

TECHNICAL EXPLANATION OF ECOSYSTEM TARGETS

The following section provides a technical background and explanation of the quantitative ecosystem targets in the CCMP. Explanation is provided for each target on how and why the given metric and specific target were chosen and how progress toward the target will be measured (e.g., what the baseline value is, clarification of specific terms, what datasets will be used, etc.).

CLEAN WATERS AND HEALTHY WATERSHEDS

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.

The average size of the maximum summertime extent of hypoxia ($DO \leq 3.0$ mg/L) from 1987–2000 was 208 square miles. Based on the last 20 years of interannual variability, a 28 percent reduction would be necessary to achieve a “measurable reduction,” defined as the ability to statistically differentiate (either by regression or by ANOVA) that a change has occurred with 95 percent confidence after 20 years (in 2035). We chose areal extent from the available hypoxia metrics tracked by LISS (areal extent, duration) because this metric is most closely correlated to the severity of impact and is the least environmentally variable of the metrics.

NITROGEN LOADING

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

Discharges from wastewater treatment facilities are tracked for compliance with permit limits consistent with the LIS Dissolved Oxygen TMDL for nitrogen (CTDEEP, NYSDEC 2000). This target is to attain the TMDL allocation for wastewater treatment facilities (in trade equalized pounds per day) by 2017 and

maintain compliance with that cap into the future.

The allocations for nonpoint sources in the LIS TMDL require implementation of a variety of best management practices to control nonpoint source pollution. This target is to have all the necessary practices to attain the TMDL nonpoint source allocation in place by 2025. Because it is difficult to directly monitor nonpoint source nutrient loads, a BMP tracking and modeling approach will be used to assess attainment of the TMDL stormwater and nonpoint source allocations. This approach will produce quantitative estimates of nitrogen load controlled as a result of those practices. The estimation of nitrogen load controlled will be used to measure attainment of the TMDL targets to reduce nitrogen loading from stormwater and nonpoint sources.

WATER CLARITY

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

Water clarity is one of the major factors affecting eelgrass health and therefore extent. For most of LIS water clarity is correlated with phytoplankton levels and measured using standard light penetration techniques (e.g., Secchi disk, photosynthetically active radiation sensors). For the purposes of this goal, “improved” is defined as an increase in the overall numeric criterion for water clarity in the Long Island Sound water quality report card (under development) by at least half letter grade (e.g., B to B+) between the initial 2015 report card evaluation and the evaluation conducted in 2035.

IMPERVIOUS COVER

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

The degree of impervious cover, particularly near waterbodies, has been shown to be associated with degradation of water quality in rivers and streams. The analysis is based on UCONN Center for Land Use Education And Research (CLEAR) Land use data (http://clear.uconn.edu/publications/research/Statewide_riparian_final.pdf) (Wilson and Arnold 2008) and can be tracked using the CLEAR estimate of impervious cover. Low impact development projects (e.g., green roofs, permeable parking lots) logged in the CLEAR Low Impact Development Atlas would be considered pervious for the purpose of this analysis. The 2010 baseline is 296,000 acres (463 square miles) of impervious cover in the LISS Study area. The study area is defined by the TMDL, and the study area boundary can be found here: <http://longislandsoundstudy.net/wp-content/uploads/2010/01/LISSHabMap02.pdf>.

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 2010 baseline of 65 percent.

Naturally vegetated zones around the shorelines of all waterbodies provide a buffer that has been shown to be effective in removing contaminants from groundwater before it enters into receiving waters. The target is to have 75 percent of areas within 300 feet of a stream or lake within the Connecticut and New York portions of the LIS watershed naturally vegetated by 2035, based on UCONN CLEAR land use data (http://clear.uconn.edu/projects/riparian_buffer/results/CLEAR_%20Summary_021508.pdf). Naturally vegetated includes forest, grassland, shrub, and wetland land use categories, but not turf grass or agriculture field classes. This target is based on analysis of land use and water quality in CT (Goetz, 2003; Wilson and Arnold 2008).

APPROVED SHELLFISH AREAS

Upgrade 5 percent of the acreage currently restricted or closed for shellfishing by 2035 from 2014 baseline.

Each state has designated areas for safe shellfishing; the "growing waters" designation is common to both CT and NY. Currently Connecticut has approximately 128,000 approved acres, 248,000 acres of conditionally approved or restricted beds, and 23,500 acres prohibited, while New York has 412,000 acres certified, 1,613 acres seasonally certified (restricted), and 75,500 acres uncertified. Thus, to meet this target, 17,400 of the 349,000 closed or conditionally closed acres would need to be upgraded. This metric is reported by the states and tracked by the Long Island Sound Study Indicators program.

SEDIMENT QUALITY IMPROVEMENT

Reduce the area of impaired sediment in Long Island Sound by 20 percent by 2035 from 2006 baseline.

Sediment quality is determined by EPA's National Coastal Assessment Sediment Quality Index. This index is based on concentrations of 28 contaminants, characterized as "good," "fair," or "poor" for each station based on the number and severity of exceedances, and weighted by the portion of the Sound represented by each station. Our target is to reduce the net area that is impaired (rated as fair or poor) in Long Island Sound by 20 percent.

In 2006, 34 stations had data sufficient to establish a rating, and of those, 15 scored good, 11 fair, and eight poor. Spatially weighted (because sampling density is higher further west in LIS), 51.5 percent of LIS scores "good," 30 percent "fair," and 18.5 percent "poor." By this definition, 48.5 percent of LIS is considered impaired. To accomplish the goal of reducing this impairment by 20 percent we need to see net improvement in 10 percent ($48\% \times 0.2 = 9.6\%$) of the area weighted stations.

We define "improvement" to be upgrading from "poor" to "fair" or from "fair" to "good," and net improvement to be the area of stations improving minus the area of stations regressing (from "good" to "fair" or "fair" to "poor"). By this definition, our goal can be accomplished by reducing the percentage of LIS scoring poor from 18.5 percent to less than 8.5 percent (as long as the percentage scoring "fair" does not increase to more than 40 percent) or by increasing the percentage scoring "good" from 51.5 percent to more than 61.5 percent, or a combination of both (e.g., 57% good, 33% fair, 10% poor = 5.5% increase in good + 8.5% decrease in poor = 13.5% of LIS area improved = 27% decrease in impairment).

THRIVING HABITATS AND ABUNDANT WILDLIFE

COASTAL HABITAT EXTENT

Restore 350 acres of coastal habitat by 2020 and a total of 3,000 acres by 2035 from a 2014 baseline.

Between 1998 and 2014, LISS partners have restored 1,650 acres of coastal habitat. The interim goal is to restore an additional 350 acres by 2020, for a cumulative total of 2,000 acres. The final goal is to restore an additional 2,550 acres between 2021 and 2035, bringing the cumulative total of acres restored since 1998 to 4,550 acres. The target for the coastal habitat extent includes restoration in any of the 12 targeted habitat types, including eelgrass and tidal wetlands. While separate and specific restoration targets are set for these two habitat types, gains in these two areas can be used to reach the total coastal habitat restoration targets. The Habitat Restoration Work Group tracks coastal habitat restoration projects that are in progress within the watershed by various partners and reports the total acres restored annually.

Eelgrass extent

Restore and maintain an additional 2,000 acres of eelgrass by 2035 from a 2012 baseline of 2,061 acres.

The 2012 eelgrass baseline comes from a 2012 USFWS survey that found 2,061 acres of eelgrass in the Eastern Basin of the Long Island Sound. While the survey was only conducted in the Eastern Basin, eelgrass experts believe that eelgrass beds in the Central Basin are small or nonexistent while beds are absent from the Western Basin. Therefore we use 2,061 acres as an estimate of total eelgrass coverage in the Sound, and the goal is to increase this to 4,061 acres of areal eelgrass extent as measured by aerial imagery.

This target will be achieved through the successful implementation of additional water quality protections and associated reductions in land based inputs of nutrients, as well as restoration (replanting) efforts led by academic, government, and nonprofit agencies and partners. The Habitat Restoration Work Group tracks eelgrass restoration projects that are in progress within the watershed by various partners and reports the total acres restored annually. However, this ecosystem target is influenced by both habitat restoration projects as well as natural gains and losses in eelgrass extent.

Tidal wetland extent

Restore an additional 515 acres of tidal wetlands by 2035 from a 2014 baseline.

As of 2014, 985 acres of tidal wetland habitat have been restored in the LISS study area since 1998. The 2035 target is to restore an additional 515 acres, bringing the cumulative total of restored tidal wetland acres since 1998 to 1,500. For the purposes of this metric, a wetland is considered “restored” after a successful effort to restore tidal flow (e.g., culvert enlargement, fill removal). The Habitat Restoration Work Group tracks tidal wetland restoration projects that are in progress within the watershed by various partners and reports the total acres restored annually.

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.

This target will be attained by reopening, either through dam removal or fish passage projects, an additional 200 riverine migratory corridor miles (RMC). The 2014 baseline is 317 open RMC miles in Connecticut and three open RMC miles in NY. For context, there are an estimated 1,850 total RMC miles in Connecticut, more than half of which are dammed or otherwise not passable for fish. The length of New York total RMC miles has not been estimated, but is much smaller. The Habitat Restoration Work Group tracks fish passage projects that are in progress within the watershed by various partners and reports the total miles restored annually.

SHELLFISH HARVESTED

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

This is defined as the total harvest, by weight, of oysters, clams, and scallops harvested commercially or recreationally from open areas and/or shellfish leases. These data are collected by the states, and reported by the LISS Indicators program. Specific targets and timeframes will be developed after considering shellfish management plans under development such as the Connecticut statewide plan.

HABITAT CONNECTIVITY

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

Research shows that improving habitat connectivity allows for genetic and ecological flow. Corridors provide fish and wildlife with greater ability to move for the purposes of feeding, breeding, and resting. Promoting restoration and protection projects which increase aquatic and terrestrial connectivity, is an important component of ecosystem resilience, or the ability of an ecosystem and the fish and wildlife it supports to maintain function in the face of change. Connectivity gains can be both targeted and monitored by mapping restoration and protection projects in a GIS database and using decision support tools like the Stewardship Site Identification GIS Tool (SIGT) and Landscape Conservation Cooperative Connecticut River Pilot Landscape Design Tool which highlights the best areas of intact, resilient and connected habitat and identifies corridors between these areas of high quality patches. Using decision support tools like these will help to guide land protection decisions by highlighting areas on the landscape that have the greatest ecological value and identifying corridors between them. Efforts to refine these decision support tools are still underway as part of Implementation Action HW-4. Once these tools are complete, they will be used to establish a quantitative metric which will be used to estimate a baseline and set a more specific quantitative goal to be accomplished by 2035.

PROTECTED OPEN SPACE

Conserve an additional 4,000 acres of Connecticut land and 3,000 acres of New York land within the Long Island Sound coastal boundary by 2035, while maintaining or increasing the total area of protected land.

Connecticut's goal is to conserve an average of 200 acres per year within the Long Island Sound coastal boundary over the next 20 years, resulting in a total of 4,000 acres.

New York State is currently working on the latest version of their New York Open Space Conservation Plan. The Plan serves as the blueprint for the State's land conservation efforts and is required by law to be revised every three years. The most recent revision will be released in 2015. In the Plan, open space is considered an area of land that is either publicly or privately owned that will remain in its natural state or is used for agriculture, free from intensive development for residential, commercial, industrial or institutional use. The Plan identifies conservation projects and objectives for all counties found within the Long Island Sound watershed. These projects and objectives were determined by Regional Advisory Committees composed of county and state, land conservation organizations, and community interest group representatives, along with public comments received through the Plan review process. This Plan will help guide land acquisition in New York State for the coming years. The target number of acres to be acquired each year within the Long Island Sound watershed for New York is 150 acres per year. This number was determined by reviewing and averaging the total number of acres acquired each year and reported to the National Estuary Program Online Reporting Tool (NEPORT). The total number of acres acquired each year (includes acres acquired by all possible land acquisition entities: state, municipal, and land conservation organizations) for the last eight years (2007-2014), within the Long Island Sound watershed in New York State, was analyzed. Thus, the target is to preserve 3,000 acres of New York land within the Long Island Sound watershed by 2035. There is, however, a need for an accurate, complete inventory of protected land statewide in Connecticut and in the coastal area of Connecticut and New York to assess progress toward these goals.

SUSTAINABLE AND RESILIENT COMMUNITIES

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.

Sustainable development and redevelopment as well as the protection of urban and suburban infrastructure from the effects of climate change are two of the main principles driving the revision of the CCMP. This target will encourage municipalities, within the coastal zone, to develop and implement comprehensive plans, which will have long lasting benefits to their residents. The implementation of these plans should not sacrifice ecosystem integrity. The Sound-wide enumeration of coastal municipalities will be quantified and tracked by the LISS (in Connecticut there are 36 coastal municipalities, in New York there are 96).

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.

Maintenance of navigational channels is essential to sustain both recreational and commercial activities in harbors and embayments along the Connecticut and New York shorelines. This target ensures that dredging and dredged material disposal operations are accomplished in a sustainable manner, consistent with the Marine Protection, Research, and Sanctuaries Act, Clean Water Act, National Environmental Policy Act, and the Long Island Sound Dredged Material Management Plan so that future generations can enjoy boating in LIS and be assured that environmental degradation does not occur from the maintenance of harbors and embayments. The LIS Dredged Material Management Plan is presently under development. Project lists and dredge material amounts can be found at <http://www.epa.gov/region1/eco/lisdreg/index.html>.

PUBLIC ENGAGEMENT AND KNOWLEDGE

Increase the knowledge and engagement of the public in the protection and/or restoration of Long Island Sound.

A 2006 public perception survey supported by the LISS was conducted to gauge the knowledge of residents in the watershed. The survey correlated environmental knowledge with behaviors contributing to environmental stewardship. However, achieving positive behavior changes requires understanding and addressing the specific barriers preventing individuals and communities from their adoption. This target will require the development of baseline and trends metrics through best available research methods (SC-14 and SC-22) or review of existing social data that assess the degree to which the public understands its role in the protection of Long Island Sound and acts on that knowledge.

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.

LISS presently tracks closure days at 648 Connecticut and New York beaches using the EPA BEACON system (<http://watersgeo.epa.gov/beacon2/reports.html>). The five-year rolling average is 1,317 closure/advisory days, which translates to almost exactly two closure days per monitored beach. Of the 648 beaches reporting, 132 (20.5 percent) had at least one closure day. The target therefore is to reduce the five-year rolling average to about one closure day per monitored beach per year (658 total closure days assuming constant number of beaches sampled), or to reduce the total number of beaches reporting a closure to less than 10.25 percent of the total number of tracked beaches (66 at present sampling level).

MARINE DEBRIS

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

While LISS tracks several measures of marine debris, including boom/skimmer data, debris collected by vessels, and various annual beach cleanup statistics, the currently tracked indicator of pounds of debris removed per mile of beach cleanup performed is the best “effort independent” metric of the presence of debris in LIS. The data are obtained from Long Island Sound coastal cleanup days conducted as part of the International Coastal Cleanup coordinated by the Ocean Conservancy. The target is to reduce the five-year rolling average of this indicator, compared to the 2013 baseline (five-year rolling average from 2009 to 2013) of 313 pounds of debris removed per mile surveyed.

PUBLIC ACCESS TO BEACHES AND WATERWAY

Increase the number of public access points accessible by the public to the Sound and its rivers by at least 10 percent by 2035.

Public access to the shore for all members of the LIS community is an important design principle for the CCMP. There is not much undeveloped waterfront left along the coast. The CCMP includes an action (SC-37) to undertake a Sound-wide evaluation of coastal public access needs including a re-evaluation of existing public access for state/municipal sites that would most benefit for improvements to existing facilities. Such as plan would include the following steps: identify the current number of points and miles accessible; identify specific potential public access sites that could be re-developed in the future, as well as areas and stretches requiring additional attention; describe planning challenges to be considered in adding

new access sites; summarize findings and set out steps for implementing the plan and increasing access. Measurement methods for shoreline accessibility will be based on this Sound-wide public access plan.

The current suggested metric for this is the quantity of public access points. Currently in Connecticut, there are 328 access points, so a 10 percent increase would require 33 new access points. New York does not currently track this metric, but would begin doing so as part of SC-37. Additional measurement methods and numeric targets for shoreline accessibility (e.g., ADA compliant access points) may arise upon completion this Sound-wide public access plan.

References:

- NYSDEC, CTDEP, 2000. *A Total Maximum Daily Load Analysis to Achieve Water Quality Standards for Dissolved Oxygen in Long Island Sound*. Connecticut Department of Environmental Protection, Hartford, Connecticut, New York State Department of Environmental Conservation, Albany, New York.
- Goetz SJ, Wright RK, Smith AJ, Zinecker E, Schaub E. 2003. "IKONOS imagery for resource management: Tree cover, impervious surfaces, and riparian buffer analyses in the mid-Atlantic region." *Remote Sensing of Environment* 88(1-2), 195-208.
- Skinner LC, Kane MW, Gottschall K, Simpson DA. 2009. *Chemical Residue Concentrations in Four Species of Fish and the American Lobster from Long Island Sound, Connecticut and New York: 2006 and 2007*. Final Grant Report from EPA.
- Wilson E, Arnold C. 2008. *The Status of Connecticut's Coastal Riparian Corridors, Center for Land Use Education and Research (CLEAR)*.
- Wilson E, Arnold C. 2011. *The Status of Connecticut's Coastal Riparian Corridors, Center for Land Use Education and Research (CLEAR)*.