maine*, 469 U.S. 504.
[248] 1881 New York Laws Chap. 695.
[249] *See* National Response Plan available at http://www.dhs.gov/interweb/assetlibrary/NRP_FullText.pdf.
[250] Captain of the Port Long Island Sound addressed a letter to the Attorney General for the State of New York addressing this issue but has not received a reply. These questions have been forwarded to the Governor's Office.

of the FSRU. This is due in part to the fact that typically a state's jurisdiction extends 3 miles seaward. Long Island Sound is internal waters of the US and thus all falls within state waters extending state jurisdiction as much as 9 or 10 miles from shore at the widest portion of the Sound, which is near the proposed location of the FSRU. Local authorities do not currently routinely operate at those distances from shore. This uncertainty is an obstacle that would need to be addressed in order to establish a seamless security protocol for the proposed FSRU.[251]

5.2.2.2 Private Property vs. Public Trust

A significant difference between a facility located on shore and the proposed Broadwater Energy FSRU is that the facility operator has control of the land on which the shore side facility is located. This enables the facility operator to leverage state and local statutes establishing private property rights to restrict access by the public to land on which the facility is located. This can be accomplished through a number of different means including: fences and gates to control access; lights, cameras, alarms and roving patrols to detect unauthorized access; and use of armed security personnel to detain intruders pending arrival of local law enforcement personnel. It also allows the facility operator to establish a setback or buffer between critical components of the facility and the facility's border. Although some minimum setback may be required by applicable safety standards, e.g., NFPA 59A for LNG storage and regasification facilities, it also creates an effective setback that can reduce the effectiveness of certain attack vectors, e.g., standoff weapons or vehicle-borne improvised explosive devices (IEDs).

In contrast, the waterways of the United States are held as a public trust.[252] The implication is that although Broadwater Energy can use private property laws to control access to the FSRU, they cannot use those laws to restrict access to the waters adjacent to the FSRU. However, it does appear that the New York State private security statute allows facility operators to use armed private security guards to conduct on-water patrols on public waterways in order to prevent unauthorized access to a facility or vessel.[253] An issue that would need to be addressed if FERC approves the Broadwater Energy proposal is how far from the proposed FSRU these patrols by private security guards could be conducted.

An additional measure that can be employed to help protect the FSRU from an attack is the establishment of a security zone around it by the Coast Guard as provided for by 33 C.F.R. §§ 165.30 and 165.33. The purpose of a security zone around the FSRU would be to reduce the potential for an attack, to reduce the effectiveness of an attack if one was attempted, and to safeguard maritime security on Long Island Sound as well as a component of the region's energy infrastructure. Enforcement of security zones is a law enforcement function and is the

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[251] It may also be an obstacle to developing an emergency response plan as required by Section 311 of the Energy Policy Act.
[252] *See United States v. Chandler-Dunbar Co.,* 229 U.S. 53, 69 (1913).
[253] Commander, First Coast Guard District Memo 16610 dated June 16, 2005 addressing private security firms and facility security.

responsibility of the Coast Guard,[254] and thus it cannot be delegated to a private entity, e.g., Broadwater Energy or its private security contractor. It should be noted that statutory authority exists that permits the Coast Guard and Connecticut or New York to reach an agreement to have state law enforcement assets enforce a security or safety zone.

5.2.2.3 Maritime Response to Security Incidents

Due to the proposed location, any Coast Guard response to a security incident at the proposed FSRU will have to be by water or air. A land based response is not an option. The time required to respond will be a function of the availability and proximity of appropriate response assets as well as existing weather conditions, e.g., winds, sea state and visibility.

5.2.3 Consequences

Assessing the consequences of an attack requires an understanding how a particular type of attack might affect a target. In particular, the ability of a particular attack vector to actually breach one or more of the LNG carriers tanks and the size of the breach were key factors used in assessing consequences. The AMSC Sub Committee determined that the most credible attack scenarios were similar to those upon which the intentional breach and spill analysis in the Sandia Report is based.[255]

Secondary effects, such as the regional or national strategic consequences of an attack on the broader critical infrastructure, such as shutting down ports and waterways were not considered in the scope of this assessment.

As discussed in Section 1.4, using modeling conducted by Det Norske Veritas (DNV) on behalf of Broadwater Energy in conjunction with modeling conducted by FERC, it was determined that the sizes of the hazard zones for the Broadwater Energy FSRU and the next generation of LNG carrier were larger than those in the Sandia Report. The extent of these zones are shown in Figures 2-1 and 2-2. This information was used to determine potential consequences of an attack.

The consequence scores used for the security risk assessment are shown in Table 5-3. The assigned score for a particular type of attack was arrived at based on whether the outcome might result in the criteria for at least one of the consequence categories, i.e., safety, economic or national defense. The next higher score was assigned if all the criteria for at least two of the consequence categories were met. Scores of 2 or 4 were assigned if it was determined that the

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[254] 46 U.S.C. § 70119 provides for state and local law enforcement agencies to enforce safety and security zones established by the Coast Guard. The Coast Guard is currently working with the State of New York to establish a Memorandum of Agreement for this purpose. This effort is not linked to the Broadwater Energy proposal.

[255] See Sandia Report, Chapter 5. A detailed discussion of specific types of attacks and outcomes is contained in a second report issued by Sandia National Laboratories. This report is classified and is marked SECRET. Access to this report is restricted to individuals with an appropriate clearance and who have need to know.

conditions for neither the higher or lower scores were fully met. More details of potential attack scenarios are discussed in the SSI section of this report.

Table 5-3: Consequence Scores

Score	Descriptor	Safety Impact	Economic Impact	National Defense Impact
1	NEGLIGIBLE	Injuries that require more than first aid, i.e. may require hospitalization or result in lost work days	FSRU sustains some structural damage; vessel seaworthy but requires some temporary repairs; or, port operations delayed	Naval unit transits are delayed for less than 6 hours
2	LOW			
3	MEDIUM	Injuries that may result in permanent disability	FSRU significant structural damage; vessel not seaworthy; or, port operations disrupted up to 24 hours	Naval unit transits are delayed for more than 6 but less than 12 hours
4	HIGH			
5	CRITICAL	Multiple deaths (does not include suspected terrorist)	FSRU must be rebuilt; vessel declared total constructive loss; or, port operations disrupted for more than 24 hours	Naval unit transits are delayed for more than 12 hours

Based on Coast Guard Risk Based Decision Making Guidelines, Vol. 3, Chap. 4.

Unlike the assessment of potential risks to waterway safety, which accounted for all potential consequences of a particular event, the assessment of potential risks to maritime security focused on worst-case consequences only. The reason is that whereas risks to waterway safety are the result of unintended events (thus it is assumed that those whose actions caused the accident will also attempt to minimize the resulting damage), risks to maritime security are the result of intentional events, i.e., attacks designed and executed to cause the greatest damage possible.

5.2.4 Risk Index Number

A risk index number was calculated using the values for threat (Table 5-1), vulnerability (Table 5-2), and consequences (Table 5-3) in order to rank the relative risk of different potential attack scenarios against either the proposed FSRU or LNG carriers. As discussed in Section 5.2, security risks are a function of threat, vulnerability and consequences. Therefore, the risk index number, which is dimensionless, was calculated using the following formula: $RIN = TxVxC$, where T is the threat score, V is the vulnerability score, and C is the consequence score.

5.3 Potential Attack Scenarios

Potential attack scenarios against the proposed FSRU or LNG carriers were identified using the Sandia Report, the Coast Guard Atlantic Area's threat assessment, input from members of the AMSC Sub Committee, as well as the PPSAO submitted by Broadwater. Potential attack scenarios that were identified include:

- Sabotage;
- Highjacking of the LNG carrier;
- Standoff weapons;
- Aerial attack;
- Surface attack;
- Subsurface attack; and,
- Cyber attack.

The threats and vulnerabilities associated with the attack scenarios that were identified are discussed in the SSI portion of this report. The threat values in this section are based on the terrorist intentions, capabilities, histories, and targeting throughout the world, not the specific region. This approach was intended to apply general threat information based on the types of attacks that have been carried out in other parts of the world to potential attack vectors in the absence of a specific, credible threat against the proposed FSRU.

The vulnerability values are based on examining the scenarios as if there are no security measures applied that would reduce vulnerabilities. The values reflect an assessment of "pure" vulnerability, before mitigations are put in place.

All attacks against the FSRU were assumed to occur at the location where Broadwater Energy has proposed to build the FSRU. For attacks against the LNG carriers, the AMCS Sub Committee also assessed where along the route that a particular attack could potentially occur and as well as the potential consequences associated with an attack in that area. The route segments, which include information regarding how close an LNG carrier could get to shore as well as the extent to which the hazard zones would include land areas, discussed in Section 3.2 were used for this purpose.

An inherent consideration for the Sabotage and Highjacking scenarios included unauthorized access to the LNG carrier and the FSRU. It was recognized that access control would be an important component of any security regime. Access control protocols would need to consider access to the FSRU from shoreside, access to the shoreside support facility, access between moored LNG carriers and the FSRU and access to the LNG carriers at the lading port.

5.4 Risk Assessment Results

The AMSC Sub Committee identified several potential methods that could potentially be used to attack either the proposed FSRU or LNG carriers and result in a breach of the LNG containment and subsequent release. Whereas some of the potential means of attack are external, e.g., vessel borne improvised explosive devices, others are internal, e.g., sabotage, to either the proposed FSRU or LNG carrier. None of the direct consequences associated with hazard Zones 1 and 2 resulting from a potential attack against the FSRU would reach shore. If there was a release of LNG and there was not an ignition source, a vapor cloud (hazard Zone 3) could extend over land along limited portions of the tanker route, but would not extend to land from the FSRU location. The extent of the hazard zones is discussed in Section 1.4 and is portrayed in Figures 2-1, and 2-2.

The complete results of the assessment of potential risks to maritime security are detailed in the SSI portion of this report.

5.5 Risk Management Strategies

The ASMC Sub Committee concluded that mitigation measures would need to be implemented to mitigate potential risks to maritime security associated with the Broadwater Energy proposal. Risk mitigation measures generally fall into one of two categories: prevention and consequence management. This recognizes that although preventing an attack is preferred, a determined enemy can attempt to identify and exploit vulnerabilities to attack a target of choice.

Although there are currently no specific, credible threats against Broadwater Energy's proposal, this could change in the future. Therefore, based on the results of the security risk assessment, and taking into consideration:

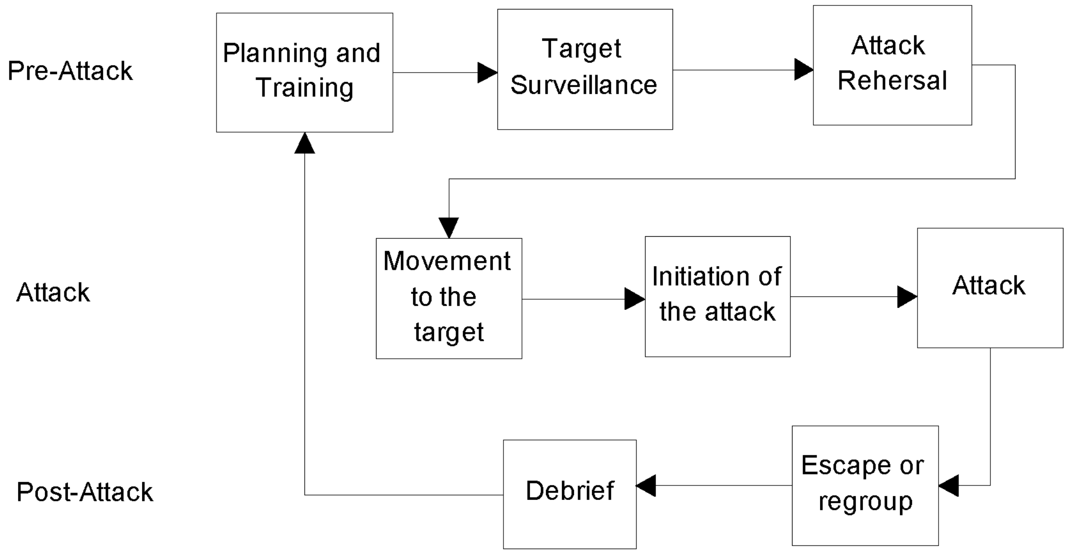
- threats that are unknown,
- a changing threat environment, and
- established Coast Guard policy and procedures,

mitigation measures (and associated resource) will need to be implemented in order to address potential risks to maritime security associated with Broadwater Energy's proposal to build and operate the FSRU on Long Island Sound if it is approved by FERC.

5.5.1 Terrorist Attack Cycle

The terrorist attack cycle is shown in Figure 5-1. Generally, the attack cycle consists of three phases: pre-attack, attack, and post-attack. The goal of effectively managing risks to maritime security associated with a potential terrorist attack is to disrupt the cycle as early as possible using deterrent, or prevention, measures. In the event an attack is attempted, then the focus of any mitigation measures shift to response, i.e., directly engaging the attackers and / or managing the consequences of the attack. Historically, the disruption of the terrorist attack cycle by security forces has either diverted potential attackers from the target or significantly delayed their attack planning.

Figure 5-1: Terrorist Attack Cycle



5.5.2 Assumptions

The following assumptions were, to the maximum extent possible, taken into consideration while identifying recommended measures to effectively mitigate potential risks to maritime security associated with the Broadwater Energy proposal:

- Broadwater Energy, to the maximum extent possible consistent with MTSA regulations (33 C.F.R. part 105) and the New York State private security statute, as well as other applicable federal, state and local laws, should be responsible for security functions that would be a facility operator's responsibility if it were located on shore, i.e., perimeter security;
- Law enforcement functions must be performed by law enforcement agencies;
- Emphasis was placed on the deterrent value of any proposed measures that would disrupt the attack cycle as early as possible as well as measures that would be potentially effective against multiple attack vectors in order to maximize the benefit/cost balance;
- The proposed measures should create a layered security system;
- Any proposed security measures should be consistent with current uses of Long Island Sound; and,
- Minimize potential for imposing the burden of adjusting transit patterns / schedules on non-LNG related traffic to the maximum extent possible.

Based on the dynamic nature of potential threats to maritime security, it is recognized that a periodic assessment would be required to assess the effectiveness of the mitigation measures that might have been implemented and to identify any necessary changes based on the then-current threat environment. The recommended mitigation measures, which were developed with input from the AMSC Sub Committee, are outlined in detail in the SSI supplement.

Any proposed mitigation measures must be accompanied by a sensitivity analysis that assesses the potential impact of the measures on potential threats. This analysis, which is included in the SSI Supplement, contributes to an understanding of the relative benefits versus the relative costs of proposed measures. Several factors need to be considered when conducting a sensitivity analysis. These include the deterrent value of the measures as well as changes in the nature of the threat. The deterrent value of proposed security measures are directly related to the nature of the threat. However, commonly accepted security measures provide a baseline of security practices and procedures that can be implemented that will provide security against those scenarios currently considered most likely as outlined in section 5.3. Changes and modifications to the proposed security measures will be recommended or directed in response to changes in threat.

5.5.3 Consequence Management

Although risk management reduces the potential that an attack against the proposed FSRU would be attempted, it does not totally eliminate the possibility of such an attack. Therefore, in addition to identifying means of reducing the potential that an attack will be attempted, it is also necessary to identify measures to mitigate the consequences of an attack. Insofar as the consequence management planning process is the same for both navigation safety and maritime security incidents, a single section that discusses the emergency response consequence management planning process is contained in Section 6.

5.5.4 General Risk Management Strategies

What follows is a summary of some of the recommended measures made by the AMSC Sub Committee to address potential risks to maritime security associated with the proposed project. A complete list of recommended measures to mitigate potential risks to maritime security as well as their intended benefits are contained in the SSI portion of this report, which will be provided to FERC and on request to representatives of other agencies that have need to know and meet the requirements to be granted access to SSI information per 49 C.F.R. part 1520.

- Require Broadwater Energy to submit a facility security plan that meets all of the applicable requirements of 33 C.F.R. part 105 that includes an armed security force capable of conducting on water patrols to Captain of the Port Long Island Sound for review and approval a minimum of 6 months before the FSRU goes into operation, if the Broadwater Energy proposal is approved by FERC;[256]
- Permit the selective application of the security requirements for Outer Continental Shelf facilities in 33 C.F.R. part 106 as part of the Broadwater FSRU facility security plan when appropriate;
- Implement a security zone around the FSRU and LNG carriers (note enforcement of the security zone is a law enforcement function);

[256] Per 33 C.F.R. § 105.410 the minimum period is 60 days before beginning operations. The additional time for the Broadwater FSRU facility security plan is warranted do to the unique nature of the facility.

- Permit only one LNG carrier to be on the waters of Block Island Sound or Long Island Sound inshore of the pilot stations at Point Judith and Montauk Channel without express approval of the Captain of the Port Long Island Sound;
- Conduct Coast Guard security boardings of LNG carriers;
- Provide Coast Guard escort of LNG carriers;
- Conduct pre-arrival screening of all LNG carriers to assess potential risk to port security;[257]
- Conduct periodic Coast Guard assessments of the security at overseas LNG loading ports.

5.5.5 Security Zone

The AMSC Sub Committee recommended that a security zone[258] should be in place around LNG carriers while they are underway on the waters of Block Island Sound and Long Island Sound and around the FSRU. Examples of safety/security zones currently in place around LNG carriers while they are underway are:[259]

- Boston Harbor: 2 NM (4000 yards) ahead, 1 NM (2000 yards) astern, and 500 yards on each side;[260]
- Chesapeake Bay: 500 yard radius around the LNG carrier;[261]
- Savannah River: 2 NM (4000 yards) for all vessels greater than 1600 GT and all other vessels must remain clear;[262]
- Lake Charles, LA: 2 NM (4000 yards) ahead, 1 NM (2000 yards) astern, and the width of the ship channel on either side.[263]

Based on the assessment of potential risks to the LNG carrier while on the waters of Block Island Sound and Long Island Sound, it was recommended that the minimum size of the security zone should be approximately 500 yards. This distance is based in part on existing Department of Defense security set back requirements, in particular Naval vessel protection zones. It should be noted that the purpose of the security zone is to protect the LNG carrier from external threats, not protect the public from a potential fire. Public safety and navigation concerns are addressed through the use of a safety zone.

As discussed in Section 4.6.1.4, the moving safety zone around LNG carriers would extend 2 NM (4000 yards) ahead, 1 NM (2000 yards) astern, and 750 yards to either side of the vessel.

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[257] The Coast Guard currently screens all vessels over 300 Gross Tons prior to arrival in U.S. ports. The screening involves both safety and security risk assessments.
[258] Although the terms safety and security zones are frequently used interchangeably, safety zones and security zones are established using different statutory authorities and are intended to accomplish different purposes. Whereas safety zones are intended to protect what is outside of the zone from what is inside, security zones are intended to protect what is inside the zone from what is outside.
[259] These zones are the same size as the safety zones discussed in Section 4.6.1.4.
[260] 33 C.F.R. § 165.110(b)(1)
[261] 33 C.F.R. § 165.500(b)
[262] 33 C.F.R. § 165.756(d)(1)
[263] 33 C.F.R. § 165.805(b)

The safety zone around the FSRU would be a circle with a radius of 1210 yards centered on the mooring tower (see Section 4.6.1.5). In contrast to the purpose of a security zone, the purpose of a safety zone is to protect the public and marine transportation system from the hazards associated with a breach of the LNG carrier's tanks.

To ensure both the security of the LNG carrier and safety of the public, the necessary security zone should have dimensions of the greater of the two - in this case, the safety zone. In other words, the zone would be considered to be a combined safety and security zone. The dimensions of the combined zone around LNG carriers would be 2 NM (4000 yards) ahead, 1 NM (2000 yards) astern, and 750 yards to either side of the vessel. The combined safety and security zone around the FSRU would be a circle with a radius of 1210 yards centered on the mooring tower. It is recommended that the security zone move with the LNG carriers while they are underway and not gas free.

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

5.5.6 Flight Restrictions

The AMSC Sub Committee recommended that consideration be given to establishing flight restrictions around the FSRU and LNG carriers while in the waters of Long Island Sound. Flight restrictions currently exist around LNG Carriers as they enter Boston Harbor.

It should be noted that the purpose of the flight restrictions is to protect the FSRU and LNG carrier from external threats, not protect the public from a potential fire. Public safety and navigation concerns are addressed primarily through the use of a safety zone.

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

5.6 Evaluation of Mitigation Measures

The estimated benefits the potential mitigation measures for reducing the identified risks to waterway security associated with the Broadwater Energy proposal were evaluated in order to help determine which of the potential mitigation measures should be recommended to be implemented if the Broadwater Energy proposal is approved by FERC. The values used for this assessment are identical to the Safety Benefit Estimation Scale located in Table 4-8, shown again below for convenience.

Estimate of Effectiveness	Description
1	Mitigation results in a negligible reduction of risk if implemented
2	Mitigation results in some reduction of risk if implemented
3	Mitigation results in moderate reduction of risk if implemented
4	Mitigation results in a significant reduction of risk if implemented

The evaluation of the effectiveness of the mitigation measures recommended by the AMSC Sub Committee is contained in the SSI portion for this report.

6 Consequence Management

6.1 Overview

Concerns related to emergency response and marine fire fighting have been consistently raised by the public, representatives of emergency response organizations, and elected officials throughout the process of assessing potential risks associated with the Broadwater Energy proposal. As noted during the PAWSA, there are currently very limited resources immediately available to respond to a large marine fire on Long Island Sound. The consensus of the Harbor Safety Working Group and AMSC subcommittee was that, if the Broadwater Energy proposal is approved by FERC, it is imperative that issues related to emergency response and marine fire fighting be addressed during the development of the emergency response plan required by Section 311 of the Energy Policy Act of 2005.

The focus of this section is the identification of potential measures for mitigating risks associated with either a navigation safety accident or a terrorist attack against either the Broadwater FSRU or an LNG carrier. Although identifying potential mitigation measures and evaluating their effectiveness is a primary focus of the emergency response planning process, several potential mitigation measures were identified during both the navigation safety and maritime security assessments. Recommendations were also made regarding the development of the required emergency response plan if the Broadwater Energy proposal is approved by FERC.

6.2 Emergency Response Plan

In accordance with Section 311 of the federal Energy Policy Act of 2005, Broadwater Energy would be required to develop an Emergency Response Plan in consultation with the U.S. Coast Guard and State and local agencies. This plan would have to be approved by FERC before Broadwater Energy could receive approval to begin construction of the facility.[264] What follows are recommendations from the Harbor Safety Working Group and the AMSC subcommittee regarding the emergency response plan.

6.2.1 Participation in the Planning Process

The emergency response plan should be developed through a transparent, public process that actively involves the U.S. Coast Guard and appropriate agencies and key officials of state and local governments. Although the proposed FSRU would be located in New York state waters, due to its close proximity to the border with the state of Connecticut, and because LNG carriers

[264] During the Cryogenic Technical Conference conducted in Port Jefferson, NY on June 6, 2006, Broadwater Energy indicated they would propose that the date construction would begin for the proposed project would be when a contract was awarded for the construction of the FSRU. Based on the proposed schedule for the project, this could be in late 2007 or early 2008. The determination of “when construction begins” for this project will need to be made by FERC.

supplying the FSRU may also regularly enter the state waters of both Rhode Island and Connecticut, officials from all three states should be involved in the planning process.

Although Broadwater Energy has stated that they do not expect assistance from local emergency service providers when responding to an emergency on board the FSRU, and presumably an LNG carrier, other than the transport and treatment of personnel and crew evacuated from the FSRU or an LNG carrier,[265] this does not relieve local police chiefs or fire chiefs of their public safety responsibilities under state and local law. Based on this, it was the consensus of both the Harbor Safety Working Group and the AMSC subcommittee that local emergency response officials from all three states whose jurisdictions may be affected by a release of LNG and potential fire should also be involved throughout the planning process. A first step in the process would be identifying which local jurisdictions may be affected as well as the authority and jurisdiction of the local law enforcement and emergency response organizations. The New York Department of Public Service has raised issues related to jurisdictions and local government responsibility for fire protection, including that for an offshore facility (for which it stated that they (local governments) have no legal responsibility, nor capability).[266] It is anticipated that these same concerns could also apply to the local governments of Connecticut and Rhode Island.

6.2.2 Interoperability Requirements

Emergency response organization representatives on the Harbor Safety Working Group and the AMSC subcommittee agreed that the emergency response plan should be interoperable across jurisdictions, e.g., both state and local. This requires that it be consistent with the National Response Plan in its use of the National Incident Management System (NIMS) as well as, to the maximum extent possible, with applicable state and local requirements.

6.2.3 Unambiguous Statement of Planning Assumptions and Responsibilities

These representatives also agreed that the planning assumptions upon which the emergency response plan would be based would have to be agreed to and validated by all involved local and state emergency response organizations and the Coast Guard. This would be critical for ensuring that the scope of the plan addressed all reasonably foreseeable contingencies as well as for identifying technical capabilities of first responders and equipment requirements.[267] At a minimum, the plan should address responses to the safety and security scenarios discussed in this assessment as well as events such as hurricane preparation. It should also include procedures for managing potential risks associated with the dispersion of an LNG vapor cloud over land areas.

Representatives of local emergency response organizations were unequivocal in recommending that the emergency response plan clearly establish Broadwater Energy's responsibilities as well as those of local emergency response organizations. This is considered critical for identifying possible gaps in the emergency response capabilities of those agencies, particularly municipal

[265] Broadwater Energy LLC, Resource Report No. 11, Section 11.6
[266] NY Dept. of Public Service, Advisory Report to FERC dated February 28, 2006, Appendix D filed pursuant to Sec. 311, Energy Policy Act of 2005
[267] This applies whether the first responders are employees of Broadwater Energy or emergency service personnel.

emergency, medical services, and fire response capabilities. It is also critical for identifying and validating the emergency response capabilities that Broadwater Energy would need to provide in order to operate the facility if it is approved.

6.2.3.1 *Marine Fire Fighting*

Broadwater Energy has stated publicly its intent to be "self sufficient for purposes of fire safety."[268] In addition to the fire fighting systems on the FSRU and LNG carriers, which would comply with the requirements established by the International Gas Carrier Code,[269] Broadwater Energy has proposed that the assist tugs will be equipped with fire fighting equipment that meets the International Association of Classification Societies "Fi-Fi 1" notation.[270] The equipment required to meet this standard is outlined in Table 6-1.[271] Firefighters have noted that since the emergency planning process has not been completed, it is too early to determine whether these capabilities are sufficient. In addition, it has not been determined how many tugs with fire fighting capabilities would need to be available and what an acceptable response time would be. This is of particular concern for areas of the anticipated transit route in relatively close proximity to large concentrations of commercial or recreational vessel traffic or where a release of LNG could reach shore.

Table 6-1: Minimum Fire Fighting Requirements for Fi FI 1 Notation

Equipment	Capability (metric units)	Capability (English units)
Monitors	2	
Monitor output	1200 m^3/hr	5283 gpm
Fire pumps	1-2	
Total pumps capacity	2400 m^3/hr	10,567 gpm
Fire pumps fuel oil capacity	24 hours	
Minimum Throw of Water Monitor Stream Length	120 m	394 ft
Minimum Stream Height	45 m	147.6 ft

6.2.3.2 *Cost Sharing Plan*

As required by Section 311 of the Energy Policy Act, the emergency response plan is required to include a cost-sharing plan. The cost-sharing plan shall include a description of any direct cost reimbursements that Broadwater Energy would agree to provide any state and local agencies with security and safety responsibilities, either at the terminal itself or in proximity to vessels that serve the facility, i.e., the shore side support facility.

[268] NY Dept. of Public Service, Advisory Report to FERC dated February 28, 2006, Appendix D *See also* PAWSA, p. 32.
[269] Broadwater Energy, *Resource Report 11, Section 11.4.4.2*
[270] Broadwater Energy reply of November 1, 2005, Para. 8(c) to Coast Guard Request for Information dated Oct. 5, 2006
[271] Society of International Gas Tanker and Terminal Operators (SIGTTO), Liquefied Gas Fire Hazard Management (First Edition), Witherby and Company Limited, London, 2004

6.3 Other Consequence Management Recommendations

Members of the Harbor Safety Working Group and AMSC Sub Committee recommended the following measures for mitigating consequences associated with either a navigation safety accident or a terrorist attack against the FSRU or an LNG carrier.

6.3.1 Escort Tugs

There was general consensus among members of the Harbor Safety Working Group that there are portions of the LNG carriers' anticipated transit route where it would be prudent to have escort tugs present, including The Race and the easternmost portion of Long Island Sound. The presence of these tugs would serve several purposes:

- Serve as 'picket boats,' potentially assisting the Coast Guard with patrolling the moving safety zone around LNG carriers along the transit route.
- Be able to take an LNG carrier in tow in the event of a sudden loss of steering or propulsion in order to prevent a collision or grounding;
- Respond immediately to a fire in the event of a collision or grounding involving a release of LNG and a subsequent fire.

The Harbor Safety Working Group recognized that the capabilities (horsepower and bollard pull) required for a tug to serve effectively as an escort tug are different than what may be required for an assist tug. Therefore, it was recommended that Broadwater Energy conduct model testing to establish the performance standards for escort tugs. It was also recommended that Broadwater Energy determine the number of tugs required to ensure an escort tug is available for each inbound transit.

Escort tugs were considered to have a moderate to significant impact on reducing risks associated with the consequences of a navigation safety accident.

6.3.2 Coast Guard Escort

It was recognized that having Coast Guard assets on scene if an accident occurred would facilitate emergency response activates and hence would have a moderate to significant effect on reducing risks due to an accident. Both the Harbor Safety Working Group and the AMSC subcommittee identified this as an ancillary benefit to having Coast Guard vessels on scene enforcing the moving safety and security zone.

6.3.3 Safety Zone

Having appropriately sized safety zones around the LNG carriers and the FSRU was recognized by the Harbor Safety Working Group as being an effective means of mitigating some of the immediate consequences of an LNG release and fire insofar as it would help ensure that other vessels were outside of the most hazardous zone of concern, i.e., Zone.

7 Resource Requirements

7.1 Overview

Using standing Coast Guard policy guidance, personnel and equipment resource requirements needed to implement the measures identified in Section 4.6 and Section 5.5 of the SSI Supplement of this Report for managing potential risks to navigation safety and maritime security associated with the Broadwater Energy project were identified. Resources needed to implement the Emergency Response Plan will be identified as part of the planning process discussed in Section 6.2.1 and are not addressed in this section.

7.2 Base Resource Requirements

Table 7-1 is a summary of Coast Guard equipment and personnel resources required to implement the risk management measures discussed in Section 4.6 and Section 5.5 of the SSI Supplement to this Report. The analysis used to identify these requirements was based on the operations order for Operation Neptune Shield,[272] as well as other more general guidance related to staffing and resource employment standards.[273] This analysis is on file at Coast Guard Sector Long Island Sound. As discussed in Section 5.2.1, there is currently no credible threat against the proposed Broadwater Energy FSRU or LNG carriers operating on the waters of Block Island Sound and Long Island Sound. However, as also discussed in Section 5.2.1, there may be unknown threats. Standing Coast Guard policy guidance for port and coastal security operations takes this into account.

Table 7-1: Summary of Additional Required Resources

Resource	Number Required
87 or 110 coastal patrol boat	1 (900 - 1800 hours)
RBM/UTB	10
Security Boarding Team	1 Boarding Officer (E-5 – E-6) and 7 Boarding Team Members (E-3 – E5)
Boat Crews	10 – 12 (40 – 48 personnel, E-3 – E-6)
Marine Inspectors	2 (CWO4 – O3)
Facility Inspectors	2 (E-5 – E-6)
Logistics Support Personnel	4 (E-4 – E-5)

Based on current levels of mission activity, Coast Guard Sector Long Island Sound currently does not have the resources required to implement the measures that have been identified as

[272] This operations order is classified SECRET.

[273] Other guidance used when developing resource requirements includes Coast Guard Staffing Standards Manual (COMDTINST M5312.11A), the U.S. Coast Guard Maritime Counter Drug and Alien Migrant Interdiction Operations Manual (COMDTINST M16247.4, NWP 3-07.4) and the U.S. Coast Guard Boat Operations and Training Manual, Vol. I (COMDTINST M16114.32), and Marine Safety Manual, Vol. II (COMDTINST M16000.7). Cutter and boat employment standards are based on budget models. These models are based on coastal patrol boats being underway 1800 hours a year and small boats (RBMs/UTBs) being underway 600 hours a year.

being necessary to effectively manage the potential risk to navigation safety and maritime security associated with the Broadwater Energy proposal. Obtaining the required resources would require either curtailing current activities within the Sector, reassigning resources from outside of the Sector, or for the Coast Guard to seek additional resources through the budget process. Provided the conditions outlined in Section 7.4 are met, some of the required resources, e.g., small boats used for LNG carrier escorts or to patrol the safety and security zone around the FSRU, could be provided by a state or local law enforcement agency.

7.3 Potential Additional Resource Requirements

In addition to the resources identified in Section 7.2, additional Coast Guard resources may be required to implement the vessel traffic management recommendations that were identified in Sections 4.6.1.6 and 4.6.1.7 as well as some of the maritime security measures identified in Section 5.5 of the SSI portion of this Report. The resources required to implement these measures cannot be identified insofar as additional analysis is required to establish specific operational capabilities. Resource requirements would be identified after the operational capabilities are established.

7.4 Other Agency Resource Requirements

State or local law enforcement agencies could potentially assist with implementing some of the measures identified for managing potential risks to maritime security associated with the proposed Broadwater Energy project. With the appropriate legal agreement (i.e. Memorandum of Understanding), State law enforcement personnel could enforce Coast Guard safety or security zones either around the FSRU or the transiting LNG carrier. This assumes the state law enforcement agency has the appropriately trained and outfitted personnel in addition to small boats capable of operating in the most probable worst case sea condition of Long Island Sound. Currently the agencies that could potentially provide such assistance do not have the necessary personnel, training, or equipment.

The Coast Guard would consult with the Long Island Sound AMSC as well as the head of the appropriate state or local law enforcement agency prior to using non-Coast Guard resources to assist with conducting LNG carrier escorts as well as safety and security zone enforcement around the FSRU. If local or state law enforcement agencies are used, that agency would be responsible for negotiating a cost sharing plan with Broadwater Energy. As discussed in Section 6.2.3.2, Section 311 of the Energy Policy Act of 2005 this cost sharing plan would be incorporated into the emergency response plan.

8 Conclusion and Recommendations

8.1 Overview

The information regarding the proposed facility detailed in this Report was derived from Broadwater's Application to FERC, supporting Resource Reports filed with the application, as well as information provided directly to the COTP Long Island Sound by Broadwater. Broadwater Energy is proposing to build a floating storage and regasification unit (FSRU) in Long Island Sound. The FSRU would be supplied by LNG vessels, which will transit to Long Island Sound from foreign ports.

The proposed LNG facility will consist of a floating storage and regasification unit (FSRU). The steel hull of the FSRU would measure approximately 1,215 feet (370 meters [m]) in length, 200 feet (60 m) in width, and would rise approximately 80 feet (25 m) above the water line to the deck. The FSRU's draft would be approximately 40 feet (12 m). The FSRU will be designed with base vaporization capabilities of 1.0 bcf/d using a closed-loop shell and tube (STV) vaporization system. The FSRU will be a vessel-shaped, double hulled facility, built specifically to transfer, store and regasify LNG. The entire cargo containment system of the FSRU is protected by a double hull.

The FSRU itself will have 8 LNG tanks, each having an approximate volume of 44,850 m^3, for a total net storage capacity of 350,000 m^3. The LNG will be maintained at a temperature of minus 260° F and at a normal operating pressure of 1-3 pounds per square inch (psi), closely approximating atmospheric pressure. No mechanical means of refrigeration will be required because the LNG is refrigerated (liquefied) at the sending site and transported in thermally insulated LNG carrier cargo tanks.

The FSRU will be secured in place in Long Island Sound via a Yoke Mooring System (YMS) attached to a stationary tower structure that is secured to the seabed which houses the sendout pipeline. The YMS also is designed to allow the FSRU to orient in response to the prevailing wind, wave, and current conditions, that is, it will be able to pivot or weathervane around the tower. The FSRU will be non-propelled; however, it will be equipped with electrically powered azimuth stern thrusters to maintain a constant heading when LNG carriers are mooring at or getting underway from the FSRU. In addition, the FSRU will have a single berth on its starboard side to accommodate LNG carriers for off-loading of LNG. Living quarters to accommodate approximately 30 permanent and 30 temporary crew members will be installed on the facility aft of the LNG storage and containment area.

As proposed, LNG would be delivered to the FSRU in LNG carriers with cargo capacities ranging from 125,000 m^3 to 250,000 m^3. As proposed, 2 to 3 LNG carriers per week would deliver LNG to the FSRU. The FSRU would be equipped on its starboard side with berthing and unloading facilities for a single LNG carrier. The berth can accommodate one LNG carrier in the range of 125,000 - 250,000 m^3 at a time.

The location where Broadwater Energy has proposed to construct and operate the floating storage and regasification unit (FSRU) as an LNG import facility is in state waters. Therefore, the lead federal agency for this project is the Federal Energy Regulatory Commission (FERC). As the lead federal agency, FERC is responsible for making the decision whether to license the project.

In accordance with an interagency agreement, the Coast Guard is a cooperating agency and is responsible for providing input regarding navigation safety and maritime security to FERC as part of the environmental review process required by the National Environmental Policy Act (NEPA, *see* 42 U.S.C. §§ 4321 - 4370). This input is provided via this Waterway Suitability Report. FERC's decision whether to license the proposed Broadwater Energy FSRU will be based on a number of different issues, including the Coast Guard's recommendation.

The Coast Guard Captain of the Port (COTP) Long Island Sound will issue a Letter of Recommendation (LOR) in accordance with 33 C.F.R. § 127.009 to Broadwater Energy and the appropriate federal, state and local agencies. The LOR will be an official determination regarding the suitability or unsuitability of Long Island Sound to support the proposed FSRU and associated LNG carrier traffic. The LOR, which will be based on this Waterways Suitability Report, will not be issued until after the NEPA process has been completed.

In making a recommendation to FERC, the Coast Guard is not advocating for or against the proposed project. Rather, as the lead federal agency responsible for waterway safety and maritime security, the Coast Guard's recommendation is based solely on an objective assessment of whether the waterway is suitable for LNG marine traffic and the operation of the proposed FSRU. This assessment is based on the Coast Guard's statutory authority provided by the Ports and Waterways Safety Act (33 U.S.C. §§ 1221 *et seq.*) and the Maritime Transportation Security Act of 2002. This Report will be provided to FERC as an input for the draft Environmental Impact Statement for the proposed project.

This Waterways Suitability Report (WSR), which is based on guidance provided by the Coast Guard's Navigation and Vessel Inspection Circular (NVIC) 5-05, took over a year to complete and is based on an analytic and systematic assessment of potential risks to navigation safety and maritime security associated with the proposed Broadwater Energy project. The assessments of potential risks were evaluated in terms of the components of risk – threats, vulnerabilities and consequences.

The assessment included input from a Harbor Safety Working Group that was comprised of approximately 30 representatives of commercial, recreational and government waterway users as well as state and local agencies with responsibilities related to waterway safety. It also included input from a Sub Committee of the Long Island Sound Area Maritime Security Committee that included approximately 20 representatives of federal, state and local agencies with responsibilities related to maritime security. Extensive public input was also received through written comments that were submitted to the Coast Guard's docket for this project and during public scoping meetings that were held with FERC.

8.2 Key Points

The following key points are provided as a summary of the Coast Guard's assessment of safety and security issues related to determining the suitability of Long Island Sound for the Broadwater LNG project. This list is not all inclusive; detailed discussion of these key points and other information considered is contained in the text of this report.

- Long Island Sound is a mixed use waterway. Recreational, commercial, and fishing boats share this estuary of national significance. With respect to commercial traffic, Long Island Sound serves as thoroughfare of traffic destined for ports along the Sound, including the Riverhead and Northport Terminals, both of which are located on the north shore of Long Island and the Ports of New London, Bridgeport, New Haven, which are located in Connecticut. It also includes through traffic from the Port of New York / New Jersey that is transiting to or from ports located in Rhode Island and Massachusetts. The proposed location of the FSRU is in close proximity to this thoroughfare.
- Typically 450 foreign flagged vessels call on ports in Long Island Sound. In addition, approximately 4000-7000 domestic commercial vessels transit Long Island Sound. The addition of the proposed LNG carriers transiting to the FSRU would increase foreign flagged vessel traffic volume by 20-30%. The overall increase of commercial usage (tugs and barges, ferries, etc.) volume would be less than 1%.
- There are currently no known, credible threats against the proposed Broadwater Energy facility. However, it should be noted that the threat environment changes and that some threats may be unknown. If the project is approved by FERC, periodic threat assessments must be conducted in order to ensure the security measures in place are appropriate.
- The proposed location of the FSRU (approximately 10.2 miles from Connecticut and 9.2 miles from New York) has a number of significant safety and security benefits associated with its remoteness, especially with respect to threat and consequence since it would be remote from population centers. This fact would also serve to lessen the FSRU's attractiveness as a target. However, the remote location also creates some challenges in projecting a law enforcement presence to the center of the Sound. The proposed location also provides protection from weather and sea conditions on the open ocean, e.g., the Atlantic Ocean off the south shore of Long Island.
- The LNG carriers for the proposed project will transit waters under the jurisdiction of the state of New York, and in some cases may transit waters under the jurisdiction of the states of Rhode Island or Connecticut.
- Over the approximately 45 years since the shipment of LNG began, more the 33,000 LNG carrier voyages have taken place. Eight marine incidents worldwide have resulted in LNG spills. No cargo fires on LNG carriers have occurred.

- The principle characteristic of the consequences of a large open air release of LNG due to an accident or an attack is a fire, not an explosion. LNG fires are very intense and are of short duration, e.g., less than an hour.
- The hazard zones associated with the FSRU and next generation LNG carrier used in this report (250,000 m^3 capacity) are larger than those described in the Sandia Report. However, none of the hazard zones (Zone 1, Zone 2, or Zone 3) around the FSRU would impact any population centers due to their distance from land. Neither hazard Zone 1 nor Zone 2 for the next generation LNG carrier would impact land along the proposed transit route. Hazard Zone 3 (unignited vapor cloud) could impact land along some portions of the proposed LNG tanker transit route.
- Additional resources would be needed to mitigate safety and security risks associated with the Broadwater LNG project, if approved. The required security resources, in particular law enforcement capable personnel and small boats, are based on existing Coast Guard security policy. This policy takes into account a changing threat environment and the potential for unknown threats. The most probable security regime would consist of a mix of federal, state, and local law enforcement. If state and local law enforcement agencies are involved, they would also require additional resources. In the event that state and local law enforcement agencies are involved, these agencies and Broadwater Energy would be responsible for brokering a cost sharing agreement.
- The proposed safety/security zone around the FSRU is a circle centered on the mooring tower with a radius of 1210 yards. Long Island Sound is approximately 1320 square miles (an area that is approximately 4 percent smaller than Long Island, which is 1379 square miles). The area covered by the proposed safety security zone for the FSRU is approximately 0.12% of the total area of Long Island Sound.
- The proposed safety/security zone around the LNG carrier while in transit in Long Island Sound would extend 2 nautical miles in front of, 1 nautical mile behind, and 750 yards to either side of the LNG carrier. The safety/security zone would move with the LNG carrier. At a typical LNG carrier speed of 12 knots, it would take the entire zone approximately 15 minutes to pass a given point.
- The purpose of the safety/security zones is two-fold: to reduce risks to the public by limiting access to the areas of highest consequences should an LNG fire occur; and, to provide a security perimeter to protect the FSRU and LNG carriers.
- The Race is a critical waterway connecting Block Island Sound and Long Island Sound used for national defense, commerce and recreation. The impacts of the moving safety and security zone around LNG carriers on other waterway users could be managed.
- Additional marine firefighting resources would be required to mitigate fire risks associated with the Broadwater LNG project, if approved. Existing marine firefighting capability in Long Island Sound is inadequate.

8.3 Conclusion

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

Based on the results of the assessment of potential risks to navigation safety and maritime security associated with Broadwater Energy's proposal, the Coast Guard has determined that to make the waters of Block Island Sound and Long Island Sound suitable for LNG vessel traffic and the operation of the proposed FSRU, additional measures are necessary to responsibly manage the safety and security risks associated with the proposed project. The necessary measures, which are based on the recommendations and evaluation of effectiveness in Sections 4.6 and 4.7 as well as Sections 5.5 and 5.6 in the SSI Supplement to this Report, are outlined in Section 8.4.

8.4 Risk Management Strategies

Both the Harbor Safety Working Group and the AMSC Sub Committee developed a thorough set of recommended strategies for effectively managing risks to navigation safety and maritime security associated with the Broadwater Energy project. These management strategies include measures designed to reduce risk by reducing the potential that an accident or terrorist attack may be attempted as well as measures designed to reduce the potential consequences if there was a large release of LNG from either the proposed FSRU or an LNG carrier. These strategies are intended to manage low probability, high consequence events. The Coast Guard has determined that the recommended measures in Sections 4.6 and Section 5.5 of the SSI Supplement to this Report as well as the consequence management measures discussed in Section 6, are necessary to responsibly manage safety and security risks associated with the proposed Broadwater Energy project.

8.4.1 Broadwater Energy Actions

If the Broadwater Energy proposal is approved by FERC, the Coast Guard recommends that the following conditions be included on the Commission's Authorization for the project:

- Broadwater Energy shall provide proposed measures to prevent the FSRU from being set adrift following a potential failure of the mooring regardless of the cause of the failure. Proposed measures should take into account, among other things, adverse wind and sea conditions, potential impacts of mishaps onboard the FSRU (e.g. fire, collision damage, etc.), time of day, proximity to shoal waters, and other vessel traffic in the vicinity. A layered approach for mitigation measures is necessary.
- Develop and submit to FERC and the Coast Guard a process for developing the Emergency Response Plan required by Section 311 of the Energy Policy Act of 2005

that incorporates the recommendations in Section 6.2 of this Report. The timeline for developing the Emergency Response Plan must be linked to the design timeline so to ensure consistency.

- Broadwater Energy shall equip the FSRU with appropriate navigation equipment to assess the risk of allision and to communicate with vessels transiting in the vicinity as well as appropriate lights and sound signals. Minimum equipment requirements are listed in Appendix I of this report.
- The marine crew for the FSRU shall, in addition to the Port Superintendent, Mooring Master, Cargo Supervisor and Cargo Transfer Assistant discussed in Section 11.3.6.1 of Resource Report 11, include three Vessel Traffic Supervisors. The professional training requirements and duties of the Vessel Traffic Supervisors are outlined in Appendix I of this report.
- Broadwater Energy shall conduct the simulations as discussed in Section 4.6.1.3 of this Report to determine the number and capabilities of the assist tugs required to support LNG carrier berthing and unberthing. In addition, Broadwater Energy shall provide suitable documentation, e.g., a contract, to FERC and the U.S. Coast Guard indicating that the required number of assist tugs will be available at all times while the FSRU, if constructed, is in operation.
- Broadwater Energy shall schedule LNG carrier arrivals and departures to minimize conflicts with other waterway users, including the U.S. Navy, as discussed in Section 4.6.1.2 of this Report.
- Broadwater, in coordination with the Connecticut Department of Transportation, the New York Board of Pilot Commissioners, and the U.S. Coast Guard shall conduct full mission bridge simulator training for all pilots who may be responsible for serving as a pilot on LNG carriers calling at the FSRU. In addition, Broadwater Energy shall arrange to have a pilot licensed by either the State of New York or the State of Connecticut remain on board LNG carriers while they are moored at the FSRU.
- Broadwater Energy shall conduct the modeling necessary to establish the performance requirements for escort tugs as discussed in Section 6.3.1. In addition Broadwater Energy shall provide FERC and the U.S. Coast Guard suitable documentation, e.g., a contract, indicating that the required number of escort tugs will be available at all times to escort LNG carriers through The Race and eastern Block Island Sound. It should be noted that additional requirements for escort tugs may be identified during the emergency response planning process.
- Broadwater Energy shall mark the outer limits of the safety / security zone around the FSRU as follows: the cardinal points will be marked with lighted buoys and the inter-cardinal points with unlighted buoys. Broadwater Energy will be responsible for applying for all required permits and for maintaining these buoys in accordance with the requirements in 33 C.F.R. part 66.
- Broadwater Energy shall prepare and submit an Operations Manual as required by 33 C.F.R. § 127.305 and an Emergency Manual as required by 33 C.F.R. § 127.307 to the Captain of the Port Long Island Sound for review and approval at least 6 months but no more than 12 months before the FSRU would receive LNG deliveries. These manuals shall include the applicable requirements stipulated on the facility license and shall be consistent with the facility's Emergency Response Plan.

- Broadwater Energy shall amend the PPSAO to incorporate the recommendations in Sections 5.5.1, 5.5.2, 5.5.3, 5.5.7, 5.5.8, 5.5.9, 5.5.11, 5.5.14, and 5.5.17 of the SSI Supplement to this Report. In addition, Broadwater Energy shall annually review and amend, as necessary, the PPSAO and submit it to Coast Guard Captain of the Port Long Island Sound for review. A facility security plan prepared in accordance with 33 C.F.R. part 105 shall be submitted for review and approval at least 6 months but no more than 12 months before the FSRU would receive LNG deliveries.

8.4.2 Coast Guard Actions

If the Broadwater Energy proposal is approved by FERC, the Coast Guard will continue to systematically analyze the waters of Block Island Sound and Long Island Sound to effectively manage the potential risks to navigation safety and maritime security associated with the project. For these waterways to be suitable for LNG marine traffic and operation of the Broadwater FSRU would require the Coast Guard to:

- Continue to cooperate with FERC on the review and approval of the design and construction of the yoke mooring system and the FSRU as outlined in Section 1.2.1 of this Report. The Coast Guard will also work with FERC to implement as appropriate the recommendations related to the design and construction of the yoke mooring system outlined in Sections 4.6.2.1 and 4.6.2.2 as well as Section 5.5.1 of the SSI Supplement of this Report. Of particular concern will be ensuring the adequacy of the yoke mooring system.
- Continue to work with FERC to establish an inspection regime that is consistent with the recommendations in Sections 4.6.2.1, 4.6.2.2, and 4.6.2.3 of this report.
- Coordinate with FERC to provide appropriate oversight and to participate in the development and approval of the Emergency Response Plan required by Section 311 of the Energy Policy Act of 2005.
- Initiate the development of regulations promulgating a moving safety and security zone around LNG carriers and a fixed safety and security zone around the FSRU as described in Sections 4.6.1.4 and 4.6.1.5.
- Conduct a Port Access Route Study (PARS) as required by 33 U.S.C. § 1223(c) to evaluate the recommendation in Section 4.6.1.6 of this Report to establish vessel traffic routing measures on Block Island Sound and Long Island Sound. The PARS could result in alternative recommendations to those included in this Report.
- Conduct an evaluation with waterway users of potential options, including the recommendation in Section 4.6.1.7 to establish of a Vessel Traffic Service, for real time monitoring and, when necessary directing, vessel traffic on Block Island Sound and Long Island Sound. This evaluation could result in alternative recommendations to those in this Report.
- Develop for consideration a resource proposal to obtain additional Coast Guard personnel and equipment resources necessary to conduct compliance inspections on the FSRU as well as port state control exams on LNG carriers.
- Develop for consideration a resource proposal to obtain additional Coast Guard personnel and equipment resources necessary to implement the recommendations in Sections 5.5.7, 5.5.9, 5.5.10 and 5.5.11 of the SSI Supplement and Section 6.3.2 to

this Report. Basic equipment and personnel resource requirements are described in Section 7.2.

- Coordinate with the Transportation Security Agency and the Federal Aviation Administration to further evaluate the recommendation in Section 5.5.6 to establish flight restrictions over the FSRU.

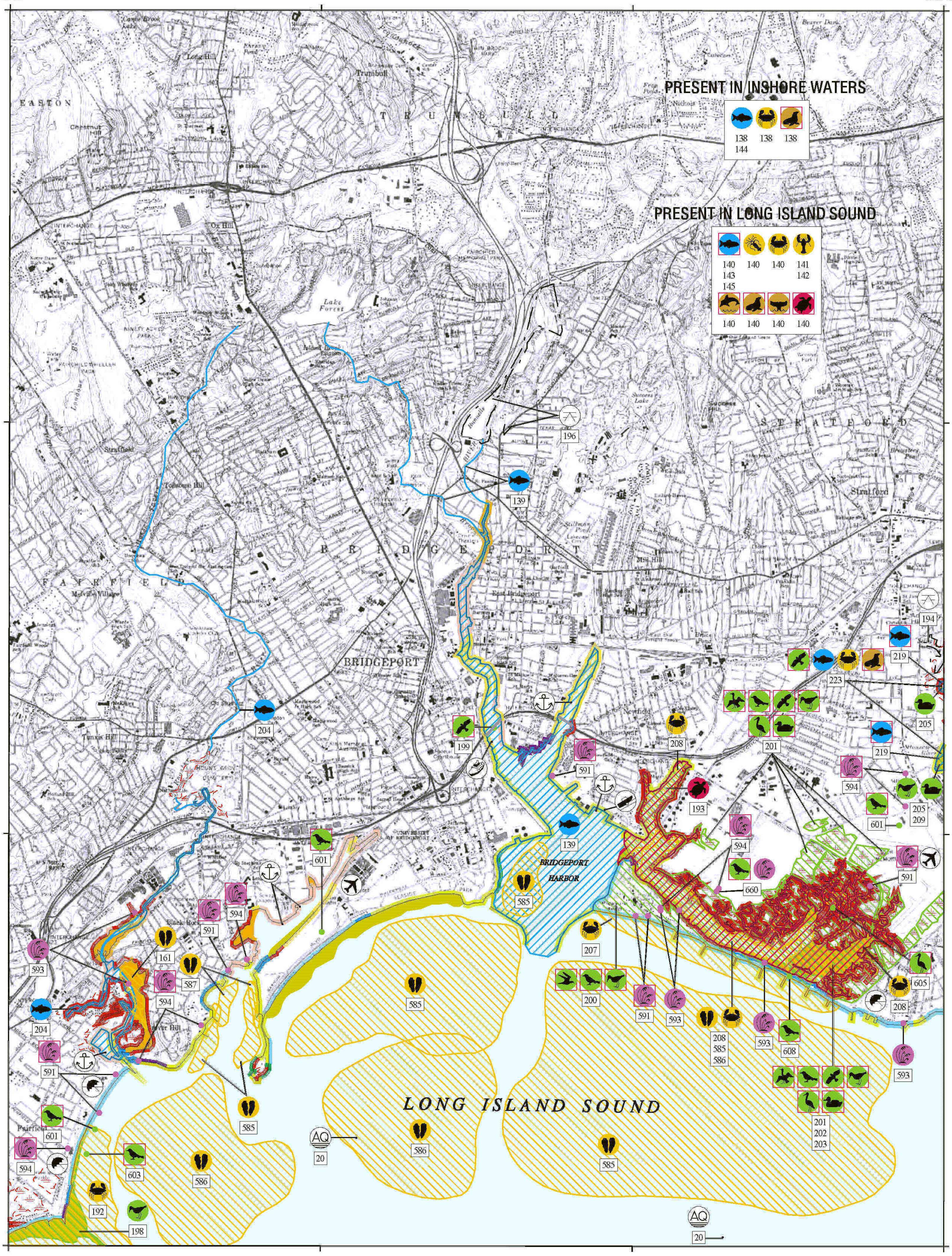
8.4.3 Other Government Agency Actions

If the Broadwater Energy proposal is approved by FERC, other federal, state, and local agencies with responsibilities related to the proposed project or whose jurisdiction may reasonably be expected to be impacted by a potential navigation safety accident or terrorist attack should engage in the development of the Emergency Response Plan Required by Section 311 of the Energy Policy Act of 2005. The Coast Guard will facilitate this process by continuing to involve the Long Island Sound AMSC in the development and review of the facility security plan for the FSRU and the Harbor Safety Committee in the development of the Emergency Response Plan. The Coast Guard will also involve waterway users in the development of risk management strategies such as vessel traffic routing measures.

APPENDIX G TO THE WSR

ESI MAPS

ENVIRONMENTAL SENSITIVITY INDEX MAP



SHORELINE HABITATS (ESI)

- 1A EXPOSED ROCKY SHORES
- 1B EXPOSED, SOLID MAN–MADE STRUCTURES
- 2A EXPOSED WAVE–CUT PLATFORMS IN BEDROCK
- 2B SCARPS AND STEEP SLOPES IN MUDDY SEDIMENTS
- 3A FINE–TO MEDIUM–GRAINED SAND BEACHES
- 4 COARSE–GRAINED SAND BEACHES
- 5 MIXED SAND AND GRAVEL BEACHES
- 6A GRAVEL BEACHES
- 6B RIPRAP
- 7 EXPOSED TIDAL FLATS
- 8A SHELTERED ROCKY SHORES
- 8B SHELTERED, SOLID MAN–MADE STRUCTURES
- 8C SHELTERED RIPRAP
- 8F VEGETATED STEEPLY–SLOPING BLUFFS
- 9A SHELTERED TIDAL FLATS
- 9B SHELTERED VEGETATED LOW BANKS
- 10A SALT–AND BRACKISH–WATER MARSHES
- 10B FRESHWATER MARSHES
- 10C SWAMPS
- 10D SCRUB–SHRUB WETLANDS

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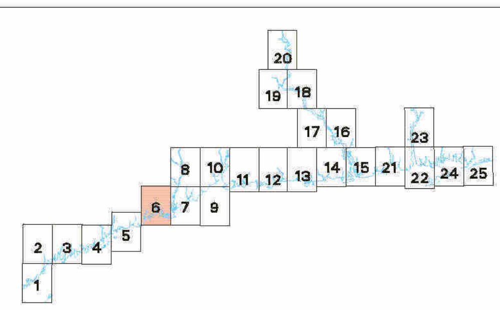
Not For Navigation

Published: October 2001

Published at Seattle, Washington
National Oceanic and Atmospheric Administration
National Ocean Service
Office of Response and Restoration
Hazardous Materials Response Division



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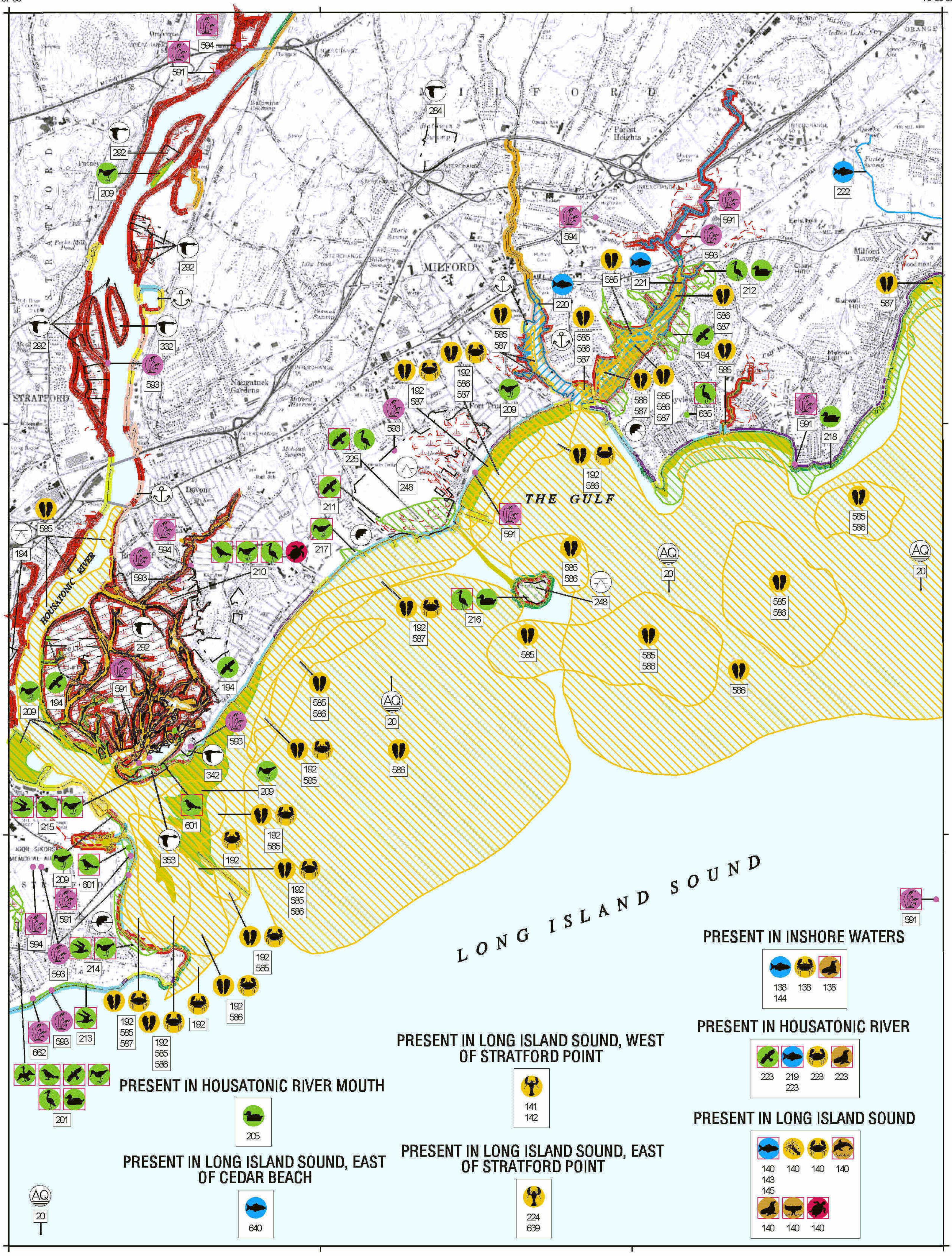
ENVIRONMENTAL SENSITIVITY INDEX MAP



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- 10C SWAMPS
- 10D SCRUB-SHRUB WETLANDS

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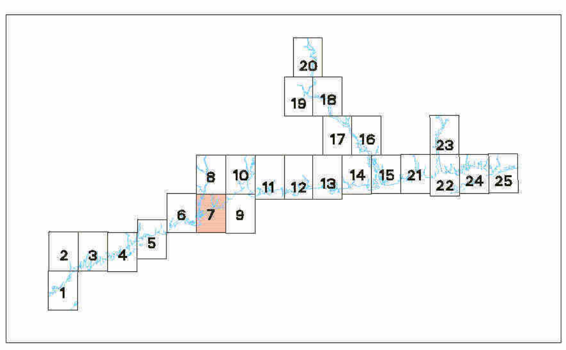

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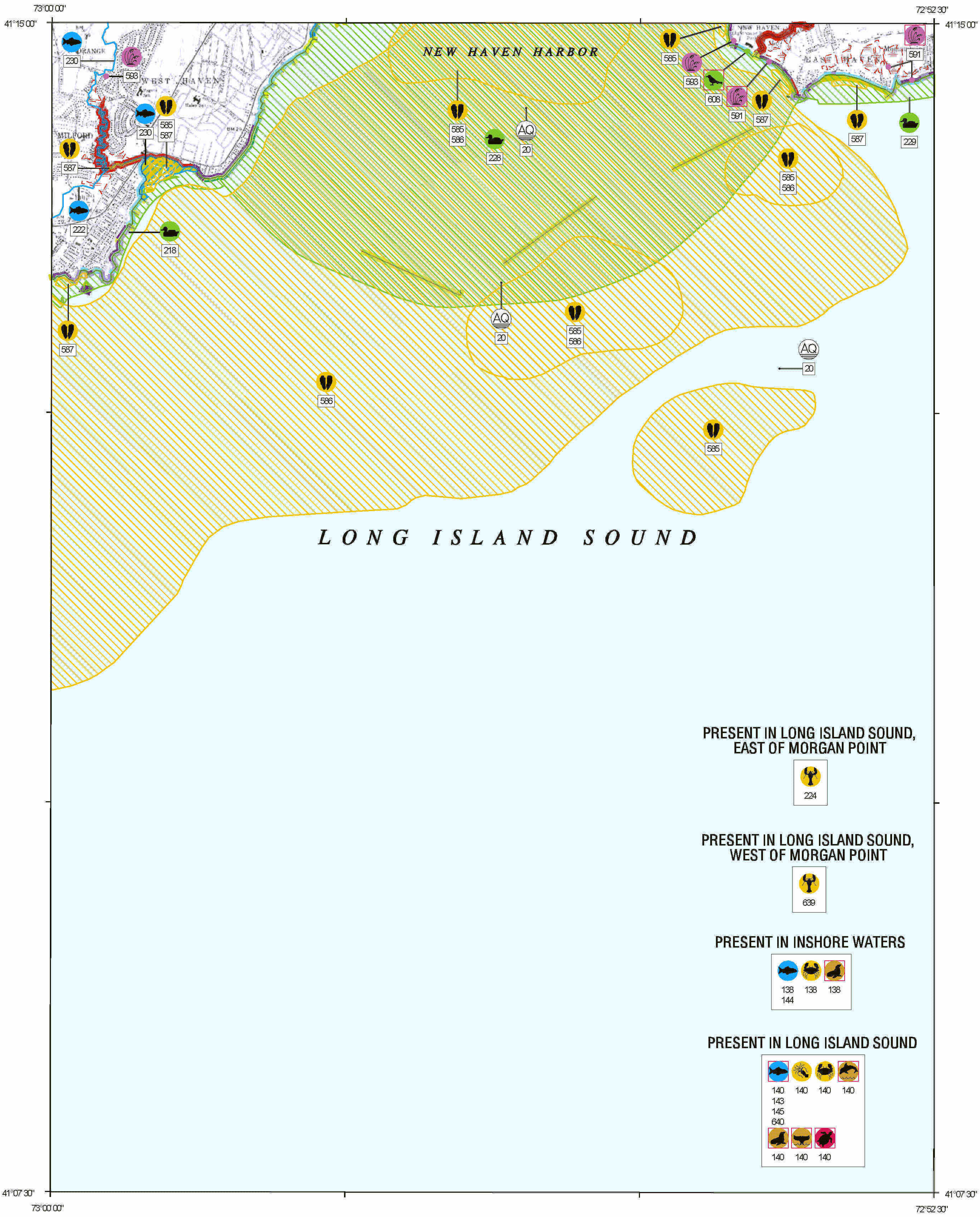
ENVIRONMENTAL SENSITIVITY INDEX MAP



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- 7 EXPOSED TIDAL FLATS
- 8A SHELTERED ROCKY SHORES
- 8B SHELTERED, SOLID MAN-MADE STRUCTURES
- 8C SHELTERED RIPRAP
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- 10A SALT- AND BRACKISH-WATER MARSHES
- 10B FRESHWATER MARSHES
- 10C SWAMPS
- 10D SCRUB-SHRUB WETLANDS

N W E S

SCALE 1:50000

1 .5 0 1 KILOMETER

1 .5 0 1 MILE

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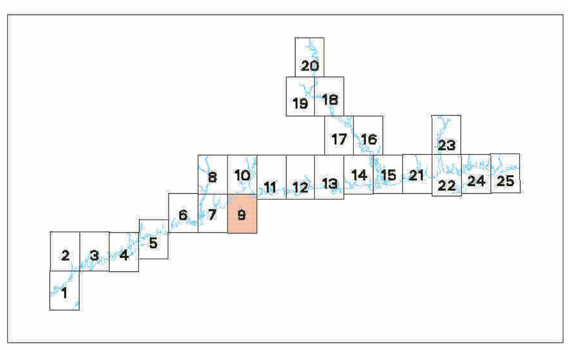
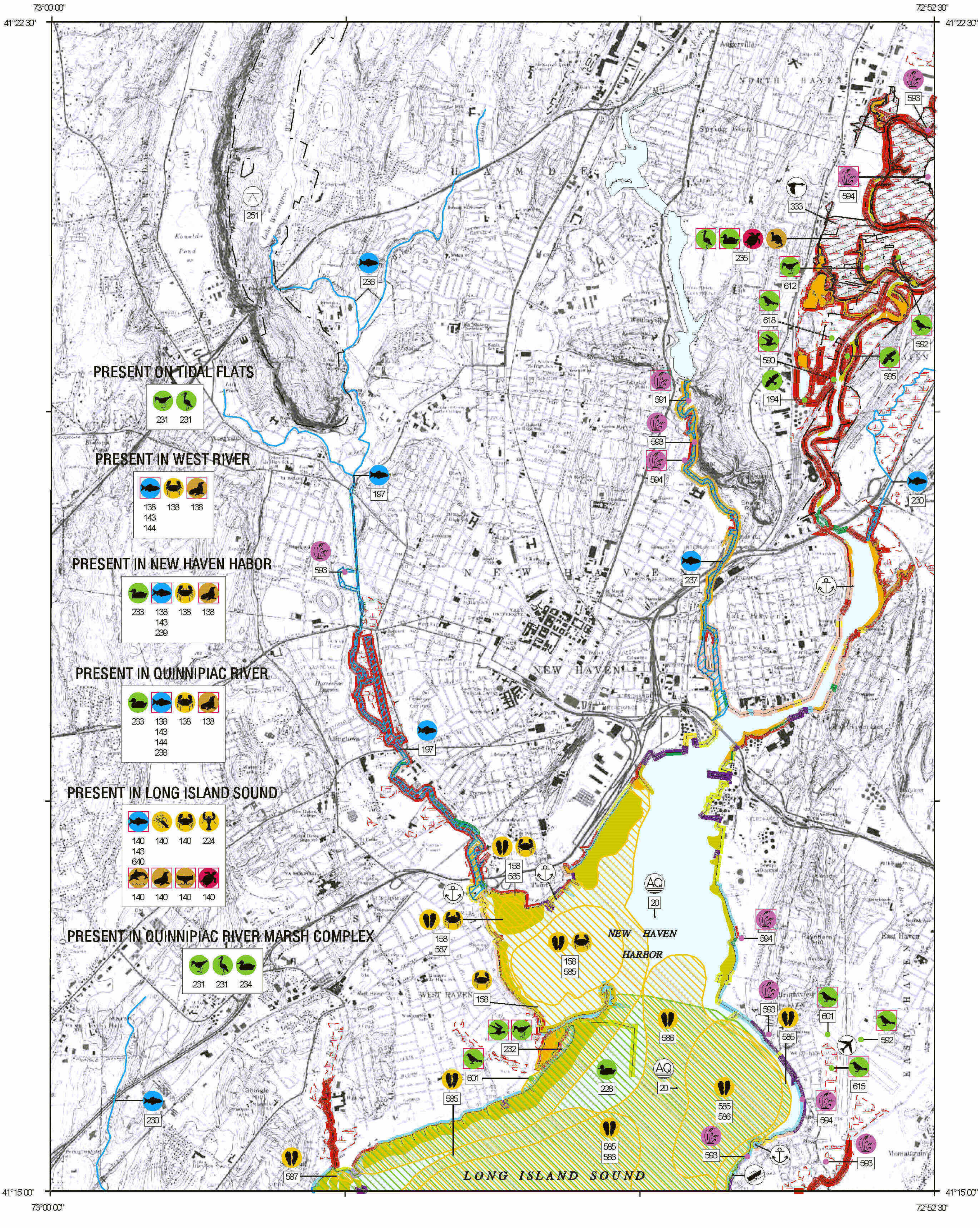


WOODMONT, CT. (1976) CT-9

ENVIRONMENTAL SENSITIVITY INDEX MAP



SHORELINE HABITATS (ESI)

- 1A EXPOSED ROCKY SHORES
- 1B EXPOSED, SOLID MAN-MADE STRUCTURES
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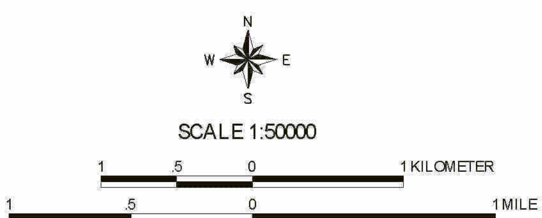

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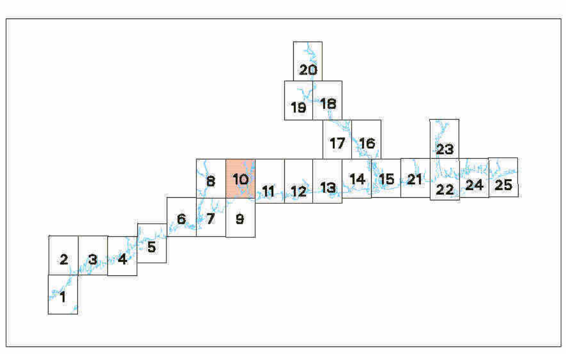
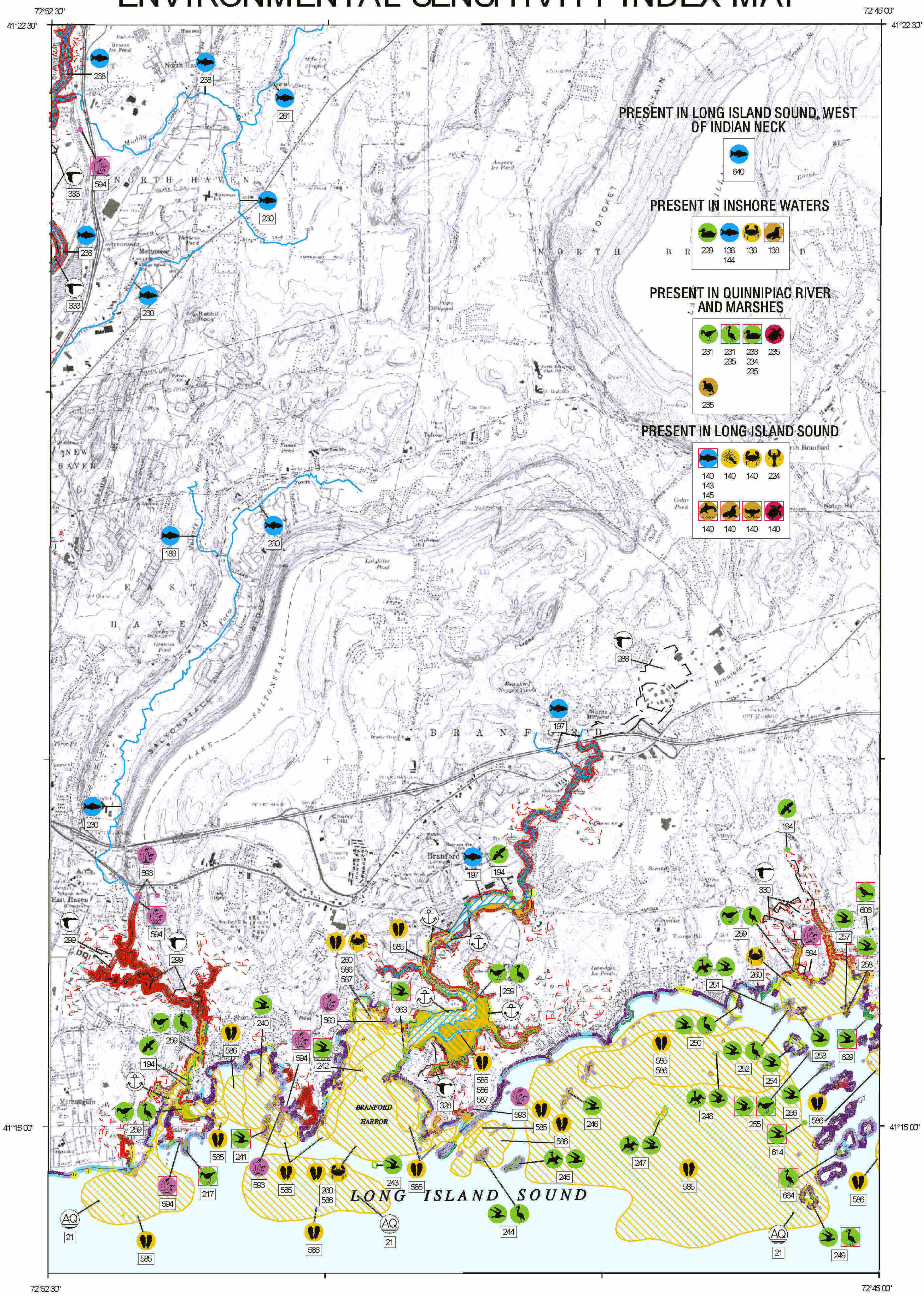


NEW HAVEN, CT. (1984) CT-10

ENVIRONMENTAL SENSITIVITY INDEX MAP



SHORELINE HABITATS (ESI)

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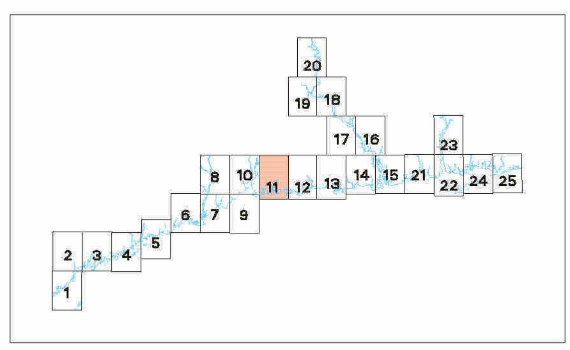
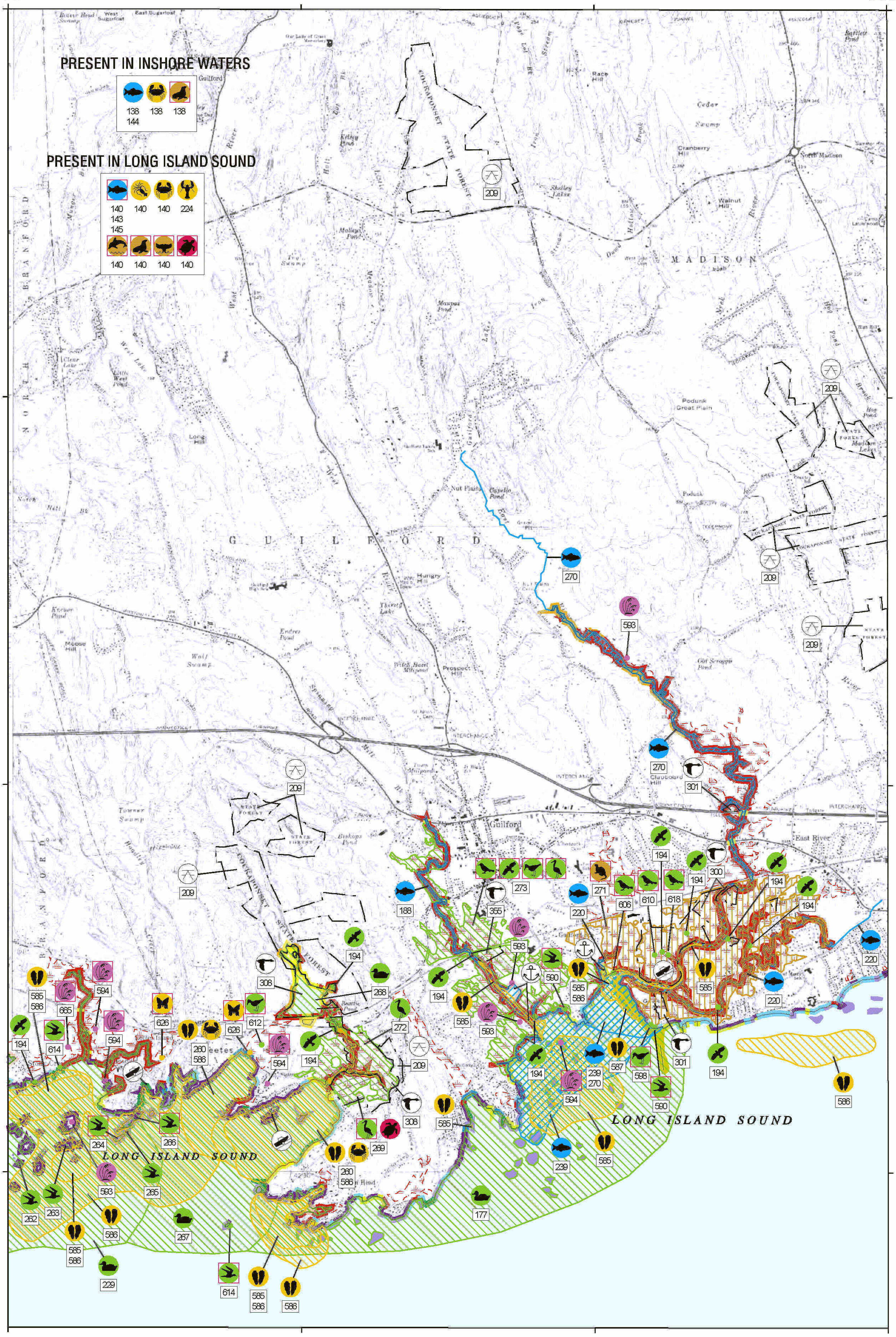


BRANFORD, CT. (1984) **CT-11**

ENVIRONMENTAL SENSITIVITY INDEX MAP



SHORELINE HABITATS (ESI)

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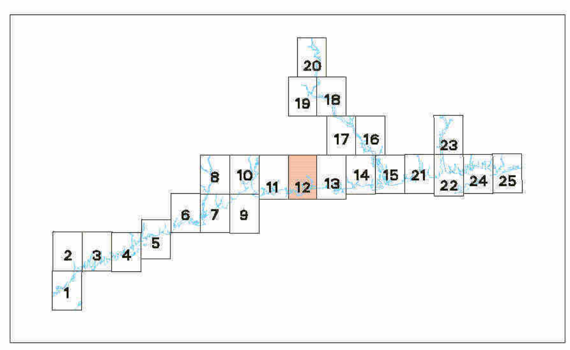
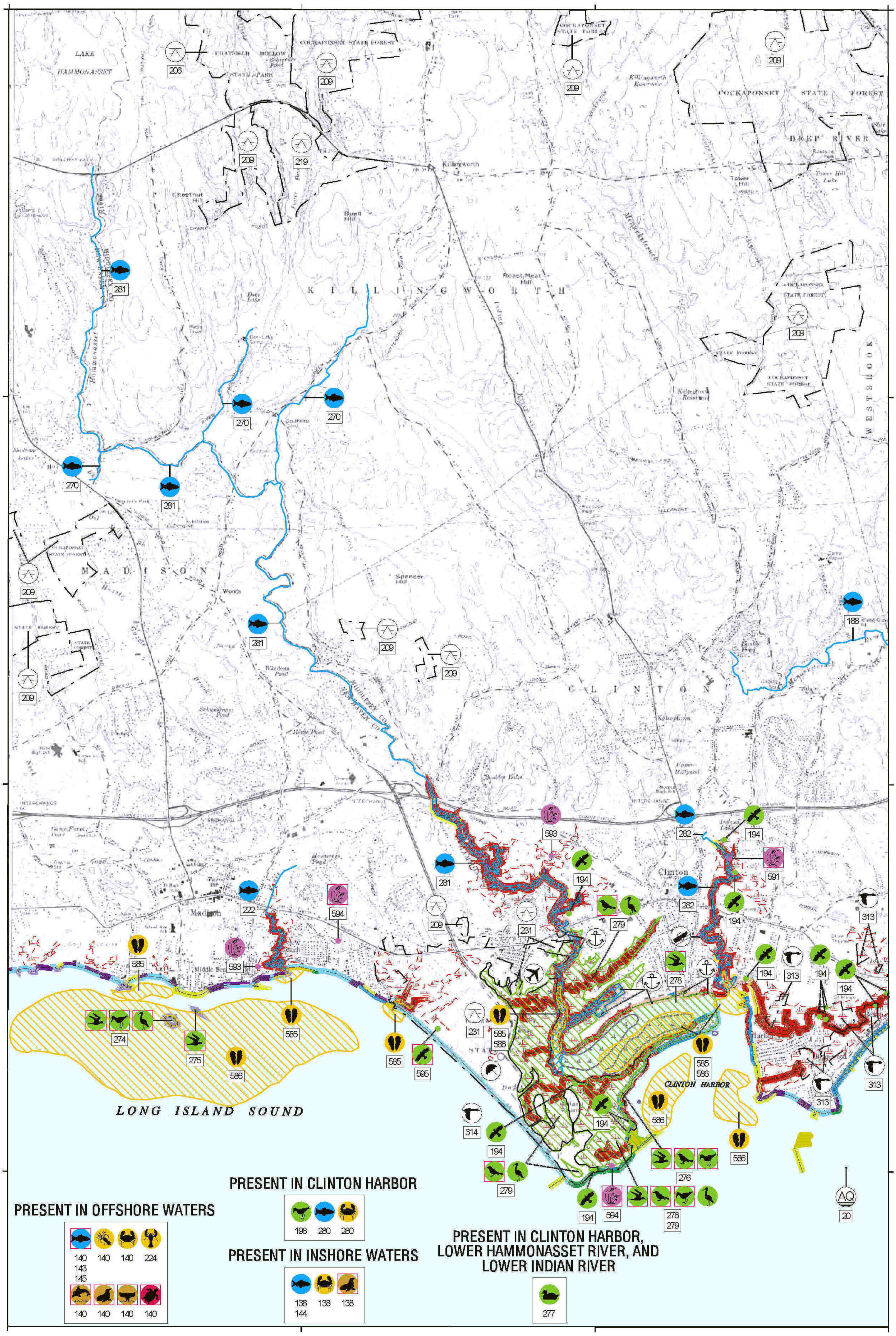


GUILFORD, CT. (1984) **CT-12**

BW029542

ENVIRONMENTAL SENSITIVITY INDEX MAP



SHORELINE HABITATS (ESI)

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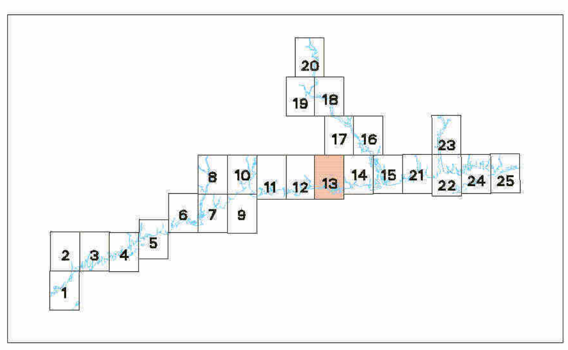
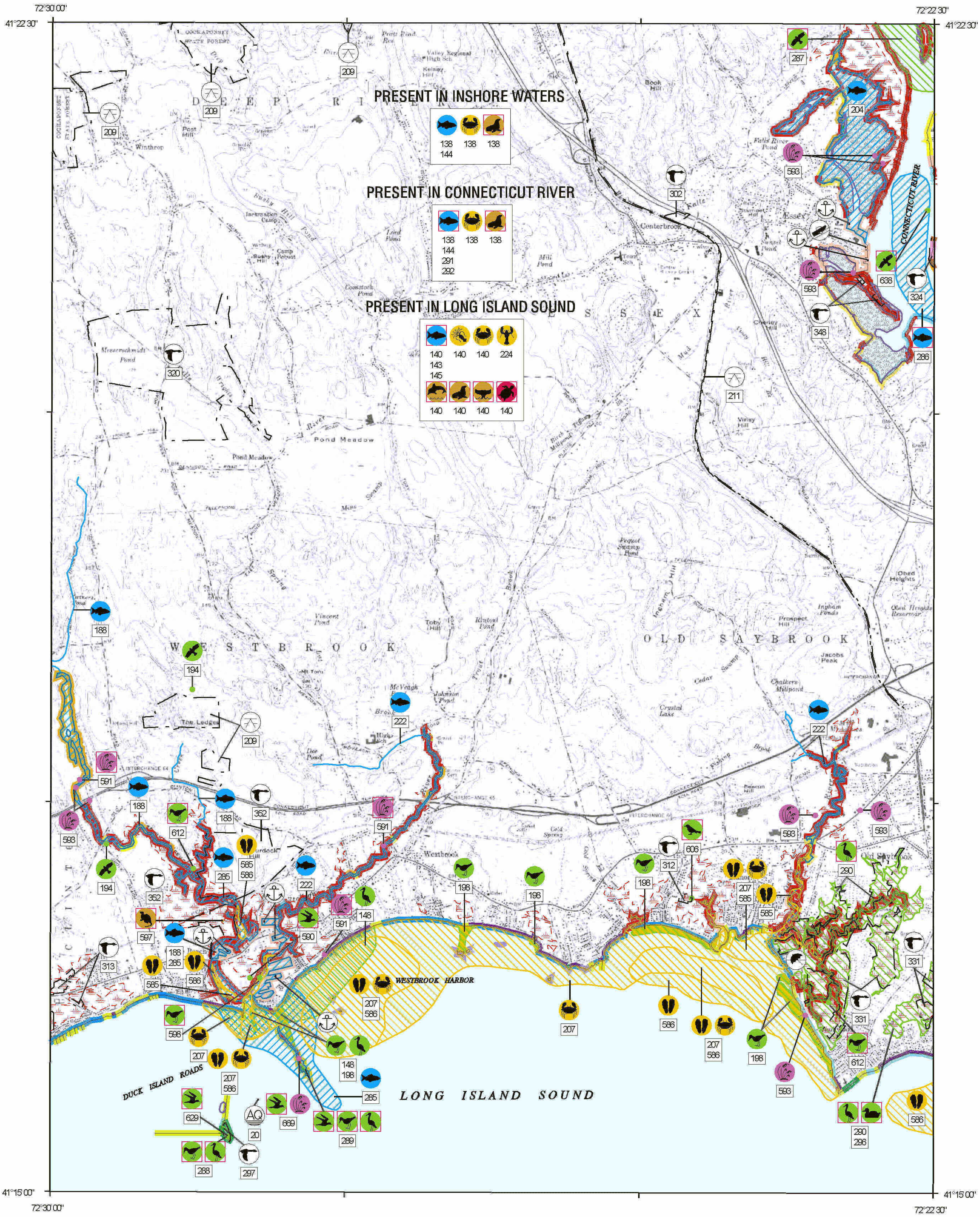


CLINTON, CT. (1984) CT-13

ENVIRONMENTAL SENSITIVITY INDEX MAP



SHORELINE HABITATS (ESI)

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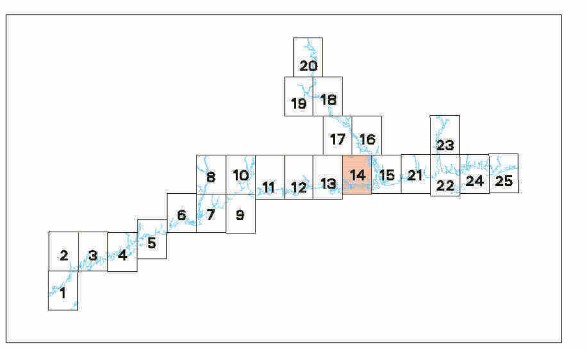
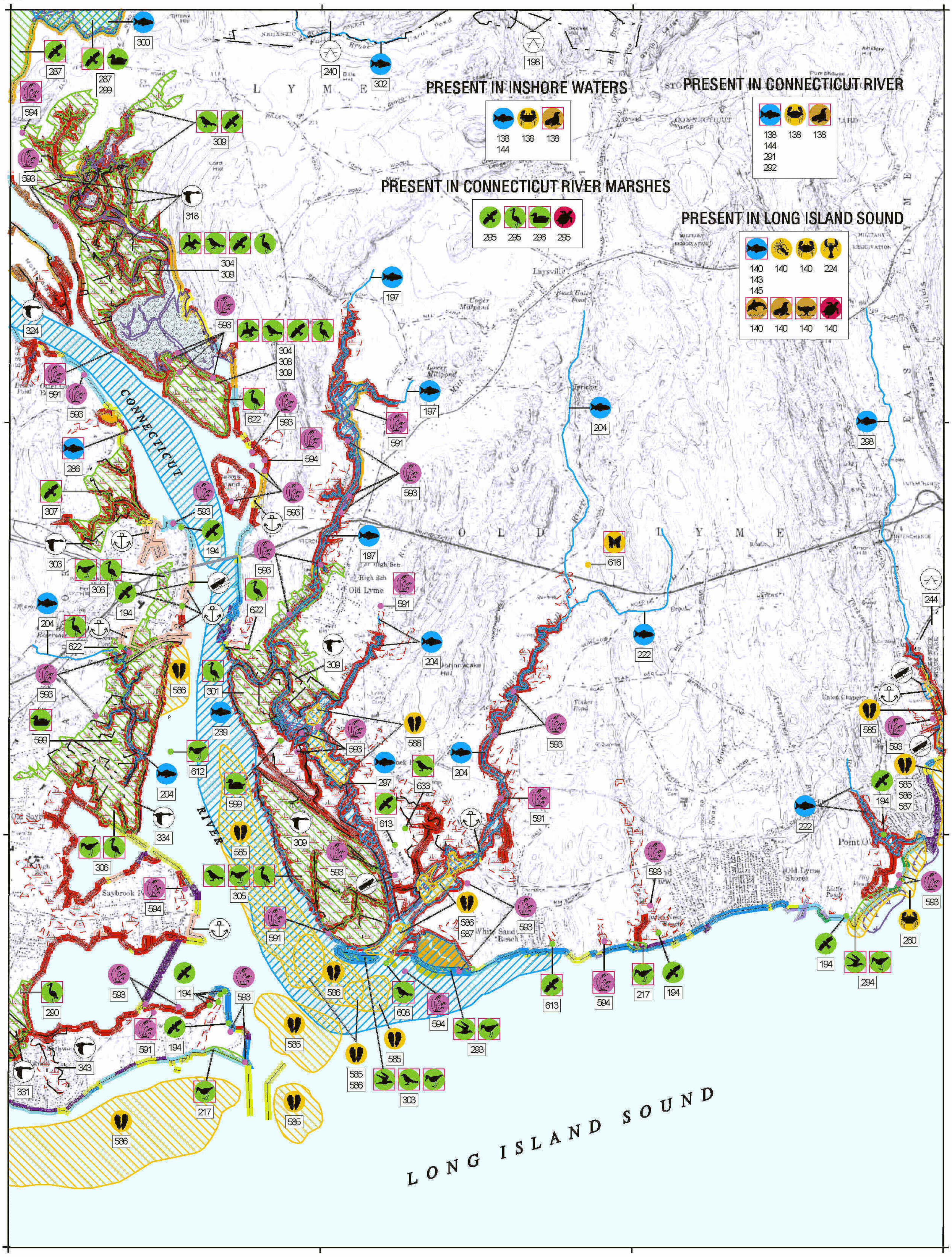


ESSEX, CT. (1977) **CT-14**

ENVIRONMENTAL SENSITIVITY INDEX MAP



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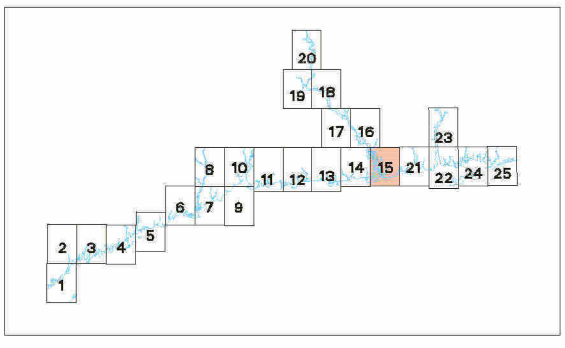
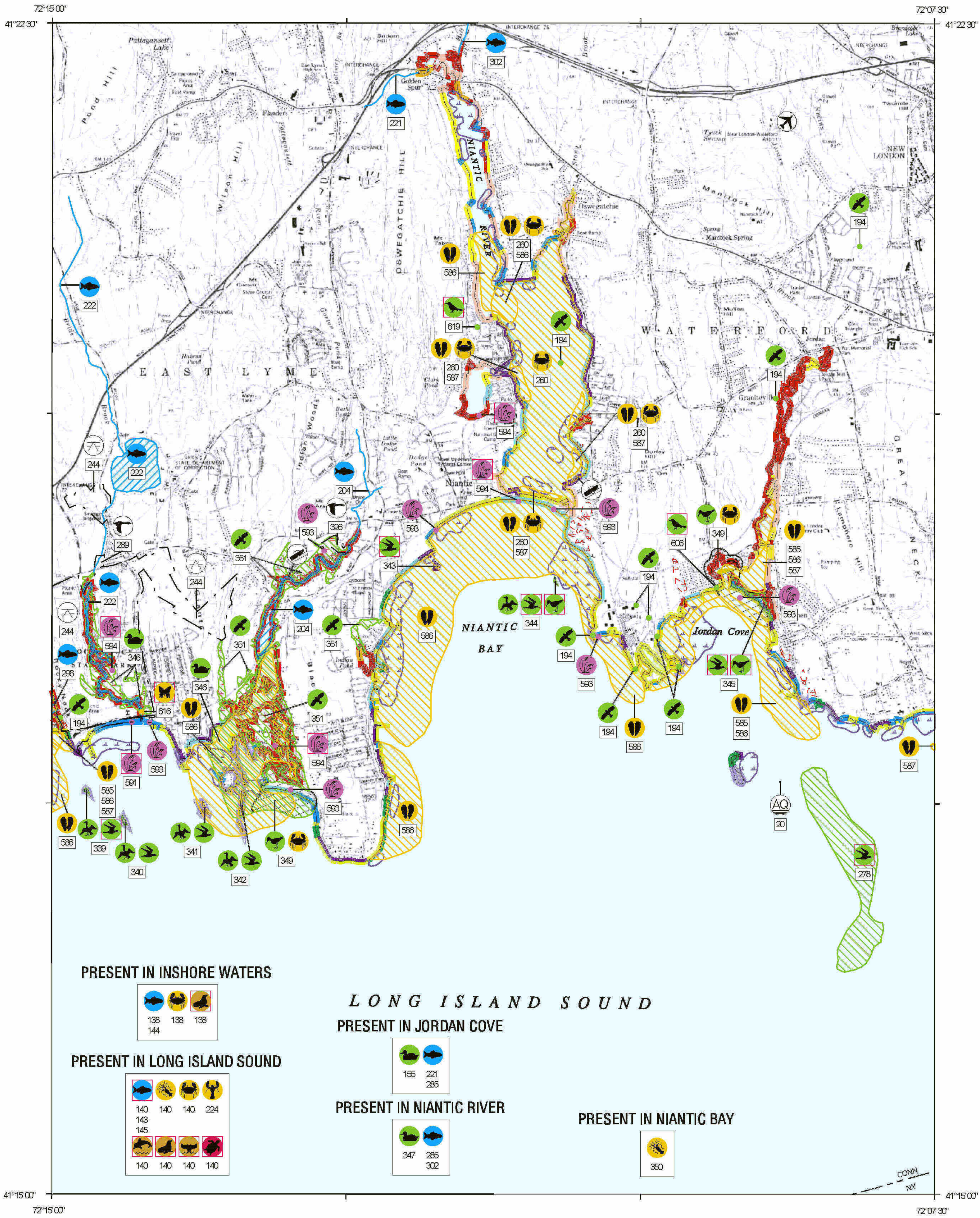


OLD LYME, CT. (1976) **CT-15**

BW029545

ENVIRONMENTAL SENSITIVITY INDEX MAP



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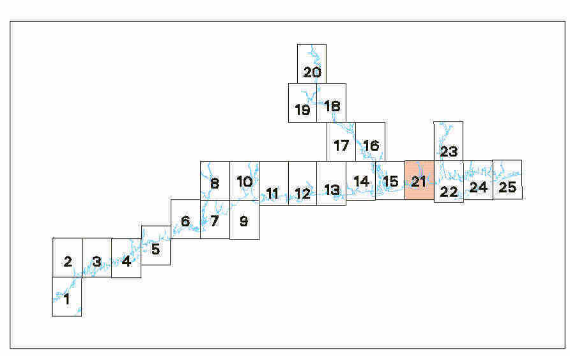
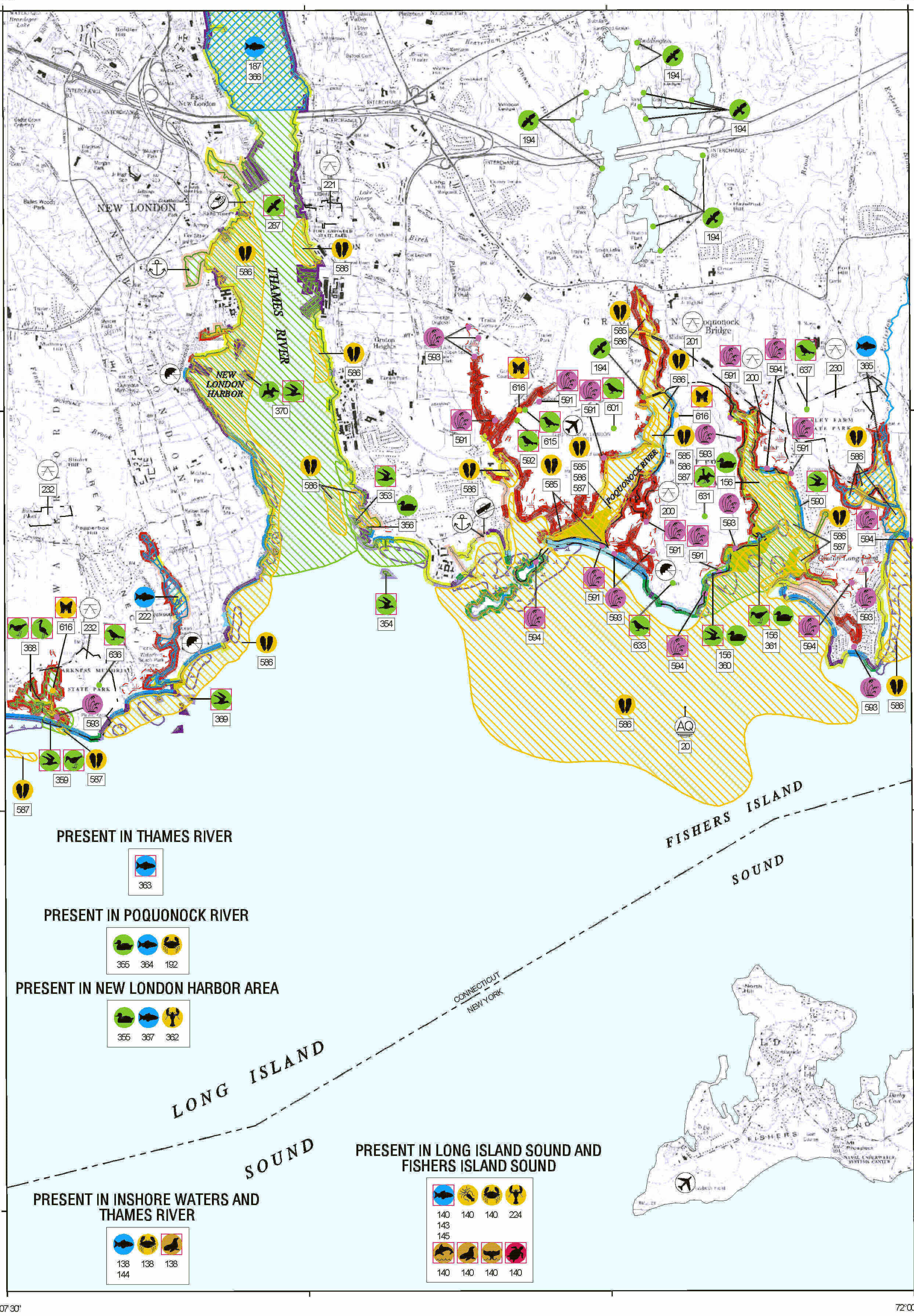


NIANTIC, CT. - N.Y. (1983) **CT-21**

BW029546

ENVIRONMENTAL SENSITIVITY INDEX MAP



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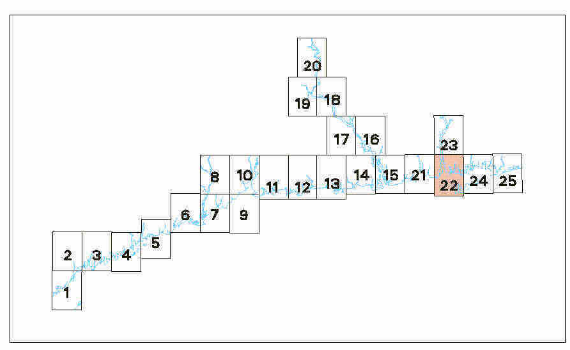
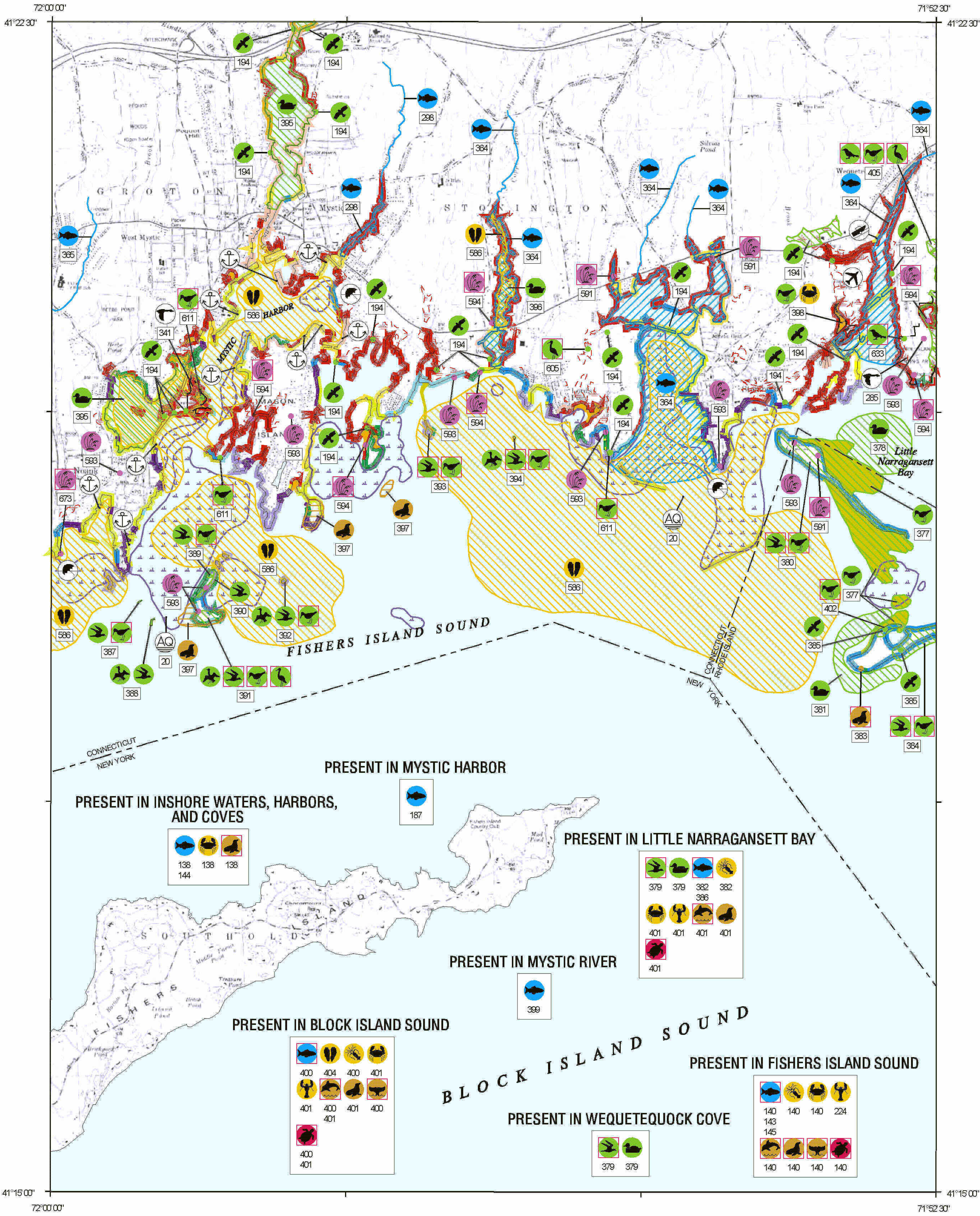


NEW LONDON, CT. - N.Y. (1984) **CT-22**

BW029547

ENVIRONMENTAL SENSITIVITY INDEX MAP



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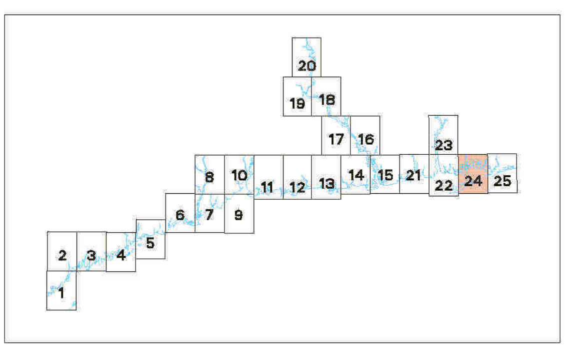
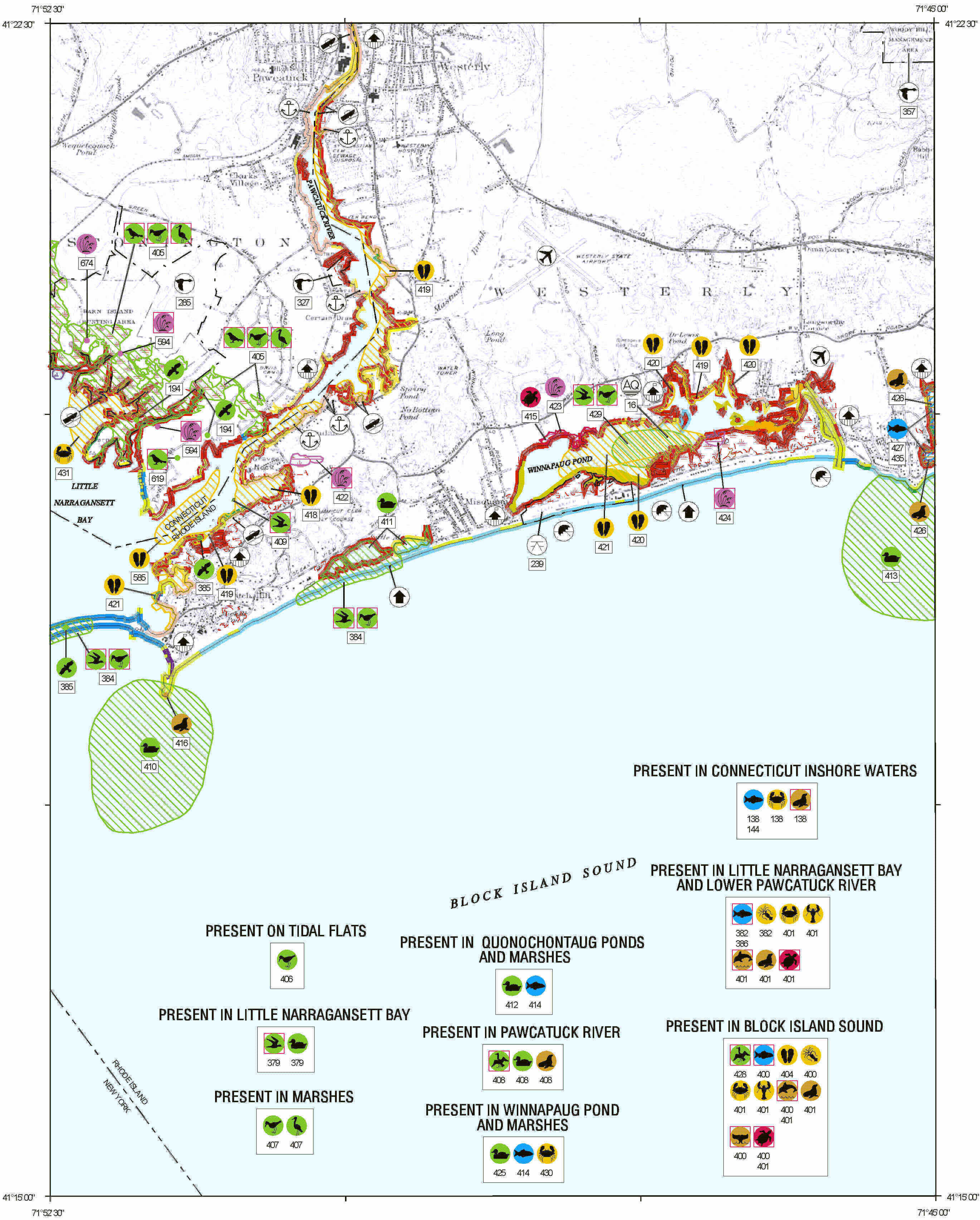


MYSTIC, CT. - N.Y. - R.I. (1984) **CT-24**

BW029548

ENVIRONMENTAL SENSITIVITY INDEX MAP



SHORELINE HABITATS (ESI)

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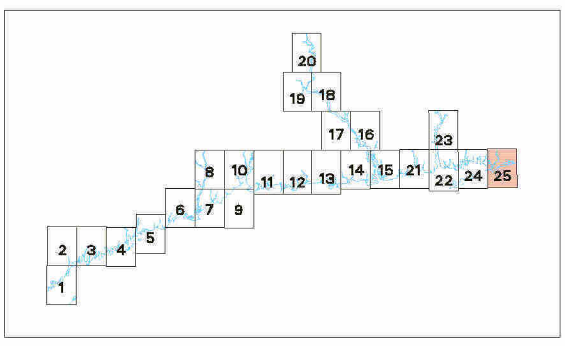

WATCH HILL, R.I. - CT. (1984)

CT-25

ENVIRONMENTAL SENSITIVITY INDEX MAP

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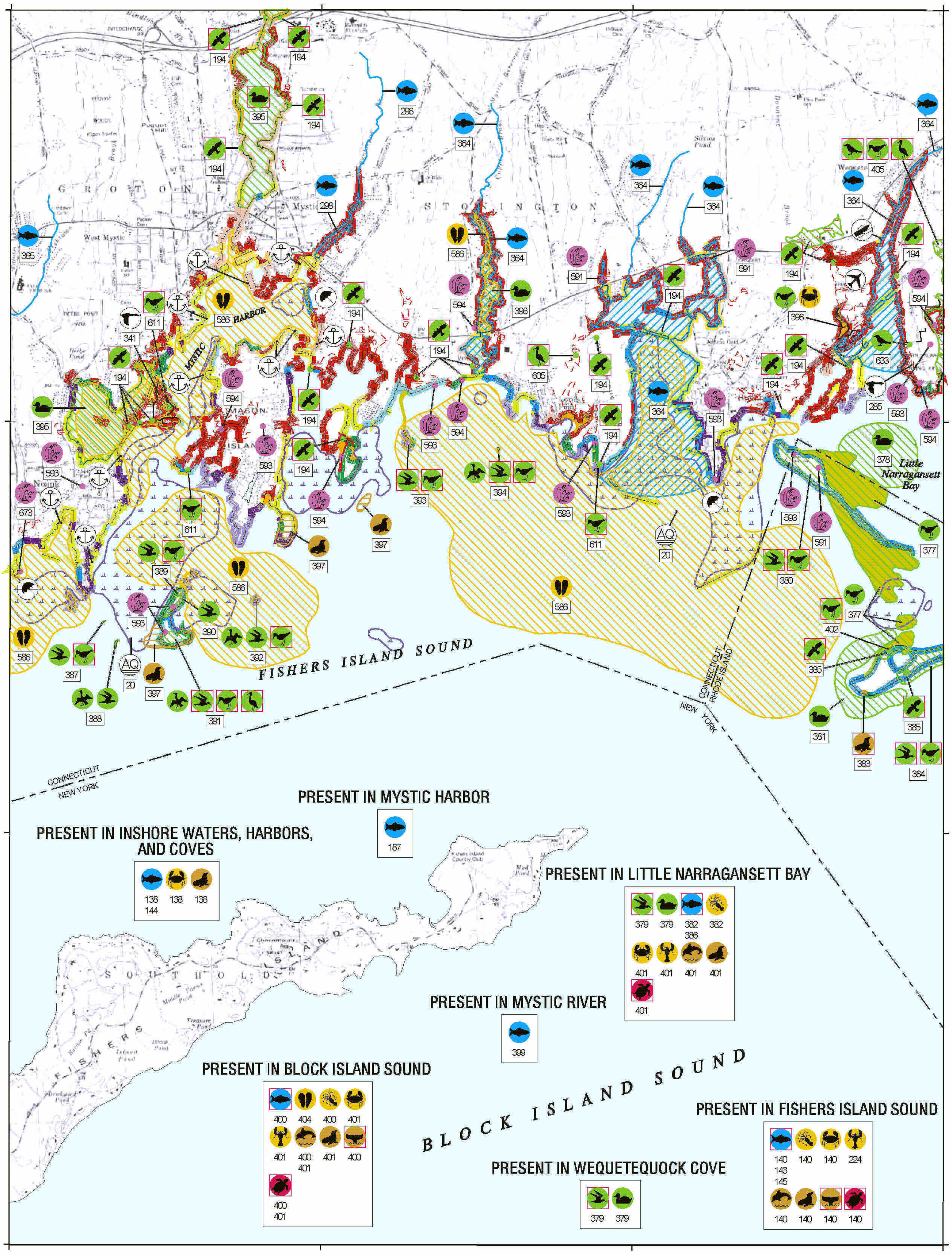
41°22'30" 41°22'30"



41°15'00" 41°15'00"
72°00'00" 71°52'30"

SHORELINE HABITATS (ESI)

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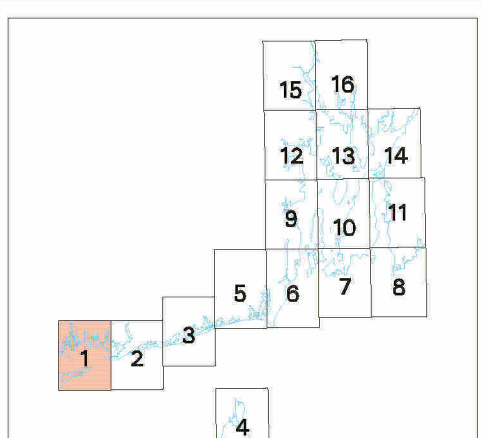
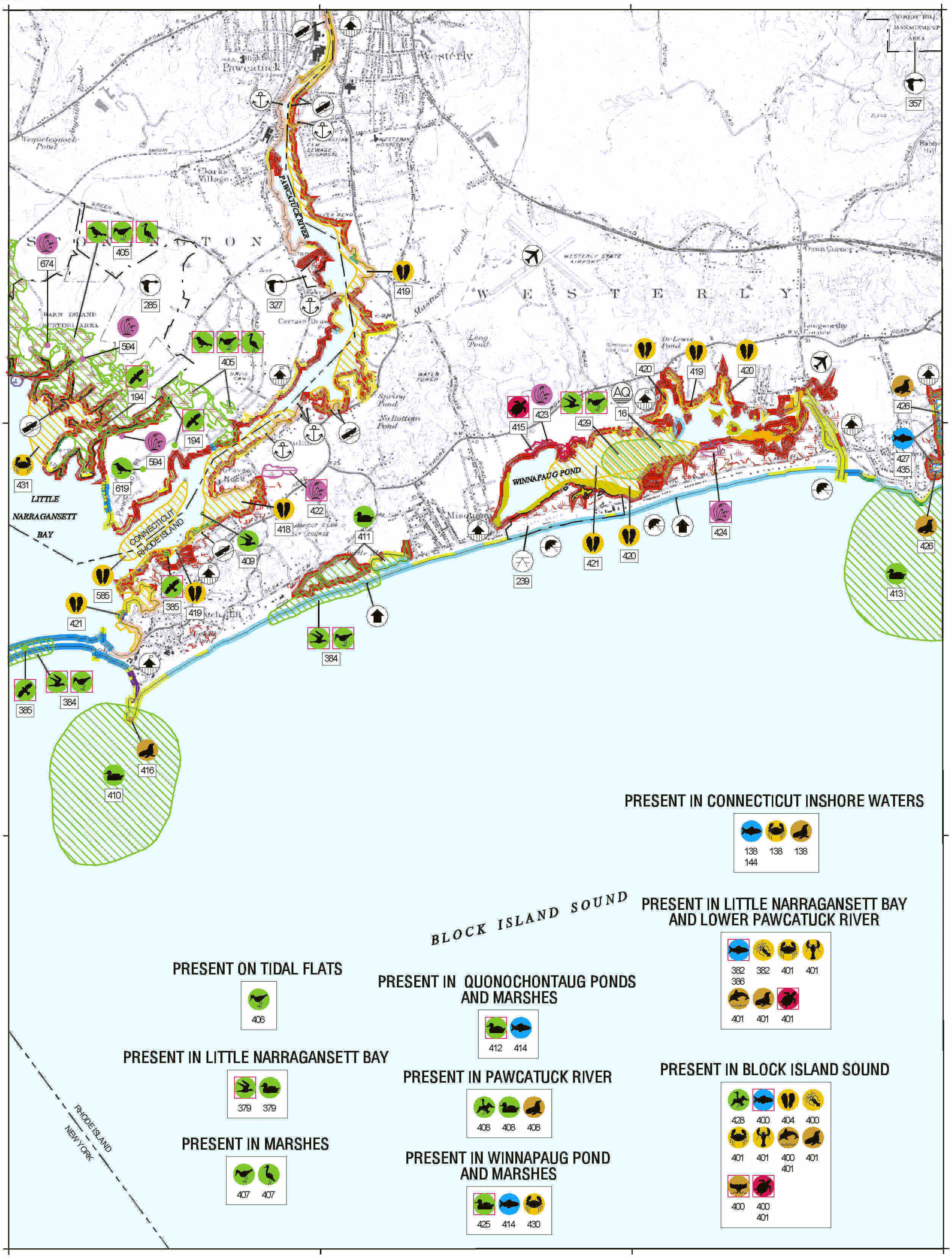


MYSTIC, CT. - N.Y. - R.I. (1984) **RI-1**

ENVIRONMENTAL SENSITIVITY INDEX MAP

71°52'30" 71°45'00"
41°22'30" 41°22'30"



41°15'00" 41°15'00"
71°52'30" 71°45'00"

SHORELINE HABITATS (ESI)

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SCALE 1:50000

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1 .5 0 1 MILE

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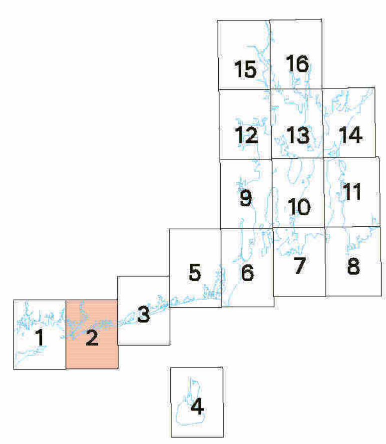

WATCH HILL, R.I. - CT. (1984) RI-2

BW029551

ENVIRONMENTAL SENSITIVITY INDEX MAP

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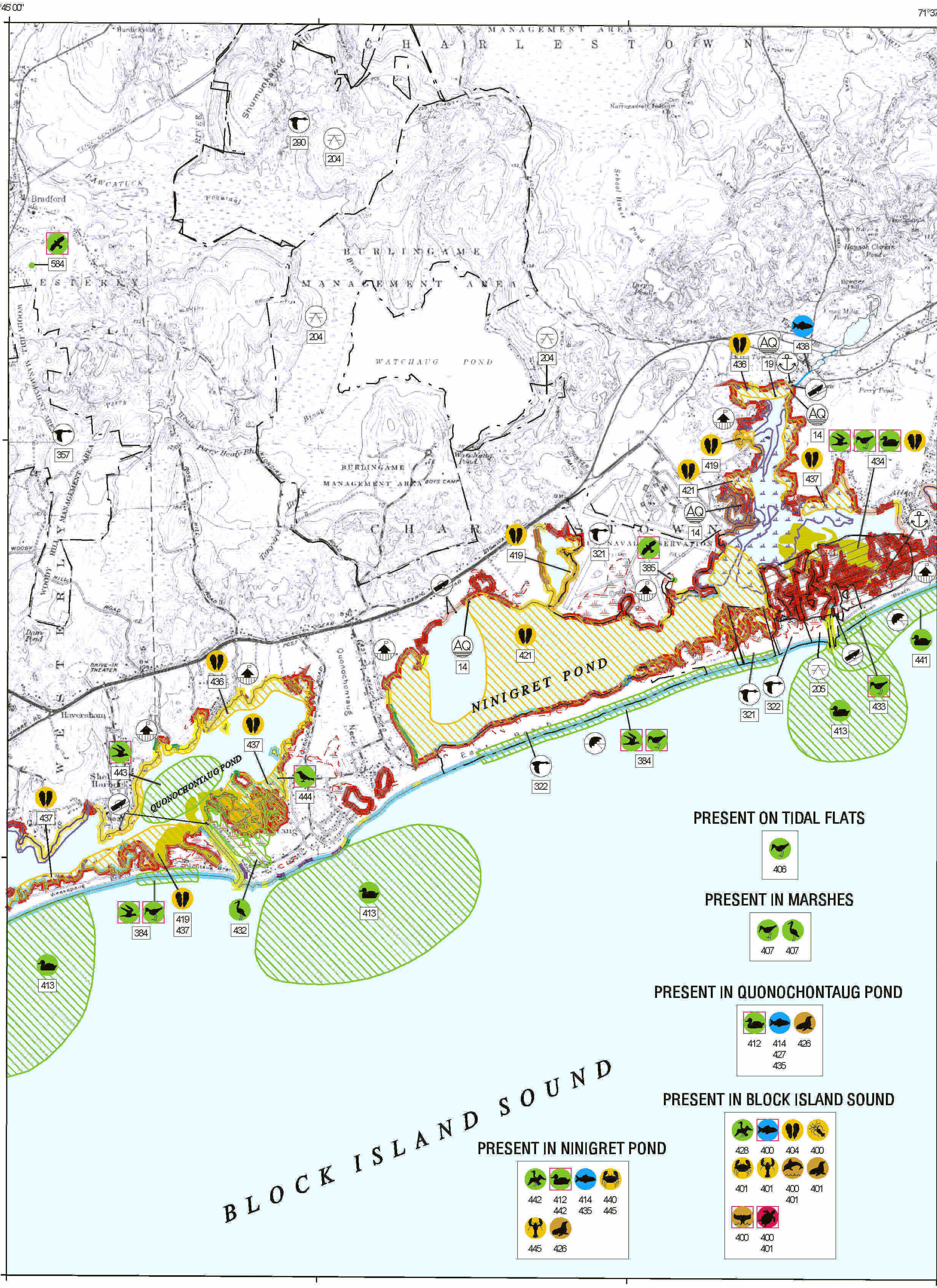

SHORELINE HABITATS (ESI)

- 1A EXPOSED ROCKY SHORES
- 1B EXPOSED, SOLID MAN-MADE STRUCTURES
- 2A EXPOSED WAVE-CUT PLATFORMS IN BEDROCK
- 3A FINE-TO MEDIUM-GRAINED SAND BEACHES
- 3B SCARPS AND STEEP SLOPES IN SAND
- 4 COARSE-GRAINED SAND BEACHES
- 5 MIXED SAND AND GRAVEL BEACHES
- 6A GRAVEL BEACHES
- 6B RIPRAP
- 7 EXPOSED TIDAL FLATS
- 8A SHELTERED ROCKY SHORES
- 8B SHELTERED, SOLID MAN-MADE STRUCTURES
- 8C SHELTERED RIPRAP
- 9A SHELTERED TIDAL FLATS
- 9B SHELTERED VEGETATED LOW BANKS
- 10A SALT- AND BRACKISH-WATER MARSHES
- 10B FRESHWATER MARSHES
- 10D SCRUB-SHRUB WETLANDS

N W E S

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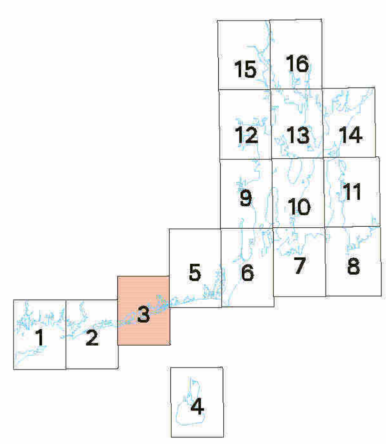
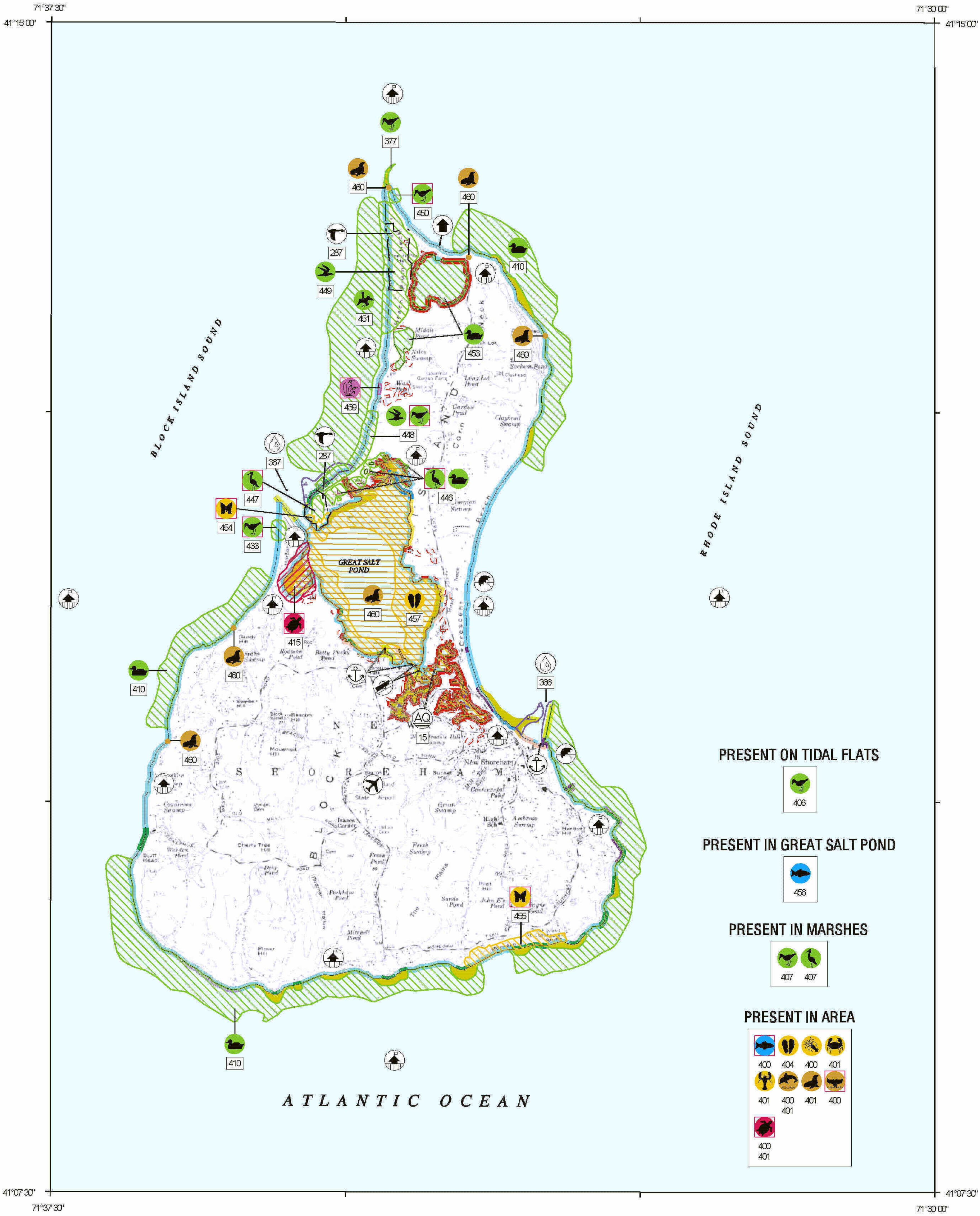


CAROLINA, R.I. (1970), QUONOCHONTAUG, R.I. (1975) **RI-3**

ENVIRONMENTAL SENSITIVITY INDEX MAP



SHORELINE HABITATS (ESI)

- 1A EXPOSED ROCKY SHORES
  1B EXPOSED, SOLID MAN-MADE STRUCTURES
- 2A EXPOSED WAVE-CUT PLATFORMS IN BEDROCK
- 3A FINE-TO MEDIUM-GRAINED SAND BEACHES
  3B SCARPS AND STEEP SLOPES IN SAND
- 4 COARSE-GRAINED SAND BEACHES
- 5 MIXED SAND AND GRAVEL BEACHES
- 6A GRAVEL BEACHES
- 6B RIPRAP
- 7 EXPOSED TIDAL FLATS
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  9B SHELTERED VEGETATED LOW BANKS
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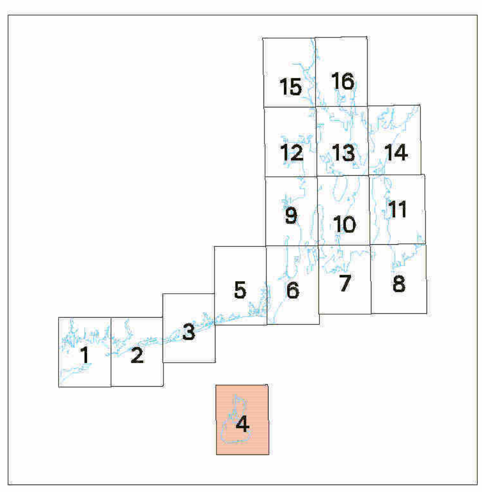
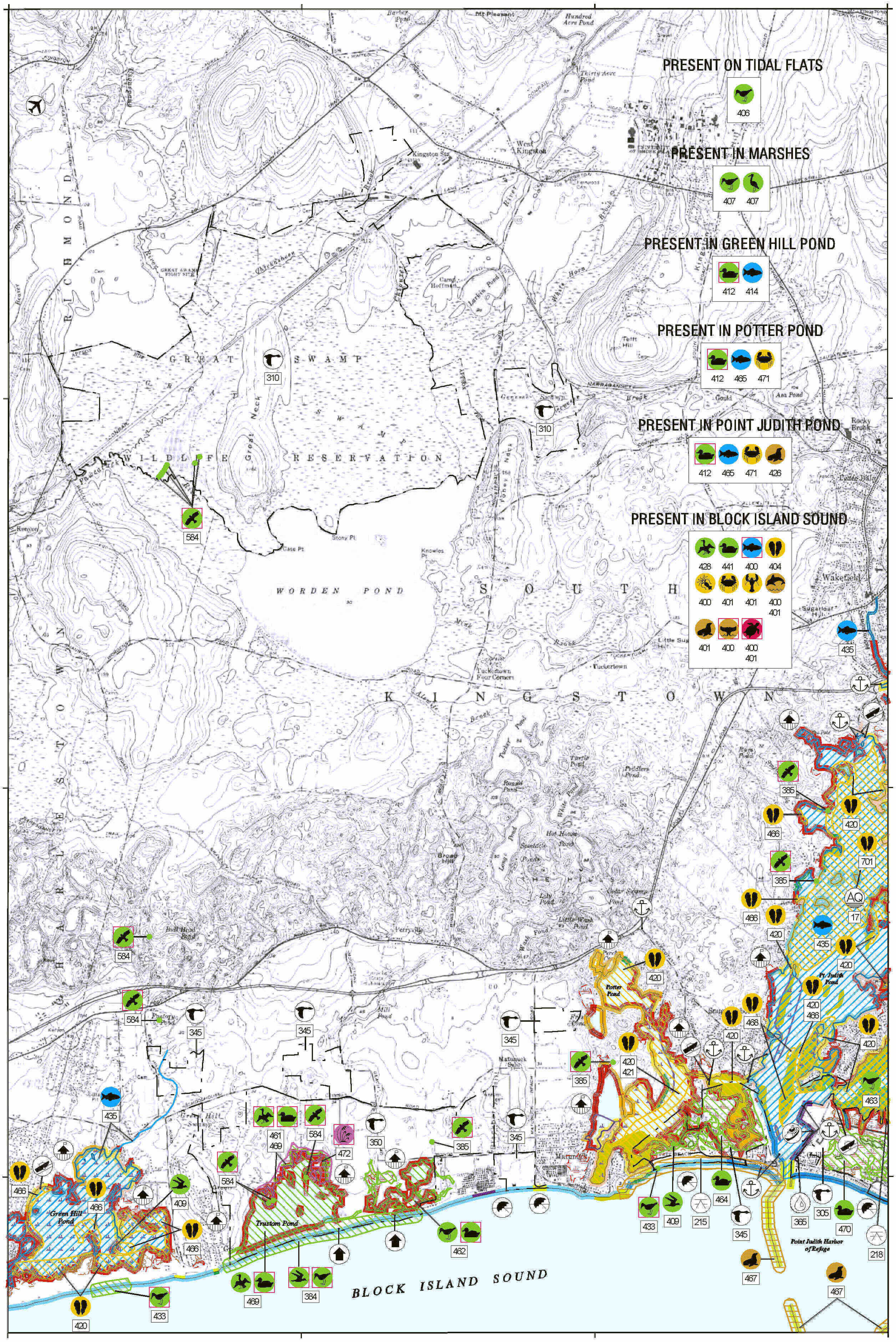


BLOCK ISLAND, R.I. (1975) **RI-4**

ENVIRONMENTAL SENSITIVITY INDEX MAP



SHORELINE HABITATS (ESI)

- 1A EXPOSED ROCKY SHORES
- 1B EXPOSED, SOLID MAN-MADE STRUCTURES
- 2A EXPOSED WAVE-CUT PLATFORMS IN BEDROCK
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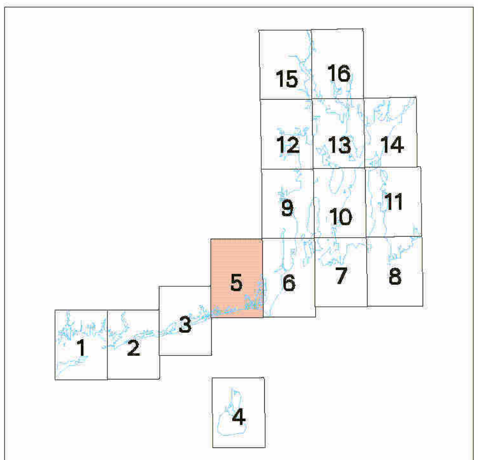
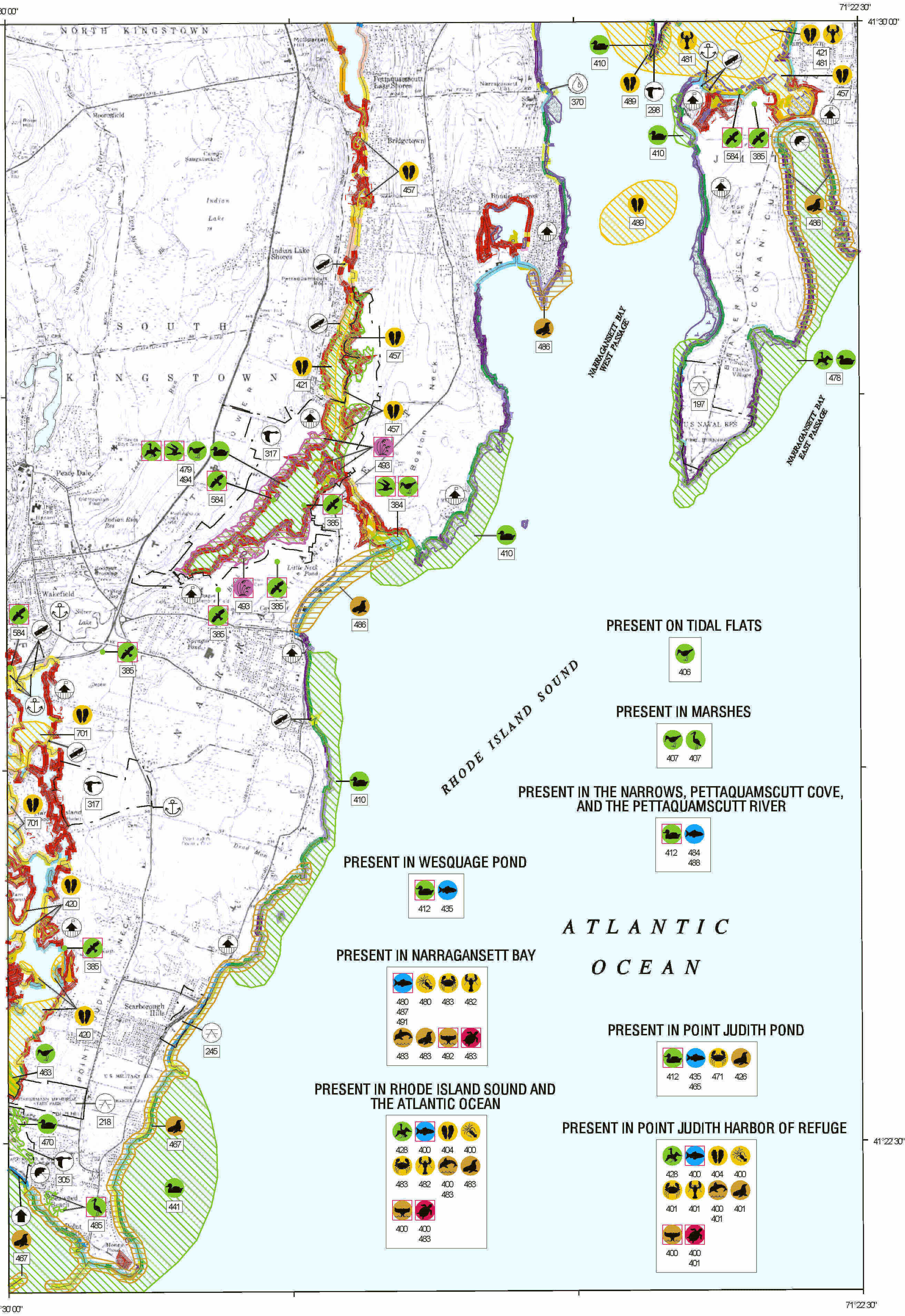


KINGSTON, R.I. (1975) **RI-5**

BW029554

ENVIRONMENTAL SENSITIVITY INDEX MAP



SHORELINE HABITATS (ESI)

- 1A EXPOSED ROCKY SHORES
- 1B EXPOSED, SOLID MAN-MADE STRUCTURES
- 2A EXPOSED WAVE-CUT PLATFORMS IN BEDROCK
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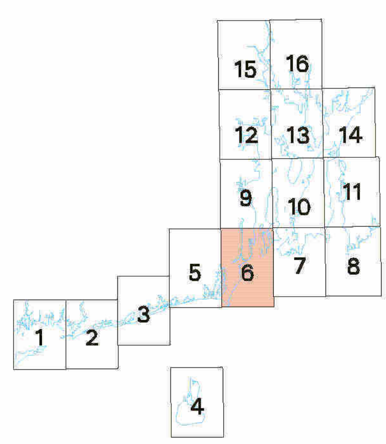
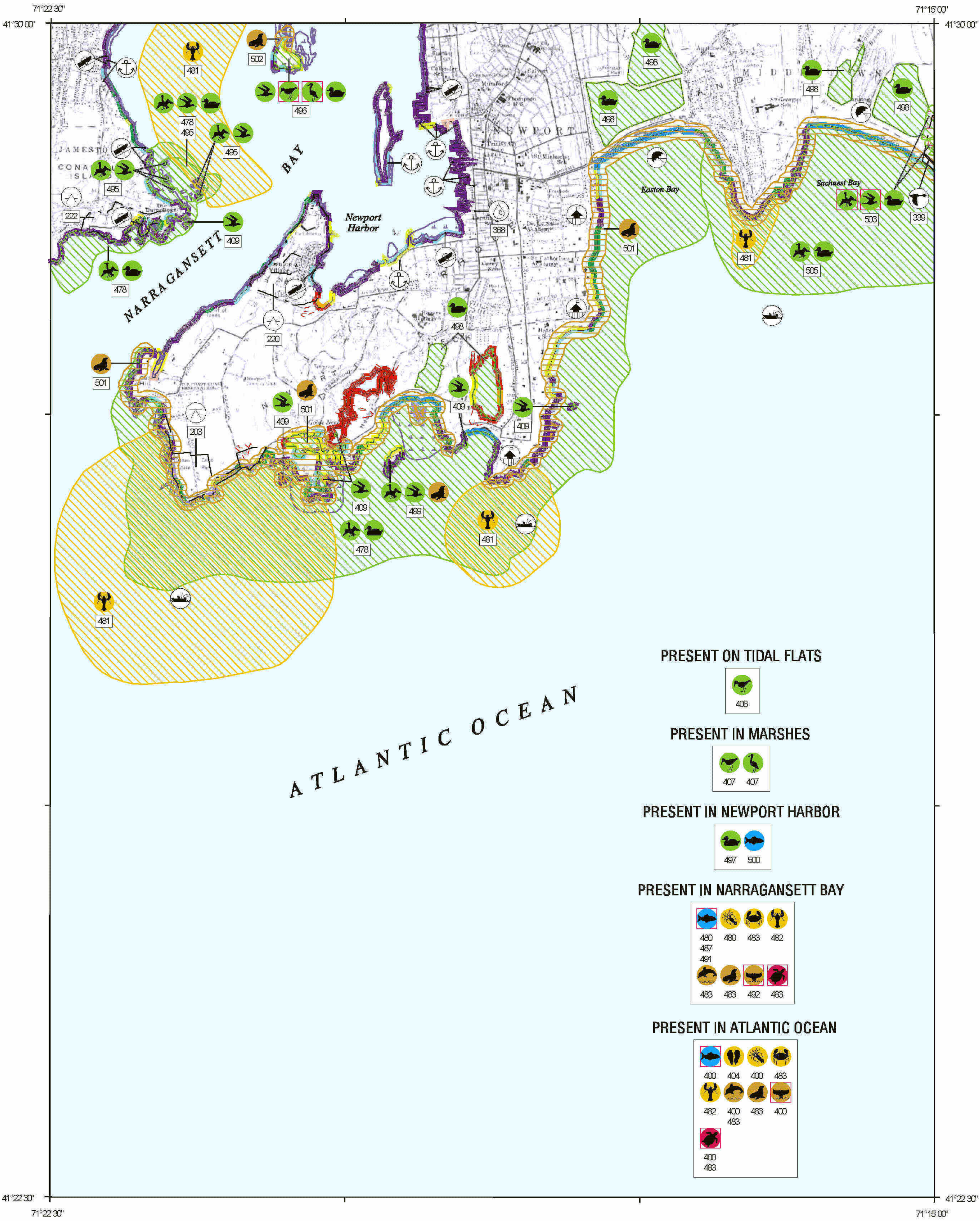


NARRAGANSETT PIER, R.I. (1975) **RI-6**

BW029555

ENVIRONMENTAL SENSITIVITY INDEX MAP



SHORELINE HABITATS (ESI)

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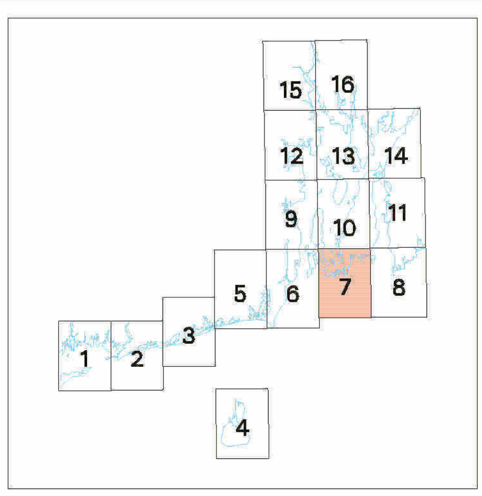
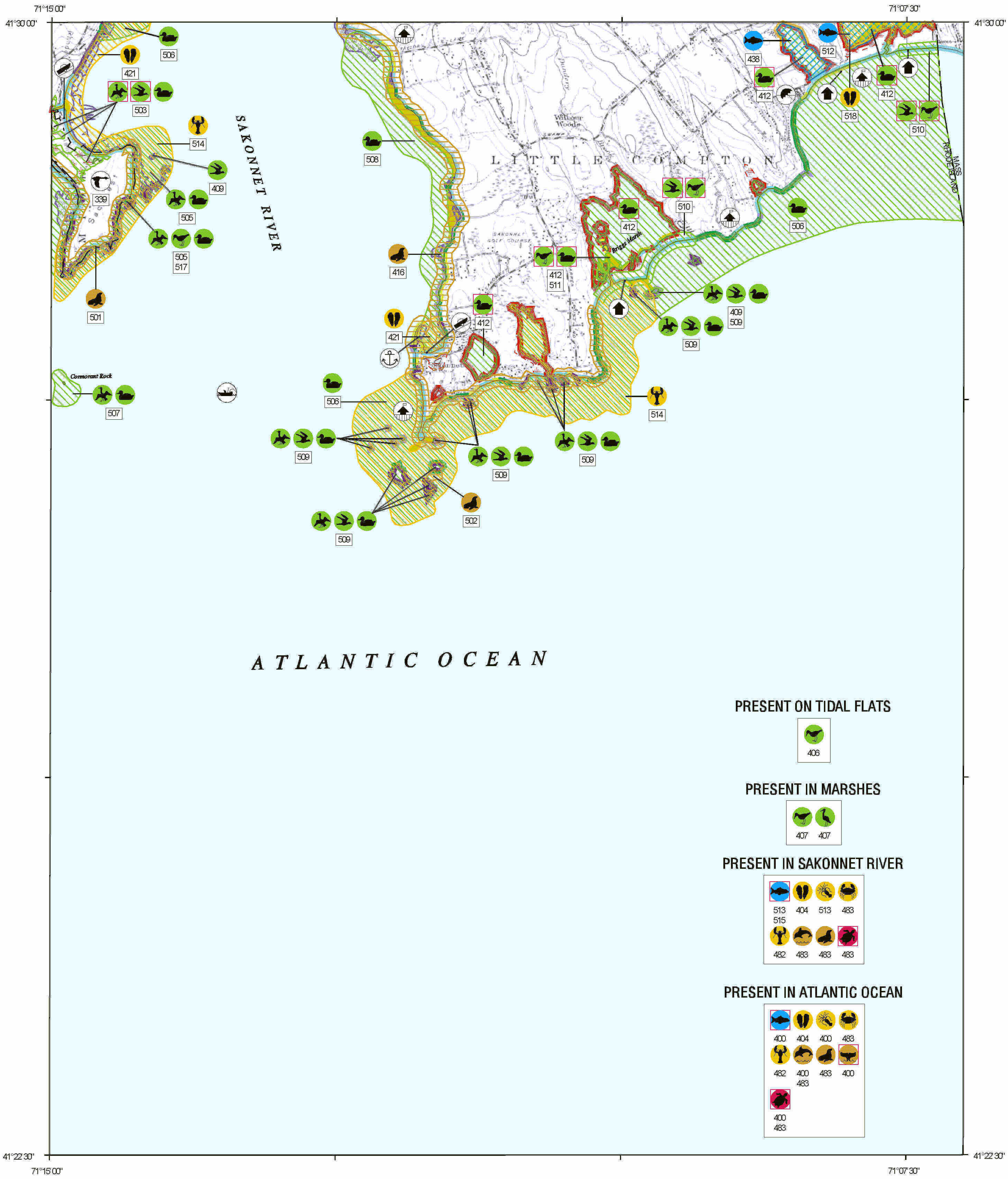


NEWPORT, R.I. (1975) **RI-7**

ENVIRONMENTAL SENSITIVITY INDEX MAP



SHORELINE HABITATS (ESI)

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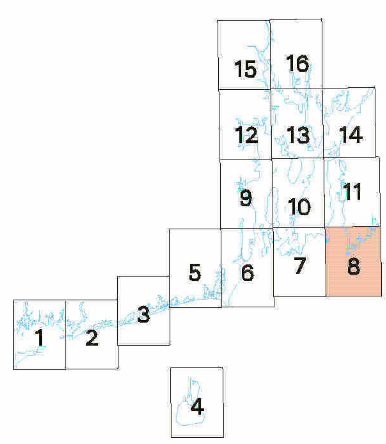

SAKONETT POINT, R.I. (1970) **RI-8**

BW029557