EXECUTIVE SUMMARY

STUDY OBJECTIVES

The Connecticut Academy of Science and Engineering (CASE) convened the "Long Island Sound Symposium: A Study of Benthic Habitats" on July 28-29, 2004 on behalf of the Connecticut Energy Advisory Board (CEAB). An agenda (see Appendix E: Agenda) was developed as a framework for discussions at the symposium. The symposium assembled national and local experts to provide guidance for understanding, analyzing and evaluating data about Long Island Sound (LIS), and to enhance the capability of the CEAB and state agencies in planning, managing and evaluating proposed energy-related uses of LIS and its benthic habitats.

The symposium provided information that was utilized by a CASE Study Committee to develop its findings and suggestions for the consideration of the CEAB.

SUMMARY OF FINDINGS

The CEAB intends to create an efficient mechanism by which the state and its subdivisions periodically proactively identify future energy-related needs and/or problems. They plan to evaluate proposals based on established criteria; preferential standards in the areas of energy reliability, environmental and natural resource protection; cost effectiveness and other impacts; and how well such proposals solve the problem or address the state's needs. A final, approved proposal is expected to embody the highest level of benefit with the lowest potential impact.

The LIS Symposium provided information in selected areas of interest and was divided into two sections with several sessions comprising each section, as follows:

- Long Island Sound Data and Information: Benthic Habitat Classification and Mapping; Endangered and Threatened Species; and Mollusks;
- Impact Analyses: EMF; Temperature Impacts; Safety Issues and Impacts; and Installation and Maintenance Impacts.

The findings and suggestions included in this report can be used as a tool in the development of the preferential standards, and for next steps in an effort to learn more about the environment of LIS for a variety of purposes, including the consideration of energy-related projects. Most importantly, the symposium identified a need to focus attention on the general issue of the overall management of LIS for the purpose of gaining a better understanding of a variety of LIS issues and needs in an effort to balance the need for installation of energy-related projects with protection of the Sound's sensitive environmental areas and ecosystems. Organizational structures such as the Chesapeake Bay Program, the Gulf of Maine Council on the Marine Environment and the Gulf of Maine Mapping Initiative, and the LIS Study (LISS) can serve as useful models for creating a mechanism to address Sound-wide environmental matters.

Consideration should be given to creating an organizational structure such as a Long Island Sound Center for the Marine Environment (LISCME) as a joint initiative of state (Connecticut and New York) and federal agencies, academic institutions, and scientists to coordinate and oversee a collaborative effort for the purpose of developing a better understanding of, and improving decision making with regard to, the environment and ecology of LIS. This type of regional collaborative effort could help ensure that LIS is viewed as a regional resource and that future research and studies will meet the needs of all agencies and regulators. This center would require funding and staff support at levels to assure it is sustainable and effective in meeting its goals and objectives. A strategy for securing adequate funding for operations and projects would need to be developed.

It is recognized that it may not be feasible or possible to create such a center, in which case it is suggested that the state consider implementing the suggestions and developing the concepts envisioned for the center within the various Connecticut state agencies and organizations that could assume such responsibilities.

Understanding the characteristics of the seabed is an essential tool for managing the marine environment for a variety of purposes including: installation and maintenance of energy infrastructure such as cables, pipelines, and renewable energy structures; development and management of marine sanctuaries; commercial and recreational fishing, including shellfishing; aquaculture; and shipping. The purpose for which information about the marine environment will be used is a critical factor in determining the level of detail necessary for mapping all or portions of LIS.

Physical environment (non-living resource) mapping provides a foundation of information that can then be used to create habitat (living resource) maps of a variety of benthic organisms and species of interest. The ability to translate physical environment maps into habitat maps requires a better understanding of the relationships among species of interest and their physical, chemical, and biological environments. More detailed physical mapping of LIS may be necessary to develop habitat maps in areas of interest and on a Sound-wide basis. It is suggested that progress in understanding infrastructure impacts on LIS's benthic communities, and the broader but essential task of better understanding the overall structure and importance of benthic communities in LIS, should be included in this effort.

Regardless of the organizational structure of such an entity, the following concepts should be considered:

- ➢ Develop the purpose and scope of an environmental evaluation program for LIS. This plan should take into consideration:
    - The need for a focused evaluation program for those regions of LIS most likely to be considered for energy infrastructure crossings. Possible mapping projects would include:
        - Mapping regions surrounding existing cables and pipelines, as well as integrating any data and information available from existing underwater infrastructure projects.
        - Selection of additional targeted areas that can be projected for use as future infrastructure crossings based upon the location of land-based support

infrastructure and known sedimentary environments of LIS.

- LIS-wide environmental management initiatives to identify resources for the purpose of creating marine sanctuaries or reserves, and for other purposes that may require additional detailed data, as well as mapping all or portions of LIS.

➢ Formulate goals and objectives for a LIS environmental evaluation program, such as:

- Conducting an assessment of what is known, including the collection and analysis of existing data and maps, for adequacy to support program goals and objectives.
    - Certain areas may need to be mapped by securing additional data in finer detail based upon the characteristics of the sedimentary environment. For example, heterogeneous areas may need to be mapped in greater detail, while existing data and maps may be adequate in homogeneous areas. Determination and analysis of discriminators such as these will provide a foundation for decision making and a more focused mapping effort.
- Developing technical projects to secure data and information, including additional mapping initiatives, where necessary, in support of the overall goals and objectives of the evaluation program.
- Reviewing and assessing whether a standard habitat classification system for LIS should be adopted, and if so, facilitating a process for this purpose.
- Identifying a risk assessment protocol for future infrastructure encroachments into LIS.

➢ Create a centralized data repository that is recognized and financially supported to inventory, archive, and disseminate all LIS technical information. This repository would develop a system to assure that various data and information and resultant products will be compatible with each other, with the needs of the environmental evaluation program, and in compliance with federal standards. This system should include requirements, standards and protocols for data collection, navigation, and architecture for a GIS-based data and information system including appropriate metadata. This would enable data and information collected from publicly-funded research projects, and, as may be required, from owners of infrastructure projects installed in LIS, to be preserved and available for developing a comprehensive understanding of LIS. Additionally it is suggested that the repository:

- Be non-regulatory.
- Require agencies, contractors and academics who work in LIS to report results and raw data, where appropriate. Protocols can be established to keep certain kinds or aspects of data confidential for some appropriate time period, so that contributing data to the repository does not compromise academic or business enterprises.
- Consider development of a policy to provide free access to data and information to all researchers, agencies, companies, and possibly the public in an effort to promote the best studies, analyses, and infrastructure proposals.

➢ The mapping initiative for LIS would include:

- Creating non-living resource maps that identify the geology of the bottom and sub-bottom of LIS. These maps provide a foundation of information that can be used to create living resource maps. The characteristics of the bottom provide clues as to the type of living resources that may populate certain areas of the seabed. These types of maps include:
    - Sedimentary environment and textures maps created from sidescan or multibeam sonar or other technologies. Ground-truthing is used to verify the data that are collected electronically by using grab sampling, video and photo surveys and other methods. Figures 1A, 1B, and 1C represent examples of these types of maps.
    - Bathymetric maps to identify elevations of the seafloor and in conjunction with sedimentary environment mapping, provide a three-dimensional picture of the bottom.
- Creating living resource maps to identify benthic habitats, mobile fauna habitats and endangered and threatened species. These maps would be created by using non-living resource maps and information to identify and prioritize areas for study, with sampling being done to identify specific habitats. A process to determine targeted species of concern for further study should be created. Additional research and study is necessary for scientists to develop methods to be able to produce habitat maps.
- Prioritizing the importance of nearshore, coastal and deep water mapping regions, and identifying the best and most cost effective methods and technologies for various types of mapping projects.

It should be expected that a complete mapping of the physical environment and living resources of LIS would involve significant cost and time. However, a suggested starting point for an initial pilot mapping project could be based on the state's interest in comparing the environmental impacts of various alternative routes for the purpose of siting future energy infrastructure crossings of LIS. The project would include selecting regions of the Sound to be mapped based on the location of relevant existing land based energy infrastructure. The process to determine the specific mapping activities would include a review of existing physical environment maps with sampling to determine if additional mapping is necessary. These maps would then be used to identify various habitats and to create habitat maps. Initial physical environment mapping of the nearshore areas within the targeted mapping region should be expected since very little physical environment information is currently available for nearshore areas of LIS.

Long Island Sound Data and Information

Any attempt to minimize the impacts of infrastructure development on the Sound's ecosystem requires a better understanding of key aquatic resources, habitats, species and ecological service functions. The CEAB's "Draft Preferential Criteria" provides a preliminary list of sensitive coastal resources and habitats and recognizes that other sensitive habitats may exist. Also, these criteria identify a need to avoid, minimize or mitigate effects of infrastructure development on these resources and habitats.

The LIS Symposium provided useful insights regarding some of the key habitats, species and processes, and identified a need for a process to facilitate the development of an overview of LIS as an ecosystem. However, although the need for additional data about LIS is important, it is suggested that the initial focus should be placed on developing a process that ensures adaptive management of LIS and the development of science-informed policy based on the best available science, while recognizing that the future will bring more and, hopefully better, scientific information.

Options for establishing the LISCME to address Sound-wide environmental matters include expanding the mission of the Long Island Sound Study (LISS), creating a new bi-state organizational entity specifically designed for this purpose, or creating an initiative comprised of various Connecticut state agencies and organizations to assume such responsibilities. The LISS is a cooperative effort that was created to protect and improve the health of the LIS by implementing the Sound's Comprehensive Conservation and Management Plan (1994). The LISS website states: *"the Plan identifies the specific commitments and recommendations for actions to improve water quality, protect habitat and living resources, educate and involve the public, improve the long-term understanding of how to manage the Sound, monitor progress, and redirect management efforts. Using the Plan as a blueprint, the Long Island Sound Study has continued to refine and add detail to commitments and priorities, including the 1996 Long Island Sound Agreement and the 2003 Long Island Sound Agreement."* Although other factors may be considered in the decision to develop the LISCME, an advantage to utilizing the LISS is that they have already begun to develop a framework for bringing scientists and managers together.

Other programs previously mentioned, including the Chesapeake Bay Program and the Gulf of Maine Council/Gulf of Maine Mapping Initiative can provide insight and guidance for the development of a Connecticut LIS initiative or the LISCME.

There are data relevant to LIS, including bathymetric maps, molluscan fisheries areas and habitat classification information that have been gathered over the last 50 years. However, these data do not provide a level of detail sufficient to allow informed decision making for future encroachments into LIS. It is suggested that this information be archived in any future LIS centralized data repository.

Benthic Habitat Classification and Mapping

Non-living resource mapping initiatives have been completed for the Hudson River and are on-going for the Gulf of Maine. Benthic habitat mapping is being considered for both of these areas. A very rough estimate of the cost of a detailed, Sound-wide, non-living resource mapping initiative could exceed $10 million, and could be significantly higher based upon the scope of the mapping initiative. This estimate is based only on information available from non-living resource mapping initiatives in the Gulf of Maine and Hudson River. Relatively detailed non-living resource maps exist for LIS, but more detail is needed in correlating bottom types with habitat classifications. In addition, the shallow regions of LIS (< 5 m) have not received sufficient attention due to the difficulty and cost of using standard acoustic techniques to secure bathymetric data and bottom type information. New spectral imaging systems should be pursued for accurate and reduced-cost mapping efforts in the shallow nearshore regions of LIS, although the timeline for using such systems is not yet known. Acoustical mapping techniques, such as multibeam technology, can map most areas of the bottom without the projected development time associated with optical techniques. More accessible survey vessels may also provide greater access to certain shallow water areas.

Overall, there is currently insufficient information to determine the relative merits of comparing different cable or pipeline routes for planning and siting decision purposes. Also, there is a need to develop methods for generating habitat maps from acoustic and/or optical images and bottom samples. Separate habitat maps must be generated for each species of interest, which requires an understanding of how a particular species uses the physical, chemical, and biological environment. Consideration should be given to supporting targeted habitat mapping pilot projects to test methods and apply lessons learned in order to develop habitat mapping protocols that could be used on a wider scale.

Endangered and Threatened Species

While both the state of Connecticut and the federal government have adopted an endangered and threatened species program, very little information is available on species that rely on LIS. Some information is available on large species, especially mammals, but no information has been systematically gathered on benthic species in LIS. Consideration should be given to developing a program within the LISCME to identify and list the benthic species, including species that are endangered and threatened species as well as of special concern. However, it should be noted that although there have been efforts in other estuaries to identify and list benthic species, there do not appear to be any known efforts to identify or list benthic species that may be endangered, threatened, or of special concern.

Mollusks

The review of mollusks in this study focuses on oysters and clams, due to their inability to move in response to anthropogenic disturbances on the seafloor. Information regarding the location of leased oyster and clam shellfish beds that are utilized for growing, cultivating and harvesting activities is known and available. However, it is suggested that more detailed maps identifying the level of productivity of these regions should be produced to provide more accurate information; such information could then be used to assess the impacts of energy infrastructure installation and maintenance activities on this habitat. It seems possible that a cooperative effort of academics, personnel from the Connecticut Department of Agriculture, and individuals employed in shellfish harvesting could produce the information necessary to create accurate maps that could be used for planning purposes.

Long-term impacts of encroachment activities can be severe, altering both the bottom topography and sediment density to such a degree that it would impact the productivity of the impacted shellfish beds for future mollusk growth and harvesting. This long-term impact can last for years, even after mitigation. Reportedly, following the installation of cables and pipelines, impacted shellfish beds in LIS have not been restored to pre-construction levels of productivity. As a minimum, mitigation efforts should include: detailed mapping of the pre-installation conditions using high-resolution techniques; harvesting of all shellfish prior to project initiation; restoration of the bottom after the disturbance, matching sediment, morphology and especially planting shell where appropriate, and assessing financial penalties if restoration is not possible; and replacing lost shellfish with seed or market size, as appropriate. Although the technology and methods for shellfish bed restoration are known — including matching sediment layers and the pre-construction elevation profile — a variety of factors affect the ability to successfully accomplish this task. Successful restoration of a disturbed swath through a shellfish bed as a result of construction activity may be more difficult to achieve than creating a new shellfish bed. Pilot projects can test methods to construct new shellfish beds in LIS. If successful, creating new shellfish beds should be considered as an alternative for mitigating an encroachment into an existing shellfish bed.

Impact Analyses

EMF

No electric field is produced outside the shielded conductors of submerged cable installations. Additionally, the magnetic field produced in the operation of a cable is weak and at a level similar to that produced by the earth's magnetic field. Therefore, it is not expected that EMF generated by the operation of a submerged cable will have any impact on flora and fauna communities. If desired, existing measurement methods can be used to detect EMF from existing cables to confirm the values predicted in project planning.

Temperature

The low rate of steady-state energy dissipation from installed electric cables cannot have a significant impact on LIS given its large mass of water and rapid circulation. Therefore, the concern regarding temperature is more with the location of this energy transfer into the sediment layer and bottom boundary. In general, cables are designed so that during their operation, sediments located near a cable do not dry out. Under these conditions, little temperature rise is expected at the sediment-water interface. The thermal conductivity of the sediment layer, coupled with the known energy losses from the electric cables, will allow for accurate predictions of temperatures throughout the sediment layer — predictions that can be confirmed by careful measurements. Biologists will be able to evaluate these temperatures and predict if there will be any negative impacts on flora or fauna from these temperature changes. It is expected that, although there will be some change in temperature in the sediment immediately surrounding a cable, the depth of the cable's burial and insulating factors of the cable will minimize the impacts, if any, on the benthic habitats located in its immediate vicinity.

Since pipelines operate at near-ambient temperatures, it is not expected that their operation will cause any negative impacts due to temperature.

Safety Issues and Impacts

An anchor striking a submerged object was the main safety issue addressed during the symposium. Some of the older electric cables are fluid-filled, contributing to the potential environmental impacts of a broken cable. However, more recent cables don't have a fluid component, which eliminates one of the potential environmental consequences of a severed cable. Safety systems installed on existing electric cables in LIS are equipped with high speed circuit breakers that very quickly de-energize a cable in case of an anchor strike of other equipment snag. These systems eliminate any hazard to the public from the release of energy caused by a break in a cable.

Several panelists were involved in projects that used engineered materials to provide protection for cables and pipelines. Most recently, this method was used to protect a section of the Hubline, a submerged natural gas pipeline located in Boston Harbor. These same materials can also be

applied to submerged electric or telecommunication cables. The effects on benthic habitat of materials used to armor cables and pipelines need to be better understood. It is suggested that the planning phase of a project should include a risk assessment to determine the degree to which areas along a project's proposed route are susceptible to anchors strikes and thus worthy of protection. Additionally, it is suggested that a risk assessment for a pipeline project include an analysis of any impacts or hazards caused by a sudden release of compressed natural gas between the pipeline's isolation valves.

Installation and Maintenance Impacts

Initial installation and subsequent maintenance activities can be expected to produce repeated sea bottom disturbances from virtually any encroachment into LIS. Given that any infrastructure project will require occasional maintenance, and possibly removal at the end of its design life, it is suggested that cumulative impacts of infrastructure projects should be considered. It is generally understood that initial impacts can be expected to last for months, with long-term effects possibly lasting for years. For example, there may be a rapid return of biomass, though not necessarily recovery, to a disturbed area, but it may take longer for a more typical bottom benthic community to be rebuilt. However, the precise nature of the impacts, as well as the sedimentary conditions, both in shallow and deep water, that are needed to minimize impacts on the various benthic habitats, need to be better understood. Additionally, habitat restoration efforts, such as valuable shellfish beds, need to be completed in a manner so as to restore such areas to pre-construction productivity, or provide compensation for the loss of productivity of these impacted areas.

It appears that the industry is continuing to seek methods to minimize the impacts of the installation and maintenance of cables and pipelines. Certain methods, such as horizontal drilling, can currently transit areas up to 7,200 feet with little or no impact to the surface over which the cable or pipeline is installed. Also, the timing of construction activity should be planned to minimize its effects on the benthic community and life within the water column.

Aesthetics

The question of the aesthetics of LIS was not included in the scope of this project, but was added to this report in order to identify it as an issue that may need to be considered in the future. It is suggested that the value of LIS cannot be measured simply in the value of fish produced or other economic criteria. Consideration should be given to identifying a value that can be applied to the aesthetic enjoyment of the Sound's open surface and long vistas with regard to the evaluation of projects that may be considered for placement on the surface of or above LIS.