



CLEAN WATERS AND HEALTHY WATERSHEDS

Improve water quality by reducing contaminant and nutrient loads from the land and the waters impacting Long Island Sound.

CHALLENGES

- Further reducing nitrogen pollution requires addressing sources that are smaller, more diffuse, or more distant from the Sound.
- Polluted runoff from developed lands contaminates waters with pathogens, which result in closed beaches and restrictions on shellfish harvest areas.
- Aging infrastructure leaks untreated sewage to coastal waters.
- Water quality must be improved in bays and harbors to protect and restore submerged aquatic vegetation and benthic community health.

SOLUTIONS

- Reduce nitrogen from decentralized, on-site wastewater treatment systems and turf fertilizer applications.
- Work with states and communities in the entire watershed, not just in Connecticut and New York, particularly on low-cost upgrades to centralized wastewater treatment facilities.
- Document the economic and ecosystem consequences of nitrogen pollution from hypoxia, eelgrass and wetland loss, and increased vulnerability to acidification.
- Implement smart growth and low impact development policies to minimize the environmental impacts of new development while green infrastructure is increasingly added to areas already developed.
- Continue capital investments in wastewater treatment infrastructure.
- Identify and control local pollution sources through community-based watershed monitoring (including citizen science) and protection programs.

CLEAN WATERS AND HEALTHY WATERSHEDS

Clean water is the foundation of a healthy Long Island Sound—for human use and recreation, for thriving fisheries, and for productive habitats. The condition of the Sound depends on the quality of the waters draining from the landscapes surrounding it. This connection between the land and water, between healthy, sustainable upland communities and a healthy Long Island Sound is the foundation of the Clean Waters and Healthy Watersheds theme.

The issues affecting water quality in Long Island Sound that were the focus of the 1994 CCMP—low dissolved oxygen (hypoxia), toxic contaminants, pathogens, floatable debris, and land use and development—remain. Despite improvements, Long Island Sound still suffers from hypoxic "dead zones," beach closures, and other effects of contamination that keeps the Sound from meeting water quality standards. Addressing these issues requires integrated approaches to address polluted stormwater and ground water, contaminants of emerging concern, the resiliency of natural and built infrastructure, and land use planning that protects water resources, includes adaptation to changing climate and extreme weather, and ensures the sustainable use of the Sound's resources. The 2015 CCMP also places additional emphasis on assessing and improving the water and habitat quality of the Sound's embayments, where much of the public goes for recreation and enjoyment.

ECOSYSTEM TARGETS

The following ambitious, but achievable, ecosystem targets have been developed to drive progress toward attaining the **Clean Waters and Healthy Watersheds (WW)** goal. Achieving these targets can also contribute to the goals for the other themes. Likewise, multiple strategies and implementation actions throughout the four theme areas apply directly and indirectly to these targets. Measuring, tracking, and reporting environmental indicators of each ecosystem target will provide information to assess progress and refine and adapt management as needed. A detailed explanation about the rationale and quantification of these targets is included in Appendix B.

Extent of Hypoxia: Measurably reduce the area of hypoxia in Long Island Sound from pre-2000 Dissolved Oxygen TMDL averages to increase attainment of water quality standards for dissolved oxygen by 2035, as measured by the five-year running average size of the zone.

Nitrogen Loading: Attain WWTF nitrogen loading limits at the 2000 Dissolved Oxygen TMDL allocation level by 2017 and maintain the loading cap. Have practices and measures instituted to attain the allocations for stormwater and nonpoint source inputs from the entire watershed by 2025.

Water Clarity: Improve water clarity by 2035 to support healthy eelgrass communities and attainment of the eelgrass extent target.

Impervious Cover: Through green infrastructure, low impact development, and stormwater disconnections, decrease by 10 percent the area of effective impervious cover in the Connecticut and New York portions of the watershed by 2035 relative to a 2010 baseline.

Riparian Buffer Extent: Increase the percent area of natural vegetation within 300 feet of any stream or lake in the Connecticut and New York portions of the Long Island Sound watershed to 75 percent by 2035 from the 2010 baseline of 65 percent.

Approved Shellfish Areas: Upgrade 5 percent of the acreage restricted or closed for shellfishing in 2014 by 2035.

Sediment Quality Improvement: Reduce the area of impaired sediment in Long Island Sound by 20 percent by 2035 from a 2006 baseline.

Controlling nitrogen pollution remains the top priority for the region. *The Total Maximum Daily Load Analysis to Achieve Water Quality Standards for Dissolved Oxygen in Long Island Sound* (CTDEP, NYSDEC 2000) set allocations for nitrogen among five watershed states. The plan also identified steps to evaluate additional nitrogen reductions and alternative technologies while continuing monitoring and research programs to assess water quality standards attainment. Wastewater treatment facilities are the largest source of nitrogen. Connecticut in 2014 and New York by 2017 are on target to meet the reduction targets for these sources through investments to upgrade WWTFs. Nitrogen reductions from atmospheric deposition and agricultural sources are also meeting TMDL allocations. Nitrogen from on-site wastewater treatment systems, residential turf fertilizer applications and stormwater runoff, however, have remained level or increased (NEIWPC 2014). To continue progress in attaining water quality standards it is necessary to manage adaptively, continuing to seek aggressive and practical nitrogen reductions from all sources while evaluating the effectiveness of these reductions. This is all the more important due to the changes in the ecosystem brought about by climate

change that may make Long Island Sound more susceptible to hypoxia (Tedesco et al. 2014). With new information on the success of reducing nitrogen and the response of Long Island Sound to these reductions, the TMDL target will need to be assessed and revised as appropriate.

OUTCOMES, OBJECTIVES, STRATEGIES, AND IMPLEMENTATION ACTIONS

To accomplish the Clean Waters and Healthy Watersheds goal and to achieve progress toward the ecosystem targets, the plan includes specific outcomes, objectives, strategies, and actions. The Implementation Actions (IAs) have been formulated to carry out the WW theme strategies. All IAs are important to meeting the plan's objectives and outcomes. While recognizing that the priorities of each implementing organization will vary according to its mission and the purpose of available funds, the CCMP identifies the highest overall priorities, whether for new or underway actions, by consensus of the Management Conference partners. Highest priority actions are indicated by a "◆" symbol. The complete five-year implementation action plans (further described in Appendix C) are included in the supplement to the CCMP posted on the LISS website.

1 - 1 OUTCOME: CONTAMINANT AND NUTRIENT LOADS FROM LAND-BASED SOURCES IN THE WATERSHED OF LONG ISLAND SOUND ARE REDUCED.

Objective 1-1a: To reduce contaminant and nutrient loads from point and nonpoint sources:

Strategy 1-1a1: Continue mitigation of Combined Sewer Overflows (CSOs) and Municipal Separate Storm Sewer Systems (MS4s), incorporating climate change and sea level rise in planning, regulation, and BMPs.

WW-1: Evaluate the impact of increasing human population, climate change, and land use trends in the Long Island Sound watershed to determine nutrient and contaminant stressors on sewage loads from Wastewater Treatment Facilities (WWTFs)/Combined Sewer Overflows (CSOs) and decentralized/on-site wastewater treatment systems (OSWTS).

WW-2: Strategically plan for and implement capital improvements, BMPs, and improved operation and maintenance to mitigate CSO, stormwater, and nonpoint source loadings, taking into account the analysis of potential future changes in loading (see WW-1).

Strategy 1-1a2: Evaluate and improve the clean water infrastructure for wastewater treatment facilities (WWTFs), conveyance systems, and associated sewer lines.

WW-3: Explore expansion of point source and nonpoint source nutrient trading programs for the Long Island Sound watershed.

◆ WW-4: Pursue opportunities to further improve nitrogen removal, particularly low-cost retrofits, at WWTFs, throughout the watershed.

WW-5: Improve integrity of sewage collection infrastructure and institute sustainable asset management programs.

Other Actions that support Strategy: WW-1, WW-2

Strategy 1-1a3: Enhance implementation of the existing 2000 Dissolved Oxygen Total Maximum Daily Load throughout the watershed; and adapt and revise it based on monitoring, modeling, research, and how climate change may affect attainment of water quality standards in the future.

◆ WW-6: Enhance implementation of the 2000 Dissolved Oxygen TMDL and evaluate revision of the TMDL and allocations as needed to attain water quality standards.

Other Actions that support Strategy: SM-23, SM-36

Strategy 1-1a4: Ensure cross department collaboration and cooperation at the municipal level to implement MS4 BMPs (e.g., involve highway departments).

◆ WW-7: Improve the reporting requirements of MS4 communities for Dissolved Oxygen TMDL implementation tracking to better quantify the effectiveness of control measures.
Other Action that supports Strategy: SM-23

Strategy 1-1a5: Assess and mitigate agricultural nonpoint source loads.

WW-8: Improve and enforce pesticide/herbicide/fertilizer regulations and other Best Management Practices (BMPs) for agriculture and urban turf.

Strategy 1-1a6: Implement low impact development and green infrastructure for new and existing development, and mitigate pollution from commercial and industrial sources.

◆ WW-9: Develop a nonpoint source and stormwater tracking system tool for the Long Island Sound watershed.
Other Actions that support Strategy: WW-1, WW-5, WW-15, SC-25, SC-26, SC-27

Strategy 1-1a7: Improve comprehensive management and performance of decentralized wastewater treatment systems, and residential, on-site wastewater treatment systems (OSWTSS).

◆ WW-10: Develop improved policies for use and performance of decentralized and on-site wastewater treatment systems.
◆ WW-11: Improve understanding, management, and design of denitrifying decentralized and residential, on-site wastewater treatment systems.
Other Actions that support Strategy: SM-1, SM-23

Strategy 1-1a8: Incorporate climate change and sea level rise in planning, regulation, and BMPs for stormwater and wastewater treatment.

◆ WW-12: Improve efficiency and resiliency of existing/new waste treatment systems including septic, WWTF, and stormwater infrastructure to accommodate sea level rise.
Other Actions that support Strategy: SC-23, SC-24, SC-25, SC-26, SC-29, SM-31

Objective 1-1b: To balance multiple uses and maximize ecosystem services through watershed-based planning:

Strategy 1-1b1: Develop and implement watershed management plans in Long Island Sound communities and sub-watersheds.

WW-13: Develop watershed management plans for sub-watersheds, including urban areas, within the Connecticut and New York portions of the Long Island Sound watershed, and track their implementation and effectiveness.

Strategy 1-1b2: Protect wetlands, healthy watersheds, riparian buffers, and open land to minimize land disturbance and impervious cover through land protection, sustainable development, and green infrastructure.

◆ WW-14: Promote establishment and protection of riparian corridors and wetland buffers at the municipal level through development of local ordinances and increased permanent land protection.
Other Actions that support Strategy: WW-15, HW-3, SC-25, SC-26, SC-27

Objective 1-1c: To restore and protect the natural hydrologic and ecological functions of the watershed:

Strategy 1-1c1: Preserve hydrologic function (e.g., flooding, buffer zones, resiliency, groundwater, etc.) in developing watersheds and restore in impaired watersheds.

WW-15: Support implementation of stormwater permit guidance requiring all new development and substantial redevelopment to capture and infiltrate runoff from the 90th percentile storm, (generally a 0.8–1.3 inch storm).
Other Actions that support Strategy: WW-14, HW-3, SC-25, SC-26, SC-27

1-2 OUTCOME: NEGATIVE IMPACTS OF CONTAMINANTS AND NUTRIENTS IN THE WATERS AND SEDIMENTS OF LONG ISLAND SOUND AND TRIBUTARIES/EMBAYMENTS ARE REDUCED.

Objective 1-2a: To reduce direct sources of nutrients, contaminants, and debris to the Long Island Sound ecosystem:

Strategy 1-2a1: Minimize vessel/marina discharge impacts. WW-16: Improve environmental practices (boat wrap, bottom paint, pump out, etc.) at marinas.
Other Action that supports Strategy: SC-34

Strategy 1-2a2: Reduce generation of marine debris and improve and increase its cleanup in Long Island Sound waters. WW-17: Develop a Long Island Sound-specific marine debris reduction plan and implement actions to support trash-free waters.
Other Actions that support Strategy: WW-16, SC-34

Objective 1-2b: To mitigate impacts of nutrients and contaminants to human health and to the biota and ecosystem of Long Island Sound:

Strategy 1-2b1: Mitigate impacts from emerging and existing toxic contaminants in water and sediment. WW-18: Support and promote pharmaceutical and prescription medicine take-back programs at the state and municipal level to inform the general public about the pathways and impacts of emerging contaminants entering the waters and sediments of Long Island Sound.
Other Action that supports Strategy: WW-26

Strategy 1-2b2: Reduce human health risks through increased or targeted pathogen beach and embayment monitoring and fish and shellfish contaminant testing. WW-19: Encourage state and local health departments to adopt emerging rapid bacterial detection technologies that would allow shorter duration administrative beach/shellfish closings than those based on rainfall only.

Strategy 1-2b3: Develop and implement methods (e.g., bioextraction) for removal of nutrients and contaminants. WW-20: Evaluate challenges to implementation of bioextraction in Long Island Sound, including use conflicts, economic viability, permitting and testing requirements and potential environmental impacts, and make recommendations to overcome them.
WW-21: Improve the permitting and certification process for new aquaculture projects with products intended for human consumption, particularly those projects with a bioextraction focus.

1-3 OUTCOME: RESEARCH, MONITORING, AND MODELING TO SUPPORT ATTAINMENT OF WATER QUALITY OBJECTIVES IS MAINTAINED AND IMPROVED.

Objective 1-3a: To further improve understanding of the causes and impacts of eutrophication and hypoxia:

Strategy 1-3a1: Understand the effects that nutrient ratios (nitrogen, phosphorus, carbon) have on ecosystem structure and function in freshwaters, embayments, and in Long Island Sound and consider them in setting nutrient control policies.

WW-22: Estimate future phosphorus loading to Long Island Sound and its impact on Long Island Sound nutrient dynamics.

Strategy 1-3a2: Better understand eutrophication dynamics, effects, and mechanisms and continue support for modeling and synthesis efforts and their application to management scenarios.

WW-23: Improve ability of models and/or studies to estimate contaminant and nutrient loads in critical areas and evaluate the effectiveness of remedial actions.

Other Actions that support Strategy: SM-1, SM-11, SM-13

Objective 1-3b: To research, monitor, and assess water quality and factors that contribute to water quality change:

Strategy 1-3b1: Improve identification and source tracking of nonpoint sources (e.g., watershed, groundwater, atmospheric deposition) and sinks of nutrients and their impacts on water and habitat quality.

◆ WW-24: Maintain and enhance the utility and efficiency of water quality monitoring of nutrient loads to Long Island Sound science and management efforts.

WW-25: Develop and implement a water quality monitoring strategy for nitrogen in the upper basin states of Massachusetts, Vermont, and New Hampshire.

Other Actions that support Strategy: WW-31, SM-4, SM-5, SM-23

Strategy 1-3b2: Research, monitor, and assess emerging and legacy toxic contaminants and their impacts on water and habitat quality.

WW-26: Assess and identify the impact of emerging (e.g., PBDE, pharmaceuticals) and legacy (e.g., heavy metals, PCBs) contaminants on the ecosystem services and biota of Long Island Sound.

Strategy 1-3b3: Improve understanding of climate change impacts (e.g., acidification, sea level rise, temperature) on Long Island Sound water and habitat quality and biota, and their interaction with other water quality issues (e.g., eutrophication).

WW-27: Develop water quality monitoring programs associated with coastal habitat restoration projects.

◆ WW-28: Determine the level of spatial and temporal sampling needed to assess Long Island Sound water quality as impacted by climate change drivers (SLR, warming, acidification).

WW-29: Complete LISS Sentinel Monitoring for Climate Change pilot projects and evaluate results to guide strategy development and future implementation.

WW-30: Conduct periodic (five year) review and revision of Sentinel Monitoring Strategy document.

Other Actions that support Strategy: WW-31, SM-4, SM-5, SM-31

Strategy 1-3b4: Research, monitor, and assess pathogens, their sources and their impacts on water quality.

◆ WW-31: Assess sources of nutrient and pathogen contamination to Long Island Sound embayments.

Strategy 1-3b5: Research, monitor, and assess Harmful Algal Blooms (HABs) and their impacts on water quality and public health.

◆ WW-32: Monitor and track occurrences and contributing factors of biotoxin and harmful algal blooms (HABs) outbreaks.

Objective 1-3c: To improve access and usage of information, databases, and resources and incorporation of data into management actions:

Strategy 1-3c1: Support collaboration between Long Island Sound Study partner organizations, including upper basin agencies/partners (USGS, CTDEEP, CTDOA, NYSDEC, MassDEP, SCDHS, etc.), to improve utility of monitoring data and the sentinel monitoring program.

WW-33: Develop a regional partnership that will continue to support the implementation and advancement of the LISS Sentinel Monitoring for Climate Change Program and integrate it with regional and national efforts.

Other Actions that support Strategy: SM-4, SM-5

Strategy 1-3c2: Implement improved data storage and sharing solutions to support collaboration and incorporation of data into management decisions.

WW-34: Continue to support, improve, and utilize the Sentinel Monitoring Data Citation Clearinghouse and other data synthesis, storage, and sharing efforts.

Other Actions that support Strategy: SM-4, SM-5



THRIVING HABITATS AND ABUNDANT WILDLIFE

Restore and protect the Sound's ecological balance in a healthy, productive, and resilient state to benefit both people and the natural environment.

CHALLENGES

- Tidal marshes and other coastal habitats are threatened with drowning from rising seas if they cannot build upward or migrate inland because of natural or man-made barriers.
- The balance among coastal habitats such as marshes, beaches, dunes, grasslands, and forests has been altered due to development, decreasing the resiliency of Long Island Sound.
- Remaining open spaces along the coast are under development pressure.
- Invasive/nonnative species threaten ecosystem diversity and compete with native animals & plants.
- Development and use of the coastal zone conflicts with the needs of some wildlife species (e.g., roseate terns) for forage and nursery areas.

SOLUTIONS

- Identify and conserve open space landward of coastal habitats to allow for natural transition upland.
- Enhance the resiliency of coastal habitats by strengthening living shorelines such as marshes, beaches, and dunes.
- Understand the historic balance of natural habitats and work to restore desired values and functions of the ecosystem.
- Prioritize open space protection to save the last remaining high-value undeveloped lands.
- Develop site management plans for eliminating invasive/nonnative species, involving community organizations and volunteers.
- Involve communities in the stewardship of wildlife.

THRIVING HABITATS AND ABUNDANT WILDLIFE

The natural and cultural heritage of Long Island Sound is inextricably connected to its living resources. For hundreds of years humans living along Long Island Sound have relied on the land and wildlife for food, shelter, and other day-to-day necessities. To this day, we still rely on fish and shellfish populations to contribute to the economy and ecosystem, benefiting the residents of all watershed communities. Moreover, the protection and restoration of ecologically significant shorelines and habitats of Long Island Sound will serve to protect the diversity and richness of native species, enhance the public's enjoyment of active and passive recreational opportunities such as hunting, boating, and wildlife viewing, and increase resiliency of communities to storms and flooding.

The 1994 CCMP identified habitats and living resources for management, monitoring, research, and protection. LISS and its partners have made great strides over the last two decades to accomplish these tasks. The LISS has targeted 12 types of coastal habitats for restoration to sustain living resources and ecosystem services: Beaches and Dunes, Cliffs and Bluffs, Estuarine Embayments, Coastal and Island Forests, Freshwater Wetlands, Coastal Grasslands, Intertidal Flats, Rocky Intertidal Zones, Riverine Migratory Corridors, Submerged Aquatic Vegetation Beds, Shellfish Reefs and Tidal Wetlands. Program partners have restored and/or protected thousands of acres of habitat, opened hundreds of river miles to migratory fish and other wildlife species, implemented ecosystem management plans, and funded multiple research and monitoring projects to provide insight into wildlife and ecosystem function.

Despite these successes, much still needs to be done to improve and protect the species and habitats found within and around the Long Island Sound. As a first step, Appendix D of the 2015 CCMP lists five priority sites for habitat connectivity and five priority sites for riverine migratory corridor reconnections in order to assist local and regional funding program administrators with prioritizing and funding grant proposals. In addition, warming waters and sea level rise pose new threats to habitats and wildlife, and there is improved understanding of the impacts of previously

ECOSYSTEM TARGETS

The following ambitious, but achievable, ecosystem targets have been developed to drive progress toward attaining the **Thriving Habitats and Abundant Wildlife (HW)** goal. Achieving these targets can also contribute to the goals for the other themes. Likewise, multiple strategies and implementation actions throughout the four theme areas apply directly and indirectly to these targets. Measuring, tracking, and reporting environmental indicators of each ecosystem target will provide information to assess progress and refine and adapt management as needed. A detailed explanation about the rationale and quantification of these targets is included in Appendix B.

Coastal Habitat Extent: Restore 350 acres of coastal habitat by 2020 and a total of 3,000 acres by 2035 from a 2014 baseline, including:

- **Eelgrass Extent:** Restore and maintain 2,000 additional acres of eelgrass by 2035 from a 2012 baseline of 2,061 acres.
- **Tidal Wetland Extent:** Restore 515 additional acres of tidal wetlands by 2035 from a 2014 baseline.

River Miles Restored for Fish Passage: Open 200 additional miles of fish riverine migratory corridors in the Connecticut and New York portions of the watershed by 2035 from a 2014 baseline.

Shellfish Harvested: Increase the harvest of oysters, clams, and scallops in the Sound through a combination of habitat management and shellfish aquaculture.

Habitat Connectivity: Increase connectivity of coastal habitat by 2035 by restoring and/or protecting habitat patches that increase biodiversity and support migratory pathways.

Protected Open Space: Conserve an additional 4,000 acres of Connecticut land and 3,000 acres of New York land within the LIS coastal boundary by 2035, while maintaining the total area of protected lands.

reported threats such as nitrogen pollution and invasive species. So while the Thriving Habitats and Abundant Wildlife theme continues to emphasize monitoring, research, restoration, and protection, it includes new approaches, such as developing resilient coastal habitats through the creation of living shorelines and green infrastructure, to address current and future threats to habitats and wildlife.

The natural habitats of Long Island Sound and its coastal areas support diverse populations of wildlife and living resources, provide recreational opportunities, and function as an environmental infrastructure that provides services and benefits to the region. The Thriving Habitats and Abundant Wildlife theme addresses the balance between people and the natural environment and the need to continue restoration and protection of priority habitats and wildlife to sustain a healthy, productive, and resilient Long Island Sound benefiting all inhabitants. All of the goals and actions outlined in this theme should provide multiple benefits to both wildlife and humans alike.

OUTCOMES, OBJECTIVES, STRATEGIES, AND IMPLEMENTATION ACTIONS

To accomplish the Thriving Habitats and Abundant Wildlife goal and to achieve progress toward the ecosystem targets, the plan includes specific outcomes, objectives, strategies, and actions. The Implementation Actions (IAs) have been formulated to carry out the HW theme strategies. All IAs are important to meeting the plan's objectives and outcomes. While recognizing that the priorities of each implementing organization will vary according to its mission and the purpose of available funds, the CCMP identifies the highest overall priorities, whether for new or underway actions, by consensus of the Management Conference partners. Highest priority actions are indicated by a "♦" symbol. The complete five-year implementation action plans (further described in Appendix C) are included in the supplement to the CCMP posted on the LISS website.

2-1 OUTCOME: SYSTEM RESILIENCY AND FUNCTION ARE MAINTAINED BY PROTECTING, RESTORING, AND ENHANCING HABITATS.

Objective 2-1a: To restore and enhance targeted habitat types:

Strategy 2-1a1: Develop and implement innovative and effective habitat restoration plans and projects including restoring quality and quantity of coastal habitat and fish passage.

- ♦ HW-1: Complete projects that result in restoration of coastal habitat.
- HW-2: Develop a list of current and new or innovative restoration techniques.
- ♦ HW-3: Complete projects that result in restored habitat connectivity (i.e., river miles reconnected and/or contiguous acres of coastal habitat protected or restored). Generate supporting GIS data to help measure extent of connectivity enhanced.
- Other Actions that support Strategy: HW-6, HW-7, WW-27

Strategy 2-1a2: Restore and enhance connectivity of targeted habitat types.

- ♦ HW-4: Develop or apply habitat connectivity models to provide metrics for all restoration and protection projects.
- Other Actions that support Strategy: HW-3, WW-14

Objective 2-1b: To protect targeted habitat types through acquisition and other mechanisms:

Strategy 2-1b1: Identify high-priority areas to protect using a repeatable, criteria-based process to minimize bias, supplemented by expert knowledge.

- ♦ HW-5: Use remote sensing, mapping tools, modeling, and field verification to determine sites that are likely to be impacted by sea level rise, and which sites are ideal for habitat migration.
- ♦ HW-6: Develop and apply habitat quality metrics and assessment methodology across targeted habitat types.
- HW-7: Develop a habitat quality index for tracking the success of habitat restoration projects and programs on habitat quality.
- ♦ HW-8: Use leading-edge design tools to prioritize future conservation investment and management plan development for Long Island Sound's most significant and imperiled terrestrial and intertidal coastal habitats.
- ♦ HW-9: Conduct an ecological assessment of land surrounding Long Island Sound Stewardship Sites and design green infrastructure/low impact development pilot projects that minimize negative impacts and enhance beneficial ecosystem services of lands within or surrounding the Sites.
- Other Actions that support Strategy: HW-4, SC-38

Strategy 2-1b2: Conserve and enhance natural areas and open space to benefit ecosystem function and wildlife.

◆ HW-10: Protect high-priority conservation land from development through property acquisition and create a registry of protected conservation land in Connecticut and New York, which encompasses both existing protected properties and future acquisitions.

Strategy 2-1b3: Conserve and enhance natural areas and open space to benefit public access, recreation, and shoreline and community protection.

◆ HW-10: See Strategy 2-1b2

Objective 2-1c: To increase or maintain resiliency of coastal habitats and the services they provide:

Strategy 2-1c1: Identify and prioritize upland, wetland, and aquatic habitats that are vulnerable to climate change impacts and take action to mitigate or adapt to these impacts (e.g., remove or mitigate barriers to habitat migration).

◆ HW-11: Develop and promote the use of living shoreline habitat protection methods (dunes, shorelines, coastal marshes) and living shoreline monitoring protocols.

HW-12: Promote the conversion of existing armored shorelines (seawalls, riprap, bulkheads, etc.) to softer living shorelines to mitigate the impacts of new (and authorized) armored shorelines.

Other Action that supports Strategy: HW-5

2-2 OUTCOME: SYSTEM RESILIENCY AND FUNCTION ARE MAINTAINED BY DIVERSE, BALANCED, AND ABUNDANT POPULATIONS OF FISHES, BIRDS, AND OTHER WILDLIFE.

Objective 2-2a: To manage invasive species:

Strategy 2-2a1: Develop volunteer stewardship programs to manage invasive species to ensure habitats are healthy and include representative plant and animal species.

HW-13: Promote volunteer-driven invasive species reconnaissance and removal work.

Other Action that supports Strategy: SC-11

Strategy 2-2a2: Teach and promote measures that will help to prevent the introduction and spread of invasive biota in Long Island Sound and connected upland areas.

HW-14: Develop and implement invasive/non-native species management plans for priority sites, including promoting the widespread use of BMPs or Hazard Analysis and Critical Control Point plans.

HW-15: Assess adequacy of current legislation and programs that target prevention and spread of invasive/non-native species.

Other Actions that support Strategy: HW-14, SC-11

Objective 2-2b: To manage state and federal listed species and species whose Long Island Sound population is regionally or globally important:

Strategy 2-2b1: Prioritize habitat restoration projects for targeted and Trust Species.

◆ HW-16: Collect data on, and restore habitat for, listed and forage species.

Strategy 2-2b2: Manage habitat threats (e.g., climate change driven threats and predator-prey relationships) to targeted and Trust Species.

HW-17: Reduce and manage threats to populations of targeted listed species.

Objective 2-2c: To manage and restore populations of harvested species:

Strategy 2-2c1: Create or update species management plans for commercially and recreationally important species.

HW-18: Develop a shellfish management plan that supports BMPs for aquaculture, recreation, and restoration that ensure sustainable marine populations.

Objective 2-2d: To maintain or improve diverse/resilient communities of native fish, birds, and other wildlife:

Strategy 2-2d1: Promote projects that protect and restore biological and ecological diversity.

HW-19: Update and implement Connecticut and New York State Wildlife Action Plans, and continue to update or draft new site-specific management plans as needed.

Other Actions that support Strategy: HW-13, HW-14, HW-15, SC-11

2-3 OUTCOME: THE PUBLIC IS EDUCATED AND INVOLVED IN RESTORATION AND PROTECTION OF HABITATS AND LIVING RESOURCES.

Objective 2-3a: To educate and engage the public, particularly in urban areas, in both large and small-scale habitat restoration projects, research, monitoring, management, and stewardship associated with priority habitat types and living resources:

Strategy 2-3a1: Promote the creation of educational and outreach programs tailored for multiple user groups.	HW-20: Develop programs to assist landowners with using habitat protection and management methods on their own properties. Other Actions that support Strategy: SC-5, SC-10, SC-11, SC-15
Strategy 2-3a2: Communicate the importance of ecosystem services to the public and municipal leaders.	HW-20: See Strategy 2-3a1 Other Actions that support Strategy: SC-10, SC-11

Objective 2-3b: To instill a sense of stewardship by increasing people's awareness of, and visitation to, priority habitats and LISS Stewardship Sites:

Strategy 2-3b1: Enhance and promote innovative and relevant ways of connecting people to Stewardship Sites.	HW-21: Design, develop, and promote coupled habitat restoration and monitoring projects that incorporate meaningful citizen science, engagement, and participation.
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2-4 OUTCOME: KNOWLEDGE OF HABITATS AND LIVING RESOURCES IS ADVANCED THROUGH MONITORING, ASSESSMENT, AND RESEARCH.

Objective 2-4a: To enhance knowledge of habitats and living resources through research, collaboration, and distribution of useful habitat and living resource data:

Strategy 2-4a1: Support ecosystem science research such as habitat modeling and landscape design efforts to enhance protection of living terrestrial and aquatic resources.	HW-22: Collect data on targeted habitat types to assist with development of habitat quality metrics and assessment methodology. Other Actions that support Strategy: HW-4, HW-5
Strategy 2-4a2: Inventory status and trends in quality, quantity, and distribution of priority habitats and species.	HW-23: Assess additional habitat types to target for habitat restoration and protection, considering opportunities for restoration and new information on submerged habitats. ◆ HW-24: Continue Long Island Sound eelgrass abundance surveys and promote eelgrass management. Other Actions that support Strategy: HW-6, HW-7, HW-9, HW-22
Strategy 2-4a3: Identify surrogate/representative species for long-term monitoring to evaluate ecosystem health.	HW-25: When merited, use a species-based approach (i.e., surrogate species or species by species restoration targets) in conjunction with a habitat restoration focused approach to understand and monitor habitat health. Other Action that supports Strategy: HW-17
Strategy 2-4a4: Identify water quality conditions necessary to support priority habitats and use suitability models to evaluate appropriate restoration priorities through pollution controls.	◆ HW-26: Assess locations of tidal marsh loss and the parameters impacting tidal marshes through research and monitoring, and use this information to create a suitability model to determine sites for restoration. Other Action that supports Strategy: SM-1



Triumph

SUSTAINABLE AND RESILIENT COMMUNITIES

Support vibrant, informed, and engaged communities that use, appreciate, and help protect Long Island Sound.

CHALLENGES

- Coastal properties are at risk from rising waters and more intense or frequent storm events.
- Environmental protection and economic development are not fully integrated into local community planning and development.
- Building environmental stewardship for urban waters.

SOLUTIONS

- Support coastal communities in developing and adopting resiliency plans.
- Coastal communities integrate transportation, conservation of energy and water, and pollution control policies through sustainable development plans.
- Fully involve underserved communities and respond to their needs and perspectives.

SUSTAINABLE AND RESILIENT COMMUNITIES

The coastal counties in Connecticut and New York bordering Long Island Sound have the second highest population density in the northeast, second only to those bordering New York/New Jersey Harbor.

Local government decisions affecting development, land use, and population density have a strong impact on water and habitat quality in the Sound and its tributaries. Ultimately, local government leadership, private sector engagement, community organization empowerment, and individual stewardship are vital to efforts to restore the Sound.

Long Island Sound has a venerable maritime heritage. Important marine trades such as ship-building, transportation, and fishing mingle with many recreational, residential, and commercial uses of its dynamic shorelines and waters. The economy, culture, and environment all interact to influence the quality of life in the communities around the Sound.

The Sustainable and Resilient Communities theme emphasizes that restoring Long Island Sound can increase human appreciation, use, and enjoyment of the resource. It emphasizes that there are opportunities to redefine normal, accepted practices in a sustainability framework and instill them in our culture. What becomes customary should contribute to our economy and lifestyle while protecting the Long Island Sound ecosystem. Communities and businesses that use less energy to produce needed goods and services can save money and reduce their carbon footprint while improving public health and the environment. Residential landscapes that are more compatible with our climate and water resources cost less money and require less time than traditional yards. Resilient shorelines that include stable areas of tidal wetlands and dunes will help to prevent shoreline erosion and protect built infrastructure and are necessary for the long-term sustainability of these uses.

ECOSYSTEM TARGETS

The following ambitious, but achievable, ecosystem targets have been developed to drive progress toward attaining the **Sustainable and Resilient Communities (SC)** goal. Achieving these targets can also contribute to the goals for the other themes. Likewise, multiple strategies and implementation actions throughout the four theme areas apply directly and indirectly to these targets. Measuring, tracking, and reporting environmental indicators of each ecosystem target will provide information to assess progress and refine and adapt management as needed. A detailed explanation about the rationale and quantification of these targets is included in Appendix B.

Waterfront Community Resiliency and Sustainability:

All coastal municipalities have prepared plans for shoreline resiliency and infrastructure sustainability and resiliency by 2025, with all future development compliant with those plans by 2035.

Harbor and Bay Navigability: Maintain all federal navigation channels in harbors and bays and manage dredged material in a cost-effective and environmentally sound manner, consistent with a bi-state Dredged Material Management Plan, by 2035.

Public Engagement and Knowledge: Increase the knowledge and engagement of the public in the protection and/or restoration of Long Island Sound compared to the 2006 public perception survey.

Public Beach Closures: Reduce by 50 percent the number of beaches reporting at least one closure day or the total number of beach-day closures per monitored beach due to water quality impairments by 2035, compared to a five-year rolling average from 2014.

Marine Debris: Decrease the mass of marine debris in Long Island Sound by 2035.

Public Access to Beaches and Waterways: Increase by at least 10 percent the number of public access points to the Sound and its rivers by 2035.

It is critical to the health and sustainability of the Sound to engage the communities that use the Sound to understand, appreciate, and protect it. The Sustainable and Resilient Communities theme addresses the need to support vibrant, informed, and engaged communities as stewards of the resource.

OUTCOMES, OBJECTIVES, STRATEGIES, AND IMPLEMENTATION ACTIONS

To accomplish the Sustainable and Resilient Communities goal and to achieve progress toward the ecosystem targets, the plan includes specific outcomes, objectives, strategies,

and actions. The Implementation Actions (IAs) have been formulated to carry out the SC theme strategies. All IAs are important to meeting the plan's objectives and outcomes. While recognizing that the priorities of each implementing organization will vary according to its mission and the purpose of available funds, the CCMP identifies the highest overall priorities, whether for new or underway actions, by consensus of the Management Conference partners. Highest priority actions are indicated by a "◆" symbol. The complete five-year implementation action plans (further described in Appendix C) are included in the supplement to the CCMP posted on the LISS website.

3-1 OUTCOME: RESIDENTS HAVE THE AWARENESS, KNOWLEDGE, AND SKILLS TO PROTECT THE SOUND.

Objective 3-1a: To increase appreciation of Long Island Sound and opportunities for residents to get a meaningful experience on the Sound and on its shoreline:

Strategy 3-1a1: Encourage opportunities to enjoy Long Island Sound through activities such as fishing, swimming, and bird watching.

- SC-1: Provide technical and grant assistance to support festivals and celebrations that encourage appreciation and use of the Sound.
- SC-2: Provide support through technical and grant assistance to organizations that promote environmentally sustainable recreational activities along Long Island Sound.
- SC-3: Continue programs to promote youth and adult fishing and boating as healthy and sustainable recreational sports.

Strategy 3-1a2: Support maritime and cultural heritage awareness.

- SC-4: Seek a National Heritage Area designation for Long Island Sound that will promote the Sound's heritage as the "Urban Sea" and the Sound's cultural, historical, maritime, and natural resources.
- Other Actions that support Strategy: SC-1, SC-2, SC-3

Strategy 3-1a3: Connect/reconnect urban populations, including underserved and non-English language communities, to the Sound.

- ◆ SC-5: Provide technical and grant assistance to support federal and local initiatives that increase appreciation and understanding of the Sound for underprivileged and non-traditional audiences in urban areas.
- Other Actions that support Strategy: HW-20, HW-21

Objective 3-1b: To increase public knowledge and understanding of the ecological health of Long Island Sound:

Strategy 3-1b1: Provide information products that educate communities about the health of Long Island Sound and about the collaborative efforts to restore and protect the Sound.

- ◆ SC-6: Produce informational materials that can be distributed through multiple formats to encourage stewardship and increase the public's understanding of the ecological, cultural, and recreational value of Long Island Sound.
- SC-7: Develop innovative projects with partners to disseminate knowledge and results from Long Island Sound monitoring and research.
- SC-8: Raise awareness through various media formats about the Sound's water quality conditions that could impact human health.
- SC-9: Expand efforts, through the LISS website and social media channels, to educate the public about the impacts of climate change on Long Island Sound and in Long Island Sound Stewardship Areas.

Objective 3-1c: To increase public stewardship, at home and in the community, to protect the natural resources of the Sound

Strategy 3-1c1: Involve the public in the cleanup and restoration of Long Island Sound through volunteerism and community action.

SC-10: Provide technical and grant assistance to local volunteer organizations working towards the ecological restoration of the Sound.

SC-11: Continue staff support for Sound Stewardship volunteer projects and other outreach activities at New York and Connecticut Stewardship Areas.

SC-12: Continue the Long Island Sound Citizens Summit, and support other Sound-wide events that encourage dialogue between resource managers, environmental stakeholders, and residents.

Other Actions that support Strategy: HW-13, HW-21

Strategy 3-1c2: Encourage residents, both homeowners and renters, to engage in environmentally-friendly practices around their homes and communities.

SC-13: Provide natural landscaping guidance to communities and homeowners to encourage the use of alternatives to chemical and nutrient-intensive landscaping, and the establishment of natural vegetated buffers near bodies of water.

◆ SC-14: Support efforts through technical and grant assistance to develop behavior change campaigns that result in measurable environmental improvements to the Sound's ecosystem.

SC-15: Develop a Sound-wide marketing campaign to increase the public's safe and sustainable use of the Sound.

3-2 OUTCOME: FUTURE GENERATIONS HAVE THE SKILLS TO BECOME LEADERS AND STEWARDS FOR THE SOUND.

Objective 3-2a: To incorporate Long Island Sound topics, including its ecology and history, into New York and Connecticut classrooms and curriculum, and informal settings:

Strategy 3-2a1: Support professional development of formal and informal educators.

SC-16: Continue programs such as the Long Island Sound Mentor Teacher Program that provide formal and informal K-12 educators with opportunities to learn how to include Long Island Sound instruction in their classrooms.

Strategy 3-2a2: Provide science-based information products and supplemental resources such as lesson plans for specific Long Island Sound topics.

SC-16: See Strategy 3-2a1

Objective 3-2b: To provide youth with opportunities to learn about Long Island Sound and its related issues:

Strategy 3-2b1: Support informal education at aquariums, museums, and coastal environments with facilities such as nature centers.

SC-17: Provide technical and grant assistance to encourage informal education activities on Long Island Sound.

SC-18: Create an annual "get out on Long Island Sound day" of informal educational activities around the Sound to promote "on-the-water" experiences.

Strategy 3-2b2: Engage youth in stewardship opportunities.

SC-11: See Strategy 3-1c1

Other Actions that support Strategy: HW-13, HW-21

3-3 OUTCOME: POLICY MAKERS, RESOURCE MANAGERS, AND OTHER STAKEHOLDERS HAVE THE INFORMATIONAL RESOURCES TO UNDERTAKE COLLABORATIVE EFFORTS TO RESTORE AND PROTECT THE SOUND.

Objective 3-3a: To ensure that policy makers, environmental professionals, health professionals, and other stakeholders have the best available information in order to make decisions that will improve the management of Long Island Sound:

Strategy 3-3a1: Support the dissemination of the best practices to reduce contaminants, improve water quality, and protect habitats through professional development training and workshops.

SC-19: Provide training to municipalities on low impact development and green infrastructure.

◆ SC-20: Develop and implement regional outreach and training programs on innovative/sustainable flood and erosion control for municipalities.

Strategy 3-3a2: Update and disseminate information on the best available scientific, socioeconomic, and environmental trends to policy makers, resource managers, and stakeholders.

SC-21: Provide support, including funding and technical assistance, for the development and dissemination of environmental technical manuals and studies to environmental decision makers and resource managers.

◆ SC-22: Use the best available social science research methods to understand the public's role in the Long Island Sound ecosystem, and use that information to help support campaigns to reduce pollution and improve water quality.

3-4 OUTCOME: NEW AND EXISTING DEVELOPMENT IS SUSTAINABLE AND RESILIENT.

Objective 3-4a: To encourage and facilitate the development of regional, state, and local sustainability, mitigation, and resiliency plans and integrate them into community comprehensive plans:

Strategy 3-4a1: Provide support to municipalities to facilitate the development and updating of sustainability and resiliency plans that incorporate current concepts on these topics.

- ◆ SC-23: Develop a handbook, website, and, or, other materials (e.g., regulations, funding sources, and best practices) to be used by municipal officials to aid in the development of sustainability and resiliency plans and their integration into comprehensive plans.
 - ◆ SC-24: Conduct region-wide and town-specific workshops to assist municipalities in developing sustainability and resiliency plans and integration into their comprehensive plans.
 - ◆ SC-25: Support communities as they develop and adopt new or updated stand-alone Municipal Sustainability Plans.
 - ◆ SC-26: Support communities as they develop and adopt new or updated Coastal Resiliency Plans.
- Other Actions that support Strategy: WW-12, WW-15

Strategy 3-4a2: Ensure consistency among economic development and sustainability and resiliency planning efforts.

- SC-27: Conduct reviews of waterfront revitalization, economic development, and, or, redevelopment plans, to assess the degree to which sustainability and resiliency concepts are incorporated.
- SC-28: Develop guidance for quantifying the benefits and costs of sustainability activities and economic development to incorporate into sustainability and resiliency planning efforts.
- Other Action that supports Strategy: WW-15

Objective 3-4b: To develop and implement sustainability and resiliency plans for new and existing development, housing, transportation, emissions control, energy efficiency, and job creation programs for all municipalities:

Strategy 3-4b1: Revise zoning, permitting, and related regulations to ensure that future development and redevelopment conform to sustainability, mitigation, and resiliency plans.

- ◆ SC-29: Identify and recommend removal and, or, protection of sensitive infrastructure in the coastal zone (e.g., oil tanks, pump, power stations, etc.) and work to prevent future siting of such infrastructure in vulnerable coastal floodplains.
- Other Actions that support Strategy: SC-25, SC-26, WW-12, WW-15

Strategy 3-4b2: Provide technical assistance and training for homeowners, municipal officials, developers, engineers, and consultants on sustainability, adaptation, and resiliency concepts and opportunities for implementation.

- ◆ SC-30: Implement standards, best practices, and educational materials for Green Infrastructure/Low Impact Development planning and implementation.
- SC-31: Develop regional outreach programs and training modules on sustainability and resiliency planning topics.
- Other Actions that support Strategy: SC-25, SC-26, WW-12, WW-15

Strategy 3-4b3: Balance waterfront recreational, commercial, and industrial uses according to sustainability and resiliency plans.

- SC-32: Remediate and sustainably develop abandoned and underutilized sites (brownfields).
- SC-33: Develop and implement the Long Island Sound Dredge Material Management Plan.
- SC-34: Conduct a review of the implementation of resiliency and sustainability plans as they relate to community and waterfront development and redevelopment.

3-5 OUTCOME: PUBLIC ACCESS AND SUSTAINABLE ECONOMIC ACTIVITIES ALONG THE WATERFRONT ARE ENHANCED, BALANCED, AND RESILIENT.

Objective 3-5a: To encourage communities to identify priority waterfront economic development activities and then to implement economic development strategies and infrastructure planning that result in vibrant, resilient, and environmentally sustainable communities:

Strategy 3-5a1: Establish programs and provide support to communities to help them in obtaining recognition for exemplary sustainability programs.

- SC-35: Establish a sustainability and resiliency grant program to encourage implementation of sustainability and resiliency plans.
- SC-36: Develop a municipal sustainability recognition program that incorporates ideas from other states to incentivize sustainable development and economic planning.

Strategy 3-5a2: Improve access to Long Island Sound and its embayments, maintain and enhance view corridors and blueways, and enhance water-dependent uses.

- ◆ SC-37: Develop a Public Access Plan to increase public access points and the length of shoreline accessible by the public to the Sound and its rivers.
- SC-38: Encourage the sustainable use of natural coastal areas, including Long Island Sound Stewardship Areas, through support of sustainable blueways, bikeways, and greenways.
- Other Action that supports Strategy: HW-8



SOUND SCIENCE AND INCLUSIVE MANAGEMENT

Manage Long Island Sound using sound science and cross-jurisdictional governance that is inclusive, adaptive, innovative, and accountable.

CHALLENGES

- Coastal waters are becoming warmer and potentially more acidic, both of which may alter the food web and negatively impact human uses.
- Assessing the health of the Long Island Sound ecosystem and linking it to human pressures that impair it.
- Developing diverse funding strategies that consider the social, environmental, and economic benefits of actions.
- Changes in fish and shellfish populations and habitats have made Long Island Sound more susceptible to nutrient pollution.
- Demands for uses of Long Island Sound such as energy transmission lines can result in conflicts with existing uses.

SOLUTIONS

- Integrate climate change science into management and adaptation activities.
- Integrate research and monitoring (including citizen science) to refine and adapt management solutions.
- Estimate changes in the value of ecosystem services that result from impairment or restoration to inform and sustain investment in protecting and restoring those assets.
- Increase the capacity of Long Island Sound to assimilate nutrients without harmful effects by restoring wetlands, eelgrass, and harvesting (aquaculture) of shellfish and seaweed.
- Increase collaboration among marine users and stakeholders through coastal and marine spatial planning.

◀ **CTDEEP SCIENTISTS CONDUCT** trawl surveys of the Sound's marine life, including horseshoe crabs, on board the Research Vessel *John Dempsey*. (Photo by Richard Howard)

SOUND SCIENCE AND INCLUSIVE MANAGEMENT

The Long Island Sound watershed covers more than 16,000 square miles in six states and encompasses hundreds of local watersheds. Effective and efficient management of Long Island Sound, as with any large waterbody, requires collaboration and governance among numerous cross-jurisdictional partners and stakeholders. In March 1988, the Long Island Sound Study Management Conference was convened, representing a partnership of federal, state, interstate, and local agencies, universities, environmental groups, industry, and the public to guide the management of Long Island Sound and become the coordinating entity of the CCMP.

Inherent to effective management is thorough scientific understanding through strengthened research, monitoring, assessment, mapping, and modeling programs. As new data, research, knowledge, and issues emerge, it is critical that implementation and management is adapted and improved. Ecosystem-based management (EBM) provides a framework for both science and management that accounts for the complex interrelationships of human society and the environment. It means planning on an ecosystem level, involving multiple stakeholders and integrating the full spectrum of ecosystem services supporting human wants and needs, developing cross-jurisdictional goals, implementing programs through coordinated, accountable strategies across levels of government, incorporating adaptive management that acknowledges uncertainty in our understanding, and establishing long-term observation, modeling, and research programs (McLeod et al. 2005).

Our estuarine and coastal systems have been impaired primarily from overharvesting of living natural resources, pollution, and habitat loss and degradation. Invasive species and climate change also have had an impact that will likely become more influential in the future. To address these drivers and pressures successfully, LISS management must develop and support integrated, adaptive, and coordinated relationships among fisheries, coastal zone, and pollution management programs in the context of human use of the

The Sound Science and Inclusive Management (SM) theme addresses EBM through research, monitoring, modeling, and assessment. Monitoring is further detailed in Section 4. These efforts need to be maintained and enhanced to increase understanding of Long Island Sound and support management outcomes. In addition, this theme addresses the coordination of the many entities involved in CCMP implementation, funding, and application of an adaptive management framework.

Sound. Societal needs and the economic consequences of activities to ecosystem services that society relies upon are vital elements to be integrated into management. In this way, EBM is an integral part of meeting pressing social needs in environmentally sustainable ways.

OUTCOMES, OBJECTIVES, STRATEGIES, AND IMPLEMENTATION ACTIONS

To accomplish the Sound Science and Inclusive Management goal and to achieve progress toward the ecosystem targets, the plan includes specific outcomes, objectives, strategies, and actions. The Implementation Actions (IAs) have been formulated to carry out the SM theme strategies. All IAs are important to meeting the plan's objectives and outcomes. While recognizing that the priorities of each implementing organization will vary according to its mission and the purpose of available funds, the CCMP identifies the highest overall priorities, whether for new or underway actions, by consensus of the Management Conference partners. Highest priority actions are indicated by a "◆" symbol. The complete five-year implementation action plans (further described in Appendix C) are included in the supplement to the CCMP posted on the LISS website.

4-1 OUTCOME: THE SCIENTIFIC UNDERSTANDING OF LIS TO SUPPORT MANAGEMENT IS INCREASED THROUGH STRENGTHENED RESEARCH, MONITORING, ASSESSMENT, MAPPING, AND MODELING.

Objective 4-1a: To enhance the research portfolio to answer questions relevant to Long Island Sound management:

Strategy 4-1a1: Identify and support science activities needed to transparently link outcomes and objectives to strategies and actions, setting priorities based on management relevance and scientific merits.

◆ SM-1: Identify and communicate high-priority science needs relating to the understanding and attainment of management objectives and ecosystem targets, and support research programs to fulfill these needs.

Other Actions that support Strategy: WW-11, WW-23, WW-26, HW-26

Objective 4-1b: To maintain and enhance monitoring and assessment programs to increase understanding of Long Island Sound and assess progress toward management outcomes:

Strategy 4-1b1: Characterize, inventory, and map open and shallow water habitats to support resource management and marine spatial planning.

SM-2: Complete seafloor mapping conducted under the Sound Cable Fund, and use results to guide additional mapping.

Strategy 4-1b2: Characterize, inventory, and map human uses, both recreational and commercial, of open and shallow water habitats to support resource management and marine spatial planning.

SM-3: Identify key datasets needed to support coastal and marine spatial planning for Long Island Sound and initiate collection.

Strategy 4-1b3: Evaluate, enhance, integrate, and coordinate ongoing monitoring programs.

SM-4: Develop an integrated Monitoring Plan considering developing technologies and citizen science.

SM-5: Develop an integrated Data Management Plan considering local, regional, and national observing initiatives.

SM-6: Incorporate the Interstate Environmental Commission's monitoring efforts into the Long Island Sound water quality monitoring program.

SM-7: Continue National Coastal Assessment monitoring of Long Island Sound.

Other Actions that support Strategy: WW-25, WW-27, WW-28, WW-33, WW-34

Strategy 4-1b4: Strengthen monitoring of conditions in embayments and near-shore waters, and integrate the resulting data and assessments into open water monitoring programs.

◆ SM-8: Coordinate and leverage community water quality monitoring programs, enhancing citizen science and the utility and application of data.

Other Actions that support Strategy: WW-24, WW-25, WW-28, WW-31

Strategy 4-1b5: Improve regional identification, storage, and sharing of spatial and temporal data.

SM-9: Assess options for establishing a secure, long-term Long Island Sound data portal that can be accessed by other regional data systems, such as the Northeast Ocean Data Portal.

◆ SM-10: Improve the use and utility of Long Island Sound data for GIS applications.

Objective 4-1c: To develop and improve modeling capabilities to provide predictive assessments of resources, physical dynamics, and water quality:

Strategy 4-1c1: Transition existing and new models to a community modeling framework that provides open source access to facilitate external collaboration, assessments, and enhancements.

◆ SM-11: Enhance modeling of eutrophication in Long Island Sound to support nitrogen management and Dissolved Oxygen TMDL implementation.

SM-12: Make publicly available the System-wide Eutrophication Model code and products to enhance transparency and collaboration.

SM-13: Link water quality models of Long Island Sound to watershed and groundwater pollutant loading models to better elucidate sources and relative contributions of nitrogen, including all coastal watersheds.

Other Action that supports Strategy: WW-23

4-2 OUTCOME: ACTIONS ARE IMPLEMENTED THROUGH COORDINATED STRATEGIES BY ALL LEVELS OF GOVERNMENT AND DIVERSE STAKEHOLDERS.

Objective 4-2a: To increase communication, coordination, and reduce institutional barriers to cooperation on an ecosystem level among all levels of government, stakeholder groups, and the general public:

<p>Strategy 4-2a1: Maintain and enhance the Long Island Sound Management Conference as the coordinating entity to implement the CCMP, and expand opportunities for local government involvement.</p>	<p>SM-14: Continue program administrative, financial, and technical assistance support to Management Conference.</p> <p>SM-15: Continue state program coordination and involvement in the Management Conference.</p> <p>◆ SM-16: Optimize structure and function of the Management Conference with a focus on implementation of the revised CCMP.</p> <p>SM-17: Reauthorize Clean Water Act sections 119 and 320, and other relevant statutes to support LIS.</p> <p>SM-18: Support involvement of, and communication with, the bi-state LIS Congressional Caucus and bi-state Connecticut and New York legislative caucus on issues of common concern.</p> <p>◆ SM-19: Support involvement of, and communication with, local governments, which have front line authority for implementing many of the CCMP strategies.</p> <p>◆ SM-20: Reach out to traditionally underrepresented stakeholders and encourage them to participate in the Management Conference.</p>
<p>Strategy 4-2a2: Ensure that the CCMP is incorporated into and carried out through existing state and local policies and regulatory programs.</p>	<p>SM-21: Incorporate relevant updated elements of the CCMP into state regulatory and planning programs such as coastal zone management program consistency reviews and state environmental equality reviews (State Environmental Quality Review Act in New York).</p>
<p>Strategy 4-2a3: Maintain EPA, NYSDEC, and CTDEEP support of the Management Conference to provide leadership and accountability.</p>	<p>SM-22: Convene senior EPA and state management to help direct, inform, and coordinate policy relevant to Long Island Sound.</p>
<p>Strategy 4-2a4: Enhance opportunities for cooperation and involvement of the tributary states of Massachusetts, New Hampshire, Rhode Island, and Vermont to address stressors that contribute to downstream effects on LIS.</p>	<p>SM-23: Foster involvement of the tributary states in Management Conference activities by maintaining the Five State/EPA TMDL Work Group.</p> <p>Other Actions that support Strategy: WW-6, WW-7, WW-9, WW-10, WW-11, WW-25</p>
<p>Strategy 4-2a5: Through Marine Spatial Planning, facilitate the management of multiple human uses of the Sound compatible with the conservation of natural resources and habitats.</p>	<p>◆ SM-24: Develop a bi-state framework (or guidance) for Coastal and Marine Spatial Planning for Long Island Sound to more comprehensively manage Long Island Sound resources.</p>
<p>Objective 4-2b: To maintain and enhance efficient public investments in restoration and management:</p>	
<p>Strategy 4-2b1: Apply concepts of economic valuations of the natural capital of LIS and its watershed (i.e., the value of the goods and services supported by natural ecosystems) to inform and sustain investment in protecting and restoring those assets.</p>	<p>SM-25: Conduct primary valuations of the critical ecosystem goods and services supported by Long Island Sound and its coastal habitats.</p> <p>SM-26: Conduct return on investment analysis for Long Island Sound restoration and preservation strategies to inform priority setting for implementation of the CCMP.</p>
<p>Strategy 4-2b2: Identify critical funding needs for protection and restoration projects, science, education, and involvement, and relate these needs to available or new funding sources.</p>	<p>SM-27: Capitalize Connecticut Clean Water Fund and New York State Revolving Fund adequately to finance Clean Water infrastructure needs.</p> <p>◆ SM-28: Research and develop innovative, locally appropriate funding mechanisms to provide sustained, reliable sources of investment capital to restore and protect ecosystem services.</p> <p>SM-29: Coordinate and target funding for implementation of protection and restoration, science, and education and involvement projects.</p>

Strategy 4-2b3: Evaluate cross-agency expenditures on Long Island Sound to identify how funding levels match with priority needs, assess whether resources are being optimally applied, and identify leveraging opportunities.

SM-30: Develop an annual budget for each Federal department and agency involved in the protection and restoration of the Long Island Sound watershed.

4-3 OUTCOME: IMPLEMENTATION IS ADAPTED AND IMPROVED THROUGH THE APPLICATION OF NEW INFORMATION AND KNOWLEDGE.

Objective 4-3a: To frame sustainability, adaptation, and resilience in relation to the drivers of ecosystem change:

Strategy 4-3a1: Include important environmental drivers (e.g., climate change) in all relevant management planning initiatives.

SM-31: Incorporate climate change-driven factors such as temperature and sea level rise in model applications to assess factors that can influence future attainment of water quality standards and habitat protection and restoration goals.

SM-32: Develop a vulnerability assessment of how climate change will affect attainment of the CCMP goals and objectives.

Other Actions that support Strategy: WW-12, WW-28, WW-29, WW-30

Strategy 4-3a2: Consider the spectrum of desired ecosystem outcomes when planning and implementing resiliency of both built and natural systems.

SM-33: Incorporate desired ecosystem outcomes for planning and implementation of Hurricane Sandy Relief funds and ongoing coastal resiliency programs.

SM-34: Collaborate with the Connecticut Institute for Resiliency and Climate Adaptation (CIRCA).

Objective 4-3b: To apply an adaptive management framework to CCMP implementation when warranted by the level of uncertainty in the underlying science:

Strategy 4-3b1: Establish baselines of historical or pre-historical conditions of ecosystem attributes and magnitudes of change to help provide a basis for setting restoration goals.

◆ SM-35: Refine the ecosystem metrics and targets based on the underlying science of the Long Island Sound ecosystem to clearly identify the characteristics of a “restored” Long Island Sound.

Strategy 4-3b2: Utilize and learn from cutting edge approaches and methods to improve management options for pollution mitigation and ecosystem protection (e.g., marine spatial planning, innovative source reduction technologies, and in situ extractive technologies).

SM-36: Incorporate bioextraction analyses in Dissolved Oxygen TMDL assessments on the assimilative capacity of Long Island Sound to process nutrients without loss of designated uses.

Other Action that supports Strategy: WW-6

Strategy 4-3b3: Prepare periodic progress reports on the health of the Sound and on implementation progress.

SM-37: Prepare and make available to the public annually the LISS Implementation Tracking Report using *E-Sound*.

◆ SM-38: Issue a “report card” on water quality conditions in Long Island Sound.

SM-39: Refine and communicate information on the Long Island Sound ecosystem and watershed using environmental indicators (drivers, pressures, conditions, and response indicators).

Strategy 4-3b4: At five-year intervals refine implementation actions and priorities by incorporating and integrating new information (including emerging issues) relating to science and management.

SM-40: Develop annual Long Island Sound Study work plans that consider progress made and recommendations for improving implementation to achieve desired outcomes.

◆ SM-41: Every five years develop a comprehensive, specific, target-oriented implementation plan engaging all Long Island Sound partners.