



South Shore
Estuary Reserve

Long Island South Shore Estuary Reserve Comprehensive Management Plan 2022



Kathy Hochul, Governor
Robert J. Rodriguez, Secretary of State

Acknowledgements

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Kathy Hochul, Governor

Robert J. Rodriguez, New York State Secretary of State

South Shore Estuary Reserve Council Members/Designees

Robert J. Rodriguez, Secretary of State, Council Chair/
Kisha Santiago-Martinez, Deputy Secretary of State
Office of Planning Development and Community
Infrastructure
Steven Bellone, Suffolk County Executive/Dorian Dale
Bruce A. Blakeman, Nassau County Executive/Dan Fucci
Donna M. Gayden, City of Long Beach Manager/Joe
Febrizio
Donald X. Claven, Jr., Town of Hempstead Supervisor/
Thomas E. Doheny
Joseph S. Saladino, Town of Oyster Bay
Supervisor/Stephen Koester
Richard H. Schaffer, Town of Babylon Supervisor/
Richard Groh
Angie Carpenter, Town of Islip Supervisor/Carlie Schecht
Edward P. Romaine, Town of Brookhaven Supervisor/
Peter Fontaine
Jay Schneiderman, Town of Southampton Supervisor/
Marty Shea
NYS Conference of Mayors, Vacant
Maureen Dolan Murphy, Citizens Advisory Committee
Chair
Tara Schneider-Moran, Technical Advisory Committee
Chair
Robert Grover, Great South Bay Audubon Society
Paul Shepson, Dean, SUNY School of Marine and
Atmospheric Sciences/Thomas Wilson
New York Sportfishing Federation, Vacant
Matthew Cohen, Long Island Association
Mitch Pally, Long Island Builders Institute/Amani Hosein
Property Owners Association/Vacant
Christopher Squeri, New York Marine Trades Association
Alison Branco, The Nature Conservancy in New York
Brookhaven Baymen's Association/Vacant
Michael Eagan, Captree Boatmen's Association

Council Advisors

Basil Seggos, Commissioner, NYS Department of
Environmental Conservation/Cassandra Bauer
Erik Kulleseid, Commissioner, NYS Office of Parks,
Recreation and Historic Preservation/George Gorman
Marie Therese Dominguez, Commissioner, NYS
Department of Transportation/Gregg Williams

New York State Department of State Office of Planning, Development and Community Infrastructure

Sarah Crowell, Director
Peter Lauridsen
Rebecca Newell
Carolyn Fraioli
Jeffrey Herter
Michael Snyder

South Shore Estuary Reserve Office

Jeremy Campbell
Sally Kellogg
Rachel Neville

Other Contributors

James Browne, Town of Hempstead
Maureen Dunn, Seatuck Environmental Association
Adrienne Esposito, Citizens Campaign for the Environment
Anthony Graves, Town of Brookhaven (retired)
Kristin Kraseski, NEIWPCC
Tony Leung, NYS DEC (retired)
Susan Van Patten, NYS DEC
Carl Lobue, The Nature Conservancy in New York
Enrico Nardone, Seatuck Environmental Association
Nancy Solomon, Long Island Traditions
Robert Weltner, Operation SPLASH
Lane Smith, NY Sea Grant

Former Department of State Staff: Gregory Capobianco,
Peter Clouse, Lori Heithoff, Kaitlyn Smith, Jeffrey Zappieri

Former South Shore Estuary Reserve Office staff: Sherry
Forgash, Christie Mazzeo-Pfoertner, Lou Siegel

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Abbreviations and Terms

| | |
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| AEM | Agricultural Environmental Management |
| BMP | Best Management Practices |
| CCE | Cornell Cooperative Extension |
| CERCOM | Center for Environmental Research and Coastal Oceans Monitoring |
| CPF | Community Preservation Fund |
| CRRA | Community Risk and Resiliency Act |
| CDBG-DRF | Community Development Block Grant - Disaster Recovery Fund |
| CRESLI | Coastal Research & Education Society of Long Island, Inc. |
| CWRMS | Long Island South Shore Estuary Reserve Coordinated Water Resources Monitoring Strategy |
| EBM | Ecosystem-based Management |
| EPA | Environmental Protection Agency |
| EPF | Environmental Protection Fund |
| FEMA | Federal Emergency Management Agency |
| FIMP | Fire Island to Montauk Point Plan |
| FINS | Fire Island National Seashore |
| GIS | Geographic Information System |
| GOSR | New York Governor's Office of Storm Recovery |
| HAB | Harmful Algal Bloom |
| HUD | United States Department of Housing and Urban Development |
| I/A OWTS | Innovative/Alternative Onsite Wastewater Treatment System |
| ISR | Implementation Status Report |
| LINAP | Long Island Nitrogen Action Plan |
| LIREDC | Long Island Regional Economic Development Council |
| LWRP | Local Waterfront Revitalization Program |
| MS4 | Municipal Separate Storm Sewer System Program |
| NDZ | No Discharge Zone |
| NLM | Nitrogen Load Models |

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| NOAA | National Oceanic and Atmospheric Administration |
| NRCS | Natural Resource Conservation Service |
| NWR | National Wildlife Refuge |
| NYRCR | New York Rising Community Reconstruction Program |
| NYSDAM | New York State Department of Agriculture and Markets |
| NYSDEC | New York State Department of Environmental Conservation |
| NYSDOS | New York Department of State |
| NYSDOT | New York State Department of Transportation |
| NYSEFC | New York State Environmental Facilities Corporation |
| NYSERDA | New York State Energy Research and Development Authority |
| NYSESD | New York State Empire State Development |
| NYSOGS | New York State Office of General Services |
| NYSG | New York Sea Grant |
| OPRHP | New York State Office of Parks, Recreation and Historic Preservation |
| OS | Open Space |
| OWTS | Onsite Wastewater Treatment System |
| Reserve | Long Island South Shore Estuary Reserve |
| RIS | Reserve Interpretive System |
| SAV | Submerged Aquatic Vegetation |
| SCDHS | Suffolk County Department of Health Services |
| SCFWH | Significant Coastal Fish and Wildlife Habitats |
| SPDES | State Pollution Discharge Elimination System |
| SPLASH | Operation S.P.L.A.S.H. |
| SoMAS | Stony Brook University School of Marine and Atmospheric Sciences |
| STEM | Science, Technology, Engineering, and Mathematics |
| STP | Sewage Treatment Plant |
| SWCD | Soil and Water Conservation District |
| TDR | Transfer of Development Rights |
| TMDL | Total Maximum Daily Load |
| TNC | The Nature Conservancy |

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| USACE | United States Army Corps of Engineers |
| USGS | United States Geological Survey |
| USFWS | United States Fish and Wildlife Service |
| WMP | Watershed Management Plan |

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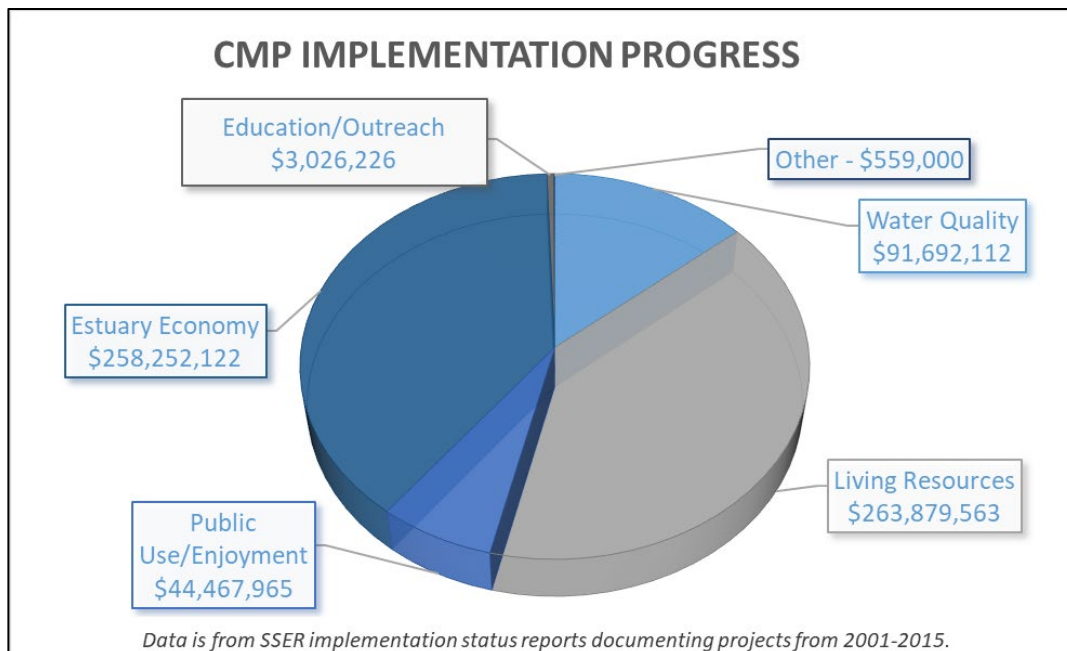
Executive Summary



The South Shore estuary is a rich and complex ecosystem. Its beaches, shallow bays, tidal marshes, tributaries, and upland areas make the South Shore Estuary Reserve (Reserve) one of the most ecologically productive regions in the United States. In addition to providing the necessities for estuarine life, the estuary, its shoreline, and upland areas provide open space, contribute to the scenic beauty of the region and support its tourism, recreation, and seafood industries.

To preserve, protect and enhance the natural, recreational, economic, and educational resources of the Reserve, the New York State Legislature passed the Long Island South Shore Estuary Reserve Act (Act) in 1993 thereby creating the South Shore Estuary Reserve. The Reserve, consisting of Long Island's South Shore interconnected bays and the watersheds that drain to them ranging from Nassau County in the West to the Village of Southampton and the Shinnecock Nation in the East, is administered by the Department of State with guidance from the South Shore Estuary Reserve Council chaired by the Secretary of State and comprised of representatives from the State and local governments, non-profit and academic organizations and other local stakeholders focused on the preservation, protection, and enhancement of the natural, recreational, and economic resources of the Reserve. The Act charged the Council with developing a Comprehensive Management Plan for the South Shore Estuary Reserve.

In 2001, the Long Island South Shore Estuary Reserve Comprehensive Management Plan (CMP) was approved. Collectively, State, federal, and local programs have provided more than \$660 million in funding for close to 460 projects since 2001 to assist implementation of the recommended actions identified in the Reserve's CMP.



While many of the recommended actions identified in the 2001 CMP have been completed, many of the priority actions still need attention including the reduction of stormwater and nutrient pollution, restoration of wetlands, improvements to seagrass and shellfish habitat, increasing open space, and public education on the value of the South Shore Estuary. This update of the CMP addresses these priority actions and captures emerging issues such as harmful algal blooms, nitrogen pollution from inadequate and outdated onsite wastewater disposal systems, climate change, and ecosystem resilience which was brought to the forefront after Superstorm Sandy.

A key component of the Reserve ecosystem's integrity and health is the maintenance and improvement of water quality. Water quality in the Reserve is critical to the overall health of the ecosystem, the water dependent economy, and the public's use of the estuary. However, high levels of nutrients, pathogens, pesticides, herbicides, and pharmaceuticals along with the loss of wetlands and natural buffers are affecting both surface water and groundwater quality, biological productivity and public health in the Reserve. The pollutants are the result of municipal wastewater treatment plant discharges, inadequate onsite wastewater disposal systems and cesspools, fertilizer runoff and stormwater. The increasingly developed landscape rendered impervious by roads, parking lots, roofs and bulkheads also contributes to the increased levels of pollutants in the Reserve.

Population growth and burgeoning development continue to have a dramatic effect on habitat loss in the estuary and the public's ability to use and enjoy the estuary. Other development activities, including construction of canals, roads, bridges and shoreline hardening activities such as bulkheads have also destroyed or degraded habitats. Elevated levels of pathogens, excessive nutrients and sediment have also affected the viability of fish populations in the Reserve's tributaries and have led to the closure of more than 34,000 acres of shellfish beds in its bays¹.

The public's ability to use and enjoy the natural resources of the estuary is critical and depends on access to its tributaries, bays, and shoreline. Shoreline hardening can erode beaches and marsh edges, interfering with the public's right to access and utilize the shoreline. The supply of formal, dedicated shoreline public access sites and recreational facilities is finite, and opportunities to increase the supply will become fewer as private shoreline development continues. As development activities continue, the value and need for protecting and securing new open space increases. Open space is

South Shore Estuary Reserve Council

- New York State Department of State
(Secretary of State - Council Chair)
- Suffolk County
- Nassau County
- City of Long Beach
- Town of Hempstead
- Town of Oyster Bay
- Town of Babylon
- Town of Islip
- Town of Brookhaven
- Town of Southampton
- NYS Conference of Mayors (Represents Villages in the Reserve)
- (Chair) Citizens Advisory Committee
- (Chair) Technical Advisory Committee
- Great South Bay Audubon Society
- Stony Brook University School of Marine and Atmospheric Sciences
- New York Sportfishing Federation
- Long Island Association
- Long Island Builders Institute
- Property Owners Association (Appointed by Secretary of State)
- New York Marine Trades Association
- The Nature Conservancy in New York
- Brookhaven Baymen's Association

critical to the health of the estuary and its coastal habitats, environmental quality, and the coastal character of Long Island's South Shore.

Traditional estuary-related uses such as commercial and recreational fishing, island bay houses, docking facilities, recreational boating, yacht clubs, marinas, boat repair shops, ferries and shorefront parks are all part of the region's maritime heritage and still define its present-day culture. However, these traditional estuary-related uses are gradually being displaced by more economically competitive non-traditional uses. Today's emerging multifaceted sectors of recreation and tourism including birding, hiking, wildlife watching, kayaking, paddle boarding, swimming, outdoor photography, wind and kite surfing, bed and breakfasts, hotel accommodations, and the second home industry contribute significant economic support to New York State and local towns. Concerted public and private efforts will be needed to perpetuate the region's historical legacy together with the evolving uses for the estuary.

Over time, the water-related economy in the Reserve has evolved from the harvesting of feathers, eggs, oysters, hard clams, salt hay, and boat building, to recreational boating, sportfishing, waterborne transportation and tourism. These changes reflect the influence of a growing population, market demand, transportation improvements and increased recreational demands.

The estuary is home to the largest concentration of commercial and recreational vessels, marinas, and other water-dependent businesses in the State. The estuary supports, in whole or in part, about 3,000 water-dependent and water-enhanced businesses that employ nearly 30,000 people.² However, the amount of estuary shoreline available for expansion of existing, or the establishment of new, water-dependent uses is limited, and some existing water-dependent businesses are gradually being displaced by non-water dependent uses that are more economically competitive. This is a concern in maritime centers where water-dependent uses are concentrated and embody much of the estuary-related cultural identity and heritage that supports local tourism.

To help protect the valuable resources of the Reserve it is necessary to consider the resilience of the ecosystem to threats such as climate change and sea level rise. Water is the connecting element throughout the Reserve. The major hazards affecting the Reserve are water related, and the Reserve is vulnerable to existing and future threats caused by both natural hazards and human influence. As made apparent by Superstorm Sandy, the Reserve's moderate to high residential densities together with low elevations relative to sea level, proximity to large bodies of water, tidal wetland losses, and impervious surfaces all greatly increase the risk of flooding, erosion, storm surge damage and associated pollution. The latest sea level rise projections intensify the importance of the Reserve's effort to protect and address these vulnerabilities.

To meet the goals identified in this CMP update and to address the issues facing the estuary, the Reserve office, Reserve Council, and all levels of government will work together to implement the recommended actions outlined in this document. The Reserve office will lead the Reserve Council and its partners in the conservation and protection of the South Shore Estuary Reserve by improving water quality, restoring living resources, protecting public access and recreational facilities, supporting the estuary-related economy, and incorporating practices to increase ecosystem resilience.

The following chapters describe the region of the South Shore Estuary and identify the challenges facing the Reserve. For each focus area of the CMP the issues along with the recommended actions for addressing the issues will be described. The document will help target the efforts of all parties interested in the health of the South Shore Estuary on high priority activities that matter to the people living in the Reserve.

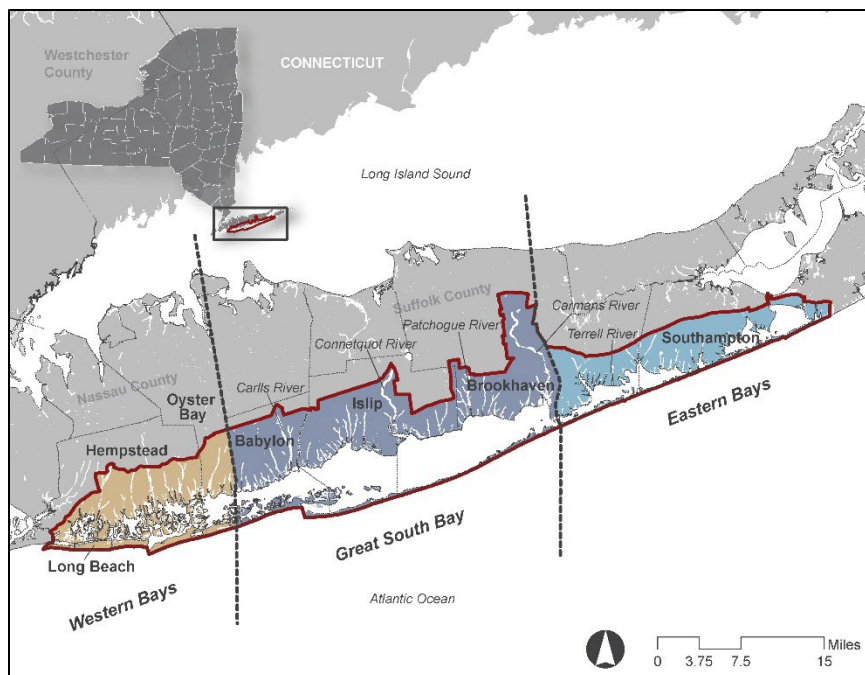
Chapter 1: The Region



Overview

The Long Island South Shore Estuary Reserve is home to about 1.1 million³ people and is the anchor of the region's tourism, seafood, and recreation industries. The Reserve's remarkable biodiversity and irreplaceable ecosystem services, together with its intrinsic values make the Reserve a maritime region of statewide importance. Stretching about 70 miles from the western boundary of the Town of Hempstead to the middle of the Town of Southampton. South to north, the Reserve extends from the mean high tide line on the ocean side of the barrier islands to the inland limits of the mainland watersheds that drain into Hempstead Bay, South Oyster Bay, Great South Bay, Moriches Bay and Shinnecock Bay (see Map 1).

The estuary is a dynamic ecosystem, formed during the past 5,000 years by the interaction between a rising sea level and the glacially deposited material that makes up Long Island. The entire natural system, including the barrier islands and the 173 square miles of shallow bays behind them, is constantly evolving in response to wave action, tides, coastal storms, and sea level rise. The tidal marshes, mud and sand flats, underwater plant beds and broad shallows of this estuarine environment support microscopic plants and animals, which in turn support the finfish, shellfish, waterfowl, and other wildlife that typify the South Shore Estuary. The region is also home to the highest concentration of marinas in New York State, some of the best beaches in the Northeast, and more than 20 state and county parks with millions of total annual visitors.

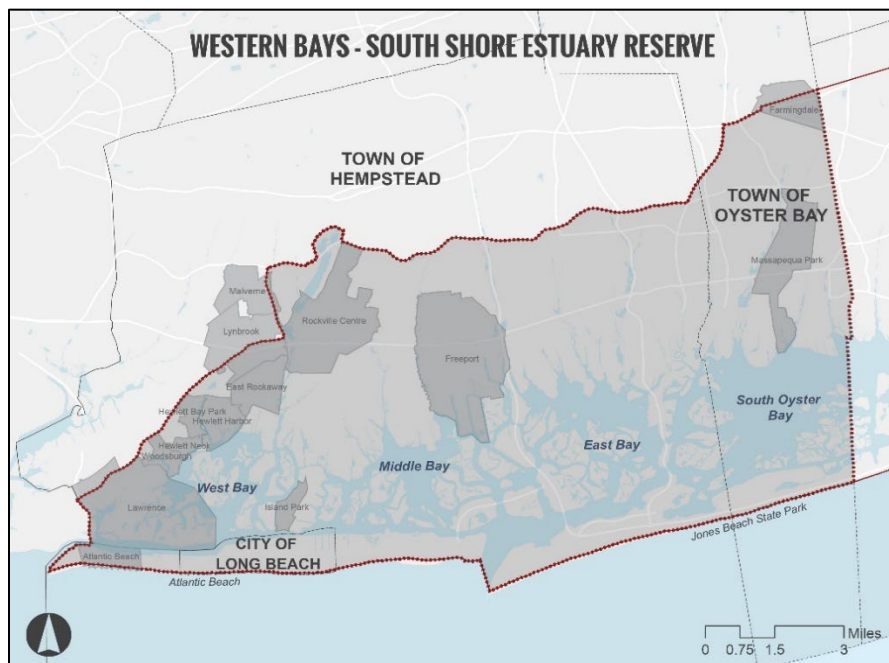


Map 1 - Long Island South Shore Estuary Reserve boundary

For purposes of planning and description, the South Shore Estuary Reserve is conveniently viewed as three sub-regions: the western bays, Great South Bay, and the eastern bays.

Western Bays

The western bays sub-region extends from the western boundary of the Town of Hempstead to the Nassau-Suffolk County line, including Hempstead Bay, South Oyster Bay, and all the lands that drain to them (see Map 2). These bays are characterized by an extensive area of shallow water and salt marsh islands connected by channels and tidal creeks. This portion of the Reserve contains the greatest concentration of salt marsh islands, most of which have been ditched through mosquito control programs. These islands frequently experience erosion due to their relatively high tidal range and proximity to heavy commercial and recreational boat traffic. Dredged material islands are also prominent in the sub-region.



Map 2 - Western Bays sub-region

Most of the mainland shoreline in this sub-region is bulkheaded, with the most intense development along the shoreline in the western part of the sub-region. Much of the shoreline development occurred in the 1950s and 60s when thousands of acres of tidal wetlands were filled to create new home sites. Virtually all mainland tidal wetlands were eliminated in this manner.

The western bays support a variety of benthic macroalgae (seaweed) and submerged aquatic vegetation (seagrasses), the most important of which is eelgrass. Disease and water quality problems have caused

significant losses of submerged aquatic vegetation beds in parts of these bays.

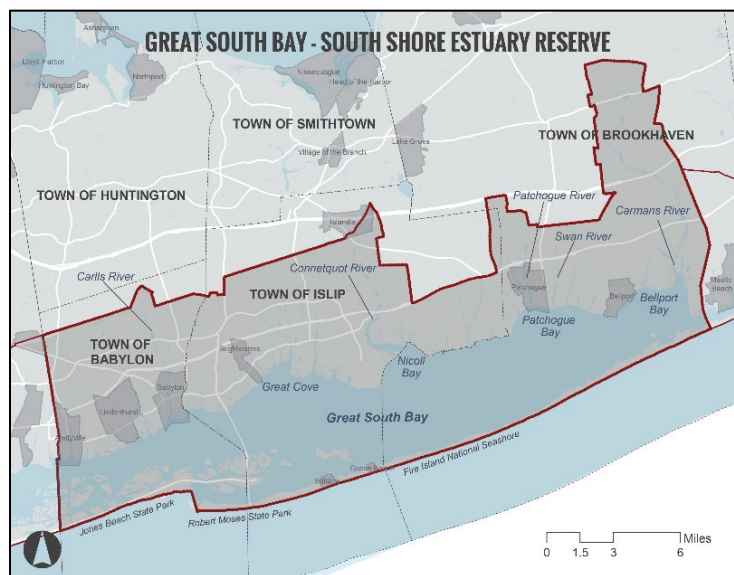
Habitat loss and poor water quality have negatively impacted most of the estuarine species in the western bays, including horseshoe crabs and diamondback terrapins. Recreational finfish species have declined, as have shellfish populations. The sub-region's significant concentrations of shorebirds, wintering waterfowl and colonial nesting waterbirds have also been reduced. Most waterbird colonies in the Reserve occur on the islands of the western bays. South Oyster Bay and Hempstead Bay are important stops on the Atlantic Flyway for migrating and wintering waterfowl, particularly small geese called "Brant." The importance of the western bays for migrating, wintering, and resident coastal birds must be recognized along with their increasing use by gray seals and harbor seals.

The sub-region of the western bays is the most densely populated in the Reserve. It exhibits the highest proportion of impervious surfaces from roads, parking lots and roofs. Land use south of Sunrise Highway and Merrick Road is highly urbanized and predominantly residential. Intersections along major highways are developed with high density residential, industrial, and/or transportation and utility uses. Land use close to the bays includes parks, nature preserves and protected areas for local and regional recreational purposes. However, residential development along tributaries and the shoreline continues to put pressure on these natural areas.

Municipal sewage treatment plant discharges, stormwater runoff from the developed landscape, and groundwater are significant sources of pollution reaching the sub-region's tributaries and bays. Elevated levels of coliform bacteria are responsible for the closure of 13,338 acres of shellfish beds in the western bays and periodic bathing beach closures.⁴ Human waste discharges from vessels, excrement from waterfowl and discharges from municipal wastewater treatment plant outfalls in the western bays are also contributing sources. Nutrients from these same point and nonpoint sources encourage the growth of extensive mats of seaweed, which are partially responsible for the loss of valuable seagrass beds in the area. Nutrients along with sediments in stormwater runoff also threaten fish survival and propagation in several of the sub-region's tributary streams.

Great South Bay

Great South Bay is the largest shallow estuarine bay in New York State, with extensive back barrier and tidal creek salt marshes, eelgrass beds and intertidal flats. (see Map 3) Most marshes in the sub-region are ditched, with many mainland marshes impaired by fill and bulkheads or restrictions to tidal flow. Great South Bay's living resources have been significantly affected by diminished tributary water quality. The degradation of water quality and loss of tidal marshes and other coastal habitats has reduced estuarine productivity and impacted critical feeding and nursery habitats for finfish, shellfish, shorebirds and colonial waterbirds.



Map 3- Great South Bay sub-region

In 2012, over wash from Superstorm Sandy created a barrier island breach in the wilderness area of Fire Island National Seashore and increased ocean-bay water exchange, leading to localized water quality improvements in the Bellport Bay area of Great South Bay. Breaches may provide localized water quality improvements, however long-term management and outcomes are complex as demonstrated by the [West Shinnecock Bay Water Quality Feasibility Study](#).⁵

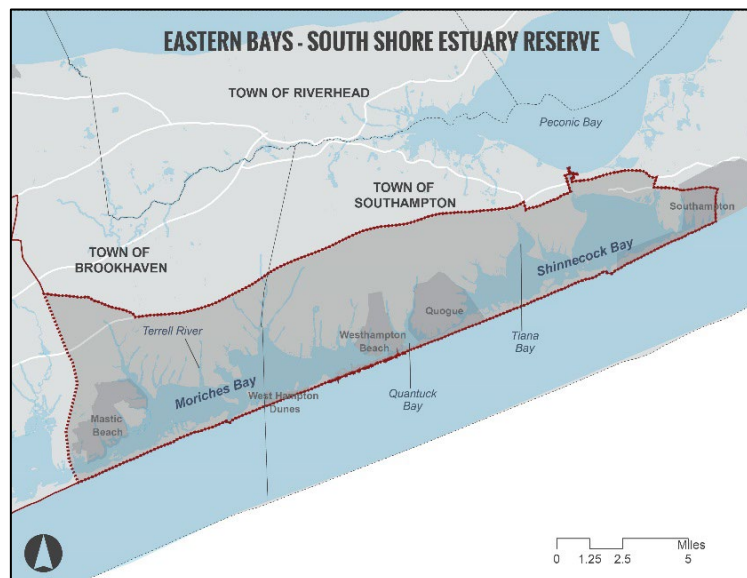
In contrast to the more fully “developed” western bays region, the Great South Bay sub-region can be described as “developing.” Development here is generally less intense than in the western bays, and there is more open space. The primary land use pattern is medium density development with pockets of more intense residential use on fingers of land separated by canals and waterways. Along the shoreline are substantial areas of green space dedicated as parklands and preserves. The intensity of development lessens from west to east within the sub-region.

Despite lower development density than the western bays sub-region, the Great South Bay sub-region has extensive impervious surfaces. For this reason, polluted stormwater runoff contributes nutrients, sediment and coliform bacteria to the sub-region’s tributaries and ultimately the Great South Bay. Vessel waste discharges and waterfowl are also contributors to the bacterial load. Elevated levels of coliform are responsible for the year-round closure of 17,770 acres of shellfish beds⁶ in Great South Bay and the periodic closures of bathing beaches. Pathogens and sediments in stormwater runoff threaten fishing, fish propagation and fish survival in the sub-region’s tributaries and coves. Hydro-modification, alterations to water level and stream flow and lowering of groundwater levels significantly impacts tributary fisheries.

The Great South Bay is frequently impacted by brown tide during spring through fall because of excess nutrients entering the bay from fertilizer and inadequate onsite wastewater disposal systems. The recurring brown tide events reduce light penetration through the water column, leading to declines of submerged aquatic vegetation and creating conditions potentially toxic to shellfish propagation.

Eastern Bays

The shallow eastern bays - Moriches and Shinnecock - are distinguished by the presence of inlets, strong tidal exchanges between the ocean and the bays and minor inflows of lower salinity water from the Great Peconic Bay through the Shinnecock Canal. (see Map 4) Salt marshes and dredged material



Map 4 - Eastern Bays sub-region

islands of the eastern bays support significant nesting colonies of terns, gulls and wading birds. Shallow water areas are highly productive habitats, especially the salt marshes and intertidal flats that fringe the barrier islands and the estuarine habitats around the tributary mouths. The deeper water habitats are composed of sandy shoals and submerged aquatic vegetation beds.

The major land use in the sub-region is medium to low density residential, with the greatest concentration of residences along the shoreline and waterways. The area is interspersed with parks, conservation areas and small clusters of service-oriented commercial establishments. Although the watersheds of Moriches and Shinnecock

bays are the least developed in the Reserve, elevated levels of fecal coliform bacteria from stormwater runoff and waterfowl have closed 3,260 acres of shellfish beds⁷ in the sub-region. Nutrients, primarily in groundwater from inadequate onsite wastewater disposal systems, along with sediments in stormwater runoff, have reduced fish survival in tributaries and led to harmful algal blooms including brown tide, red tide and rust tide outbreaks in the sub-region.

Historic and ongoing agriculture in this sub-region creates a continuous threat to water quality from sediments, fertilizers and pesticides. The Agricultural Environmental Management Initiative, headed by the Department of Agriculture and Markets, is aimed at minimizing potential pollution from agricultural operations of all types to help control nonpoint pollution. Further threats to water quality in this sub-region are created by the historic presence of duck farms. While today there are no active duck farms in the Reserve, their legacy remains in the potential pollution from sediments at the sites of former duck farms, which can contribute nitrogen and other contaminants to adjacent waterbodies.

Chapter 2: Water Quality



Overview

Improving and maintaining the quality of waters that make up the South Shore Estuary Reserve (Reserve) is critical to Reserve health and the economy. Increasing population growth, development, and improper management of wastewater can impact water quality in tributaries and groundwater draining into the Bays. Impacts include reduced clam landings, increased occurrence of harmful algal blooms (HABs), increased areas of seasonal hypoxia/anoxia, loss of seagrass and tidal marsh habitat, and shifts in ecological community make-up.

The most recent [New York State Department of Environmental Conservation \(NYSDEC\) 2018 303\(d\) List](#)⁸ (see Figure 1) identifies 74 waterbodies in the Reserve with use impairments from nutrients, pathogens or sediment. The list identifies waterbodies that do not support appropriate uses (shellfishing) and may require the development of a total maximum daily load (TMDL). The majority of water bodies in the Reserve are considered impaired due to excessive pathogen loads. There is much work that needs to be done to reduce pollutants in the Reserve.

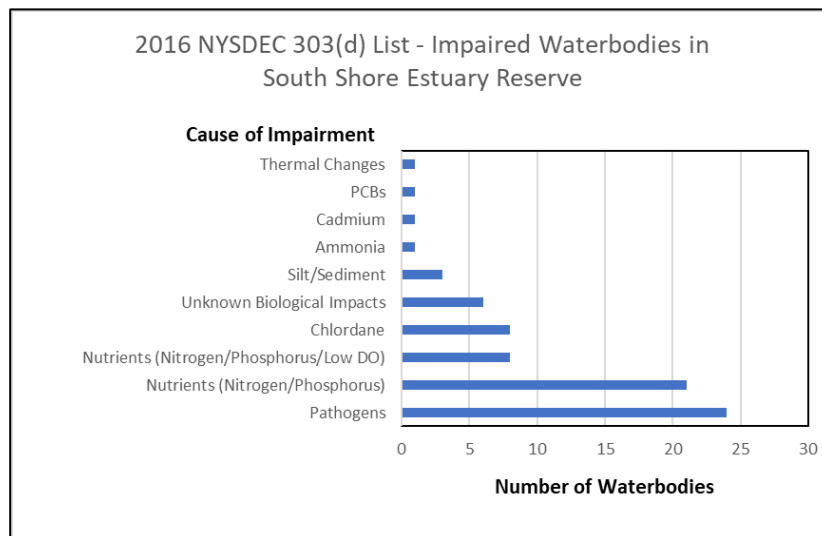


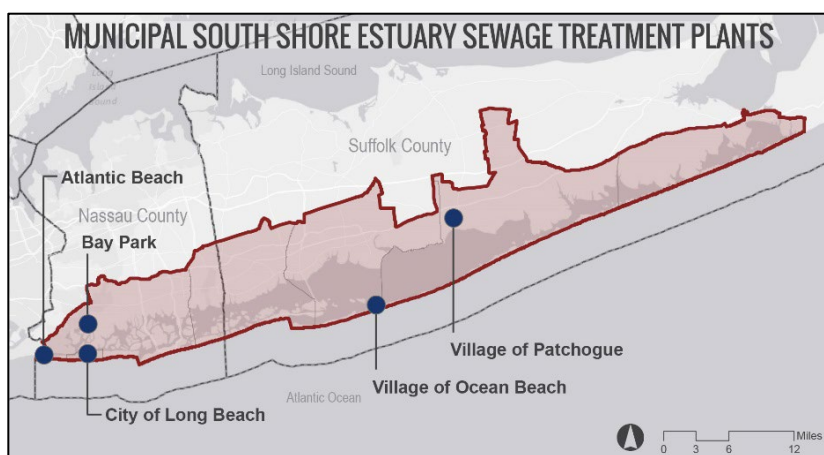
Figure 1 - Analysis of the DEC's 2018 303(d) List shows that pathogens are the significant contributor to the impairment of water quality in the Reserve.

Issues Faced

Nutrient Pollution

A major stress on the health of the Reserve is the eutrophication, or over enrichment of nutrients, in Reserve waters. The leading contributors of nitrogen to both surface water and groundwater are onsite wastewater disposal systems, including septic systems and cesspools. Additional sources include sewage treatment plants (STPs), fertilizer use, agricultural practices, and atmospheric deposition of byproducts such as nitrogen oxides.⁹

Onsite wastewater disposal systems are not designed to remove nutrients and are often in areas with shallow groundwater. Combined, these conditions allow nutrients to flow directly into the groundwater and surface water entering the estuary's bays.¹⁰ Regulation of onsite wastewater disposal systems is the



Map 5 - Municipal STPs Discharging to the Reserve

responsibility of Nassau and Suffolk Counties, but the Towns and Villages in the Reserve may enact more restrictive standards than the County to address nutrient pollution.

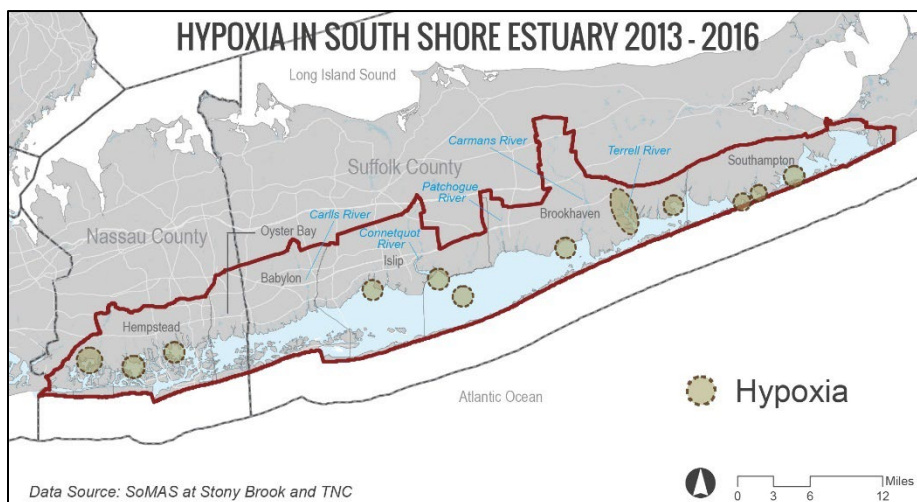
Five municipal STPs contribute nutrient pollution directly to the surface waters of the Reserve; The Bay Park STP, Long Beach STP and Atlantic Beach STP discharge treated effluent into Reynolds Channel in the Western Bays. (see Map 5) The Ocean Beach STP and Village of Patchogue STP discharge treated effluent to the Great South Bay. Effluent from two other STPs was removed in the early 2000's when the Village of Cedarhurst and the Village of Lawrence transformed their STPs into pump stations and now convey sewage to the Bay Park STP for treatment.

Fertilizer use for golf course maintenance, residential lawn care, and the agricultural operations are locally significant contributors of nitrogen in the watershed. Excess nutrients from fertilizer use can reach receiving waterbodies by leaching into groundwater and by flowing directly to surface waters through storm water drainage systems.

Eutrophication, Low Dissolved Oxygen and Bay Water Acidification

High nitrogen loading and extended residence times – the average time any given substance spends in a waterbody – has led to high eutrophication in the Reserve.¹¹ Eutrophication leads to excessive algal blooms (made up of phytoplankton and seaweeds) which can create low (hypoxic) or non-existent (anoxic) dissolved oxygen levels that seriously endanger the plants and animals living there. Although the shallow waters of the Reserve bays are well mixed (which encourages oxygenation), low levels of dissolved oxygen and long residence times are typical along the northern margins of the bays and in the mouths of the tributaries. Tributaries show clear signs of seasonal hypoxia, a serious threat to aquatic life in these areas. (see Map 6)

Acidification occurs when input of carbon dioxide to a waterbody causes a shift in chemistry towards lower pH, or more acidic waters. Often acidification occurs concurrently with oxygen depletion. Bacterial decomposition of organic matter contributes to acidification through production of dissolved carbon dioxide which reacts with water to produce acidic compounds that lower bay water pH. In addition, atmospheric deposition of byproducts of fossil fuel combustion in the form of carbon dioxide, nitric acid and sulfuric acid further lower bay water pH.¹²



Map 6 - Areas of the Reserve suffering from Hypoxic conditions

Ecosystem Impacts

Eutrophication and acidification put the health and survival of finfish, shellfish, submerged aquatic vegetation (SAV) and wetlands at risk. SAV beds are especially hard hit because in addition to acidification and eutrophication, high concentrations of algae can prevent light from penetrating the water, which causes the loss of aquatic vegetation. Eutrophication also destabilizes marsh banks and

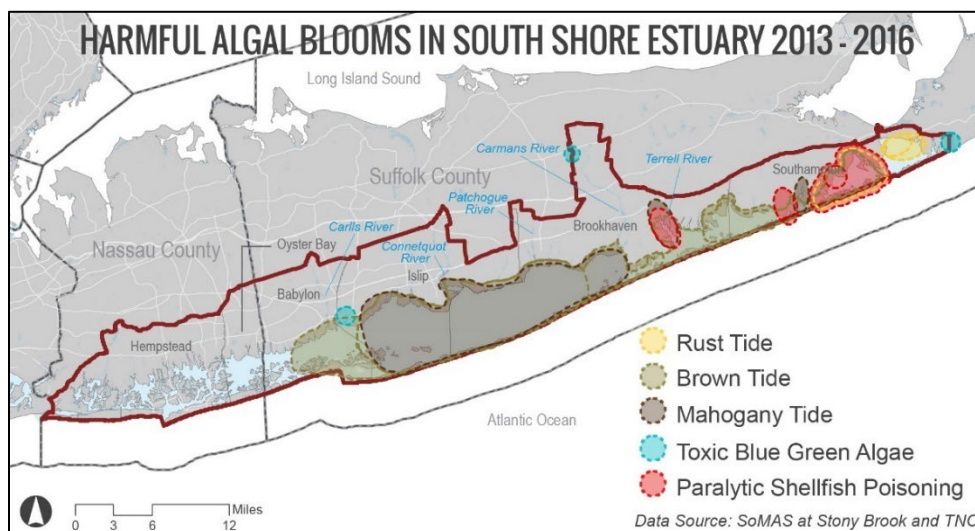
minimizes nutrient filtering and buffering capacity of tidal wetland expanses. See Chapter 3: Living Resources, for more detail. Decomposing organic matter leads to increased acidification of bay waters.

Harmful Algal Blooms

Harmful algal blooms (HABs) including brown tide, red tide, rust tide, and mahogany tide can cause a marked decline in the feeding response of shellfish. (see Map 7)

HABs, along with nuisance macro algae blooms (such as *Ulva*), reduce light penetration through the water column, limiting the growth of submerged plants. There is a connection between high nitrogen loading, long residence time, warming waters, bay water acidification and the increased occurrence of HABs.^{13,14,15}

HABs that favor lower pH and higher temperature conditions can have serious human health implications. For example, certain toxic strains of dinoflagellate phytoplankton can cause diseases such as paralytic shellfish poisoning and diarrhetic shellfish poisoning, which render shellfish unsafe for human consumption.¹⁶

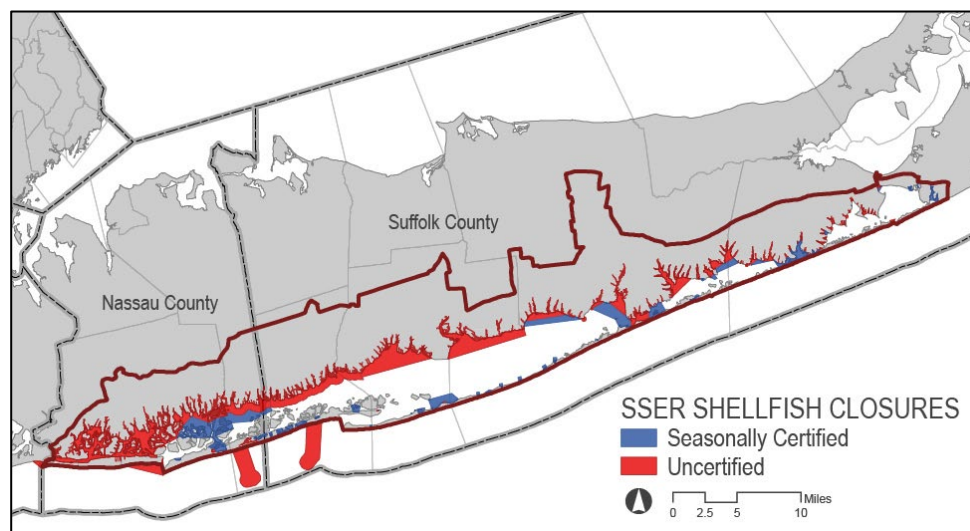


Map 7 - Areas of Reserve impacted by HABs

Pathogens

The presence of pathogens is a major source of impairments to the South Shore estuary waters. High levels of coliform bacteria indicate the potential presence of human and animal waste in surface waters. A major contributing source of this bacteria is from pets and wildlife excrement, particularly waterfowl such as geese. Failed cesspools in coastal areas with high groundwater may also contribute to pathogen loads in select waters, although additional study is needed to verify this.¹⁷

Elevated levels of coliform bacteria are responsible for the closure of about 26,000 acres (out of a total of 107,000 acres)¹⁸ of shellfish beds and bathing beaches annually throughout the Reserve¹⁹. (see Map 8)



Map 8 - Shellfish closure areas throughout the Reserve

Marine Debris

Marine debris found in Reserve waters can cause damage to sensitive habitats, impair water quality and pose health risks to humans and wildlife.²⁰ Build-up of marine debris, especially plastics, is a major concern in the Reserve. A large percentage of marine debris originates from land-based sources and debris may also be a result from storm surge. Debris can include timber, docks, decks, fences, bulkheads, oil and propane tanks, balloons, abandoned fishing gear, derelict boats, plastics, boat shrink wrap²¹ and cigarette butts.²² Serious injury can happen to seabirds, seals, sea turtles and other wildlife when they consume or become entangled in plastics or abandoned fishing gear.^{23 24}

Single Use Plastic Bags: Plastic bags are often fatally mistaken as a food source and ingested by many marine animals. In addition to posing aquatic wildlife hazards, single use bags are a major source of litter by polluting water ways, clogging stormwater infrastructure and accumulating along parks, beaches and open spaces. The Reserve receives a large amount of plastic marine debris washing up on shore. Plastic bags are the second most common item found in beach cleanups in the Reserve after plastic bottles.

Boat Shrink Wrap: Every year, the owners of more than 100,000 boats registered on Long Island are opened for the season and their shrink-wrap is removed. Traditionally, this material has been thrown away, but new programs provide an alternative. The Town of Hempstead provides a recycle bin at its Sanitation Department facility, and the Town of Huntington provides an on-site bin for recycling of boat shrink wrap. The debris is then recycled so that plastic pollution is kept out of waterways, off beaches and out of landfills.

Balloons: Litter from balloons has a significant impact on the environment. Balloons can land in our ocean, bays and harbors where they can be mistaken for prey and eaten by avian and marine life, often with fatal consequences. In the water, balloons may resemble jellyfish—a major source of food for some animals. Autopsied sea turtles, dolphins, whales, fish and seabirds are frequently reported with balloons in their stomachs. In addition, ribbons and strings tied to balloons can entangle wildlife.

Additional Sources of Plastic Debris: Straws, wrappers, fishing line and bottles are just a few other sources of plastic debris that can pose a risk to wildlife. The debris can be spread by gulls and crows from open wire receptacles allowing trash to be spread throughout the coastal environment by wind.

Abandoned fishing gear: Derelict or “ghost” fishing gear is discarded fishing gear no longer used by fishers but may continue to capture or entangle marine species. Commonly abandoned gear types include crab traps/pots, gillnets, and fishing line.

Emerging Contaminants

Emerging contaminants are man-made chemicals, pharmaceuticals, and personal care products for example, that are more frequently being detected at low levels in surface waters and may be impacting aquatic life.²⁵ Municipalities are affected by numerous emerging contaminants, such as manufacturing/industrial products and byproducts, pharmaceuticals and personal care products (PPCPs), pesticides, herbicides, and microplastics. These contaminants may reach Reserve waters through various pathways such as wastewater, stormwater runoff, groundwater leaching, and hazardous waste runoff.²⁶ Many of these contaminants contain chemicals that can bioaccumulate or accumulate in organisms and become concentrated at levels higher than the surrounding environment, and are known endocrine disruptors that can cause cancer, developmental and birth defects.^{27,28,29}

Manufacturing/Industrial Products and Byproducts

A wide range of manufacturing and industrial chemicals reach Reserve waters through various pathways. Persistent organic pollutants such as perfluorooctanoic acid (PFOA) and perfluoro octane sulfonate (PFOS), halocarbon trichloroethene (TCE) and 1,4 dioxane have all been found in the Reserve's groundwater and surface water.

Pharmaceuticals and Personal Care Products (PPCPs)

PPCPs include prescription and over-the-counter drugs, fragrances, lotions, soaps, sunscreens and more. Improperly disposed of pharmaceuticals cannot be removed with conventional wastewater treatment and are discharged to surface and groundwater throughout the Reserve. These environmental pollutants have the potential to concentrate in water, sediments and aquatic biota. Antihistamines, antidepressants, and fragrances were among the most prevalent PPCPs found in fish in a 2013 fish tissue pilot sampling study conducted by the EPA. Current concerns are related to increase in endocrine system disruption and antibiotic resistance due to accumulation of PPCPs bioavailable in the aquatic environment.³⁰

Pesticides and Herbicides

Improper use of chemicals used for lawn care, golf course maintenance, agriculture and mosquito control can have serious impacts on natural communities. These impacts include impairments to the primary production and growth rates of phytoplankton, seagrass, and seaweed, and to the health and survival of important invertebrates that form the basis of the food chain.^{31,32,33} The SCDHS and NYSDEC have found 117 pesticides in Long Island's groundwater, including the two most detected pesticides, metalaxyl, and imidacloprid. Pesticides can negatively affect submerged aquatic vegetation and aquatic organisms.^{34,35}

Microplastics

Microplastics are small plastic fragments no greater than 5mm in length. Sources include degradation of larger plastic pieces and microbeads. The small particles are not captured by water filters and are known to be damaging to some aquatic organisms.³⁶ National Geographic recently estimated that the weight of plastics in our oceans will surpass the weight of all fish by 2050.³⁷ Much of that weight will be in the form of microplastics.

Current Efforts to Address the Issues

Clean Water Infrastructure Act

The Clean Water Infrastructure Act of 2017 has provided over \$4 billion in grant funding to water quality improvement projects in New York State, including municipal wastewater treatment system improvements and source water protection actions. The act also established a \$75 million rebate program to incentivize septic system upgrades by homeowners and small business owners.

Long Island Nitrogen Action Plan

In 2015, New York State targeted \$5 million dollars for the New York State DEC and the Long Island Regional Planning Council to develop the Long Island Nitrogen Action Plan (LINAP) in conjunction with both Nassau and Suffolk counties. The Reserve is partnering in this effort focusing on the nitrogen impaired waters. Subwatersheds have been delineated in both counties and project partners have prepared Nitrogen Load Models (NLM) for each county. The NLMs identify the magnitude and sources (wastewater, fertilizer, atmospheric deposition, stormwater) of nitrogen loads and prioritize the subwatersheds in terms of load reductions. Suffolk County published the [Subwatersheds Wastewater Plan \(SWP\)](#) in 2020 which includes a series of recommendations for consideration that, if implemented, will address the primary source of nitrogen that is contributing to the degradation of Suffolk County waters (i.e., inadequate septic systems and cesspools currently used in most of the County). Working closely with the NYSDEC, the SWP was subsequently approved as a New York State 9 Element Subwatersheds Plan in August 2020. Nassau County's subwatersheds plan is underway. Ecological endpoints will be identified so that maximum nitrogen loads can be defined. An ecological endpoint is a valued feature of an ecological entity for which risk management actions can be focused, used in cases when an ecosystem component cannot be directly studied and valued.³⁸

A comprehensive nitrogen reduction strategy will be followed with management and policy actions and technological advances to restore and protect groundwater and surface water. Wastewater improvements will include conventional and decentralized wastewater systems for more densely populated areas and innovative/advanced OWTS (I/A OWTS) for homes that cannot connect to public sewers. Measures will be implemented to reduce fertilizer use, encourage re-use of treated wastewater effluent, and expand participation in agricultural best practices and management plans. The farming (aquaculture) and harvesting of shellfish and seaweed for nitrogen removal (bio-extraction) is being explored. The LINAP should be used as the standard guidance for nitrogen mitigation within the Reserve.

West Shinnecock Bay Water Quality Improvement Feasibility Study

In 2021, New York State and the Town of Southampton released the [West Shinnecock Bay Water Quality Improvement Feasibility Study](#) focused on identifying short-term measures necessary to improve water quality in western Shinnecock Bay by enhancing water exchange between the ocean and the bay. The study complements other ongoing efforts such as the Long Island Nitrogen Action Plan focused on reducing nitrogen in Long Island surface and ground water. Funding and technical assistance for this project came from the Governor's office, NYSDEC, NYSOGS, and NYSDOS.

New York Ocean Action Plan

The New York Ocean Action plan released by the NYSDEC and NYSDOS in January 2017, includes 61 actions including steps to address impacts from sewage treatment outfalls, reduce nutrient loads to the Reserve, establish a baseline ocean monitoring system in the New York Bight, revise breach contingency plans, and update community resiliency strategies.

New York Ocean Acidification Task Force

In 2016, the legislation was establishing an Ocean Acidification Task Force. The task force was established to identify the causes and factors leading to ocean acidification in New York State and evaluate potential options for mitigating the effects of ocean acidification in New York. The task force will develop a report sharing their findings and recommendations to address ocean acidification issues.

Suffolk County Comprehensive Water Resources Management Plan

In 2015, Suffolk County released the revised [Comprehensive Water Resources Management Plan](#), which now takes a broad ecological approach to address water quality-related issues by incorporating the principles of coastal resiliency and nutrient/contaminant control to protect wetlands and seagrass and to mitigate impacts of HABs on shellfish. In conjunction with LINAP, the plan includes measures to evaluate and reduce nitrogen loading from onsite wastewater disposal systems.

Suffolk County Coastal Resiliency Initiative

In 2014, New York State launched a \$383 million initiative to extend sewers to approximately 10,000 homes in Suffolk County that currently rely on inadequate on-site septic systems. The initial effort includes homes within the four priority watersheds of Forge River, Patchogue River, Connetquot River and Carlls River.³⁹

Suffolk County Innovative/Alternative Onsite Wastewater Treatment Systems (I/A OWTS) Study

Suffolk County is assessing the potential for new wastewater treatment system technology to remove nitrogen. As part of this, the County conducted two demonstration programs where manufacturers paid for I/A OWTS to be installed on private residences at no cost to the property owner so that Suffolk County could monitor performance of each system. Fourteen technologies were evaluated as part of the demonstration project; seven systems are currently approved for provisional use and several more technologies are expected to be approved by the end of 2021.

Center for Clean Water Technology at SUNY Stony Brook

The Center for Clean Water Technology is developing and commercializing cost-effective water quality protection and restoration solutions. Its initial focus is delivering affordable, high-performance technology to efficiently remove nitrogen and other contaminants from household wastewater to replace or retrofit existing cesspools and septic systems. Current research is being done on nitrogen removing biofilters, constructed wetlands, and permeable reactive barriers, among other technologies.

Innovative/Alternative Onsite Wastewater Treatment System Legislation

In June 2016, the Town of Brookhaven passed legislation requiring the use of I/A OWTS's for new construction and/or substantial renovation in all areas within 500 feet of all surface waters throughout the Town. In July 2017, the Town of Southampton adopted a local law that mandates I/A OWTS's installation for new homes and for any expansion of living area greater than 25% of the existing total living area, and in cases where alternative nitrogen reducing systems are required pursuant to town wetland permits. Also, the Town implemented the I/A OWTS private landowner assistance/rebate program that is funded by 20% of the annually accrued Town Community Preservation Fund (CPF) land transfer taxes. The CPF can also be directed to mobile vessel pump out operations, installation of green infrastructure for stormwater management and aquaculture initiatives. In July 2021, changes to Article 6 of the Suffolk Sanitary Code went into effect for new construction, expanded single-family residences and other new construction or major reconstruction of commercial/industrial buildings requiring the installation of a I/A OWT's.

Suffolk County Department of Health Services Sub-Watersheds Wastewater Plan

In February of 2020 the Suffolk County Department of Health Services released their [Subwatersheds Wastewater Plan \(SWP\)](#). This plan is a guide for transitioning away from the historical use of cesspools and septic systems as wastewater management techniques and shifting to a use of Innovative/Alternative Onsite Wastewater Treatment Systems. The SWP provides recommendations to achieve nitrogen load reduction goals through wastewater management for the protection of Suffolk County's vital water resources. The first of its kind, the SWP is built upon a foundation of state-of-the-art models to establish nitrogen load estimates, residence times, priority areas for load reduction. There are nitrogen load reduction goals for 191 individual surface waterbodies countywide. Seventy-four of the priority areas are in the Reserve. In addition to being part of the Suffolk County Reclaim Our Water initiative, the SWP is a component of the Long Island Nitrogen Action Plan ("LINAP"), a multi-organizational initiative focused on reducing nitrogen for the protection of Long Island's water resources.

Suffolk County Reclaim Our Water Initiative Septic Improvement Program

Conventional septic systems and cesspools are not designed to remove nitrogen. Under this program, Suffolk County homeowners are eligible for a grant of up to \$30,000 from Suffolk County and New York State if they decide to replace their cesspool or conventional septic system with new, individual I/A OWTS designed to significantly remove nitrogen.⁴⁰

Suffolk County Water Quality Protection and Restoration and Land Stewardship Initiatives (WQPRP) – Drinking Water Program

The WQPRP provides funding to protect and restore water resources throughout the County, including the Reserve. This includes both surface and groundwater. The highest priority use of program funds is for implementation of Suffolk County projects and activities that provide support to those programs, activities and operating expenses mandated by county laws which provide nonpoint source pollution abatement and control, aquatic habitat restoration, reduction in pesticides, pollution prevention initiatives and/or other environmental benefits.

The categories of projects eligible for funding under the WQPRP are specified in Article 12 Section 2(B) of the Suffolk County Charter and include: Nonpoint Source Abatement and Control (Remediation and Prevention); Aquatic Habitat Restoration; Agricultural Nonpoint Source Abatement and Control; Pollution Prevention Initiatives; and Land Stewardship Initiatives. Currently, the County is funding nine projects within the Reserve totaling about \$3 million including stormwater improvements, septic upgrades on County parklands, habitat restoration of various shellfish species and eelgrass and the Mud Creek Watershed Aquatic Ecosystem Restoration Plan.

Legislation to Discourage Plastics

In 2019, Suffolk County approved legislation prohibiting the intentional release of helium and other types of balloons. The ban specifies helium, latex, mylar and plastic balloons, and any that are lighter than air. This law follows recent East Hampton and Southampton town measures. A previous County law, passed in 2002, limited the number of balloons that could be released in a 24-hour period to 25. Since 2005 there has been statewide legislation introduced in the NYS Assembly and Senate that replicates Suffolk's legislation.

The Town of Southampton, City of Long Beach along with the incorporated Villages of Southampton, Quogue and Patchogue have legislation banning single use plastic bags. A Suffolk County law to discourage the use of all single use bags within the County went into effect January 1, 2018 requiring consumers to pay a five-cent retailer fee for paper and plastic bags. This action is aimed to encourage

the use of reusable bags and has resulted in a 1.1 billion reduction in plastic bags used in the year following the enactment of the law. On March 1, 2020, New York State legislation banning plastic bags went into effect.

In 2015, Suffolk County legislation went into effect banning microbeads in personal care products. The federal government passed legislation banning microbeads in personal care products starting in July 2017, banned sales of cosmetics containing microbeads beginning in July 2018, and over-the-counter drugs containing microbeads in July 2019.

Harmful Algal Bloom Studies

In 2017, the Suffolk County Department of Health Services and New York Sea Grant (NYSG) in consultation with Stony Brook University's School of Marine and Atmospheric Sciences (SoMAS), a wide variety of partner organizations, and a variety of HAB experts from across the country, completed a science based HAB Action Plan to serve as a roadmap and driver for implementing a proactive approach in neutralizing the harmful impacts and growing threat posed by HABs in Suffolk County.

SoMAS is conducting extensive research on these HABs within the Reserve and investigating the role climate change plays in coastal eutrophication.

Coalition for Fire Island Wastewater Solutions

A coalition, comprised of Federal, State, County and local government representatives along with local community groups, including the Fire Island Association is in the process of developing a wastewater management study for Fire Island communities. The effort is funded through the Suffolk County Water Quality Protection and Restoration Program and will consider options for Fire Island residents to upgrade or replace current onsite wastewater disposal systems with more sustainable and efficient nitrogen removing technologies.

Nassau County Subwatersheds Plan

The Nassau County Subwatersheds Report is an analysis of Nassau's north and south shore bays and surrounding watershed, which includes modeling the nitrogen inputs to each embayment from wastewater, fertilizer, atmospheric deposition, and storm water, modeling hydrologic residence times, and a water quality data analysis. This is a joint effort between Nassau County, Stony Brook University School of Marine and Atmospheric Sciences, and NYSDEC.

Hydrodynamic modeling

SoMAS scientists are working on hydrodynamic models for north and south shore embayments including in the Reserve. The hydrodynamic models will estimate residence times for the embayments and delineate circulation patterns.

Groundwater Sustainability of the Long Island Aquifer System

The [USGS](#) and [New York State Department of Environmental Conservation](#) are conducting a cooperative study to evaluate the sustainability of Long Island's groundwater resource, now and for the future, by performing hydrogeologic mapping, monitoring of water quality and water levels, and developing a groundwater-flow model for this sole-source aquifer system. Informed management of the Long Island aquifer system can help ensure a regionally sustainable groundwater resource.

Long Island South Shore Estuary Reserve Eastern Bays Project: Nitrogen Loading, Sources, and Management Options Report

SoMAS modeled the residence times of Moriches, Quantuck and Shinnecock Bays and estimated the extent of nitrogen loading into Eastern Long Island subwatersheds. The study used established

nitrogen load and volumetric flux models, land use patterns and population data, combined with groundwater and surface water movement data. The report identifies groundwater flow, driven by precipitation events, as a larger contributor of nitrogen to coastal waterbodies than surface streamflow.

Great South Bay and Western Bays Hydrodynamic Model

In addition to the Eastern Bays Project, the Seatuck Environmental Association is using an Environmental Protection Agency (EPA) supported model as a basis to develop a hydrodynamic model for the eastern portion of the Great South Bay. This effort is being used to estimate residence times and flushing rates, and to investigate possible pollution mitigation methods.

No Discharge Zone Designation

In 2009 the Reserve was designated a No Discharge Zone by the US EPA making it illegal for boaters to discharge onboard sewage into the waters of the Reserve and requiring boaters to dispose of sewage at pumpout stations. Pumpout stations or pumpout boats are made available throughout the Reserve by local municipalities and private marinas. Designation as a No Discharge Zone will help reduce pathogens that are currently impacting shellfishing areas in the Reserve.

Coordinated Water Resources Monitoring Strategy

The New York Department of State (NYSDOS) Office of Planning, Development and Community Infrastructure (OPDCI) and the USGS have collaborated to update the [Long Island South Shore Estuary Reserve Coordinated Water Resources Monitoring Strategy \(CWRMS\)](#). This report recommends a coordinated strategy that focuses on objectives for nonpoint source pollution control. The plan provides guidance for future water quality improvement efforts in the Reserve and several new threats to the ecological health and resilience of the Reserve. To compliment the report, a Reserve CWRMS website was developed with an interactive mapper that directs researchers, stakeholders and the public to Reserve-relevant documents and monitoring data.⁴¹

Agriculture Environmental Management Program

The New York State Department of Agriculture and Market's (NYSDAM) Agriculture Environmental Management (AEM) Program is a voluntary program that calls on local soil and water conservation districts to provide technical assistance to farm operators to assure environmental stewardship using best management practices (BMPs) and through compliance with relevant environmental regulations. In 2015, the Suffolk County Soil and Water Conservation District (SWCD) received a grant to develop Nutrient Management Plans at fifteen Suffolk County Farms. As part of this grant, Suffolk County SWCD is in the process of evaluating their AEM program to improve cost-effective and science-based decision making while meeting business objectives. NYSDAM is working with multiple partners to conduct research to inform nutrient management planning and implementation. The Nassau County SWCD is incorporating invasive species management, ecological restoration, reforestation, and the implementation of green infrastructure into their core programs.

State and Federal Stormwater Management

The State and federal government require businesses and municipalities to manage stormwater discharges. There are three State Pollutant Discharge Elimination System (SPDES) general permits required for activities associated with stormwater discharges. Municipalities in the Reserve are part of the MS4 stormwater permit program.

- The [Multi- Sector General Permit for Stormwater Discharges Associated with Industrial Activities](#) (MSGP) addresses stormwater runoff from certain industrial activities. This permit requires

facilities to develop Stormwater Pollution Prevention Plans (SWPPPs) to manage their stormwater discharges.

- Municipalities in urban areas are required to manage stormwater discharges from their systems (such as ditches, swales, detention basins). This permit is commonly referred to as the [Municipal Separate Storm Sewer Systems](#) (MS4s) permit. Permittees are required to develop a Stormwater Management Program (SWMP) that outline how they will address stormwater in their community.

Construction activities disturbing one or more acres of soil must be authorized under the [General Permit for Stormwater Discharges from Construction Activities](#). Permittees are required to develop a SWPPP to prevent discharges of construction-related pollutants to surface waters.

Individual Watershed Management Plans

The distribution and relative magnitude of nonpoint source pollution in each watershed has been identified to an extent by municipalities through individual watershed management plans. Digital ortho-imagery of land cover has been used with soils, topography, and distance to surface water data to identify nonpoint source pollution potential for the entire Reserve. This information will help focus implementation of site-specific stormwater remediation projects and water quality monitoring efforts.

To varying degrees, towns in the Reserve have put in place practices that can serve as a foundation for improving water quality. The practices include land and water use regulations, road/highway design and construction standards, capital improvement programs, operation and maintenance procedures, wetland restoration, and targeted education and outreach efforts. Strengthening, expanding and enforcing pollution control measures is critical to improving and maintaining water quality in the Reserve. Municipalities will work in partnership with ongoing research and planning efforts to continue to assess ways to mitigate point and non-point source pollution.

The Town of Brookhaven, in 2013 approved the Carmans River Conservation and Management Plan. The plan established the first standard for Sewage Treatment Plants more stringent than Suffolk County Department of Health and established numerical nutrient standard goals for the Carmans River.

Operation SPLASH

Operation SPLASH (Stop Polluting, Littering, and Save Harbors) is a non-profit volunteer organization that operates in six Nassau and Suffolk County communities from March through November of every year. One of their key initiatives is their Beach, Bay and Waterway Clean-ups. Since 1990, SPLASH volunteer crews have removed more than 2,750,000 pounds of debris from bays, beaches and waterways. Operation SPLASH has also purchased and installed fiberglass filters to prevent debris from being discharged from storm drains along Freeport's Nautical Mile.



Photo 1 - Operation SPLASH boat docked in Freeport

Save the Great South Bay

The Save the Great South Bay a non-profit organization focused on protecting the Reserve's Great South Bay have established the Creek Defender Program. The creek defender program relies on local

volunteers to participate in cleanup events along tributaries to the Great South Bay. The program is also committed to planting native plants along the Great South Bay tributaries to filter stormwater.

New York Rising Community Reconstruction Program (NYRCR)

In the wake of extreme weather events including Hurricane Irene, Tropical Storm Lee and Superstorm Sandy, the New York Rising Community Reconstruction Program was developed by GOSR and NYSDOS to develop and implement locally led reconstruction plans to rebuild damaged communities. Plans and project lists were developed by the communities in accordance with NYSDOS NYRCR guidelines. Eligible projects were funded through the Community Development Block Grant Disaster Recovery Funds allotted to each community.

Suffolk County and the Town of Brookhaven used funding through the NYRCR program to restore flood plains in low lying areas by implementing voluntary home buyout programs that were subject to repeated flooding. The program has successfully restored areas of marsh that serve as a buffer to flooding. The program also reduced nitrogen pollution by removing onsite wastewater treatment systems in high groundwater areas that caused both pathogen and nutrient impacts in the Reserve.

Explanation of the Outcomes and Implementation Actions

In keeping with Article 46 of Executive Law, the Council established as one of its goals the need to "achieve and maintain the water quality necessary to preserve and rehabilitate resources of the estuary." Achieving these ambitious water quality goals depends upon the cooperative efforts of federal, State, and local governments, non-governmental organizations, resource users, and residents. Outcomes and implementation actions in this chapter should guide public and private efforts to evaluate and control point and nonpoint source pollution.

The Council offers the following outcomes and implementation actions to achieve and maintain water quality in the Reserve. The actions are a result of meetings held by the South Shore Estuary Reserve Office to identify and discuss priority updates to the Comprehensive Management Plan. To reduce contaminant and nutrient loading to the Reserve via point and nonpoint source pollutions, Actions 2.1.1 through 2.1.23 call for addressing inadequate OWTS; mitigation of HABs; improved stormwater and land use management; and continued management of hazardous waste sites, landfills and resource recovery facilities. Actions 2.1.24 through 2.2.34 call for managing existing boating practices and reducing marine debris and pharmaceuticals in Reserve waters.

Actions 2.2.1 through 2.2.11 identify research, monitoring, and modeling efforts and suggest strategic contributions that advance water quality objectives. Necessary efforts include contributing to ongoing collaborative water quality monitoring strategies, expanding watershed analyses, evaluating the success of municipal water quality project implementation, utilizing sediment composition data to inform dredge management, and studying the effects of emerging contaminants on ecosystems and public health. These actions will help to identify information gaps that need to be addressed in the future to move toward fulfilling the Council's vision for the long-term well-being of the Reserve.

Outcomes and Implementation Actions

Outcome 2.1: Reduce Nutrient Loading to the Reserve from Inadequate Onsite Wastewater Treatment Systems

Action 2.1.1: As prioritized by LINAP, and in support of the Suffolk County program, replace inadequate onsite wastewater disposal systems (septic and cesspools) with innovative/advanced onsite wastewater treatment systems and encourage connections to Sewage Treatment Plants where feasible

The Nassau and Suffolk County Health Departments should work to develop and implement a strategy that: (1) requires periodic pumpouts and inspections of existing inadequate onsite wastewater disposal systems in Reserve portions of the county not served by public sewers, and (2) replaces existing inadequate onsite wastewater disposal systems with newly approved innovative-alternative onsite treatment systems (I/A OWTS) that reduce effluent nitrogen concentrations. (3) These I/A OWTS will be required for new construction, with change of use, or for substantial redevelopment of real property and would be managed through a single countywide wastewater district. (4) Programs for homeowners and service personnel would be offered in the proper use and necessary maintenance of such systems. (5) grandfathered technology and flow provisions in County Health Codes would be eliminated, and in LINAP priority areas connections to STPs would be encouraged where feasible.

In October 2020, the Suffolk County Legislature unanimously approved Resolution 702-2020. The legislation, that went into effect on July 1, 2021, will require all new construction and major building addition projects to install an approved I/A OWTS. In addition, the legislation increased the allowable flow of small sewage treatment plants (STPs) referred to as “Appendix A Modified Subsurface Sewage Disposal Systems” to 30,000 gallons per day. The increased allowable flowrate will provide greater flexibility for using these systems in areas with challenging site conditions such as downtown hamlets.

Action 2.1.2: Explore the feasibility of developing a funding mechanism in Reserve communities to incentivize landowners to upgrade existing onsite wastewater disposal systems to I/A OWTS providing nitrogen removal

There is a need for a locally generated, re-occurring water quality improvement fund, among other water quality improvement investments, that could be used to leverage state and federal funds. Consideration should be given to promoting new State legislation establishing the Long Island South Shore Estuary Reserve and Long Island Sound Region Community Preservation Fund to finance needed open space and water quality improvements modeled after the Peconic Bay Region Community Preservation Fund (CPF) which is supported by a 2% land transfer tax imposed in the Town of Southampton within the Reserve. Recently, New York State Chapter 551 of the Laws of 2015 was enacted to extend the Town of Southampton’s land transfer tax, known as the Community Preservation Fund (CPF), through 2050 to ensure that additional funds are generated for land preservation and protection of community character. Also, included in this extension was a new provision allowing up to 20% of the revenues of the CPF program to be used towards water quality improvement projects relating to remediation, restoration, and source load reductions, such as residential septic system upgrades.

Action 2.1.3: Implement sewer district expansions along Patchogue River, Forge River, Carlls River, Connetquot River, Fire Island and Point Lookout.

Patchogue River area: The Patchogue STP expanded its sewage processing capacity from 500,000 to 800,000 gallons per day and upgraded to tertiary treatment which removes nitrogen. The Patchogue River Watershed Sewer Project will connect over 500 South Patchogue residences to new and existing lower-pressure sewer lines. The expected costs and benefits of expanding the Village of Patchogue Sewer District to include the Patchogue River Maritime Center should be evaluated.

Forge River area⁴²: The Forge River has experienced poor water quality since the early part of the 20th century. The combination of antiquated cesspools, and septic systems, polluting duck farms, population growth and polluted stormwater runoff have severely degraded the river due to excess nutrient pollution. The upper Forge River is included in the NYSDEC 303(d) list as an impaired water body for pathogens, nitrogen and dissolved oxygen/oxygen demand. Impairments in the water are so severe they preclude habitation by most estuarine organisms.

Suffolk County has proposed the creation of a sewer district in the Forge River watershed to mitigate nitrogen pollution from wastewater sources. A large portion of the project occurs on the Mastic peninsula and will include primarily residential parcels, including areas within the groundwater contributing areas of Wills Creek, Poospatuck Creek and West Mill Ponds. The project, approved by referendum in January 2019, will connect parcels in the Mastic-Shirley area to a new sewer collection system that will flow to a new wastewater treatment plant and will also establish the Mastic-Shirley Sewer District.

Oakdale/Sayville area: Sewer lines should be expanded to the Sayville and Oakdale areas to allow the communities to hook up to the Southwest Sewer District and Bergen Point STP, thereby reducing the use of septic tanks and cesspools.

Carlls River area⁴³: The Carlls River is the 4th largest river system on Long Island. This densely populated area is currently utilizing septic systems or cesspools. Sewer district expansion to this area, estimated at a cost of \$136 million, would address storm impacts and reduce nitrogen and pathogen pollution in the Carlls River and Great South Bay. The project would connect 3,000 homes in North Babylon, West Babylon and Wyandanch to the Bergen Point sewer system within the Southwest Sewer District. The project was voted on and approved by the public in a January 2019 public referendum.

Fire Island Communities: Conduct a regional engineering study leading to a comprehensive sewage solution plan for Fire Island communities. Suffolk County provided funding in 2021.

Point Lookout (Nassau County): Conduct a feasibility study assessing the installation of sewers to connect Point Lookout to the City of Long Beach Wastewater Treatment Facility eliminating existing inadequate onsite disposal systems.

Action 2.1.4: Consider improvements to historic bay house onsite wastewater treatment.

Consideration should be given to exploring options for upgrading existing bay house wastewater treatment systems. Improvement to the bay house wastewater systems will help address reduce nitrogen entering the Reserve's bays and increase the resiliency of the bay houses.

Outcome 2.2: Reduce Nitrogen Loading from Municipal Sewage Treatment Plants

Action 2.2.1: Implement the diversion of effluent from the South Shore Water Reclamation Facility

The South Shore Water Reclamation Facility (SSWRF), formerly the Bay Park STP, discharges to Reynolds Channel in the Western Bays and has the capacity to treat up to 70 million gallons of sewage per day. Effluent from the SSWRF generates high nitrogen concentrations in the Western Bays resulting in the ecological consequences of eutrophication. County Plans include a 50% nitrogen reduction goal at the SSWRF and the diversion of effluent to the Cedar Creek STP ocean outfall via an existing pipe or an alternative approach should be explored. Expected benefits of the ocean outfall should be considered along with the costs of moving the discharge, the environmental impact on the ocean ecosystem; and alternative measures to reduce nutrient loading. Project construction started in the spring of 2021 and is expected to be complete in 2024.

Action 2.2.2: Implement the diversion of effluent from the Long Beach Sewage Treatment Plant

The Long Beach STP discharges treated effluent to Reynolds Channel. Like the SSWRF, sewage effluent from the STP is staying within Reynolds Channel. Conversion of Long Beach STP to a pump station and diversion of flow to SSWRF for treatment is recommended to complement the diversion of effluent from the SSWRF to the Cedar Creek STP.

Action 2.2.3: Explore upgrading the Village of Ocean Beach STP.

The Village of Ocean Beach STP discharges treated effluent to Great South Bay. Upgrades to the Village of Ocean Beach STP to include tertiary treatment for nitrogen removal should be considered.

Action 2.2.4: Promote efficiency and modernization of existing Sewage Treatment Plants within the Reserve.

Through cooperation with STP operators and communities located in the vicinity of STPs, explore the feasibility of upgrading existing facilities that discharge to the Reserve by 1) reducing reliance on chemical disinfectants by converting to UV disinfection; 2) exploring development and beneficial reuse of biogas generated from sewage; 3) increasing bio-solid dewatering efficiency with consequent reduction of truck traffic and the STPs carbon footprint; and 4) developing bio-solids and treated effluent re-use plans for industrial/irrigation uses.

A cost-benefit analysis should be completed to assess the up-front capital investment and economic benefits over the course of the project lifespan. The cost of the improvements should be compared with the benefit to the local communities adjacent to the STPs, the local environment and the global climate.

Outcome 2.3: Improve Stormwater Management

Action 2.3.1: Review, modernize and implement TMDLs as part of MS4 requirements.

There will be a need to establish TMDLs for waterbodies impaired by nitrogen and pathogens identified in the NYS Section 303(d) list based on findings of ongoing water quality monitoring efforts. The NYSDEC, NYSDOS, the Council and local governments should work together to implement load reduction actions that will help meet the load allocations in a TMDL. TMDLs should be used as a metric to assess improvements and TMDL Implementation Plans can guide adaptive management focused on resources in areas of greatest concern.

Action 2.3.2: Review the effectiveness of how municipalities are implementing the MS4 Permit in the Reserve.

The effectiveness of MS4 regulations and practices must be evaluated in order to identify gaps in those practices, determine the necessary actions to address those gaps, and assess municipal capacity to comply with current regulations and practices through inter-agency conversations.

Action 2.3.3: Encourage the use of green infrastructure over gray infrastructure where appropriate.

Green infrastructure practices that infiltrate, capture and reuse stormwater to maintain or restore hydrologic systems should be implemented where appropriate to reduce stormwater runoff. Design guidelines can be found in the NYS Stormwater Management Design Manual.

Action 2.3.4: Support the restoration of wetlands to help with pollutant filtration.

Restoration of wetlands and buffers provide natural treatment and filtration of stormwater along with providing a host of other benefits like improved fish and wildlife habitat, and storage of atmospheric carbon (carbon sequestration).

Action 2.3.5: Explore the feasibility of removing/cutting back paved road ends abutting waterways.

The feasibility of removing or receding paved roads perpendicular to, and adjacent to waterways should be explored as a means of reducing runoff where installation of subsurface drainage structures is impracticable due to high groundwater tables or periodic flooding. The use of porous materials should also be considered to reduce runoff. Studies should consider the inclusion of restored natural buffer areas and public access enhancements.

Action 2.3.6: Implement priority stormwater remediation projects in significant nonpoint source contributing areas identified in individual municipal watershed plans, and in the New York Rising Community Reconstruction Plans.

Stormwater remediation projects identified in [New York Rising Community Reconstruction Plans](#) can be implemented through a mix of local resources, such as general funds, capital improvements programs, special bond initiatives, municipal work crews and State funding mechanisms. Comprehensive, local implementation of these projects should be leveraged using alternative funds, because they contribute to improving the health of the Reserve and the well-being of the community members who reside within it. Some examples of water quality-related projects include STP upgrades, stormwater infrastructure upgrades, green infrastructure improvements, shoreline stabilization and marsh restoration.

Action 2.3.7: Adoption of a “pooper-scooper” law throughout the Reserve.

Support the adoption of a “pooper-scooper” law throughout the Reserve to reduce bacterial contamination of stormwater from domestic animal feces. The law should be modeled on the laws already adopted in Hempstead, Oyster Bay, Babylon, Islip and Southampton.

Action 2.3.8: Reduce negative environmental consequences of duck sludge and other legacy pollutants through removal and/or restoration.

Accumulations of duck sludge in Moriches Bay from former duck farming activities contribute nutrients and coliform that negatively affect the bay’s shellfish and submerged aquatic vegetation. Significant deposits of sediments rich in duck sludge should be identified and mapped, and steps should be taken to remediate those areas. Removal of the sludge has the potential to significantly improve the ecosystem. Suffolk County has evaluated and prioritized acquisition of former duck farms for open

space preservation and passive parkland recreation as part of their Comprehensive Master List Update. Suffolk County owns five former duck farms, shares ownership of three others, and has proposed acquisition of seven additional former duck farm sites.

Suffolk County completed a feasibility study that evaluated environmental restoration opportunities at Mud Creek County Park in East Patchogue. Mud Creek and its adjacent wetlands and uplands were heavily impacted by duck farming throughout much of the 20th century. This comprehensive study of the ecological, hydrological and physical conditions of the degraded aquatic and terrestrial habitats at Mud Creek County Park has led to a construction project that is currently restoring this aquatic ecosystem. The county should continue exploring ecosystem restoration opportunities on all the former duck farms that it owns.

The Town of Southampton is using funds through the Community Preservation Fund to acquire former duck farm properties to foster the recovery of wetlands and enhance public access.

The restoration of former duck farms represents an important opportunity to 1) restore miles of critical shoreline and wetland habitats, 2) improve aesthetic and environmental conditions for nearby neighborhoods and provide County residents with the opportunity to access these waterways for recreational and educational purposes, and 3) remove derelict structures.

Action 2.3.9: In conjunction with LINAP, reduce fertilizer, herbicide, and pesticide use, especially on shorefront or stream corridor parcels.

Reduction in fertilizer, herbicide and pesticide use may be achieved through BMPs that reduce the use of and need for fertilizers and pesticides (including spraying of mosquito larvicides). Consistent with SPDES/NYSDEC Pesticides and MS4 Regulations, BMPs should be implemented on private and public properties, including municipal golf courses. Measures to reduce impacts should include strong discouragement of use for aesthetic purposes, use of substances that are toxic to the aquatic environment, and should require new land use designs to limit impacts on water and living resources, and to use native plant species in new landscaping.

Municipalities should explore the feasibility of a shorefront overlay zoning district with stringent restrictions on fertilizer, pesticide/ herbicide use on waterfront parcels. Homeowners should be discouraged from maintaining a groomed lawn up to the water's edge and encouraged to incorporate native plants into their landscaping that use less water and fertilizer. Efforts to reduce pesticides should include a large-scale public education campaign and policies curbing the use of the most detected pesticides. Education should target individuals in both the public and private sectors.

Action 2.3.10: Prioritize watershed restoration efforts through development of GIS-based tools

In collaboration with ongoing state and county efforts a GIS-based tool could be developed to prioritize restoration of at-risk water bodies (especially tributary corridors and mouths) and prioritization of land acquisition based on proximity to waterways.

Action 2.3.11: Evaluate Permeable Reactive Barriers.

Stony Brook University School of Marine and Atmospheric Sciences is evaluating the effectiveness of permeable reactive barriers that are located behind bulkheads in Western Shinnecock Bay and Davis Park Marina.

Outcome 2.4: Improve Land Use Management

Action 2.4.1: Encourage municipalities to create and adopt Local Waterfront Revitalization Programs.

The development of Local Waterfront Revitalization Programs (LWRP) is an important land use management tool for Long Island communities. Grant funds are available for eligible communities to apply for assistance to develop an LWRP.

A State and federally approved LWRP is an enforceable, local refinement of the State's Coastal Management Program. LWRPs engage residents in the development of a waterfront vision, inventory and analysis of assets and opportunities, and implementation mechanisms such as refined local laws to improve decision-making and proposed project profiles for future funding. These land and water use plans allow for focused management of the municipality's natural, developed, public and working waterfronts. LWRPs help to ensure all levels of government action are consistent with, and advance LWRP policies. Approved LWRPs also become eligible to receive implementation grants from the Environmental Protection Fund (EPF) through the NYSDOS.

Action 2.4.2: Implementation of Agricultural Environmental Management program consistent with the priorities of the Long Island Nitrogen Action Plan.

Provide strategic support to agricultural efforts including: Suffolk County Farms' development of Nutrient Management Plans; Suffolk County SWCD's evaluation of their AEM program to improve cost-effective and science-based decision making; the NYS Department of Agriculture and Market's research to inform nutrient management planning and implementation; and Nassau County SWCD's research to address invasive species management, ecological restoration, reforestation, invasive species control and implementation of green infrastructure. (See also Action 2.1.17 regarding fertilizer use).

Action 2.4.3: Provide recommendations to increase wetland buffer areas.

Facilitate the expansion of wetland buffer areas by encouraging participation in existing voluntary incentive programs. The Natural Resource Conservation Service offers financial incentive programs to landowners and agricultural producers for the establishment and maintenance of vegetated buffer strips, including the Conservation Reserve Program, Environmental Quality Incentives Program, Wildlife Habitat Incentives Program and Wetlands Reserve Program. The SSER is within a statewide priority watershed for NYSDEC's *Trees for Tribs* program, which offers competitive funding for streamside plantings, site preparation and outreach to landowners. *Trees for Tribs* participants agree to refrain from mowing to allow for maximum runoff attenuation and nutrient uptake. An additional strategy is to partner with local land trusts to acquire key parcels that enhance wetland buffering capacity and hold them in permanent conservation easements.

The possibility of amending applicable tidal wetland regulations could be explored to expand the regulated wetland buffer zone to include the anticipated landward migration in response to climate change, and to recommend the establishment, restoration, or maintenance of naturally vegetated buffers through conversion of existing lawn and landscaping. Conversion may include installation of native plants or cessation of mowing, allowing natural vegetative succession and recovery. Restrictions on lawn maintenance within wetland buffer zones have the potential to reduce direct runoff of fertilizers, pesticides, and herbicides to receiving wetlands and waterbodies.

Action 2.4.4: Regulate and restrict discharges from chlorinated swimming pools.

NYSDEC has General Guidelines for Swimming Pool Discharges which state that chlorinated pool water should be discharged to lawns and not directly into the water. Discharging pool water directly into or within 250 feet of a waterbody or wetland may be prohibited or require a SPDES permit.

The Town of Southampton and the Town of Babylon have identified the issue of discharge from chlorinated swimming pools and have developed local guidelines that require that pools be equipped with a no chlorine (saltwater) or low chlorine treatment system and include drywells for discharge. Southampton requires as a condition of any requisite town wetland permits that a vertical buffer of at least two feet be provided between the base of a pool and the groundwater table, as verified by test hole data, to avoid the need for dewatering and to lessen risks of storm damage and contamination during flooding events. Other municipalities should consider replicating these efforts to reduce input of contaminants into the watershed.

Action 2.4.5: Improve management of upland ponds.

A majority of upland ponds within the Reserve are impounded rivers and streams. Shallow impoundments can have considerable water quality impacts on the estuarine system due to the prevention of adequate water circulation, temperature and salinity shifts, eutrophication, HABs, acidification, and hypoxia. Ecological, economic, and public health implications of these impacts should be considered, along with long-term costs of dam maintenance and management of aquatic invasive species. As recommended by the Seatuck Long Island Diadromous Fish Restoration Strategy and members of the Long Island Diadromous Fish Working Group, any efforts to manage and restore these waterbodies should first consider opportunities for dam removal and re-establishment of natural riverine conditions. The historical significance of these waterbodies to the community should also be considered through active community engagement when exploring potential mitigation options.

Outcome 2.5: Mitigate Hazardous Waste Sites, Landfills, and Resource Recovery Facilities

Action 2.5.1: Support assessment and mitigation of ground and surface water contamination originating from inactive hazardous waste sites.⁴⁴

To reduce the potential impact of inactive hazardous waste sites in the Reserve, 1) remedial investigations are planned to be completed for all NYSDEC Priority Classification 2 inactive hazardous waste disposal sites where contaminants have been identified through preliminary site assessments that pose a potential significant threat to public health or the environment; 2) feasibility studies will be developed to identify alternative remedial actions for such sites; and 3) appropriate steps to remediate these sites will be taken.

Action 2.5.2: Continue local monitoring of landfill performance and compliance.

The monitoring of ground and surface waters in proximity to landfills should be continued, strengthened and publicly disseminated as part of landfill operation and for a minimum of thirty years after a landfill stops receiving solid wastes. Such an effort is critical to assure that solid waste landfills in the Reserve perform and are operated in a manner protective of public health and the environment. As part of this effort, owners of solid waste landfills should continue to monitor their facilities and disclose results. Upgrades should be explored for facilities that may pose a significant threat to public health and the environment. In addition, local planning units should continue to re-evaluate their solid waste disposal and waste reduction strategies.

Outcome 2.6: Improve Best Management Practices for the Boating Community

Action 2.6.1: Encourage use of NYSDEC Nonpoint Source Best Management Practices for Marina Operations for Existing Facilities throughout the Reserve to reduce pollutants associated with redeveloping marinas and recreational boating.

Support implementation of [NYSDEC Best Management Practices for Marina Operations for Existing Facilities](#) and encourage marina and boat owners to participate. A comprehensive marina and boater education program is a critical component of this effort. Operation SPLASH offers education to citizens interested in learning about how to put these BMPs into practice.⁴⁵ Additionally, opportunities should be explored to reduce air, water, and noise pollution through the continued transition to four-stroke motors, hybrid propulsion engines, electric boat motors, solar powered boats, and non-motorized boating.

Action 2.6.2: Identify all land based and mobile pump out facilities throughout the Reserve.

In 2009, the entire Reserve was designated as a “No Discharge Zone.” NYSDOS will coordinate with Nassau and Suffolk Counties as well as the towns and villages within the Reserve to promote adoption of model local laws pertaining to maintenance practices of marina-based pump out facilities. This action should include: verifying the number, location, condition, and usage of existing pump out facilities in each of the Reserve’s bays, assessing their operation and maintenance and, if warranted, improving their user fee structure; increasing the numbers of land and water-based pump out facilities to meet both the needs of recreational boaters and the criteria for designation of each bay as a no-discharge zone for vessel wastes; and upgrading and coordinating enforcement of vessel waste regulations.

Action 2.6.3: Support municipal land based pump out stations and mobile pump out boats.

To maintain an adequate number of pump out facilities in the Reserve support should be provided to municipalities to prioritize the continued operation of existing pump out facilities and mobile pump out boats that are a convenient way for boaters to remove waste from boats and protect the estuary.

Action 2.6.4: Support the continued transition to alternatives for copper-based bottom paint throughout the Reserve.

Antifouling paints, otherwise known as bottom paints, are pesticide products used on vessel hulls, boat bottoms, structures and other marine surfaces to inhibit growth of aquatic organisms such as barnacles and algae. Many bottom paints contain cuprous oxide and copper. These chemicals do not degrade in soil and are harmful to marine life, particularly benthic organisms such as shellfish. Many marinas in the South Shore have switched to copper-free paint. This transition should be encouraged to continue and to expand to all marinas in the Reserve.

Action 2.6.5: Prohibit the use of treated wood in all bulkhead, dock, catwalk, and seaside deck construction

Wood treated with the preservative ‘chromated copper arsenate’, creosote, pentachlorophenol, alkaline copper quaternary, copper azole, micronized copper azole and ammoniacal copper zinc arsenate contain the toxic metals copper, chromium and arsenic that prevent decay and damage from invertebrates. These chemicals can leach into nearby sediments and into the water column, with the potential to bioaccumulate in organisms and cause adverse impacts to aquatic biota, especially at the larval stage. Wood treated with these chemicals should be prohibited in favor of less toxic alternatives including plastic lumber, metal and wood that is naturally resistant to rotting and insect boring.^{46, 47}

Outcome 2.7: Reduce Marine Debris throughout the Reserve

Action 2.7.1: Promote legislation to reduce or eliminate the release of balloons and attached streamers and develop an educational campaign in support of this initiative.

Suffolk County passed legislation in September 2019 banning the intentional release of helium balloons in the County. Several additional steps could be taken to promote this positive step to protect the South Shore Estuary: Introduce education efforts at the point of sale to reduce the release of balloons and streamers, such as offering a pledge people can sign stating that they will not release balloons and conduct a comprehensive social marketing campaign educating the public on the environmental impacts of releasing balloons into the Reserve.

Action 2.7.2: Consider legislation banning the use of the most common single-use plastics.

Working with local groups and policy makers efforts should be made to encourage legislation that bans common single-use plastics found on Reserve beaches such as straws, stirrers, utensils, balloons and other prolific plastics can be effectively replaced by reusable or more recyclable options. Eliminating the use of these plastics would reduce the amount of plastic pollution entering the Reserve and would encourage consumers to switch to more sustainable options.

Action 2.7.3 Consider legislation to reduce plastic packaging waste entering the Reserve.

To help reduce litter in the Reserve that may enter the bays legislation should be considered to reduce plastic packaging of consumer goods. Legislation would require manufacturers to take responsibility for their products by taking responsibility for their product throughout the product life cycle and bear the cost of proper recycling and responsible disposal for packaging and printed paper. The legislation would provide incentive for manufacturers to reduce packaging that could make its way into the Reserve's bays.

Action 2.7.4: Expand programs to recycle and find alternative re-uses for plastic boat shrink wrap.

The Towns of Hempstead and Huntington have established model programs that collect shrink wrap annually during the spring season and send it to a recycling facility. In 2011, the Town of Huntington collected over 300 pounds of shrink wrap in just one day from Town residents. Not only do these programs keep shrink wrap out of the estuary, it also offers cost savings to marinas by allowing them to avoid waste disposal fees. Other towns should be encouraged to follow the lead of Hempstead and establish shrink wrap collection and recycling programs. Additionally, efforts to re-use or upcycle shrink wrap should be explored and supported.

Action 2.7.5: Provide support to government and private groups for the recycling of fishing line.

Waste fishing line is a hazard to wildlife. Partnerships should be developed with local groups to deploy recycling stations for fishing line that will help to minimize environmental threats from derelict fishing lines. A survey should be undertaken to identify gaps in geographic coverage of fishing line recycling locations.

Action 2.7.6: Promote the use of storm drain filters to catch marine debris before it enters waterways.

Debris often enters waterways through stormwater systems. Operation SPLASH installed storm drain filters along Freeport's Nautical Mile and demonstrated the effectiveness of the drain filters in preventing debris from entering the waters of the Reserve. To further reduce debris in the estuary, broader installation of storm drain filters should be encouraged.

Action 2.7.7: Encourage public parks and beaches to use closed trash receptacles.

Trash disposed of in open trash receptacles may get blown away by winds or removed by wildlife and could ultimately end up in nearby waterways. Similar to the National Park Service recent efforts there is opportunity to prevent the spread of debris that is disposed of in public receptacles in parks and other public places by replacing open trash cans with closed receptacles.

Action 2.7.8: Seek funding for the Removal of Derelict Vessels in the Reserve

Derelict vessels continue to be a problem in the Reserve. Abandoned vessels are still present from Superstorm Sandy, with additional vessels accumulated since 2012. These vessels are an eye sore and can cause navigation hazards, both in and of themselves and as pieces become dislodged and float in the Bays creating a drift hazard. There are also risks of fishing gear fouling and pollution leaching from fuel tanks or engines submerged in the water. Some funding sources exist for the removal and remediation of derelict vessels and should be pursued by municipalities and not-for-profits.

Outcome 2.8: Reduce the Amount of Pharmaceuticals Entering Reserve Waters

Action 2.8.1: Support NYSDEC's pharmaceutical take-back programs within the Reserve.

NYSDEC is working with pharmacies across New York State to implement a pilot pharmaceutical take-back program. This program, if implemented in the communities within the Reserve, has the potential to reduce the quantity of certain emergent contaminants entering Reserve waters. The program would be especially beneficial in areas where there is a shortage of pharmaceutical drop box locations. In 2016, the Town of Southampton instituted pharmaceutical take-back and disposal program within the Town. A permanent disposal bin is located at the Southampton Town Police Station. Additional towns should be encouraged to institute similar programs.

Outcome 2.9: Conduct Research, Monitoring, and Modeling in Support of Achieving Water Quality Objectives

Action 2.9.1: Support ongoing local, state, federal agency and academic initiatives.

Monitoring should focus on key parameters necessary for improved water quality that are consistent with the priorities of the USGS CWRMS, Suffolk County Comprehensive Water Resources Management Plan and LINAP, and on adaptive management efforts that are being pursued for coastal areas through the Army Corps, National Park Service and other programs. Monitoring should utilize expertise and resources of local academic partners and employ modern technology. All methods should be publicly sourced, and data should be posted on publicly accessible sites.

Additional actions should include the continuation of Suffolk County's extensive water quality monitoring program; NYSDEC's Shellfish Growing Area Certification (bacteriological water quality sampling); and the Nassau and Suffolk County beach monitoring programs. It should include the installation of rain gauges at all tidal monitoring locations in the western bays and, where opportunities exist, the deployment of an additional four to six data recording instruments to supply real-time electronic data collection of tidal heights, storm surges, salinity and water temperature.

Action 2.9.2: Implement recommendations of LINAP, the Suffolk County Harmful Algal Bloom Action Plan, and Stony Brook University's Eastern Bays Project to reduce HABs in the Reserve.

The brown tide research conducted by Suffolk County must be continued in order to identify and implement successful prevention and mitigation measures. Research efforts on additional types of HABs by Stony Brook University's SoMAS should remain ongoing, and results should be used to help direct local recommendations.

Action 2.9.3: Support CWRMS efforts to establish baseline water quality data and associated ecosystem biodiversity data, particularly in the western bays.

The two-tiered approach identified in the CWRMS for the Reserve calls for the immediate implementation of a baseline monitoring program. Tier 1 would analyze historical water quality data, expand existing monitoring efforts throughout the Reserve, and provide strategic information that would identify and assess trends in water quality and the extent to which designated uses of the Reserve's waterbodies are met. Tier 2 activities would be short-term investigations designed to test specific hypotheses regarding water quality or ecological issues in the Reserve. Monitoring should also include a component that studies the ecological consequences of the presence of toxic substances, human pathogens, excessive nutrients, low dissolved oxygen levels, ocean acidification and ocean-bay water and sediment exchange.

One use of the baseline data will be to serve as a starting point to compare and evaluate the success in improving ecosystem resilience through the elimination of inadequate OWTS in Suffolk County and STP plant upgrades within the western bays, as detailed in Action 2.1.1.

Action 2.9.4: Develop a solute transport model based on historical land use data

The NYSDEC, Peconic Estuary Partnership, and USGS have developed a solute transport model for the eastern portion of Long Island. Funding has been secured by NYSDEC to contract with USGS to complete the model for the remainder of Long Island. The solute transport model will assess the time-varying discharge of nitrogen into fresh and coastal waters of Long Island. Managers will be able to use the model to simulate nitrogen reduction activities and estimate the resulting nitrogen loading rates over time. These tools will be useful to local, state and regional entities by providing insights into how nitrogen discharge likely will change in response to nitrogen mitigation efforts. The model will be available for the Reserve to use for simulations of management scenarios when completed.

Action 2.9.5: Support and strategically contribute to the development of Reserve-wide hydrodynamic models.

Hydrodynamic modifications are a management strategy in the LINAP Scope. NYSDEC is working with USGS to conduct a hydrodynamic modifications feasibility study. The goal of the hydromodification feasibility study is to model some basic scenarios on embayments to determine where and how improvements in water quality can be made. The expectation is that the information found in this analysis can be used to inform future hydrodynamic modification projects with regard to the water quality improvements and environmental benefits they may provide, along with the potential hurdles such as cost and feasibility. Information from this study will be available for the Reserve to use for future work.

Existing models and data will be utilized to develop Reserve-wide hydrodynamic models. Groundwater underflow, tributary inputs, circulation, residence time and ocean-bay exchanges need to be measured, modeled and used to predict the water quality impacts of dredging, barrier breaches, flooding, erosion,

land use decisions, shoreline hardening, sea level rise and the transport and fate of nutrients and contaminants.

Action 2.9.6: Compile and expand water quality data in tributaries of the Reserve.

Water quality data in tributary streams is minimal in comparison to data from groundwater and bay water. There is a need to compile sources of information from NYSDEC, SoMAS, Suffolk County and USGS to analyze data gaps and identify future monitoring needs in the Reserve. As part of LINAP, NYSDEC is creating a user interface for the federal Water Quality Exchange WQX database. The interface, called the Long Island Water Quality Integrated Data System (LIQWIDS), will help data generators put their data into the database and extract data from the data base. People will be able to analyze the data for trends, gaps and overall assessments. Data generators in the Reserve should be encouraged to use LIQWIDS to submit and extract data from WQX.

Action 2.9.7: Analyze and map stormwater drainage and infrastructure in Reserve communities.

In conjunction with the USGS CWRMS study, develop a comprehensive Reserve-wide map of stormwater drainage infrastructure, compiled based on existing information. Available information on stormwater systems should be reviewed and ranked according to impacts on the Reserve. Stormwater data can be used in priority watersheds to identify priority reaches or basins needing water quality improvements.

Action 2.9.8: Consider the impacts of water withdrawals, water use, and sewer district expansions on the recharge of the Glacial Aquifer.

The extensive sewerage in Nassau County and the discharge of STP effluent via an ocean outfall has lowered the water table and impacted important wetlands. Recommended sewer district expansions, water withdrawals should consider impacts to the Glacial Aquifer in project development and explore potential water reuse options to recharge the Glacial Aquifer.

Action 2.9.9: Address winter road salt use impacts on tributaries to the Reserve.

The Reserve office working with NYSDEC may develop recommendations for appropriate reductions in road salt runoff in the Reserve. Recommendations will capitalize on successes employed across the State.

Outcome 2.10: Expand Watershed Analyses throughout the Reserve

Action 2.10.1: Pursuant to MS4 requirements, complete specific watershed analyses to determine localized distribution and magnitude of nonpoint pollution, prepare and revise watershed plans and improve retrofit designs for cost-effective nonpoint source pollution control projects.

A watershed analysis involves identifying and setting priorities for improvements to storm sewers and other runoff conveyance systems. It should also: examine the overall watershed character, including existing drainage and runoff patterns; evaluate the benefits and feasibility of correcting runoff problems through road infrastructure improvements; and identify opportunities for preservation of high-quality waters from future pollution. This information could be supported with data from targeted water quality monitoring programs. Updated watershed analyses need to include climate change issues and implementation of green infrastructure practices.

Based on the results of watershed analyses, and consistent with the goals of the revised requirements for MS4 communities, watershed plans should identify significant nonpoint source contributing areas and identify and set priorities for site-specific projects for stormwater remediation. Designs for these projects should be developed according to NYRCR plans, the NYS Stormwater Design Manual, and practices from the EPA's Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters or the NYSDEC's Management Practices Catalogue for Nonpoint Source Pollution Prevention and Water Quality Protection in New York State. The latter is incorporated by reference into the New York State Coastal Nonpoint Pollution Control Program, a compendium of nonpoint pollution control and abatement practices currently implemented in New York State. Municipalities should build upon existing individual watershed management plans and continue to characterize their watersheds. These characterizations should include a delineation of sub-watersheds or contributing areas, and the location and condition of storm sewer outfalls and stormwater conveyance systems through which pollutants in stormwater are discharged. Existing drainage and runoff patterns should be accounted for in this delineation. This should be developed in concert with the ongoing Suffolk and Nassau County sub-watershed wastewater planning efforts.

Action 2.10.2: Determine the distribution and relative magnitude of nonpoint source pollution using spatial analysis of land cover, soils, topography and digital ortho-imagery in Reserve municipalities.

Comprehensive spatial analysis of land cover, soils and topography by NYSDOS has resulted in a nonpoint pollution potential model. The model identifies the potential distribution and relative magnitude of nonpoint source pollution and should be used by municipalities as they develop watershed plans that address management of nonpoint source pollution.

Action 2.10.3: Municipalities should periodically report to the Council on progress made and problems encountered in implementing the water quality component of this plan to inform implementation status reports.

The implementation status report (ISR) should continue to be used as a system of reporting to the Council by municipalities to measure Reserve-wide progress against objectives and to enable early detection and resolution of Reserve-wide problems. The ISR should also be used as a way for municipal stewards to enlist the Council's aid in identifying sources of technical assistance and potential funding. Municipalities should report out after they receive Reserve or other federal, state and local funds to complete projects.

Outcome 2.11: Research the Impacts of Emerging Contaminants in the Reserve to Improve Understanding

Action 2.11.1: Research data gaps on herbicides and pesticides focusing on ecosystem impacts.

Little is known about the impacts of herbicide and pesticide use on the aquifer system or on invertebrates, seagrass, and fish exposed to contaminated surface waters. Research on impacts of herbicides, pesticides and their derivatives are needed to aid in the development of adaptive management approach based on research findings. Existing BMP's for herbicide and pesticide application do not adequately address these issues.

Action 2.11.2: Analyze water quality impacts of emerging contaminants including pharmaceuticals, volatile organic compounds, and persistent organic pollutants.

The total loading of toxicants within the Reserve and the levels of toxic substances in the waters, sediments and aquatic biota of the Reserve need to be evaluated so that presence of toxicants in the Reserve clearly present the risks to public health. Impacts of pharmaceuticals, PFCs, PCBs, chlordane, TCE, 1,4-dioxane, PFOA and PFOS should be monitored and assessed.

Action 2.11.3: Conduct a study of microplastics in the Reserve.

Conduct a study to examine the extent and impacts of plastics and microplastics in the Reserve, identify the magnitude of the problem, and to serve as a baseline to for developing appropriate reduction goals.

Chapter 3: Living Resources



Overview

The character of the South Shore Estuary Reserve (Reserve) was once defined by highly abundant, productive and diverse living resources and ecosystems within the estuarine watershed. Over the last century the Reserve has experienced a decline in ecosystem maturity, loss of top keystone predators, a decline in connectivity to the ocean resulting in reductions of migratory species and the increasing dominance of low trophic level organisms. This long-term shift in ecosystem structure and energy flow is likely a result of both natural and anthropogenic stressors including commercial and recreational overharvest, inlet modification, rising water temperatures, eutrophication, harmful algal blooms and loss and degradation of habitat.⁴⁸ Stewardship of these living resources and protection of human health requires an ecosystem-based management approach that considers the entire ecosystem, including people.^{49,50}

Issues Faced

Deterioration of Wetlands

Tidal, freshwater emergent and freshwater forested/shrub wetlands provide significant functions and ecosystem services in the Reserve. The Reserve is supported by 19,000 acres of vegetated tidal wetlands and salt marshes make up about 15% of the total estuarine acreage. Historical wetland losses have occurred due to fill for development (e.g., mosquito ditching practices, dredged material placement) and restriction of tidal flow. Almost 1,800 acres of wetlands were lost to fill disposal and hydromodification, with another 15,000 acres of salt marsh altered by mosquito ditching practices. Approximately 2,200 acres of relatively high quality un-ditched tidal wetlands remain in the Reserve, with 5,000 acres of riparian buffer area and smaller areas of rare wetland types scattered throughout the Reserve.

Current losses of tidal wetlands stem from activities related to destruction of natural vegetation, disrupted hydrology, sediment disruption, grade changes, backfill, and impediments to landward wetland migration from shoreline hardening structures such as bulkheads; rip-rap; gabions; rock placement; bio-logs; subsidence; wave energy; erosion; historical mosquito ditching by vector control; dredging; inlet and barrier island stabilization; sea level rise;⁵¹ excess nitrogen input from septic systems, sewage outflows, fertilizers, recreational boating, and atmospheric deposition. Excess nitrogen combined with greater inundation can significantly impact wetlands. Leaching of toxic wood preservatives used on treated lumber may also impact tidal wetland health.

These stressors can adversely affect surface water quality by destroying and/or preventing the recovery of tidal wetlands which are essential for natural filtration of contaminants. For example, the deflection of wave energy from shoreline structures such as bulkheads can damage tidal wetlands and cause sedimentation of bay waters.

Combined with the impacts from historical mosquito ditching and the lack of sediment for wetlands to keep up with sea level rise contributes to the formation of pannes and the loss of sub-surface biomass integrity harming the root masses of marsh islands. Pannes are shallow depressions of stagnant water that can stunt plant growth and lead to mortality. The formation of pannes often occurs in marsh interiors with low sedimentation, limited productivity and poor drainage due to accelerated sea level rise and disrupted natural hydrology.⁵²

Reduced productivity diminishes the benefits of other wetland functions. Loss of tidal wetlands has reduced the ability of these habitats to provide primary productivity for higher trophic level organisms (organisms higher on the food chain); critical foraging, nursery and nesting sites for finfish, shellfish,

waterfowl and colonial waterbirds; stabilization of sediments; removal of water borne nutrients and contaminants; and mitigation of storm impacts. Wetlands located adjacent to tributaries play a particularly important role in mitigating water quality problems described in Chapter 2: Water Quality.

Wetland losses from filling and development have slowed in many areas due to effective regulatory management both where they exist today and where they want to migrate to in the future. However, wetlands continue to decline in other areas because of the current threats previously discussed.⁵³ The remaining wetlands present both challenges and opportunities for management and restoration of ecological functions and living resources. These areas must be recognized for their living resource value and receive active management and restoration efforts.

Deterioration of Tributary Systems

Tributary systems are focal areas of biological diversity, abundance and productivity, and have high ecological value. Approximately 100 tributaries drain into the Reserve bays. These systems, which have suffered severe impacts and loss of connectivity from the historic construction of dams and culverts, continue to be threatened by development and land use pressures including nutrient pollution, contaminants, sediment budget disruption, loss and absence of naturally vegetated wetland buffers, warming waters, hypoxia, and conversion of natural shorelines to bulkheads. These threats impact the ability of Long Island tributaries to support native ecosystems and finfish spawning.⁵⁴ This includes providing shelter, nursery and spawning areas and food sources for diadromous fish such as river herrings (alewife and blueback herring) and American eel. Due to historic losses that have limited their extent and ecological health, riverine corridors are at risk and deserve special conservation efforts.

Deterioration of Seagrass

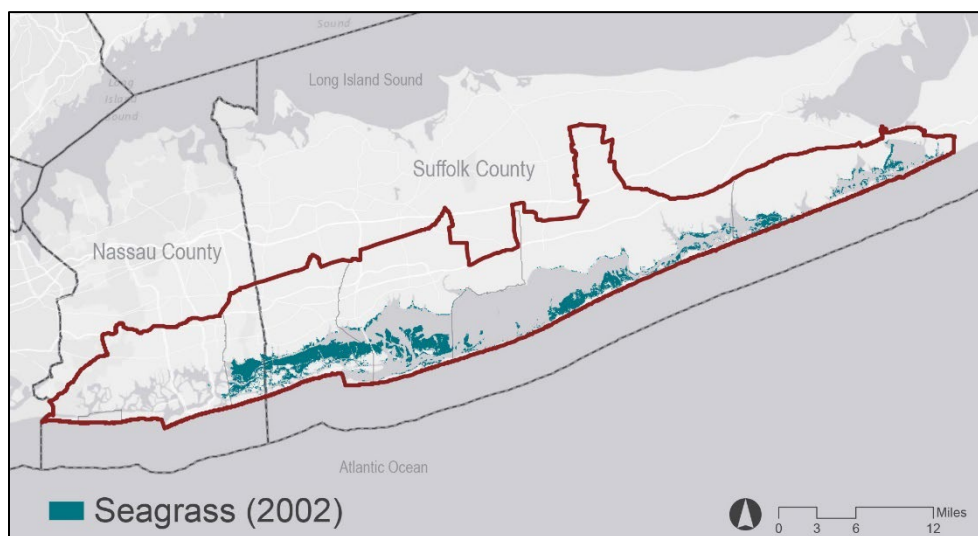
The Reserve has seen a 50% reduction in beds of seagrass, that includes eelgrass (*Zostera marina*) and widgeon grass (*Ruppia maritima*), between 2002 and 2018. Seagrass occupied 19,423 acres in 2002, roughly 20% of the Reserve's shallow subtidal zone, and in 2018 seagrass occupied approximately 10,474 acres. (see Map 9, Map 10) seagrass in the Reserve provides a considerable contribution to the overall estuarine productivity.⁵⁵ The final 2009 report⁵⁶ of the New York State Seagrass Task Force asserts that deteriorating water quality is the leading cause of decline in eelgrass habitat throughout the Reserve, particularly in the western bays, in portions of Great South Bay and in the eastern bays. Seagrass is being impacted by respiratory stress that results from low light conditions created by turbidity, which is intricately related to eutrophic algal blooms and warming temperatures. Spans of temperatures above 77°F lasting a few weeks are considered detrimental to eelgrass health.⁵⁷⁵⁸ Shorter periods of time above 80.6°F contribute to mortality.⁵⁹ Additionally, physical disturbances such as boat anchoring, propeller scars, benthic fishing gear and methods (e.g. traps, trawling), dredging, and coastal structures (e.g. docks, bulkheads, and groins) have also led to the loss of seagrass in the Reserve.

In the absence of water quality stressors, temperature stressors, and impacts from physical disturbances, seagrass beds support resilience through wave attenuation, stabilization of bottom sediments, oxygenation, carbon sequestration, and carbon storage.⁶⁰

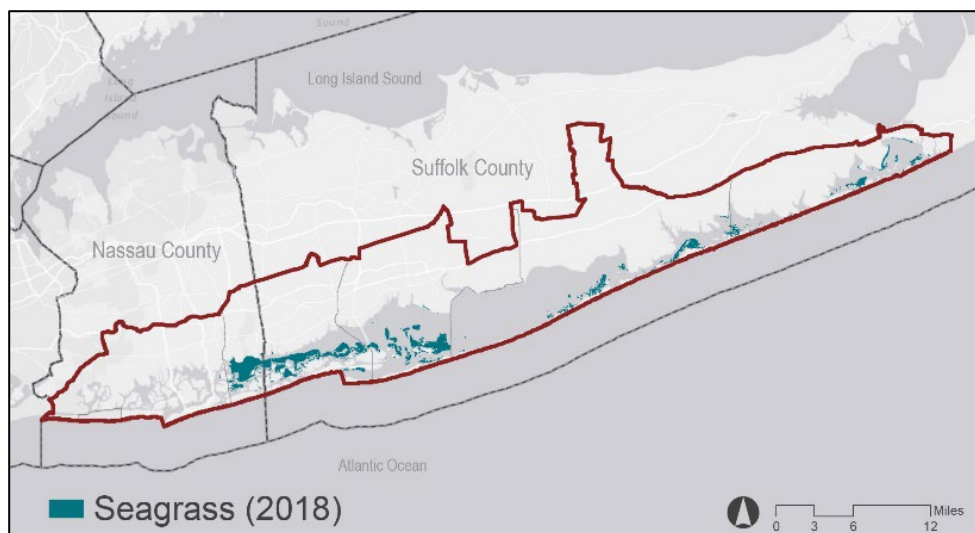
Seagrass habitat provides food sources for waterfowl, sea turtles, marine mammals, and critical foraging, nursery and spawning habitat for resident and migratory finfish, shellfish, crustaceans, and many other invertebrates. Because of water quality stressors, Seagrass beds are less able to provide ecosystem services that benefit wildlife and coastal communities.

Habitat Degradation and Population Decline of Molluscan Shellfish and Crustaceans

Molluscan shellfish are ecologically and economically important resources to the estuary providing nutrient cycling and water filtration functions for the estuary's waters. The signature molluscan shellfish species, the hard clam, was an abundant component of at least the Great South Bay portion of the Reserve through the 1970's and a significant contributor to the local economy. The hard clam is at the forefront of concern because of significant declines in productivity and commercial harvest. Overharvest and coastal eutrophication are causing bay water acidification,^{61,62} hypoxia, and algal blooms, and are reducing the productivity and sustainability of populations.⁶³ Depressed population levels serve as an indicator of commercial harvest pressure and environmental, biological and physical changes in the estuary. Because of habitat degradation, overharvesting and coastal eutrophication, bivalve molluscan shellfish such as the hard clam and oysters no longer provide the same degree of nutrient cycling and water filtration functions for the estuary's waters, nor do these species offer the substantial recreational and commercial values for people that they once did. Without shellfish, species that depend on them as a food source suffer and ecosystem services are lost.



Map 9 - Seagrass extent in 2002, 19,423 acres



Map 10 – Seagrass extent in 2018, 10,474 acres

Crustacean populations serve an equally important role as molluscan shellfish in ecology and the economy. Blue crab populations are a significant component of the estuarine food web and have the potential to be an increasingly important commercial and recreational species.⁶⁴ The species face similar pressures as molluscan shellfish, including overharvest and coastal eutrophication.

Furthermore, changes in bay-ocean interaction from barrier island breaches have the potential to affect ecosystem structure and alter commercial and recreational fisheries. Preliminary studies on the ecology of the Reserve after the breach in the wilderness area of the Fire Island National Seashore in 2012 show changes in species composition in the area of the breach.⁶⁵ For example, the shift in spatial prevalence from blue crabs to the saline tolerant lady crab exemplifies species-based change resulting from shifting ecosystem conditions driven by natural processes making for a more resilient ecological community. However, more research is needed to better understand this relationship.

Habitat Degradation and Population Decline of Horseshoe Crabs

Horseshoe crabs are an ecologically important keystone species, as spawning horseshoe crabs and their resultant eggs provide necessary food for many animal species including migrating shorebirds. Horseshoe crabs are almost exclusively harvested for bait within the Reserve. Annually, approximately 150,000 horseshoe crabs are harvested from all around Long Island, including the Reserve, for bait purposes.⁶⁶ Further research is needed with respect to the impacts of overharvest on the sustainability of horseshoe crab populations to assist with development of a regional horseshoe crab population and management plan.

Habitat Degradation and Population Decline of Finfish

The estuary's pelagic, demersal and diadromous finfish populations provide commercial and recreational benefits to the Reserve. Fishing, declining water quality and habitat loss due to hydrological modification or alteration of water table height and stream flow (by groundwater extraction and wastewater management) can significantly impact reserve populations of finfish and the benefits they provide.⁶⁷

Tidal restrictions, dams and insufficient culverts can act as barriers to fish migration and spawning. Diadromous fish, including brook trout, alewife and blueback herring, and the catadromous American eel, have experienced significant habitat loss and population decline from historic levels.⁶⁸

Historically, multiple shark species have been found to inhabit the reserve, including the sandbar shark, sand tiger shark and dusky shark. Recent research has shown annual site fidelity of sand tiger pups within the Great South Bay.

The Reserve is a complex ecological system. Changes to the ecosystem structure beyond a certain threshold can cause irreparable damage to the system. For example, abundant forage species assemblages which have a strong habitat linkage to the shallows and intertidal wetlands are necessary



Photo 2 - Carmans River fish ladder in the Town of Brookhaven

for energy transfer to higher trophic level organisms (i.e., organisms higher on the food chain). If populations are depressed, some finfish will not transfer adequate food energy to predatory finfish and avian populations. Loss of finfish could cause ecosystem structure shifts, which can have cascading impacts on Reserve-wide resources vital to the ecosystem and the economy.

Habitat Degradation, Segmentation and Population Decline of Birds

The Reserve has long been recognized for its abundant bird populations. The diversity of physical habitats and biological communities in the Reserve affects a wide variety of estuarine bird species, including colonial waterbirds, shorebirds, waterfowl species, and obligate salt marsh nesting birds. Among these species are several rare, endangered or threatened species including the piping plover, roseate tern, least tern and the common tern.

Loss in vital breeding, foraging, migration and overwintering habitat due to development and human disturbance threatens the geographical distribution and population structure of a variety of species. Most species have experienced a decline in numbers and shifts in species distribution to more isolated or protected locations such as the saltmarsh islands of the western bays or protected areas of the barrier beach. Species such as the piping plover, rely on unvegetated, sandy or gravelly substrate for nesting. Interventions in natural barrier island dynamics can prevent beach overwash and interfere with other coastal processes, resulting in diminished available habitat for this species.⁶⁹

Historic species-based management approaches have led to better understanding of the population dynamics of these species and moderate success in achieving population restoration goals. Future recognition, protection and management of key feeding and nesting areas is critical for these groups of bird species.

Habitat Degradation, Segmentation and Population Decline of Aquatic Turtles

Most marine, estuarine and freshwater turtle species have experienced severe declines. Most notably, the diamondback terrapin is threatened by habitat loss from coastal development, predation, crab pots, ghost fishing, recreational boating and sea level rise. Information on the threats to offshore marine species can be found in the New York Ocean Action Plan 2017-2027.

Habitat Use and Recovery of Seals

Seals such as the Atlantic harbor seal (*Phoca vitulina vitulina*), Atlantic gray seal (*Halichoerus grypus atlantica*), and Arctic seals such as the harp seal (*Pagophilus groenlandicus*), and the hooded seal (*Cystophora cristata*) can be found in the Reserve. These seals haulout (i.e., come onshore or onto outcrops and small islands) regularly around low tide in several areas of the Reserve in order to rest. Seals are found in Long Island's waters from September through May. Unpublished data collected by CRESLI since 2006 at the haulout site in Cupsogue Beach indicate that harbor seals make up the vast majority (over 99.56%), with grey seals at 0.39%, and Arctic seals at 0.05%. Seal haulout sites in the Reserve are typically concentrated around inlets so that seals can head to sea to feed. While feeding is possible in the Reserve, the predominant use of the Reserve is for haulout.

Historically, commercial hunts and bounties prior to the passage of the Marine Mammal Protection Act in 1972 took their tolls on harbor and grays in the US, including the east coast. Breeding populations of harbor and gray seals were nearly extirpated prior to 1972 along the east coast. Seal numbers in the Reserve have been fluctuating, but the trend shows an overall increase.

With the increase in seals comes increases in the number of people to view them and potential for conflicts based on myths about seals "eating all the fish." Seals draw people to the Reserve and can be seen as proxies for the relative health of regions around inlets.

Invasive Species

Invasive species are non-native species introduced to an area where they often outcompete native species, and cause damage to the environment, human health and the economy.⁷⁰ Invasive species are a threat to the productive resources that the Reserve provides. For example, the invasive perennial grass, common reed (*Phragmites australis*), is replacing native salt marsh species, altering ecosystems and decreasing biodiversity. Invasive species are often spread by human actions. Some of the species impacting the Reserve include: invasive tunicates, invasive macro algae, and Asian shore crabs. Aquatic invasive species can “hitchhike” on watercraft or be transported in ballast water of ships if precautions are not taken. They can also be introduced to an area through release of aquarium pets, live food or live bait.^{71,72}

Current Efforts to Address the Issues

Long Island Shellfish Restoration Project

The New York State Shellfish Restoration project was announced in 2017 and is an effort to improve water quality and coastal resilience through the restoration of native shellfish populations. Five sanctuary sites located in Bellport Bay, Shinnecock Bay, Huntington Harbor, Hempstead Bay and South Oyster Bay will be managed by SUNY Stony Brook and Cornell Cooperative Extension to transplant seeded clams and oysters. A dedicated grant program will also help to expand public shellfish hatcheries.

Coastal Habitat Restoration Project – Shinnecock Nation Reservation

In conjunction with Cornell Cooperative Extension and Suffolk County, the Shinnecock Indian Nation is undertaking a range of habitat restoration initiatives including restoring wetlands and strengthening shoreline resilience to enhance ecological integrity of the eastern shore of Shinnecock Bay.

Shinnecock Bay Restoration Program (ShiRP)

The Shinnecock Bay Restoration Program was created in 2012 by the Stony Brook University School of Marines and Atmospheric Sciences and the Institute for Ocean Conservation-Science at Stony Brook University to return Shinnecock Bay to a thriving part of the South Shore Estuary. The ShiRP Program is focused on public education, eelgrass restoration, and community oyster gardening to help reduce harmful algal blooms and restore shellfish populations in the Shinnecock Bay.

Suffolk County Great South Bay Hard Clam Restoration Working Group

The Great South Bay Hard Clam Restoration Working Group, formerly named the Bluepoints Bottomlands Council, is a partnership between TNC, Suffolk County and Great South Bay towns of Babylon, Brookhaven, and Islip. The working group sought to restore Great South Bay's hard clam population through a three-pronged approach that included stocking a protected area of the bay with reproductive adult clams, helping to enact laws to protect the existing clam population and working with partners to restore degraded water quality.

The group was responsible for the development of long-term management recommendations to restore hard clams in Great South Bay.⁷³ The work of this group contributed to the enactment of new laws to ensure sustainable populations of hard clams in the Great South Bay through protective measures against overharvesting and efforts to increase spawning in areas with low hard clam abundance. Although the Hard Clam Shellfish Restoration Working Group is no longer active it could be re-called to action if desired.

Friends of Bellport Bay Shellfish Restoration

Friends of Bellport Bay is an environmental group which aims to improve the water quality of Bellport Bay through support for keeping the new wilderness area inlet open and through seeding oysters. The oyster seeding is intended to help naturally filter bay waters to reduce nutrient pollution and allow for the regrowth of natural habitat and protect the natural shoreline. Seed oysters are sourced from the Town of Brookhaven's shellfish hatchery and from Cornell Cooperative Extension (CCE) and are placed in the water by volunteers.

Seatuck Environmental Association – Long Island Diadromous Fish Restoration Strategy and Diadromous Fish Working Group

The Diadromous Fish working group was created in 2004 through partnership between the Environmental Defense Fund and the Reserve Council with the intent of re-engineering dams to allow fish passage. It has since developed into an island wide group headed by the Seatuck Environmental Association. The Workgroup contributed ideas which led to monitoring of Alewife populations and facilitation of fish ladder projects. As a result, Seatuck Environmental Association has developed a Diadromous Fish Restoration Strategy which provides technical guidance on prioritizing and restoring Long Island's populations of brook trout, river herring and American Eel. In connection to the Strategy report, a GIS-based River Revival Project Map has been developed to illustrate which tributaries are accessible to migratory fish species and to identify known river herring runs. The Nature Conservancy Ecosystem Based Management - Great South Bay.

The Nature Conservancy (TNC) developed a revised ecosystem-based management plan for Great South Bay in 2012. The plan identifies six elements to promote a healthy ecosystem, sustainability and social values and principles. Elements include place-based management and recognizing interconnectedness of ecosystem components while acknowledging humans as part of the system. Other elements include development of a scientific baseline, development of measurable objectives to guide and assess performance, use of adaptive management to respond to emerging information and involvement of key stakeholders. The plan uses surrogates to ensure the integrity of the bay system. These nine surrogates include hard clams, salt marshes, seagrass meadows, barrier island complex, migratory predatory fishes, winter flounder, alewives, piping plover and horseshoe crabs. The surrogates allow for the creation of measurable objectives and strategies to ensure effective environmental management.

NYSDEC Long Island Tidal Wetlands Trends Analysis

In 2015, the NYSDEC published the Long Island Tidal Wetlands Trends Analysis, which assessed patterns in marsh loss between 1974 and 2008 based on observations including conversion to intertidal marsh and retreat, formation of pannes, mudflats, ponds, and ditch widening, and increased prevalence of the invasive *Phragmites australis*. For the purposes of the Study, the Reserve was divided into three distinct sections: East Rockaway Inlet to Fire Island Inlet, Fire Island Inlet to Smith Point County Park, and Moriches and Shinnecock Bays. The study mapped tidal wetlands and identified at-risk marsh complexes that experienced the greatest loss of acreage between 1974 and 2005.⁷⁴

Wetland Restoration Efforts

Wetland restoration projects are being developed by multiple agencies and institutions in the Reserve. Coordination of effort among the U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, Suffolk County, various State agencies, and NGO's is vital to achieving overall goals and securing public support.

Suffolk County Department of Economic Development and Planning, Suffolk County Parks, and Suffolk County Vector Control in NY received a U.S. Department of the Interior (DOI) Hurricane Sandy Coastal Resiliency Competitive Grant administered by the National Fish and Wildlife Foundation (NFWF) to implement Integrated Marsh Management (IMM) as described in Rochlin et al. (2012)⁷⁵ on four sites within the SSER: Suffolk County Gardiner Park West (71 acres), Suffolk County Gardiner Park East (26 acres), West Sayville Marsh (113 acres), and Timber Point Marsh (51 acres). In addition to the on-the-ground restoration, Suffolk County's project included a learning exchange among salt marsh restoration experts from across the Sandy-impacted region (from VA-ME).⁷⁶ This learning exchange, assembled

and led by The Nature Conservancy in NY (TNC), was called the Regional Technical Workgroup (RTW). The RTW was a forum for practitioners to discuss the best available restoration methods and share lessons learned to improve the success of coastal wetland restoration projects both within Suffolk County and across the larger region.⁷⁷ The Suffolk County Division of Planning and Environment is partnering with the federal NRCS to acquire small, vulnerable floodplain parcels in the Mastic/Shirley Conservation Area. The second phase of the project with NRCS will include restoration of these wetland parcels by the County Division of Vector Control. Additional work has been done at Wertheim National Wildlife Refuge and through a series of post-Superstorm Sandy projects that are underway or planned across the Reserve.

The Nature Conservancy is also working to restore wetlands with the recently completed Road-Stream Crossing Assessment and Inventory: A mapping and condition assessment of road-stream crossings completed for Suffolk County in 2021. Stakeholders including local and State highway departments, natural resource managers, and NGOs contributed to a prioritization model for the crossings and interactive web map. This prioritization identifies the structures with the greatest potential for improved public safety, ecological function, climate resilience, and reduced flooding when they are upgraded to be right-sized to pass current and future water flows. Long-term Marsh Monitoring Marsh surface elevations are found to be a critical element of their long-term sustainability. While marsh systems can adapt to sea level changes through either horizontal or vertical growth their fate under current accelerated sea level rise rates is less certain. Also, since 2011 The Nature Conservancy has been maintaining a series of long-term elevation stations that have helped us better understand the processes that are currently impacting the growth, and therefore sustainability of our marshes within the Reserve. Additional wetland restoration work is also being completed by the National Park Service and the U.S. Fish and Wildlife Service.

The Town of Southampton, through its Community Preservation fund, is reclaiming wetlands and wetland buffers through active acquisition of wetland and waterfront sites followed by removal of bulkheads and other shore hardening structures, docks, invasive vegetation and the completion of residential and commercial improvements.

NYS Seagrass Taskforce Report

Finalized in 2009, the NYS Seagrass Taskforce Report facilitated the passage of the Seagrass Protection Act in 2012. The Act acknowledges the pressing need for seagrass management areas and management plans through consultation with local governments and other stakeholders. The report analyzes the relationship between anthropogenic influenced nutrient loading, declining water quality, algal blooms, habitat degradation, fishing and boating activities, climate change and the decline in seagrass populations.

NYS Seagrass Protection Act

The Seagrass Protection Act, passed by the NYS Legislature in 2012, directs the designation of seagrass management areas and subsequent development of a seagrass management plan. The NYS Seagrass Coordinator at NYSDEC along with municipalities and stakeholders will develop conservation planning efforts for seagrass across coastal waters and the bays within the Reserve. These bays are priority areas considering they contain the greatest amount of eelgrass remaining in New York State.

SAV Mapping in the Reserve

Aerial benthic habitat mapping (mapping of the bay bottom) of submerged aquatic vegetation that includes eelgrass (*Zostera marina*) and widgeon grass (*Ruppia maritima*) was completed in the Spring of 2020 for the Reserve to update previous maps completed in 2002. This was a joint project between

NYSDOS, Governor's Office of Storm Recovery and NOAA. Continued monitoring of eelgrass and widgeon grass (*Ruppia maritima*) is needed to inform conservation, management, and restoration priorities in the Reserve.

Town of Islip Bay Bottom Leasing Program

The Town of Islip began a Bay Bottom Leasing Program in 2012 in which 100 acres of town-owned underwater lands within Great South Bay were made available to lease for aquaculture at 5-year intervals. Due to high interest in leasing of underwater lands, Islip hopes to expand their aquaculture program for oyster cultivation.

Town of Brookhaven Bay Bottom Leasing Program

The Town of Brookhaven began a Bay Bottom Leasing Program in 2015 in which 40 acres of town-owned underwater lands within Great South Bay were made available to lease for aquaculture at 5-year intervals. As of 2022 six oyster farms, varying in size from one to three acres are in operation. Six additional oyster farms are in the permitting process.

Cornell Cooperative Extension of Suffolk County

The Cornell Cooperative Extension (CCE) of Suffolk County provides a multitude of operational and educational programs that benefit the aquaculture industry within Suffolk County. The CCE Seagrass Program restores and monitors eelgrass meadows through volunteer participation efforts. To facilitate restoration, CCE transplants adult shoots.⁷⁸ CCE has a bay seeding program that is enhanced by the Suffolk Project in Aquaculture Training which educates volunteers to grow and seed shellfish. In addition, the Suffolk County Marine Environmental Learning Center provides interested individuals with the educational tools to begin their shellfish farming businesses.

Diamondback Terrapin Regulations

The NYSDEC in March of 2018 began requiring terrapin excluder devices (TEDs) for crabbing operations to reduce the impacts on the Diamondback Terrapin turtle population. TEDs will be required on all funnel entrances on commercial crab pots set in creeks, coves, rivers, tributaries, and near-shore harbors of the Marine and Coastal District.

On May 1, 2018, the NYS law closing the diamondback terrapin hunting season went into effect. Diamondback terrapins can no longer be harvested in NYS.

NYSDOS Model Local Laws to Increase Resilience

As a deliverable of the Community Risk and Resiliency Act (CRRA)⁷⁹, NYSDOS developed a compendium of model local laws to help communities address future risk from sea level rise, flooding, erosion, storm surge and extreme-weather events. The Compendium of Model Local Laws to increase resilience⁸⁰ provide a wide variety of tools, such as basic and progressive zoning, watercourse and wetlands protection measures, coastal shoreline protection, floodplain development management, and stormwater control measures.

Explanation of the Outcomes and Implementation Actions

As part of its mandate under Article 46 of Executive Law, the Council was to develop strategies to effectively manage the living resources of the Reserve. This section offers recommendations for recognizing, protecting and enhancing natural resource values throughout the Reserve.

The Council offers the following outcomes and implementation actions to achieve and maintain living resources in the Reserve. To protect, restore, and enhance key habitat types which support shellfish, finfish and coastal bird populations, Actions 3.1.1 through 3.1.9 advocate protection, restoration and management of wetlands and tributaries; protection and conservation of seagrass; and improvement of habitat connectivity for coastal birds. Actions 3.2.1 through 3.2.18 call for management and restoration of populations of harvested species; management of state and federally regulated, and regionally important species; and to improve invasive species management to ensure healthy populations of shellfish, finfish, birds and other wildlife. Actions 3.3.1 through 3.3.7 identify research, monitoring, and modeling efforts and suggest strategic contributions in support of achieving living resource objectives. Necessary efforts include improved knowledge for ecosystem-based management and invasive species management; monitoring the impacts of acidification on harvested and protected species; and research on ecosystem impacts of emerging contaminants.

Outcomes and Implementation Actions

Outcome 3.1: Protect, Restore and Manage Wetlands throughout the Reserve

Action 3.1.1: Consistent with the NYSDEC Tidal Wetlands Trends Analysis, restore and manage wetlands to improve the ecological function and productivity of the estuary by increasing the quality and quantity of its wetlands.

Opportunities for restoration efforts and assessments should be evaluated with data supported by the NYSDEC Long Island Tidal Wetlands Trends Analysis. Assessment of potential restoration sites will identify priority sites and technical approaches appropriate for towns and other restoration partners. Estuary-wide mapping of shoreline typology, including shore hardening structures, would help to better assess tidal wetland trends and to evaluate opportunities for shoreline naturalization, and wetlands restoration. This is further discussed in Action 6.3.2.

Implementation efforts should focus on restoring natural hydrology by addressing historic agricultural manipulations and mosquito ditching so that the wetlands can keep pace with sea level rise and migrate landward into available marsh migration corridors. Additional efforts that may help enhance wetland quality include open space acquisition; acquiring and establishing vegetated upland riparian protective buffer areas to allow for landward migration of salt marshes; using untreated wood support posts for in-water structures; undertaking stormwater runoff control projects using green infrastructure methods to reduce sediment budget disruption and eutrophication; and restoring tidal flow to areas impacted by man-made barriers to water flow such as berms, erosion control structures, and inadequate culverts. The practice of channeling storm water directly into tidal wetlands should be phased out. The threat presented by exotic invasive species will also need to be addressed as part of the restoration effort (see Action 3.2.17 on Invasive Species Management).

Action 3.1.2: Improve coordination of wetland evaluation, restoration and protection efforts.

Current State regulations regarding tidal wetlands have been very successful in preventing direct wetland acreage losses through development. However, significant indirect loss of wetlands through sea level rise, disrupted hydrology, sediment diversion, erosion and nonpoint source pollution impacts may still occur. Tidal wetland managers should evaluate reasons for losses and mitigate appropriately through restoration and protection. Sea level rise can result in the loss of existing low marsh and the drowning of high marsh (*Spartina patens* dominated) and subsequent conversion to low marsh (*Spartina alterniflora* dominated). Identifying parcels and acting to secure available low-lying land, and plan for the landward migration of salt marshes is critical. High marsh has tremendous flood absorption capabilities and should be protected and enhanced for both resiliency and biodiversity.

Improved coordination between restoration implementers and federal, state, and local regulatory agencies is necessary to promote wetland restoration. As part of this coordinated effort, regulations should be streamlined to facilitate habitat restoration projects. This would include instituting measures to improve communication among the various entities involved in reviewing restoration projects to coordinate efforts and speed up the decision-making process. Local tidal and freshwater wetland regulatory and restoration programs should be developed to prevent and reverse wetland loss.

Action 3.1.3: Prioritization of wetland restoration efforts through development and use of GIS-based tools.

Wetland restoration efforts could be prioritized through development of a modernized geographic information system (GIS)-based wetland restoration assessment tool and analysis of trends in concert with NYSDEC's Tidal Wetland Trends Analysis and coordinated among State and local stakeholders.

Action 3.1.4: Explore new model codes to enhance natural shoreline restoration as a practicable alternative to bulkheads, revetments, riprap and other shore hardening structures.

The Council supports natural shoreline restoration plans. Shorelines hardened by bulkheads and revetments can lead to loss of natural shorelines and intertidal areas which are critical habitat for birds, finfish, shellfish, crustaceans, and other wildlife. Natural and nature-based features, where feasible, should be favored as an alternative to traditional shoreline hardening structures in order to reverse historic losses of wetlands and seagrass meadows, allow for improved natural filtration of contaminants in surface and ground waters, absorb floodwaters and to provide wetland dependent wildlife species with necessary open space for dispersal and movement.

New model codes that enhance natural shoreline restoration resilience measures, house raising, parcel buyouts of at-risk properties, potential modification of berms, installation of bioswales and requirements for development setbacks including non-disturbance buffers along the shoreline and reduction of upland fill in floodplains, should be encouraged where applicable as measures to complement the restoration of tidal wetlands. Local laws and adoption of natural resilience measures may lead to a decrease in development of flood-prone areas which would result in decreased costs and hazards from future flooding events.

Outcome 3.2: Protect, Restore and Conserve Seagrass

Action 3.2.1: Evaluation and conservation of seagrass.

Recommendations of the New York State Seagrass Taskforce Report should be implemented along with recommendations from the *Long Island South Shore Estuary Reserve Technical Advisory Committee, Seagrass sub-committee* throughout the Reserve. Regular periodic seagrass mapping is paramount to keep up with environmental change and would serve the purpose of improved water quality, especially water clarity, planning across state waters through establishment of ecological end points and biological indicators.

Action 3.2.2: Investigate pathways for identification and designation of sensitive seagrass habitats for expanded protection

Consideration should be given to exploring the possibility of expanding the protection of sensitive seagrass habitats that would address activities that adversely impact seagrass and that would foster environmentally friendly eco-tourism ventures in the protected areas.

Action 3.2.3: Evaluate vessel use patterns and impacts on seagrass

Consider research on vessel use patterns in the Reserve to identify areas of high boat traffic that may conflict with areas known to have seagrass present.

Action 3.2.4: Identify areas most suitable for seagrass restoration and launch a seagrass restoration initiative across the SSER.

Approximately 50% of seagrass beds in the Reserve have been lost since 2002. The Reserve benthic habitat survey data show only 10,474 acres of seagrass remaining in the Reserve. Large scale efforts

are needed to identify, plan and implement seagrass restoration throughout the Reserve. Seagrass has the potential for effective and long-term carbon sequestration as seagrass is more resilient to sea level rise. Seagrasses use CO₂ and, as such, seagrass beds also serve as refugia from the local effects of coastal ocean acidification for commercially important shellfish, finfish, and other keystone species. Identification of pilot restoration sites should be undertaken along with exploring a range of methodologies for seed collection, planting, monitoring and management measures to help restore this critical resource. A large-scale restoration effort will complement a number of existing efforts including water quality improvements, shellfish restoration, and other habitat enhancements.

Outcome 3.3: Protect, Restore, and Manage Tributaries throughout the Reserve

Action 3.3.1: Implement Streamflow Augmentation Recommendations.

Fully implement flow augmentation efforts in streams identified as needing restoration by the Flow Augmentation Needs Study in Nassau and Suffolk Counties. Augmentation actions would include a variety of different stormwater diversion measures designed to mitigate loss of baseflow in these streams. Remediation activities have been completed on East Meadow Brook and Seaford Creek. Work remains on Pines Brook, Mill River, Cedar Swamp Creek, Bellmore Creek and Carmans River. Methods for improving stream flow must consider the potential effects of stormwater diversions on living resources and groundwater resources, and the potential effects of sediment check dams as physical barriers to the upstream migration of diadromous fish.

Action 3.3.2: Adopt Hydromodification Best Management Practices.

Municipal activities that involve hydromodification (e.g., channelization and channel modifications; dam construction, repair, or removal; and alterations to streambanks, culverts, stream and tidal crossings and shorelines) have the potential to negatively impact both wetland and aquatic environments. To reduce the scope of impacts, practices from NYSDEC's Management Practices Catalogue for Nonpoint Source Pollution Prevention and Water Quality Protection in New York State that protect and restore wetlands, streams and riparian corridors need to be formally adopted and incorporated into all hydromodification activities. Activities should also be designed and constructed to accommodate all wetland and stream dependent wildlife species such as diadromous fish, American Eel, and River Otter (*Lontra canadensis*).

Action 3.3.3: Develop Full Stream/Tributary Corridor Restoration Plans

Plans should be developed for full stream or tributary corridor restoration, to benefit both diadromous fish and all wetland and stream dependent wildlife species.

Action 3.3.4: Replace and Right-Size Priority Road and Stream Crossings

Priority road and stream crossings identified in The Nature Conservancy's Road and Stream Crossing Assessment Project that impact aquatic connectivity should be replaced or right sized. Replacement or right sizing of the stream and road crossings will re-establish aquatic connectivity and provide resiliency from severe storms.

Outcome 3.4: Improve Habitat for Coastal Birds

Action 3.4.1: Protect habitat for coastal birds.

Protecting shorebirds, waterfowl and colonial waterbirds, as well as coastal populations of migratory birds, will require a suite of collaborative restoration, protection and management measures. Potential measures include but are not limited to the continued support for current management programs administered by the U.S. Fish and Wildlife Service, NYSDEC, Reserve counties and towns, TNC, National Audubon Society chapters and others. The measures include protection of nesting sites on beaches and bay islands, and regulatory and educational measures to reduce both predation by domestic animals and human disturbance. Additional measures include development and implementation of improved habitat enhancement and restoration measures as well as consideration of whole ecosystem impacts, implementation of strategic de-vegetation on barrier island beach complexes to provide sandy or gravel habitat and use of dredged material placement to enhance or create nesting habitat, particularly on dredged material or marsh islands. Other measures recommended include appropriate management of barrier beach and dune areas that provide critical foraging and nesting habitat for colonial waterbirds and shorebirds; open space preservation of buffer areas to avoid disturbance to nesting birds and/or improved management actions to prevent loss of habitat. Legislation is recommended to better protect nesting birds from impacts related to clearing and development, including restrictions during breeding, nesting and fledging periods for all vulnerable species, based upon information from the New York State Breeding Bird Atlas and New York State Bird Conservation Areas for Long Island. Attention should also be directed to studying how recreational drone use may cause adverse impacts to nesting shorebirds and other coastal birds. Research and potential regulation is recommended for drone use to protect coastal bird habitat.

Outcome 3.5: Ensure Healthy Populations of Shellfish, Finfish

Action 3.5.1: Expand upon and support programs aimed at building/rebuilding populations of shellfish and finfish such as shellfish stock enhancement, spawner relay, spawner transplant and spawner sanctuaries and artificial reefs.

Maintaining and restoring healthy populations of commercially and recreationally important finfish and shellfish species is a major focus of the Council. The Long Island Shellfish Restoration Project, the Nature Conservancy, SoMAS, CCE, Friends of Bellport Bay, the Shinnecock Bay Restoration Program, and longstanding Town programs have made substantial progress in shellfish restoration efforts providing new benchmarks for shellfish restoration to be incorporated going forward. Historically important shellfish management strategies include stock enhancement of seed to a size which confers significantly higher survival rates at low associated costs, and protection of cultured stock in predator exclusion racks that could produce marked increases in survival and subsequent harvest. Spawner relay, the transplanting of hard clams, capitalizes on the spawning potential of transplanted clams to maintain spawning stock or spawning sanctuaries. Spawner sanctuaries, a concept that refines the spawner transplant program, can be established in known high productivity areas.

The New York Artificial Reef Initiative augments habitat for marine life and boosts Long Island's recreational and sport fishing industries. Artificial reefs are being constructed in or adjacent to the Reserve in the following locations: Moriches, Shinnecock, Fire Island, Kismet, Yellowbar and Hempstead. These existing reefs will be expanded in the coming years and continue to enhance marine habitats for shellfish, finfish and other benthic organisms.

Action 3.5.2: Conduct a sub-region evaluation of shellfish stock enhancement efforts to inform shellfish management decisions.

Many areas within the Reserve would benefit from sub-region evaluation of shellfish stock enhancement efforts to inform future management decisions. Areas include but are not limited to existing hard clam nursery and stock enhancement by Town of Hempstead and Town of Babylon in the western bays; shellfish bay-bottom parcel leasing to commercial shellfish farmers conducted by the Town of Islip in the Great South Bay; existing oyster and scallop stock enhancement programs conducted by the Town of Southampton; and proposed Town of Southampton aquaculture pilot projects involving improved stock enhancement techniques in the eastern bays.

Action 3.5.3: Continue to identify, prioritize and develop economically feasible and environmentally and socially compatible shellfish aquaculture opportunities within the reserve.

Consistent with shellfish stock enhancement programs facilitated by Cornell Cooperative Extension, and municipal bay bottom leasing programs for commercial shellfish farming, economically feasible and environmentally and socially compatible shellfish aquaculture opportunities need to be identified, prioritized and expanded upon. The Nature Conservancy's hard clam sanctuaries in Great South Bay have shown promise but have so far not led to increased recruitment, as brown tide has been detrimental to juvenile shellfish and hindered population restoration.

Action 3.5.4: Continued implementation of recommendations from Suffolk County's Hard Clam Restoration Working Group report.

Continuation and expansion of shellfish population assessment are critical to sustainable shellfish management. While the towns of Babylon, Brookhaven and Hempstead have well-established programs in place, the towns of Oyster Bay and Southampton can utilize these successful models in the development of their own comprehensive sampling programs to guide distribution of seed and other shellfish management actions. Town programs to increase commercial shellfish populations of hard clams, oysters and/or other shellfish through seed placement should be supported and increased where appropriate as determined by water quality, substrate character, depth and other habitat characteristics. Town seeding program strategies (e.g., seeding rates, optimal size ranges of seed, shellfish species and seed distribution) should incorporate the results of current research concerning shellfish reproduction, settlement and growth. Where practical, conditions should be improved to support building/rebuilding populations of hard clams and oysters with the goal of achieving self-sustaining abundant populations for both environmental and human utilization objectives. This could include all methods of habitat enhancement, water quality improvement and spawning population enhancement.

Action 3.5.5: Develop a forum that includes all partners involved in the Reserve shellfishery

Building upon the work done as part of the Suffolk County Hard Clam Restoration Working Group, assess the feasibility of developing a regularly occurring meeting or conference in which all public and private partners meet to discuss the state of the clam, oyster, and bay scallop fishery within the Reserve.

Action 3.5.6: Continue to explore the feasibility of using macroalgae, seaweeds, and shellfish for natural water filtration and capture of pollutants

Reseeding oysters can help naturally filter water. Municipalities should continue to explore the feasibility of re-seeding while assessing the potential significance of water quality improvements in relation to the amount of space available for oyster aquaculture (see also Action 3.2.3). The potential for public health impacts from artificially enhancing shellfish populations in "uncertified" waters should be addressed.

Other methods for water bio-filtration should also be explored. Research suggests that the use of seaweed such as sugar kelp (*Laminaria*) or macro-algae such as *Gracilaria*, that are native to the Reserve, may aid in the capture and bioextraction of excessive nutrient pollution.

Action 3.5.7: Manage and restore diadromous fish populations through removal of barriers to fish movement and natural shoreline and flow restoration

Diadromous fish are affected by warming temperature regimes due to natural and human influenced activities. Water temperature in the creeks is highly affected by impoundments, flow and riparian shading. As recommended by the *Seatuck Diadromous Fish Restoration Strategy*,⁸¹ and supported by the Long Island Diadromous Fish Working Group, efforts to manage and restore these waterbodies should consider opportunities for removal of barriers to fish movement and re-establishment of natural riverine condition. In particular, salmonid restoration efforts should focus on tributaries which provide lower stable temperature regimes, especially in the summer and fall. For river herring restoration, the goal should be the re-establishment of alewives into all former parts of their estuarine range with suitable or restorable habitat areas.

Barriers to diadromous fish movement and migration, which reduce spawning and migratory success rates, need to be removed or modified. This may involve removal of dams, locks and tidal gates, and upgrading/upsizing culverts. Retrofits such as fish ladders and other fish passage mechanisms can be successfully installed at existing barriers to allow passage upstream. Consideration should also be given to all species, such as River Otter, when mitigating barriers to species migration.

The feasibility of modifying the locks and tidal gates at the Shinnecock Canal, including both structural retrofitting and keeping the locks open for longer periods, needs to be evaluated in the interest of allowing for improved fish passage and flushing.

In addition to the removal of barriers to fish movement, the re-establishment of natural riverine conditions will require management actions that focus on management and restoration of natural shorelines and the maintenance of riparian buffers along the bay and in tributary shorelines. (see also Action 3.1.6).

A cost benefit analysis should be performed to demonstrate whether the removal of dams for the benefit of migrating fish and restoration of natural flows is less expensive than constant removal of the invasive plants and HABs brought on by alteration of natural hydrological flow, warm stagnating impounded waters, reduced connectivity to estuary and the ocean, or maintaining the safety of dams.

In the Great South Bay sub-region, priorities for trout and herring restoration should include the Carlls, Connetquot, Carmans and Swan rivers, and Champlin, Penataquit, Orowoc, and Beaverdam creeks. In the eastern bays sub-region, priorities should include the Terrell and East rivers; Tiana Bay, and Quantuck, Weesuck, Heady, and Beaverdam creeks. In the Western Bays sub-region, priorities should include the Mill River and Massapequa, Bellmore and Parsonage creeks.

Action 3.5.8: Encourage and incentivize the use of circle hooks over J hooks for fishing.

A "circle hook" is defined as a circular hook in which the point of the hook is perpendicular to – and aligned with – the shank of the hook. This differs from a J hook, which is shaped like the letter J. Circle hooks can be used in both saltwater and freshwater fishing applications. Circle hooks, are required for use with bait in striped bass tournaments, and are well known for hooking more fish in the corner of the mouth making fish hook removal quicker, easier, and less stressful to the fish, thus increasing survival rates. This change will increase the survival rates of under sized fish or unwanted catch.

Action 3.5.9: Manage competing fisheries uses.

Habitat-related recommendations in fishery management plans should be implemented. Habitat protection and restoration will benefit fish populations and fisheries. For example, special protections could be designated for areas identified as important for winter flounder spawning habitat, and/or persistent hard clam beds, or seagrass meadows. In addition, properly designed fishery monitoring programs and population assessments can inform fishery management decisions. Visions for how to manage future competing uses within the Reserve should be established with the input of stakeholders and implemented.

Action 3.5.10: Research declining apex finfish populations

Research should be undertaken to identify actions addressing stressors leading to the decline of Sandbar, Sand Tiger, and Dusky Shark populations that use the Reserve as a nursery ground.

Outcome 3.6: Improve Management of State and Federally Regulated, and Regionally Important Species

Action 3.6.1: Develop a habitat conservation plan in the Reserve for Diamondback Terrapin Turtles.

Diamondback Terrapin populations face many threats such as coastal development, predation, recreational boating and sea level rise. Strategies to mitigate these threats may include modification or removal of bulkheads, erection of barriers to prevent Diamondback Terrapins from accessing roadways and signage to make the boating public aware of terrapins in the estuary. Also, much of the historic Diamondback Terrapin nesting areas have been destroyed by bulkheads and coastal development. Identification and protection of areas known to be the last remaining places that Diamondback Terrapins nest would help to stabilize population levels. For example, there is a small nesting area identified near Gilgo Beach that locals protect by roping off the area.

Action 3.6.2: Increased protection of sea turtle populations

Several endangered species of sea turtles such as the Kemp's Ridley (*Lepidochelys kempii*), Leatherback (*Dermochelys coriacea*) and Loggerhead (*Caretta caretta*) sea turtles use areas of the Reserve for feeding and juvenile development. Biological information, regional geographic distribution of sea turtles, and boating guidelines related to improving protection for sea turtles should be incorporated into the State's existing Significant Coastal Fish and Wildlife Habitat narratives for the area. Municipalities should encourage cooperation with these guidelines by exploring the feasibility of developing a sea turtle sanctuary.

Action 3.6.3: Increased protection and monitoring of horseshoe crab populations.

In recent years, horseshoe crab harvested for conch and eel bait has become somewhat controversial with several prosecutions for illegal harvesting activities. Horseshoe crab numbers are declining in the northeast according to the Atlantic Marine Fisheries Commission, and consequently there are pressures to reduce permitted catch limits to mitigate population declines. Harvested sex ratios need to be better monitored to evaluate whether or not harvest limits should be tightened in the interest of sustaining local populations. In addition, the feasibility of developing alternatives to horseshoe crab bait should be explored. Building upon CCE and NYSDEC spawning surveys started in 2005, monitoring migration patterns can help to identify and propose measures aimed at creating no-harvest zones and potential shoreline protection provisions around important nesting beaches. Other efforts to monitor horseshoe crab populations are ongoing at Molloy College, Center for Environmental Research on Coastal Oceans Monitoring.

Action 3.6.4: Promote public education on importance of seal populations in the Reserve.

Increasing seal populations in the Reserve, will lead to more human and seal conflicts. Providing the public with information on how to interact with seals and their overall impact on the Reserve's ecosystem is important to the continued increase in seals in the Reserve.

Action 3.6.5: Protect osprey nesting locations throughout the Reserve.

Ospreys prefer to construct their nests at high elevations such as dead tree tops, designed nesting platforms and other manmade structures.⁸² Nests are often found dangerously placed atop power lines and utility poles. Communication and coordination between public utilities and environmental organizations can help to properly relocate the nests to a more suitable location. Consideration should

be given to requiring seasonal duck blinds to be removed to discourage osprey from building nests atop the blinds which are highly vulnerable to predation.

Action 3.6.6: Increase protection of key foraging and nesting habitat areas necessary for shorebird, waterfowl, and colonial waterbird populations, as well as feeding and resting areas for migratory birds.

Programs that benefit beach-nesting shorebirds by insulating them from human disturbance on the beach face and dune fronts can be highly effective. Colonial waterbirds, shorebirds and waterfowl have all benefitted from wetland protection activities and will benefit further from wetland restoration programs. An important management concern is protection of nesting sites on beaches and bay islands, including predator exclusion, management of human disturbance, vegetation management and the potential use of dredged materials placement for habitat restoration.

Action 3.6.7: Promote recognition of regionally important shorebird sites.

Undeveloped portions of Fire Island and the Carmans River corridor should be identified as regionally important sites in the Western Hemisphere Shorebird Reserve Network. The Network links wetland and associated upland sites essential to migratory shorebirds in a voluntary, non-regulatory program. The core mission of the Network's program is to improve site-based conservation of shorebird populations. The network aims to increase public recognition, improve habitat management and increase monitoring of threatened populations by providing technical assistance and management training, and by developing educational materials.

Action 3.6.8: Develop habitat recovery plans and wildlife monitoring network for regionally important wildlife species.

Notable wildlife species with sensitive populations in the Reserve such as the Northern Harrier (*Circus cyaneus*), Bald Eagle (*Haliaeetus leucocephalus*), Black Duck (*Anas rubripes*) and Mink (*Neovision vison*) need more research and plans should be developed to aid in species recovery.

Action 3.6.9 Promote recognition of NY artificial reefs for fish habitat.

Develop materials to increase public recognition and appreciation of artificial reefs which have been placed by the State, and their ability to provide habitat for benthic organisms and sportfish in the Reserve.

Action 3.6.10: Evaluate the impacts of beach driving on Reserve ecosystem.

Pilot research is needed to evaluate the impacts of beach driving on wildlife, marine life, rare plants, beaches, and dunes. Designated open and closed beach vehicular zones should be monitored and observations compared to evaluate impacts.

Outcome 3.7: Improve Management of Invasive Species throughout the Reserve

Action 3.7.1: Explore and implement measures to stop invasive species from entering the Reserve.

A better understanding of aquatic invasive species pathways, evaluation of ecosystem and economic impacts, and public education is crucial to the development of effective invasive species management strategies.⁸³ Policies and procedures should be developed to prevent or limit the introduction of invasive species. There should be public education and signage at all marinas and marine-related industries near docks with informational messages such as the Long Island Invasive Species Management Area.⁸⁴ Educational signage should strongly discourage dumping of unwanted aquarium

plants and fish into the Reserve. Management measures should include inundation, biocontrol, chemical control in combination with other measures that yield the most effective result.⁸⁵

Action 3.7.2: Research the potentially beneficial role that Phragmites may play with respect to coastal resiliency, habitat, and water quality value.

To facilitate site specific environmental impact assessment and better decision-making with regards to *Phragmites* management proposals, research is needed to determine the potential benefits this hardy pervasive invasive plant provides. Potential benefits should be examined in relation to coastal resiliency; storm damage reduction; recovery of damaged ecosystems; shoreline stabilization; contaminant uptake and filtration; maintaining thermal cover; escape cover; visual buffers; and breeding and nesting habitat, as well as dispersal and movement corridors for fish and wildlife.

Action 3.7.3: Promote natural habitat recovery and use of native seed banks for habitat restoration.

To preserve existing flora gene pools and to increase the likelihood of habitat restoration success, initiatives should, where possible, prioritize natural recovery, germination of existing native seed banks in soils, and/or use of local genotype plants (grown from locally collected seeds) that are better adapted to localized weather and soil conditions as compared to imported nursery grown plants.

Outcome 3.8: Conduct Research, Monitoring, Modeling, and Assessments in Support of Achieving Living Resources Objectives

Action 3.8.1: Implement a comprehensive strategy for monitoring the ecosystem consistent with the Coordinated Water Resources Monitoring Strategy.

Improved understanding of living resources must occur through continued, objective-driven Reserve-wide monitoring; empirical research studies designed to address specific management needs; and fundamental biological research necessary to understand the species, population dynamics and community ecology of the Reserve.

There is a need for comprehensive baseline information within the Reserve to inform ecosystem-based management decisions and to evaluate improvements achieved in quality and quantity of living resources. Following the establishment and analysis of a comprehensive baseline for the Reserve's living resources, consistent with the Ecosystem-based Management report created for Great South Bay, development and implementation of comprehensive ecosystem monitoring programs should be coordinated by the Reserve office and should be initiated for those resources and environmental factors determined to be most critical. Such a program would determine important habitat needs; develop ecological indicators of ecosystem health; examine natural and manmade factors that affect the functioning of the estuarine ecosystem; and continue regular reassessment of the status of critical species, habitat and ecosystem components.

Specific objectives for ecosystem monitoring include: determining changes in ecosystem structure as a result of more saline, cooler ocean waters coming into the bays through the Fire Island Wilderness Breach Inlet; expanding assessment of waterfowl usage; documentation of critical waterbird foraging areas; population dynamics analysis for blue crab and other crab species; surveys of benthic invertebrates including ecological assessment of shellfish such as oysters, clams, bay scallops and mussels; assessment of estuarine finfish spawning, nursery and sheltering habitat needs; and distribution and abundance of seagrasses (including species other than eelgrass) and macroalgae. Human uses of the Reserve are also important to understand and track, including but not limited to the

number and types of animals that are taken or caught and released during commercial and recreational fishing efforts, shellfishing, crabbing, trapping (whelk, eels, fish, etc.) and waterfowl hunting.

Evaluation of project achievements may include a quantitative metrics system to track long term improvement in projects for decreases in nitrogen, increases in acres of seagrass, acres of marsh restoration and increased miles of available stream habitat from fish passage projects. Monitoring these critical parameters will help inform adaptive management strategies.

Action 3.8.2: Continue the study of finfish and shellfish biology and ecology to inform fisheries harvest management and ensure sustainable populations.

The decline in shellfish populations, recruitment and growth rates in the Reserve may be attributable in part to water quality impacts, over-harvest, and ecological changes. Based on recommendations from the Hard Clam Workshop, the *Molluscan Shellfish Technical Report* and directed study supported by Sea Grant's Hard Clam Initiative, additional research should be conducted that addresses critical information on hard clam settlement, growth and recruitment.

Effective management strategies for sustainable populations of finfish require controls on fishing pressure and habitat degradation. The vast majority of finfish species of commercial and recreational concern spend only a portion of their life in the Reserve. Therefore, assessment for most of these species should consider must occur on the regional level or beyond. Inshore habitat enhancement is a small but necessary component to address habitat degradation. Accomplishing this will require increased commitments to research, assessment of existing information and changes in finfish resource management.

To sustain both fishery products and the bayman lifestyle consistent with existing Federal regulation, management of these resources must ensure that harvest does not exceed the estuary's natural productive capacity. Improved knowledge of stock levels and population dynamics including recruitment, settlement, growth and food web dynamics, should guide management decisions on harvest limits for commercially and recreationally important estuarine species. Fundamental research investigating the life history stages of various species, especially during younger life stages, would enable identification of those stages during which year class abundance is established and identification of the biotic and abiotic factors that control species abundance.

Action 3.8.3: Evaluate the impacts of harvesting by churning on the estuarine ecosystem.

Research is needed to evaluate the impacts of the harvesting method of churning on shellfish, seagrass, marshes, surface water quality, siltation, sediment flux and marine life. The evaluation should focus on thin shelled razor clams and soft-shell clams. Consideration should also be given to regulations prohibiting churning.

Action 3.8.4: Improve understanding and management of large-scale fish migrations.

Research is needed to better understand and manage large scale migrations of finfish. For example, the reasoning behind periodic large-scale migrations of bunker into New York's inshore waters due to supermoon occurrence is poorly understood. Without proper planning, large die offs of finfish may occur due to high species abundance in low oxygen waters worsened by barriers to fish movement. On the contrary, die offs may be prevented by adding new criteria to how the Shinnecock Canal locks and other impoundments are managed. Such events should be monitored and diagnosed where possible. Outreach and education are necessary to inform the public that fish kills can be natural occurrences.

Action 3.8.5: Maintain regular inventory of eelgrass distribution and identify, conserve, and monitor key locations.

The inventory of eelgrass distribution should be regularly updated and periodically, coordinated with the timing and methods used to survey eelgrass in Long Island Sound and the Peconic Bays. Benthic mapping from aerial imagery and surface level verification along with other emerging technology and methodology of the estuary's seagrass beds will determine eelgrass distribution and abundance. Periodic monitoring will provide the basis for evaluation of eelgrass loss or impairment trends in relation to management. Locations within the Reserve that possess adequate conditions for healthy eelgrass based on temperature, sediment quality and water quality should be identified, protected and monitored. The role of nutrient loading and temperature tolerance ranges in eelgrass decline needs to be researched to be better understood, along with research on carbon storage capacity and carbon sequestration provided by seagrass beds.

Action 3.8.6: Coordinate with NYSDEC to protect species of greatest conservation need.

With input from Reserve partners, natural resource professionals, and the Reserve staff will work with NYSDEC to undertake habitat improvement measures identified on their Species of Greatest Conservation Need management plan throughout the Reserve.

Outcome 3.9: Evaluate Impacts from Acidification on Harvested and Protected Species

Action 3.9.1: Monitor effects of ocean and coastal acidification on shellfish and other living resources to inform policies to combat acidification.

New York fisheries and their habitats may be at risk due to coastal bay and ocean acidification.⁸⁶ Consistent with the priorities of the New York Ocean Action Plan and the Ocean Acidification Task Force Law, there is a need to pinpoint causes of ocean acidification, evaluate how to address the issues, and educate and disseminate information to the public and state agency leaders. All continuous water quality monitoring stations within the Reserve should be monitoring pH levels to identify areas most at risk to acidification.

Outcome 3.10: Identify Ecosystem Impacts of Emerging Contaminants

Action 3.10.1: Analysis of ecosystem impacts of emerging contaminants such as pharmaceuticals, volatile organic compounds and persistent organic pollutants.

Current research does not adequately address the effects of emerging contaminants on the successful functioning of organisms and ecosystems. See Chapter 2: Water Quality, Action 2.2.10 for additional details on impacts of emerging contaminants.

Chapter 4: Expand Public Use and Enjoyment of the Estuary



Overview

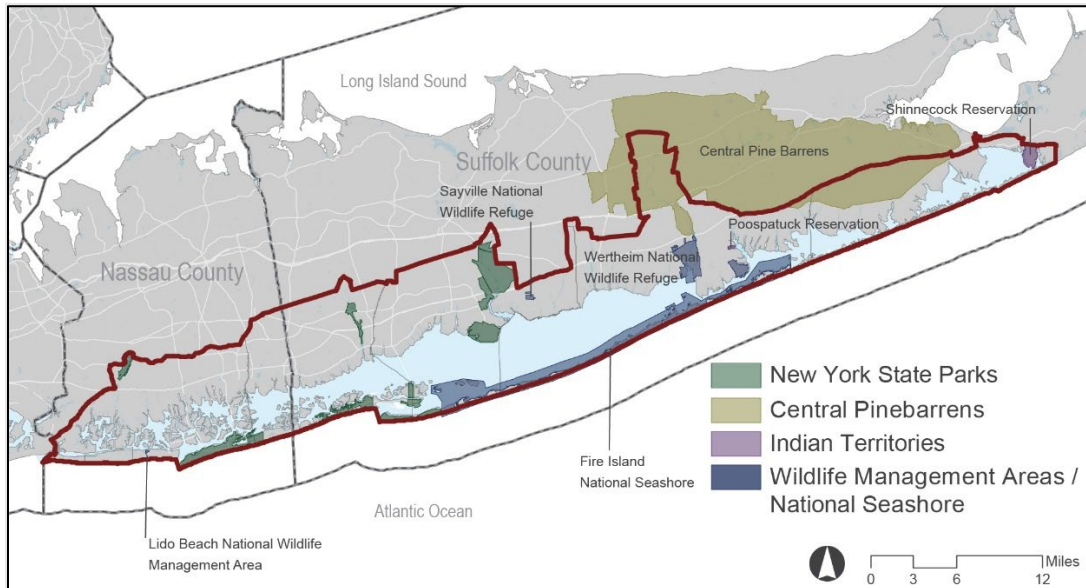


Photo 3 - Connetquot River at the Bayard Cutting Arboretum

The Long Island South Shore Estuary Reserve has much to offer both year-round residents and seasonal visitors through shoreline recreation facilities, open space and its maritime heritage and culture. The public's use and enjoyment of the Reserve depends upon convenient access to its bays, tributaries, coastal beaches and parks, and the quality of its water, habitats, and natural and cultural resources. The Reserve's many opportunities include swimming, boating, sailing, paddling, fishing, shellfishing, hiking, biking, birding, photography, and visiting vineyards, farm stands, cultural heritage sites and historic landmark sites. Commercial fishing, island bay houses, recreational boating, marinas, yacht clubs, boat repair shops, ferries and shoreline parks are

some of the facilities and activities that manifest the region's maritime heritage and contribute to its present-day culture. Visitors to NY State Parks in the Reserve increased by almost 1.3 million people to 14.3 million visitors from 2003 to 2016.

Many partners to the Reserve Council including local governments and private organizations are responsible for the protection and management of open space in the Reserve. Areas such as the Central Pine Barrens, Fire Island National Seashore, Lido Beach Wildlife Management Area, Sayville National Wildlife Refuge, Wertheim National Wildlife Refuge, New York State Office of Parks, Recreation and Historic Preservation lands (OPRHP) and the Shinnecock Nation are all significant areas of open space in the Reserve.



Map 10 - Managed Open Space Areas in the Reserve

Issues Faced

Shoreline Public Access and Recreation

There are approximately 285 dedicated shoreline public access sites including federal, State and municipally owned sites along with recreational facilities in the Reserve. Safety concerns, parking limitations, natural resource concerns, fiscal constraints or residency requirements can limit access and potential use of many existing recreational facilities. Development pressure and limited open space on the waterfront limit future additional public access and management of adjacent private land (e.g. shoreline hardening) can impact the quality of public lands. Heightened demand for open space and public access continue to grow as more people seek out outdoor recreation opportunities.



Photo 4 - Road End, Shinnecock Bay, Town of Southampton

Underwater Lands and the Public Trust

The Public Trust Doctrine describes the complex landscape of laws governing ownership and management responsibility for underwater lands. In the Reserve, the Public Trust Doctrine refers, in part, to underwater lands granted from English colonial patents now held in the public trust by the Reserve towns. The Public Trust Doctrine plays an important role in protecting public access to the Reserve and aims to perpetuate the rights of the public to pass along the foreshore and to use the water for the purposes of commerce, navigation and fishing.

Shoreline development, including shoreline protection projects, may impede the public's access to underwater intertidal lands and reduce public access to intertidal lands which are protected by the Public Trust Doctrine. Projects that interfere with the public's access to the foreshore or other access points protected under the public trust doctrine should not be undertaken.

Open Space

Open space provides variety and visual interest within the built environment of the Reserve. Parks, conservation lands, large estates, public and private institutions, agricultural and undeveloped lands contribute public values associated with open space: opportunities for public access and recreation; aesthetic qualities that benefit tourism and quality of life; and preservation and buffering of environmentally sensitive lands with high natural resource values and important habitat for the terrestrial and marine organisms. Between 2001 and 2010, the overall trend was an increase in development and a decrease in open/natural space. There was a loss of 1,198



Photo 5 - Connetquot River at Bayard Cutting Arboretum

acres of grassland, 789 acres of forested land, 145 acres of scrub/shrub land, 45 acres of emergent wetland, 502 acres of barren land, 349 acres of agricultural land, while the only gain was 124 acres of woody wetland. Efforts to protect open space should be increased and supported at all levels of government to retain the last areas of vacant, environmentally sensitive land that exists within the Reserve.⁸⁷

The Maritime Character

From an early period of subsistence farming, oyster harvesting, and near shore whaling to present day commercial fishing, recreational boating and shoreline development, generations have depended upon the resources of the Reserve and enjoyed a unique quality of life on the South Shore. Other traditional cultural resources include use of bay houses, commercial and recreational shellfishing and finfishing, boat building and repair, commercial and recreational boating and "gunning" (waterfowl hunting). These cultural resources are less tangible than physical historic resources and are vulnerable to degradation and loss due to a lack of recognition and protection.



Photo 6 - Long Island Maritime Museum

Bay houses provide an architectural link with estuary tradition. Although only a small number of the hundreds of bay houses that once sustained the fishing, waterfowl hunting and summer colony traditions of the Reserve remain, bay houses should be protected to the extent practical. It may also be prudent to upgrade the wastewater systems of some bay houses, to help maintain not only the water quality of the bays, but also preserve this historic and cultural aspect of the maritime character of the Reserve.

There are numerous significant historic sites throughout the Reserve, with only a small number listed on the State and National

Registers of Historic Places and many others potentially eligible for listing. Many sites that could be eligible for local designation, if not state and national designation, have not been formally identified. These include, for example, historic resources that are maritime-related or that once played an important role in the settlement or growth of the Reserve.

Current Efforts to Address the Issues

Improve Management of Shoreline Access

Public shoreline and recreation access in the Reserve is important to ensure that the public is conveniently able to reach the shoreline, parks, marinas and recreational facilities. This has been addressed through the following efforts:

The Governor's Office of Storm Recovery (GOSR) New York Rising Buyout and Acquisition Programs involved approximately 319 Suffolk County properties that were either part of a buyout or an acquisition, and in Nassau County there were approximately 215 acquisitions.

The GOSR Buyout Program transforms parcels of land where Sandy-damaged structures once stood, into wetlands, open space, or stormwater management systems, creating a natural coastal buffer to safeguard against future storms. The GOSR Acquisition Program, however, allows for the rebuilding of properties.

The Village of East Rockaway completed waterfront rehabilitation along the Mill River, East Rockaway Channel and Talfor Basin including completion of a park, marina, pier, bulkheading, parking and shoreline stabilization.

The New York State Office of Parks, Recreation and Historic Preservation (OPRHP) has made improvements to parking areas at Jones Beach State Park and Captree State Park by installing green infrastructure practices to control stormwater.

Connect the Community to the Waterfront

The Fire Island National Seashore (FINS) has improved public access through installation of a dock at Barrett Beach/Talisman; and a new FINS west entrance.

The OPRHP has made improvements to access by installing Mobi-Mats® at Jones Beach and Robert Moses State Parks. These mats allow wheelchair access and protection from hot sand. Additional improvements will bring more drinking water and electrical power to the Robert Moses Boat Basin.

The South Shore Blueway Trail in Nassau County is a network of water access points for human-powered boats and sail craft. The trail opened in 2016 and was funded by the NY Department of State, Nassau County and Village of Freeport. It spans 18 miles from the western border of the Town of Hempstead to the Nassau/Suffolk line at South Oyster Bay. In 2016, Suffolk County received NY Department of State funding to complete a Suffolk County Blueway extending the South Shore Blueway across the Reserve. The Town of Babylon has several launch sites for kayaks and nautical trails within Great South Bay from beginner to advanced levels.

Construct Bike Paths

Phase 1 of the NYS Department of Transportation (NYSDOT) Ocean Parkway Coastal Greenway Shared-Use Path (SUP) project was completed in 2012 and runs through Jones Beach State Park. Phase 2, completed in 2014, extends the path to Tobay Beach Town Park. Phase 3 extends the bike path from Tobay Beach through West Gilgo, Gilgo State Park and Cedar Beach, ending at Captree State Park.



Photo 7 - South Shore Blueway signage

Improve Access at Public Areas and Recreational Opportunities

Access improvements made in both Nassau and Suffolk counties include pathways, trails, boardwalks, overlooks, seating, piers, signage, parking lots, boat ramps, restrooms and campgrounds at the following locations:

- The Town of Islip expanded ferry operations at the Bay Shore Marina.
- The Town of Hempstead created the Lido Beach Passive Nature Area.
- The Village of Freeport created Seabreeze Waterfront Park at the end of Woodcleft Avenue along the Nautical Mile.

LWRP recommendations in the Reserve have led to creating access to the Patchogue River; shoreline access in East Rockaway; and access to Reynolds Channel in the City of Long Beach.

Recreational opportunities have also been expanded at Jones Beach State Park by OPRHP with the addition of kayak and paddleboard rentals.

Increase Open Space

The Town of Hempstead's Lido Beach Passive Nature Area opened and includes a phased management plan for the area.



Photo 8 - Kayak launch in Freeport

The Town of Oyster Bay completed its Open Space Preservation Plan in September 2010.

Suffolk County recently prepared a Watershed Aquatic Ecosystem Restoration Feasibility Study for the Mud Creek Watershed. It is a “shovel-ready” project to restore both the land and water flow of Mud Creek where the former Gallo Duck Farm property is located north of Montauk Highway in the hamlet of East Patchogue. Another study was undertaken for the restoration of the Robinson Duck Farm property in the hamlet of Southaven, both within the Town of Brookhaven. Both former duck farms were acquired by Suffolk County for open space preservation.

Suffolk County acquired the development rights to the former Jurgielewicz Duck Farm property on the Forge River, under its Farmland Preservation Program. The farm is in the hamlet of Moriches in the Town of Brookhaven and is currently being used to grow mushrooms.

The Town of Southampton established in 1999 a land transfer tax known as the Community Preservation Fund, which continues to be utilized for open space preservation to improve coastal resiliency and reduce storm damage, enhance public access, preserve historic structures and conserve biodiversity. As part of the program, both vacant and developed properties are acquired, and existing structures are demolished and removed to restore essential wetlands and habitat linkages, as well as to expand upon existing open space.

The Town of Brookhaven's Joseph Macchia Environmental Preservation Capital Reserve Fund is used to acquire environmentally sensitive lands in the town.

Preserve and Reinforce Maritime Character

Maritime Center Action Plans have been created for the Villages of Freeport, Bay Shore, Patchogue and Shinnecock Canal.

Long Island Traditions is a regional folk arts organization that documents maritime culture, local architecture, bay houses, and ethnic traditions through ethnographic research, historical documentation and oral histories. The organization strives to preserve Long Island's traditional maritime and occupational culture through public programs such as boat tours, bay house tours, videos, school programs and other public events. In addition, Long Island Traditions conducts historic surveys of local maritime communities and features including bungalows, boat yards and other maritime community assets in the Reserve.

The Town of Hempstead has established a caretaker provision for bay house lease holders, allowing owners to transfer their leases to non-family members if they are Town of Hempstead residents and have actively provided for the care and maintenance of the leased premises for a period not less than three years from the date of application. This provision will ensure the continuation of bay house ownership to "preserve the cultural and historic character of the Town of Hempstead bays."

The Town of Hempstead has rebuilt town-owned marinas, docks, breakwaters, floating docks and bulkheads.

As a result of Superstorm Sandy, local governments throughout the Reserve have heightened awareness of the proper application and enforcement of flood damage prevention laws, development practices, and proper elevation and anchoring of structures and tanks in the 100 year-flood zone.

The Bayway Strategic Implementation and Marketing Plan (2009) led to the preparation of a cultural resources survey, which inventories many cultural-related resources identified within the boundaries of the Reserve and builds on previous work completed by the Reserve Council and Reserve partners. The marketing plan focuses on the six major maritime centers and 14 secondary maritime centers.

Explanation of Outcomes and Implementation Actions

In keeping with Article 46 of Executive Law, the Council established as one of its goals the need to continue to provide for the Public Use and Enjoyment of the Estuary. The Reserve Council has identified important goals (Outcomes) which must be achieved over time. These Outcomes will be realized with the implementation of certain agreed upon actions to address public access; recreational opportunities (fishing/ boating/swimming); interactive centers; Blueway Trail extensions; dredging for navigation; and planning for local waterfront development.

The council offers the following outcomes and implementation actions to maintain and improve the Public Use and Enjoyment of the Reserve. To increase recreational areas in the Reserve, Actions 4.1.1 through 4.3.5 expand, protect, and create public access and recreational areas in the Reserve. Actions 4.4.1 through 4.5.2 provide expand opportunities for the public to enjoy the Reserve with the development and expansion of interpretive centers throughout the Reserve along with and recreational opportunities that provide a history of the Reserve. Actions 4.6.1 through 4.6.3 expand recreational opportunities and access in the Reserve. Action 4.7.1 focuses on Local Waterfront Revitalization in the Reserve. These actions will provide a better experience for the public when enjoying the diverse resources and recreational opportunities in the Reserve.

Outcomes and Implementation Actions

Outcome 4.1 - Expand Public Access and Recreation Opportunities/Facilities at Existing Sites

Action 4.1.1: Ensure coastline protection through implementation of smart waterfront zoning

Smart waterfront zoning will implement smart waterfront growth principals. This approach will balance the needs of the built environment with the natural one.

Smart waterfront principals will mix land uses to include water-dependent uses; take advantage of compact community design that enhances, preserves and provides access to waterfront resources; create walkable communities with access to and along the waterfront; preserve open space; provide land and water-based transportation options; and encourage waterfront revitalization. This action will be complimentary to model local laws developed by NYSDOS to implement the Community Risk and Resiliency Act (CRRRA).

Towns and Villages in the Reserve are encouraged to adopt local laws designating pre-existing marinas and boatyards as permitted uses in residential areas, along with standards for the renovation and expansion of any pre-existing marinas and boatyards in residential districts.

Action 4.1.2: Improve marine fishing access in the Reserve

Ease residency restrictions at municipal sites in the Reserve to allow for more access space. Allow more State-operated fishing access facilities. Incorporate access areas into residential or commercial development plans. Where feasible, allow end of street parking for non-residents for fishing access.

Outcome 4.2 – Protect Existing Public Access and Recreational Areas

Action 4.2.1: Review of existing Off-Road Vehicle regulations

Continued research should be undertaken to determine the potential impacts of beach driving and the need for adjusting existing rules and regulations.

Outcome 4.3 - Create New Public Access and Recreation Opportunities

Action 4.3.1: Re-utilize the City of Long Beach Sewage Treatment Plant property

The City of Long Beach should re-utilize a portion of the freed-up waterfront acreage at the City's sewage treatment plant property for water-dependent uses once the wastewater is diverted to the Bay Park sewage treatment plant and the City's sewage treatment plant is converted to a pumping station.

Action 4.3.2: Develop additional bike paths throughout the Reserve

Continue development of bike paths, including creation of a bike trail along the Meadowbrook Parkway to Jones Beach and Point Lookout. Connect south shore communities through a continuous bike path.

Action 4.3.3: Develop Recreational Rental Programs

Bicycle sharing and bike or kayak rental programs should be explored throughout the Reserve. Priority consideration should be given to development of a program for Fire Island National Seashore.

Action 4.3.4: Increase end-of-street parks and parking access to the shoreline

Implement projects that create parks at the end of streets and in vacant lots, provide public parking access, and provide benefits such as improved aesthetics and public access. Parks that utilize green infrastructure best management practices can also contribute to water quality improvement.

Action 4.3.5: Seek creative funding mechanisms and partnerships to support open space acquisition.

Explore the use of a land transfer tax or other local fees to provide funding to secure open space and land preservation. Work to develop strategic relationships with local land trusts and conservation organizations for open space acquisition and management.

Outcome 4.4 - Expand Existing Interactive Centers and Develop New Ones

Action 4.4.1: Replace a comfort station at the picnic ground at the south end of Bay Park recreational area with a new interpretive center

Support the construction of a two-story environmental/nature center made with resiliency components and green technologies. Connect the area to Pearsall Hassock via a pedestrian bridge and construct a nature walk in sections of the hassock which have been previously disturbed. This would provide a unique perspective of a wetland environment with emphasis on the importance of wetland buffers in protecting upland communities. The hassock would also provide the opportunity to directly experience the flora and fauna of this coastal environment.

Action 4.4.2: Develop interpretive centers incorporating interactive techniques

Develop interpretive centers at strategic locations across the Reserve providing environmental, natural history/resource and scientific information to the public along with direct engagement activities for visitors. To complement the interpretive centers, interactive social media applications should be developed that can be downloaded and used on smart phones.

Outcome 4.5 - Establish a South Shore Estuary Reserve Coastal Heritage Trail

Action 4.5.1: Promote activities highlighting the history and nature of the Reserve

Coordinate with Explore the South Shore and other groups to promote activities and the historic and natural resources within the Reserve (www.exploresouthshore.org).

Action 4.5.2: Adopt a “Caretaker Provision” for transfer of bay house leases

Preserve historic bay houses by creating provisions across the Reserve that require potential transferees have a specified proving period where they can show they can maintain upkeep on the bay house before having the lease officially transferred to them following approval of the town board.

Outcome 4.6 - Extend the South Shore Blueway Trail into Suffolk County

Action 4.6.1: Implement the extension of the Blueway trail into Suffolk County

Complete the extension of the Blueway Trail into Suffolk County⁸⁸ using funding from the NYS Department of State Local Waterfront Revitalization Program.

Action 4.6.2: Develop more launch sites for kayaks and canoes

As suggested in the Bayway Capital Improvement Plan, additional launch sites for kayaks and canoes should be developed. Additional sites can be included in the extension of the South Shore Blueway Trail from Nassau into Suffolk County. Recently, Suffolk County received a grant from the NYS Regional Economic Development Council to establish a Blueway Plan for its coastal areas which will connect with existing plans in the towns of Babylon and Huntington and Nassau County.

Action 4.6.3: Explore creating campsites along South Shore Blueway Trail

Conduct an inventory and feasibility analysis for camping opportunities. Initiate policies with the appropriate state, county or local governments for the siting and development of campsites for multi-day, small group camping trips.

Outcome 4.7 - Plan for Local Waterfront Revitalization

Action 4.7.1: Encourage development of local waterfront revitalization programs

Encourage municipalities within the Reserve to participate in the development and implementation of Local Waterfront Revitalization Programs. Identify new opportunities for siting new water-dependent businesses, retaining those in existence and redeveloping deteriorated or underutilized waterfront properties and brownfields.

Chapter 5: Sustain and Expand the Estuary-related Economy



Overview

The south shore of Long Island has long been regarded as an extraordinary natural resource. During the 18th century it was the site of large farms, fishing enclaves and estates of the wealthy. Many people from New York City came to Long Island to pursue game birds and fish in preserves set aside exclusively for those purposes. Gradually, more and more towns sprung up during the latter half of the 19th and early 20th centuries and the population started to increase dramatically during the mid-1900s.

Throughout the 20th Century development at various maritime centers continued to support trade, industry and recreational uses that took place on the water. The City of Long Beach and villages such as Patchogue and Bay Shore filled in significant areas of marsh land and laid out street grids. Many areas, including Freeport and Massapequa, had several large waterfront hotels that catered to visitors from New York City and beyond who came to enjoy the fresh breezes, clean waters, boating and fishing. Birding too became a popular sport on Long Island as demonstrated by the several branches of the Audubon society which developed in south shore towns.

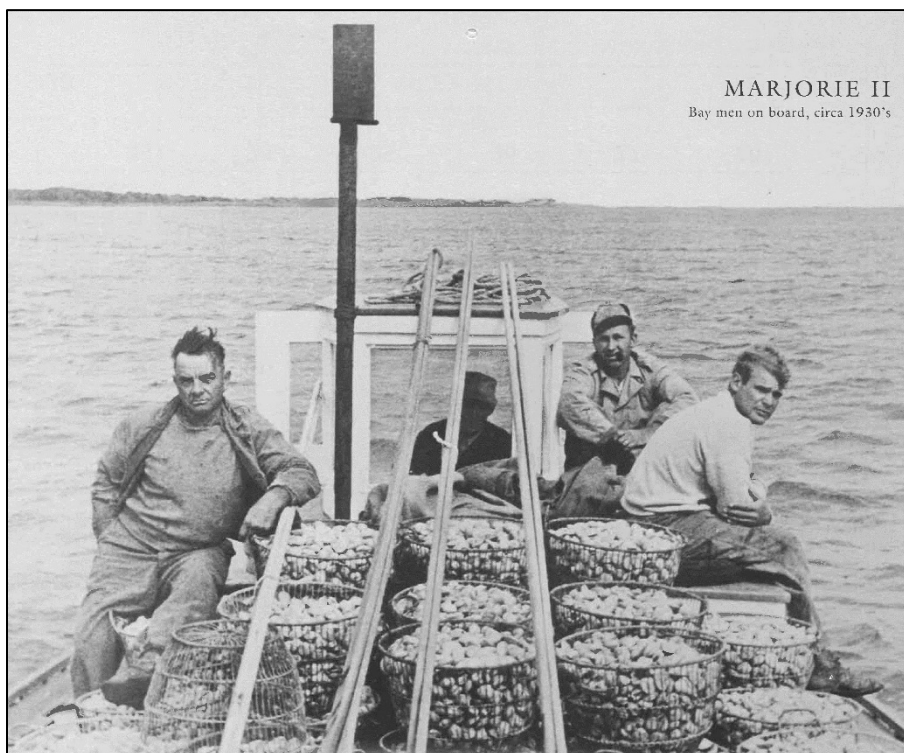


Photo 9 - 1930's Baymen - Photo courtesy of Long Island Maritime Museum

As the character of the towns progressed from rural to suburban and populations increased, there was pressure to dredge the bays, fill the marshes, stabilize the barrier beaches and dam the streams. Today's bays have evolved from harvesting of salt hay for livestock, harvesting of oysters, fishing and boat building, to recreational swimming, boating and sport fishing, commercial fishing, shellfish harvesting, waterborne transport, and tourism.

Over the last 100 years, expansive development and changing demographics have transformed the South Shore of Long Island from a sparsely populated, bucolic farm, fishing and resort community to a bustling suburban area of New York City. Nevertheless, the Reserve retains a unique character rooted in its maritime heritage. The economy reflects the Reserve's heritage and its future is dependent on the development and strengthening of commercial and recreational fishing, beach and boating activities and the continued transportation and service activities that support them.

Today, Long Island is one of the two largest concentrations of commercial and recreational vessels, marinas and other water-dependent businesses in the State of New York. The water-dependent

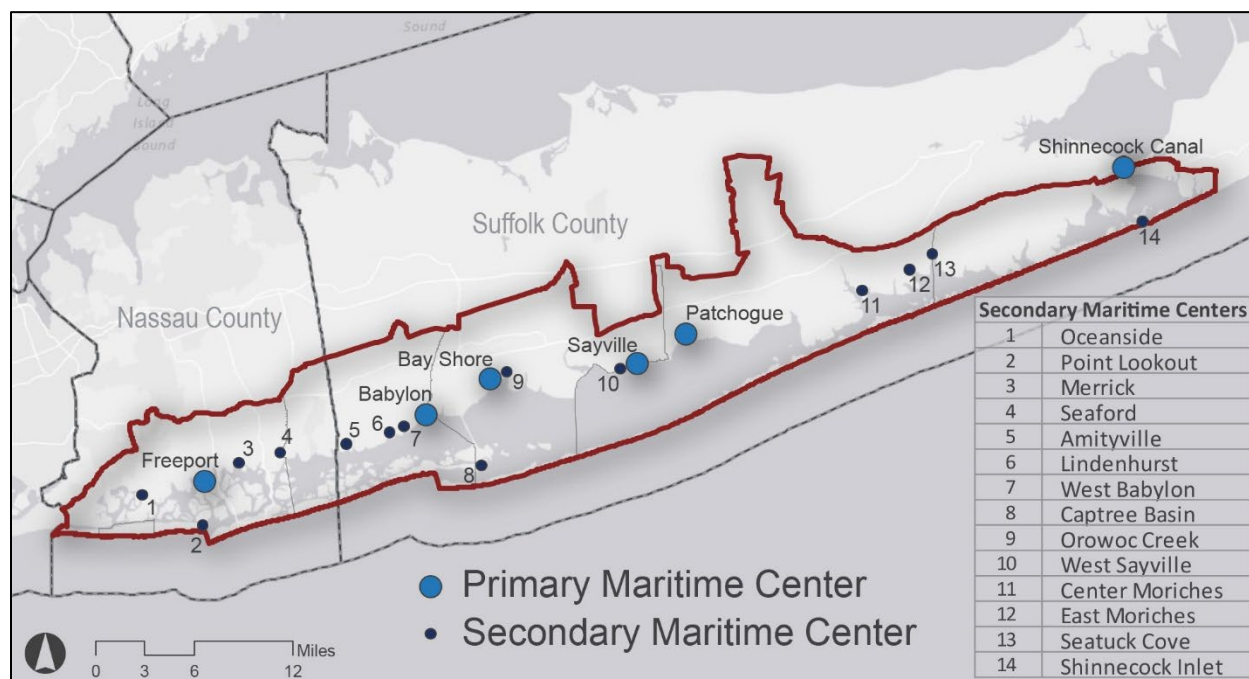
commercial uses and the residential land values of waterfront, water view and water-enhanced properties represents a significant amount of the economic value of the Reserve.

The Reserve shares many economic interests with the Long Island Regional Economic Development Council (LIREDC). In its 2015 update, the LIREDC identified the following as a Key Strategy for Economic Growth: “Produce a new generation of sustainable, well-paying jobs in the legacy sectors of agriculture, aquaculture, fisheries and tourism by enhancing the economic value of our parks, historic places, and arts venues and organizations, and expanding export opportunities, infrastructure, recreation facilities, research partnerships and workforce training.”

Issues Faced

Maritime Centers

Maritime centers are areas with concentrations of water-dependent businesses that are often supported by water-enhanced businesses and may be linked to or situated near a business district. Many of these centers embody a maritime heritage and community character uniquely associated with the estuary.



Map 11 - Maritime Centers in the Reserve

Six major and fourteen secondary maritime centers were identified in the original Reserve Comprehensive Management Plan, *Maritime Centers of the South Shore Estuary Reserve* (1999). (see Map 11) Water-dependent businesses in the Reserve, such as marinas, boat rental stations, gas docks, boat and engine repair, and boat building, are experiencing decline. Many of these properties have been converted into housing or remain empty. Efforts to reverse this trend are important for maritime centers to retain their character, the availability of marine services and attractiveness to tourists.

Fishing

Despite many efforts to reseed the stock and establish sanctuary areas, there has been a precipitous decline in the clam population over the last 40 years, most noticeable in the 1980's and 1990's. Various causes have been linked to this decline including over-fishing, disease and pollution. Over the last decade clam populations have stabilized and have started to increase, but with overall populations remaining low. Scallop populations in the Reserve have also declined over the past several decades with recent notable die-offs in 2019, 2020, and 2021. Conversely, efforts to increase the production of oysters have been met with some success with groups such as the Long Island Oyster Growers Association helping to promote the industry.

Recreational fin fishing stocks, including winter and summer flounder, are also in decline locally, mirroring a coast-wide trend. This has led to decreased commercial catches and the decline of recreational open party and charter fishing boat trips. Most recently, several charter boats have begun running marine mammal observation trips as the number of seals within the bays along with whales and dolphins in the near ocean area has increased significantly.

Addressing Impacts from Superstorm Sandy

Overall, recovery in the Reserve has been successful due to the New York Rising Community Reconstruction Plans and subsequent project implementation activities. However, the effects of Superstorm Sandy dramatically reduced property values for commercial and non-commercial real estate and businesses in the Reserve and created considerable pressure for shorefront properties to elevate or be faced with additional costs in flood insurance. Going forward, individual actions and community measures related to rebuilding for a more resilient coast will affect the character and future economic conditions of the communities within the Reserve. Recovery efforts related to Superstorm Sandy have led communities to identify and assess the risks to, and resiliency of their critical infrastructure and waterfront assets as a priority for any additional planning and implementation work to prepare for future storms.

Current Efforts to Address the Issues

Town of Islip Bay Bottom Leasing Program

The Town of Islip has an established Bay Bottom Leasing Program, which encompasses over 100 acres of Town-owned Bay Bottom. Lease parcels were approved by the New York State Department of Environmental Conservation, and range anywhere in size from 1 to 5 acres. The Program has proven successful as both a boost to the local economy, and to those entrepreneurs who lease bay bottom parcels for growing out oysters, hard clams and bay scallops. Once grown, the shellfish are harvested and sold to local restaurants and retail/wholesale establishments.

New York State Community Risk and Resiliency Act (CRRA)

The New York State CRRA amends the Environmental Conservation Law Article 6 (Smart Growth Public Infrastructure Policy Act) to add mitigation of risk due to sea-level rise, storm surge and flooding to the list of smart-growth criteria. State permitting and funding agencies are required to consider physical climate risk due to sea level rise, storm surge, and flooding.

Recovery from Superstorm Sandy

Many projects funded by various state and federal sources in the wake of Superstorm Sandy are completed or in the process of being completed. These projects directly benefit the marine-related economy and include dredging and filling operations, restoration or rehabilitation of navigational aids, rebuilding of docks and bulkheads and funding of various management plans and community development projects.

Marina Management

As land values have increased over the last 20 years, the number of marinas has significantly decreased. Many marinas have been converted to private homes, resulting in limited dockage fees, lack of dockage for commercial vessels, movement to stacking of boats and on-demand availability where boats are stored in racks and only put in the water when called for in advance. The loss of marinas has also limited the availability of fuel docks. The New York State Sea Grant's New York Marina Environmental Best Practices Program addresses many of these issues.

Dredged Materials Management

The Reserve has produced a Dredged Materials Management Plan.⁸⁹ The plan addresses navigation needs while protecting the estuarine ecosystem.

Management of dredged materials continues to be a challenge in the estuary. Economic, environmental and social services are all dependent on both federal navigation dredging projects, such as those in the intercoastal waterway and inlets, as well as private dredging needs for marinas, launches and shorefront infrastructure. Dredging for navigation safety and proper placement of fill for beach nourishment, marsh restoration and other beneficial uses, are important for both the economic and environmental well-being of the Reserve.



Photo 10 - Marina in the Reserve

Explanation of the Outcomes and Implementation Actions

In keeping with Article 46 of Executive Law, the Council established as one of its goals the need to address the estuary economy that is dependent upon the bay waters of the Reserve and their associated tributaries and watersheds. The needs and desires of the residential community must be balanced with tourism and recreation activities. Many Long Island residents are involved in enterprises related to the tourist, boating and water related recreation industries while others simply take pleasure in the Reserve's abundant resources and amenities. Recreational fin fishing is also significant revenue source for the estuary economy. Fishing occurs from private boats, shorelines and onboard head-boats or charters. Potential areas of improvement are increased advertising to attract fishers and convenient boat access by car and/or public transportation.

The outcomes and actions for the Reserve economy focus on the following: waterfront and water related businesses, and infrastructure, commercial and recreational fishing, the boating industry, maritime centers and marine trades, and tourism. Actions 5.1.1 through 5.1.5 are focused on improving and building water dependent business in the Reserve. Actions 5.2.1 through 5.3.2 will provide support to the commercial and recreational fishing industries in the Reserve. Actions 5.4.1 through 5.4.6 seek to enhance the Reserve experience for recreational boaters. Actions 5.5.1 through 5.5.3 focus on enhancement to the Reserve's maritime centers. Actions 5.6.1 through 5.6.2 seek to expand knowledge of marine trades and support future maritime industries. Actions 5.7.1 through 5.8.4 will increase water safety and expand tourism throughout the Reserve. These actions focus supporting the important maritime economy of the Reserve.

Outcomes and Implementation Actions

Outcome 5.1 - Promote Public/Private Efforts to Enhance the Economic Viability of Water-Dependent Businesses

Action 5.1.1: Develop and maintain an enhanced shoreline parcel database detailing current uses, zoning and other data to assist with planning

A shoreline parcel database would include current land use and zoning; existing land-based and in-water infrastructure; suitability for water-dependent use; availability for development or redevelopment; and other pertinent data such as elevation, orientation, flood risk, depth to groundwater and shoreline armoring.

Action 5.1.2: Sponsor an annual workshop for maritime business owners and operators to discuss issues related to the water dependent economy

Topics covered at an annual workshop for maritime business owners and operators could include, for example, planning, taxes and resiliency. This workshop could be coordinated with boat or fishing shows and State and local government and regulatory agencies could be invited to participate.

Action 5.1.3: Provide opportunities for water dependent businesses in the Reserve to identify priorities consistent with the Long Island Regional Economic Development Council (LIREDC) Strategic Plan

Identify priority projects to maintain and/or expand business opportunities and improve resilience for water dependent business consistent with the LIREDC Strategic Plan.

Action 5.1.4: Provide local maritime organizations with the information they need to encourage existing or potential business owners to apply for funding.

Existing and potential business owners should be provided with the resources to identify funding available through the New York State Regional Economic Development Council initiative.

Action 5.1.5: Support existing campaigns to promote local New York seafood.

The marketing of New York seafood in local businesses can have a positive impact with residents and tourists helping to improve both the economy and the local environment. Support should be provided to New York Sea Grant, Cornell Cooperative Extension of Suffolk County and Suffolk County to advance their efforts.

Outcome 5.2 – Address Commercial Fishing Issues Specific to the Finfish, Mollusk, Arthropod or Algae Fisheries

Action 5.2.1: Provide regulatory, technical, and/or grant assistance for a sustainable oyster industry within the bays

Several oyster farming operations have become established within the estuary. They are dependent upon workable leasing policies. Provide programs to educate potential farmers through non-profits, educational institutions or sponsored internships.

Action 5.2.2: Support hard clam nursery operations including support for research on the conditions necessary to improve the hard clam fishery within the Reserve

Funding for more Reserve specific research and demonstration projects is necessary to determine factors contributing to mollusk survival. Public and private nurseries should be supported to further their success. Possible replication of the unique solar powered grow-out barge at the Town of Hempstead might be one project to be explored.

Action 5.2.3: Explore the feasibility of commercial aquaculture of macro algae (seaweed)

There is currently no harvesting of macro algae (seaweed) in the Reserve. *Gracilaria*, from which agar is extracted, is the macro algae thought to be most appropriate for cultivating in the Reserve. Commercial harvesting would theoretically provide income while assisting with the nitrogen uptake in the Reserve. The cultivation of Sugar Kelp (*Saccharina latissima*) may also be considered in some locations of the Reserve. Efforts should also consider the feasibility of markets for aquaculture products.

Outcome 5.3 – Advance the Recreational Fishing Industry within the Reserve

Action 5.3.1: Develop materials identifying recreational shipboard fishing opportunities and shoreline fishing access points within the Reserve

To increase tourism, materials should be made available to the public offering information on locations for fishing opportunities throughout the Reserve. This can be done through pamphlets distributed at businesses selling relevant sporting equipment; through online websites; and through development of mobile applications.

Action 5.3.2: Co-sponsor events with I-Fish-NY, and other park and local groups which highlight the excellent fresh water and salt water fishing in the Reserve

Connetquot River State Park in the Town of Islip has some of the best trout fishing in the United States. Many of the tributaries to the Reserve are stocked yearly with several trout species. Information should be provided on how to obtain fishing licenses. Work with sponsors like Trout Unlimited to have events such as local fishing tournaments or free “take a kid fishing” day.

Outcome 5.4 - Enhance the Reserve Boating Experience

Action 5.4.1: Develop materials providing the location of pump-out facilities and available mobile pumpout boats

In 2009, the Reserve was designated a No-Discharge Zone, meaning the discharge of treated and untreated boat sewage is prohibited. Signage as well as maps and listings that identify locations where boaters can legally dispose of sewage should be made available as well as hard copies at marinas, launch ramps, marine supply stores and online.

Action 5.4.2: Encourage seagrass awareness with boating community

Promote best practices for boating in shallow areas and consider the installation of conservation moorings in seagrass areas where boating and anchoring frequently occur.

Action 5.4.3: Support a conference for marina operators to discuss overarching concerns

The number and character of marinas and marine related businesses have changed significantly in recent years. This conference will provide a venue for sharing concerns, highlighting services by various agencies and seeking solutions to common problems.

Action 5.4.4: Encourage expansion of the clean marina program

Support the New York State Sea Grant's New York Marina Environmental Best Practices Program. This program is designed to provide marina operators with practical information on techniques, products and practices they can use to improve environmental practices and minimize potential sources of pollution at their facilities. <http://www.seagrant.sunysb.edu/marinabmp/default.htm>.

Action 5.4.6: Support the repair and upgrading of public boat ramps

Provide funding for resilient repairs or rebuilding of boat ramps and associated facilities where necessary including an increase in permeable surfaces to allow better infiltration of water into the soil. American's with Disabilities Act guidelines should be followed. Appropriate signage at the boat ramps should be installed, consistent with state and local regulations for invasive species and harmful algal blooms.⁹⁰ Where possible and appropriate, encourage the use of pervious surface materials for boat ramps.

Action 5.4.7: Advance dredged materials management alternatives for marinas

Engage regulators and the maritime community to develop alternative beneficial use options for dredged material. Opportunities exist for regulatory coordination of dredged material disposal needs with active restoration projects that require clean fill. Additionally, uses for dredged material not suitable for beach nourishment should be explored and considered.

Outcome 5.5 – Redevelopment of Waterfronts and Revitalization of Maritime Centers

Action 5.5.1: Provide technical assistance to communities to establish, expand and retain resilient waterfront businesses

The NYSDOS will assist with development and implementation of comprehensive land use plans, zoning amendments, waterfront redevelopment plans and revitalization programs to help Reserve communities retain water-related businesses.

Action 5.5.2: Support actions such as marketing, zoning, streetscape enhancements, and dredging to enhance the economic viability of traditional estuary-related, water-enhanced businesses, especially in waterfront center areas

The Local Waterfront Revitalization Program and the Brownfield Opportunity Area Program will continue to be available through NYSDOS to support responsible, sustainable and resilient economic development of the Reserve waterfronts.

Action 5.5.3: Study increasing ferry use as a connection to sites within the Reserve

New ferry routes and connections between the various means of conveyance should be considered to encourage movement to and between Maritime Centers, waterfront dining areas, parks and other points of interest. Seek participation by the Long Island Rail Road, bus companies, government and municipal park entities, as well as the State Department of Transportation. New or upgraded parking areas for ferry riders and commuters should be designed for resilience and incorporate green designs.

Outcome 5.6 – Increase Interest in the Skilled and Technical Marine Trades

Action 5.6.1: Promote and support internships and technical courses and activities which teach traditional boatbuilding and engine repair skills

Volunteers and employees at the Long Island Maritime Museum and the Carmans River Maritime Center both build and restore vessels using traditional methods. This helps preserve the SSER's maritime heritage and transfer skills which can be used in the small but lucrative wooden boat building industry.

Action 5.6.2: Promote port facility enhancements to prepare for offshore wind industry

Communities in the Reserve with port facilities should assess their future opportunities associated with the developing offshore wind industry. Opportunities for small manufacturing, port enhancements and improvements for staging and servicing should be assessed. Opportunities for financial assistance are available through the CFA.

Outcome 5.7 – Increase Safety for Youths and Adults throughout the Reserve

Action 5.7.1: Encourage the development of various courses that increase skills, promote safety and preserve the history of the Reserve

Courses targeted at youth and adults could include topics like: skills needed to captain a boat; Coast Guard/NYS safety courses; use of jet-skis; how to oyster, clam, fish, crab, sail, SUP, kayak, surf, wind surf, or kite surf; and birding. These courses would be taught at a variety of institutions including schools and colleges as well as private businesses and informal groups.

Outcome 5.8 - Increase Tourism in the Reserve

Action 5.8.1: Promote tourism in the Reserve by facilitating the development of a Reserve partner's promotion group

A Reserve Council sub-committee on promotions led to the development of a group which focuses on the eastern Great South Bay Area called "ExploreTheSouthShore.org." This and similar groups should be supported and developed to boost the economy of the Reserve through the production of web-based and printed materials highlighting aspects of the Reserve.

Action 5.8.2: Promote environmentally sustainable eco-tourism

The Reserve provides visitors with many outdoor recreational opportunities. Environmentally sustainable eco-tourism activities such as scuba diving, underwater photography, seal walks, birding, wildlife watching, kayaking, canoeing, wind and kite surfing, and stand-up paddle boarding should be promoted to increase tourism in the Reserve.

Action 5.8.3: Work with State, federal, and regional groups to develop mechanisms to attract visitors to Reserve beaches and major event venues

Following Superstorm Sandy, several parks in the Reserve have undergone extensive rebuilding and expansion of camping and entertainment facilities. Staff from the New York State Office of Parks, Recreation and Historic Preservation (OPRHP), Wertheim National Wildlife Refuge and Fire Island National Seashore, the "I Love NY" program, and Long Island Visitors Bureau could be engaged to develop a coordinated promotional program for assets in the Reserve.

Action 5.8.4: Support festivals and other activities that advertise and highlight the maritime center and promote local and regional tourism

The Villages of Freeport, Bay Shore, and Patchogue are among the communities which have waterfront festivals that highlight the importance of the local economy, a healthy environment and the connections between them. The Reserve should assist in coordination, programming, advertising and logistical support and development of additional events.

Action 5.8.5: Prepare and distribute a tourism brochure and recreation map

Prepare, in coordination with the “I Love New York” and Long Island Visitors Bureau, a tourism brochure focused exclusively on the Long Island South Shore Estuary Reserve, highlighting the area’s natural, historic, scenic, recreational and cultural attractions.

Chapter 6: Resilience



Overview

The South Shore Estuary Reserve is a dynamic and vibrant region, offering visitors and residents alike the opportunity to connect with the water and benefit from all that it provides, including clean water, livelihoods, food and enjoyment. Water is the connecting element within the Reserve; surface water, tributaries and groundwater flow into the bays, and the bay waters and Atlantic Ocean interchange with the tides through inlets. The major hazards affecting the Reserve are likewise water related, and the Reserve is vulnerable to threats posed by both natural hazards and human influence. The Reserve's low elevation and proximity to large bodies of water, coupled with development and impervious surfaces, greatly increases the potential for human impacts and property damage from flooding, erosion and storm surge damage, all of which will be exacerbated by projected sea level rise.

Impacts to water quantity and quality related to pollution, nitrogen, inadequate onsite wastewater treatment systems, aging storm water infrastructure and increasing flood risk are also a concern throughout the Reserve watershed. The Reserve's approximate 100 tributaries and watersheds are prone to stormwater flooding in high precipitation events that can often contribute to downstream bay pollution. Impervious surfaces in urbanized areas such as those in Nassau County exacerbate flooding and nutrient pollution.

Changes in the climate, natural hazards, and human management actions and development are putting public health, safety and quality of life at risk. Recent events (such as Hurricane Irene, Superstorm Sandy, and flash flooding in Islip in August 2014) have shown that planning efforts within the Reserve must acknowledge these changes and prepare accordingly to avoid future impacts. For example, sea level rise is increasing the impacts of storm events as flood waters can reach further inland. Impacts will only continue to increase if both existing and future development and infrastructure do not consider these realities. In designated flood zones, the alteration of natural drainage patterns from fill deposition has exacerbated flooding and increased risk to neighboring properties and structures.

Resilience is the ability of a system to withstand shocks and stresses while still maintaining its essential functions.⁹¹ Natural features can mitigate risks posed by natural hazards in many ways, such as reducing wave heights, storing flood waters, or supplying sediment to the nearshore. The ability of ecosystems within the Reserve to bounce back after disturbances is currently strained by the ongoing impact of excess nitrogen, wetland and seagrass degradation, and development, among others.

Resilience is discussed in this chapter as it relates to ecosystems and issues identified in the CMP; it will not discuss community resilience as it relates to private properties at risk and social vulnerability. To improve the resilience of the Reserve, there is a need to address current impacts and prepare for future disturbances. Challenges facing coastal areas, such as aging infrastructure, competing uses and limited fiscal resources, will need to be considered with resilience in mind.

Issues Faced

Long Island has an annual average temperature of about 55°F. Precipitation is relatively consistent in all seasons, with an average of about 47 inches annually. Snowfall is typically under 36 inches per year. Coastal storms of varying intensity are a relatively common occurrence, with projections for more frequent and stronger hurricanes and nor'easters occurring in the future. Climate change projections for Long Island include increasing temperatures, more extreme rainfall events, more days of extreme heat and a middle range sea level rise of 34 inches by 2100.⁹² Scientists also expect the potential for saltwater intrusion into groundwater aquifers and more intense and/or frequent coastal storm events.⁹³

In addition, sea level rise has already begun to cause chronic flooding of low-lying communities. This impact is projected to increase throughout the Reserve in the coming years.

It is essential for the health of the Reserve that climate mitigation activities, such as Greenhouse Gas reduction, occur to limit the impacts of climate change on the estuary. However, Reserve communities should also adapt to the changes already occurring and those changes projected for the future. For example, rising air temperatures and associated increases in water temperatures will have myriad effects on water quality and living resources, such as the potential increase in the occurrence and duration of harmful algal blooms, as discussed in Chapters 2 and 3.

Climate change science is a developing field of study with associated levels of uncertainty. This uncertainty needs to be acknowledged and addressed when considering project selection and future planning. Typical means to help address uncertainty include using multiple planning scenarios and prioritization of solutions that are 'no-regrets', flexible and robust (i.e., the proposed measure will still provide benefits regardless of the climate change scenario).

Ecosystem Impacts

The ecosystems within the Reserve can be vulnerable to changes in the climate and naturally occurring disturbances. While ecosystems are resilient to many changes, and naturally adapt to disturbances like flooding and sea level rise, if they do not have clean water, adequate sediment supply, the full range of water levels and room to move, they can be stressed, degraded or lost. The following focuses mostly on ecosystem impacts due to climate change and existing natural disturbances.

Sea level rise

Sea level rise will exacerbate flooding from storm and increase frequency and extent of chronic tidal flooding.⁹⁴ Sea level rise has the potential to overwhelm existing tidal marshes and seagrasses, unless these systems have enough sediment inputs to gain elevation and room to migrate upland. Certain natural features and habitats, such as those specific to barrier islands, are also at risk of increased erosion and stabilization due to the human desire to respond to erosion. This desire has implications for the natural persistence of the barrier islands as well as many species, including some that are endangered or threatened (e.g., Piping Plover and Roseate Tern).

Physical impacts from storms

Coastal features (e.g., beaches, dunes, seagrass beds, and wetlands), while able to provide risk reduction benefits, are also vulnerable to damages from severe wind and water forces. Once these features are damaged, the natural protective capacity they provide, along with other ecosystem services, may be temporarily diminished. However, most coastal features can recover over time if left to do so. Tidal wetland may experience some edge erosion from storms, but they also rely on sediment from storm event in order to increase in elevation and persist into the future. Tidal wetlands do not need protection from storms. Breaches of the barrier island or natural inlets, typically formed due to a storm



Photo 11 - Aftermath of Superstorm Sandy on Fire Island: sediment washes over dunes and beach (photo taken on 10-31-2012)

event, are a natural occurrence, although human intervention has precluded many breaches from becoming permanent inlets. Ongoing studies on the Fire Island Wilderness breach preliminarily indicate that there are both positive and negative impacts from the barrier island breach. Positive impacts include improved water quality within the Great South Bay and improvements in the occurrence of brown tide in the eastern part of the Bay. There have also been improvements in certain coastal habitats, such as sand platforms for future establishment of marsh. However, some negative impacts include an increase in the occurrence of brown tide in the central part of the Bay and changes in the faunal community.⁹⁵

More intense rainfall events

The frequency and intensity of rainfall events projected to increase due to climate change. Projections for the 2080 range from 15-17 days of rainfall of more than 1 inch and 4-5 days of rainfall more than 2 inches.⁹⁶ More severe rain events will overwhelm already compromised storm water infrastructure in some low elevation communities such as Island Park, and inadequate wastewater infrastructure will impact communities like Mastic Beach. It may also affect erosion rates, salinity in the estuary, water quality and human health and safety, to name a few of the negative impacts.

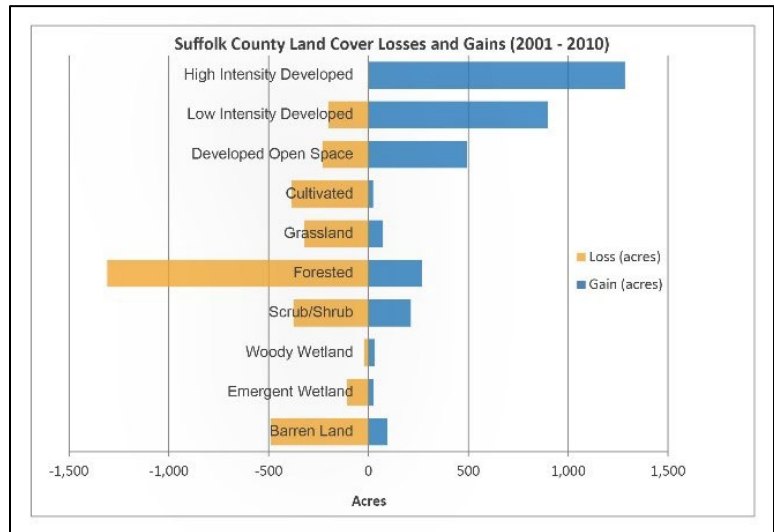


Figure 2 - Land Use and Land Cover data from 2001-2010 compared to show losses and gains in classified land use/cover types

Management Driven Impacts

Existing human influences and future management decisions such as land use regulations and stormwater management affect the resilience of the Reserve. Development is increasing, particularly in eastern Suffolk County, and natural spaces have mostly decreased in acreage. (see Figure 3) Water quality concerns are a high priority within the Reserve, as are risks to development from natural hazards such as flooding and erosion. Protecting existing and future resources is critical to maintaining and improving future quality of life, including public health and safety. The following descriptions highlight existing and potential future human disturbances on the natural and built environment.

At risk structures and properties

There are many structures within the Reserve, including bulk petroleum storage facilities and historical structures, which are not built to current flood code standards. Water-dependent or water-enhanced businesses are also at an increased risk when structures are not built to current base flood elevation standards. Flooding impacts to these structures and properties can have cascading impacts on the environment when debris and/or waste enters the surrounding environment. Certain types of uses are dependent on location near a water body, such as wastewater treatment plants. The risk associated with these locations and the criticality of the facility typically means that they must be protected from future impacts. This often entails hardened shoreline structures for protection.



Photo 12 - Debris from the aftermath of Superstorm Sandy collect near Montauk Highway

Shoreline erosion management

Erosion is a natural part of the dynamic sediment system in the Reserve. However, many structures have been built very close to the shoreline and are now threatened by this erosion. Traditional shoreline erosion management measures include hardened structures, such as bulkheads. While these structures act to protect the upland from land loss, they also can create additional erosion issues for adjacent areas as well as destroy any habitat that exists in front of the structure, such as wetlands, beaches, and public trust intertidal lands. Excessive use of bulkheads can degrade natural nearshore habitat, such as submerged aquatic vegetation (SAV) and wetlands, typically by increasing wave reflection and scour in adjacent areas. In addition, bulkheads are not easily adaptable to future sea level rise. While a majority of shorelines in Nassau County are classified as wetlands (~67%), those shorelines are mostly the uninhabited marsh island⁹⁷ within the bays. Much of the mainland shoreline in Nassau County is dominated by hardened structures⁹⁸ (see Figure 3).

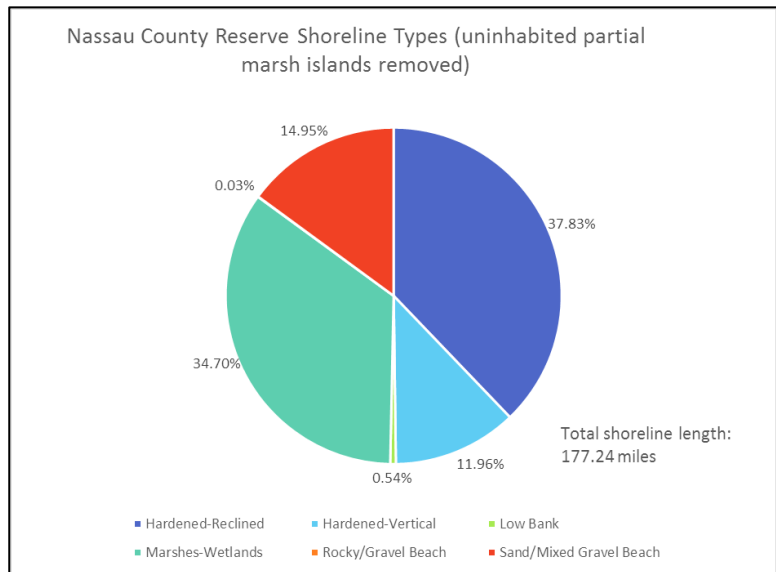


Figure 3 - Shoreline types in Nassau County portion of the Reserve, broken down by percentage of the total shoreline length

Increasing impervious surfaces

The extent of impervious surfaces, or areas where water is unable to infiltrate the ground, has increased by approximately 1,500 acres from 2001-2010 within the Reserve.⁹⁹ Impervious surfaces act to quicken water flow to receiving water bodies, which can increase erosion and pollutant runoff, and

also lead to increases in flooding because water is not absorbed into the ground. These impacts are likely to be compounded by more intense rainfall events and increased flood risk. Other impacts from increases in impervious cover include reduced groundwater recharge and base flow, and degradation of stream quality.¹⁰⁰

Wetland barriers

Existing development and management decisions impact the future of tidal wetlands in the Reserve. Physical barriers, such as roads, bulkheads, or undersized culverts, diminish the ability of tidal wetlands to migrate upland in response to sea level rise.

Inadequate Onsite Wastewater Disposal Systems

Water quality in the Reserve is severely impacted by inadequate onsite wastewater disposal systems (i.e., septic systems and cesspools) which were not designed to remove nitrogen. As a result, excessive nitrogen enters the groundwater and upwells into the bays. Aging systems and rising groundwater levels due to sea level rise together increase the potential for hydrologic failure of the inadequate onsite systems, thereby increasing the threat of pathogen pollution and further degradation of water quality. These impacts have far reaching consequences, which are discussed further in Chapter 2.

Current Efforts to Address the Issues

Resilience

There are a variety of scales and timeframes in which resilience plans or strategies have been implemented. On the local level, a variety of efforts have been undertaken, including implementation of green infrastructure solutions for stormwater management in Babylon, structure elevation and freeboard standards that go above state requirements in Freeport, and the establishment of a Community Preservation Fund (CPF) within the Reserve.

On the State level, the devastation caused by Superstorm Sandy, Hurricane Irene and Tropical Storm Lee prompted the creation of the Governor's Office of Storm Recovery and the New York Rising Community Reconstruction Program (NYRCR). Resilient projects were identified for funding through this program; however, there are many that need additional funding. These types of projects include drainage improvements, guidance or improvements to make docks and marinas more resilient, living shorelines and habitat restoration efforts, and studies of or improvements to stormwater management. Grants for planning and implementation projects related to climate change and resilience are available through a variety of state and federal opportunities.

In September 2014, the Community Risk and Resiliency Act (CRRRA). CRRRA was signed into law directing certain state permitting and funding agencies to consider physical climate risk due to sea level rise, surge and flooding. The State has adopted official sea level rise projections and will also produce guidance documents related to implementation of CRRRA.¹⁰¹ These guidance documents describe the use of natural and nature-based features to reduce risk and include a compendium of model local laws.

The model local laws are aimed at mitigating climate risk and encompass techniques such as hazard overlay districts, transfer of development rights, cluster subdivision, and watercourse and wetlands protection measures, to name a few. In July 2019, the New York Climate Leadership and Protection Act was signed into law. The Act seeks to address climate change through a wide range of mitigation measures to reduce greenhouse gas emissions and help communities adapt to a changing climate with a focus on environmental justice and underserved communities.

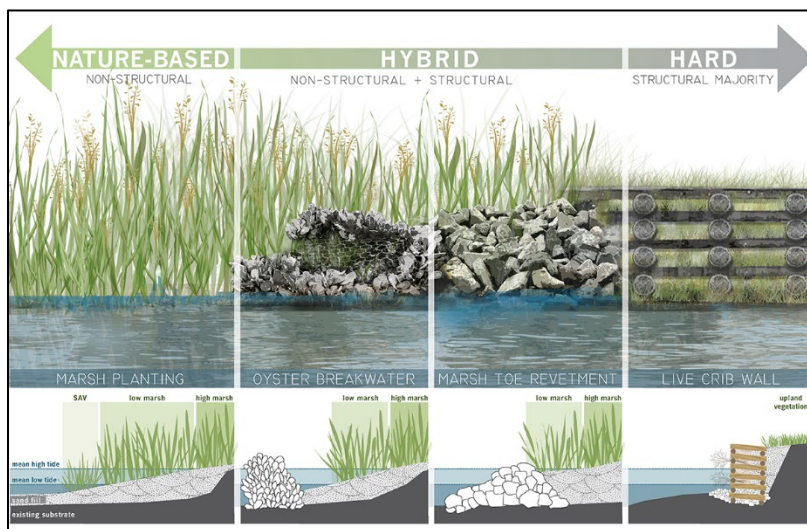


Figure 4 - Living shoreline techniques can include natural materials to a mix of natural and soft stabilization to a mix of natural and hardened structures. Site conditions, upland land use and risk tolerance are typically needed before a technique is selected

There have also been efforts on the state level to improve understanding of regulations as they relate to living shorelines, which are a management approach that incorporates natural and nature-based features into shoreline erosion management techniques (see Figure 4). Living shorelines support natural processes, as compared to hardened structures they provide ecosystem services and maintain or improve habitat connectivity across the land-water interface. The NYSDEC has issued guidance for the marine district of the state to promote the use of living shorelines and provide regulatory guidance for the development of permit applications.¹⁰² Monitoring guidelines are being developed by NYSDOS

to provide standardized metrics and protocols to better assess the success of living shorelines. Additionally, NYSDOS and NYSDEC jointly developed monitoring guidelines for salt marsh restoration, which can be used as a reference for establishing standardized marsh monitoring protocols.¹⁰³ Other efforts are underway to develop regional monitoring guidelines for a variety of natural and nature-based shoreline management measures in New York.

There are a variety of federal agencies that also provide disaster relief funding or technical assistance. In the Reserve, there are more than 60 Federal projects in a variety of stages meant to repair and rebuild infrastructure, as well as restore habitat or acquire parcels vulnerable to flooding for open space.¹⁰⁴ For example, the approved Fire Island to Montauk Point (FIMP) project is an Army Corps of Engineers coastal storm risk management project with an array of potential solutions such as: beach nourishment and restoration of natural features on the barrier island to reduce risk; a barrier breach contingency plan; home retrofits, including elevating and floodproofing structures, and limited relocations or buyouts; and road raising. The Federal Emergency Management Agency (FEMA) supplied funds for improvements to the South Shore Water Reclamation Facility (formerly Bay Park Wastewater Treatment Plant), including a seawall to provide flood risk reduction. The US Department of Interior (DOI) is providing funding for restoration of 400 acres of wetlands in Suffolk County as a response to Superstorm Sandy. Excavated materials will be used to elevate the marshes to better accommodate rising sea levels. Twenty-five parcels of wetlands in the Mastic/Shirley Conservation Area are being acquired by Suffolk County in partnership with the Natural Resource Conservation Service (NRCS) wherein NRCS is acquiring a conservation easement and the County is acquiring the residual fee title of these floodplain properties. The next phase of work will be the restoration of these floodplain/wetland parcels to aid in local coastal resiliency actions. Buyouts funded through the State's Housing and Urban Development Community Development Block Grant- Disaster Recovery (HUD CDBG-DR) grant will convert properties in flood-prone areas to permanent public open space.

Explanation of the Outcomes and Implementation Actions

Improving resilience is not a process with a finite timeline; resilience will continue to be improved over time as long as there is a goal to improve quality of life and as long as climate change and human actions disturb healthy functioning of ecological, social and economic systems. The health of these systems can be defined in a variety of ways (e.g., biodiversity is one element of healthy ecosystems), but they are all linked. When one system is impaired or not functioning effectively, it can impact the others and the overall resilience of the total system (i.e., the Reserve).

All actions taken to help advance the CMP should strive to improve the health of ecological, social and economic systems and thus the overall resilience of the Reserve. The Council offers the following outcomes and implementation actions to work towards this goal.

The Council recognizes the benefit of natural systems and habitats in offering risk reduction and other ecosystem services. There is a strong desire to protect existing natural protective features, restore degraded natural systems, and better understand how these systems may function under future conditions (Actions 6.1.1 through 6.1.3). A major contributor to understanding how these systems perform or function over time are active monitoring efforts (Actions 6.2.1 and 6.2.2). Shoreline management in the Reserve that takes climate change and resilience into account requires a better understanding of which solutions are appropriate in which location. Natural and nature-based features, used where appropriate, can provide risk reduction and added co-benefits and are also more adaptable over time compared to traditional shoreline hardening. The status of existing shoreline types should be inventoried to improve and expedite decision-making (Actions 6.3.1 through 6.3.4).

Planning within the Reserve should move beyond considering the current climate only and recognize a new normal where extreme events are more common. Future land use decisions, as well as funding, design and siting projects, should incorporate the most recent information on flooding, sea level rise and other natural hazards (Actions 6.4.1 through 6.4.4). Although impacts from sea level rise and storm surge are a primary concern on the coast, projections of increased extreme precipitation events and riverine and groundwater flooding are another threat to the Reserve. Management measures that support green infrastructure solutions and upgrades to existing culverts are recommended (Actions 6.5.1 through 6.5.5). Finally, improving resilience does not mean that only new plans or actions can be implemented. Updates to existing plans, resource management or proposed projects can often take resilience into account by including information on climate change impacts or considering risk reduction actions that are more adaptable or provide ecosystem service benefits (Actions 6.6.1 through 6.6.4). Many of the actions within this chapter support, or are supported by, other actions throughout the CMP.

Outcomes and Implementation Actions

Outcome 6.1 – Natural Features and Systems are Inventoried and Assessed for Future Conservation/Restoration

Action 6.1.1: Develop a Natural Resource Inventory

A Natural Resources Inventory (NRI) is essential for comprehensive land-use planning that proactively considers a community's land and water resources. It provides the foundation for open space planning and protection, zoning updates, conservation overlay districts, critical environmental areas and other municipal plans and policies. An NRI compiles and describes important naturally occurring resources such as forests, wetlands, seagrass beds, surface and ground waters and farmland within a given locality (e.g., municipality, watershed, or region). Cultural resources, such as historic sites, scenic vistas and recreation areas, are often included in an NRI as well. An NRI can be completed on a variety of scales, such as a watershed or municipal boundaries. See NYSDEC website for guidance on creating an NRI for the Hudson River Estuary Watershed.¹⁰⁵

Action 6.1.2: Evaluate existing natural features for current condition and potential future extent

Once existing natural features are identified, such as through an NRI, the next step is to look at the existing health of the feature and determine if there are any direct or indirect impacts on the feature that can be managed, such as development pressures or pollution. It is also important to better understand the future extent or functioning of the feature or ecosystem. Scenario planning with different management and/or emissions pathways is a method to help understand the possible range of future conditions. While research is underway to better understand climate change effects on coastal systems, tools are available to help predict future habitat on a coarse scale (see TNC's Coastal Resiliency Mapper).¹⁰⁶ Potential marsh migration and habitat conversion is captured in The Sea Level Affecting Marsh Migration (SLAMM) tool, and outputs for NY are also available.¹⁰⁷ Results from these types of analyses and from monitoring efforts can help guide future decisions on land use and resource management in light of climate change.

Action 6.1.3: Consider dam removal, dam modification, and culvert improvements at road and rail crossings that would restore natural and beneficial functions of floodplains and river systems

Dams fragment river corridors and disrupt natural floodplain functioning. Floodplains reduce water energy, absorb or infiltrate water, and provide many ecosystem services such as habitat provision and water filtration. Dam removal or modification and culvert improvements would improve sediment supply downstream, which would help restore natural sediment deposition processes. Dam removal and culvert replacement, in some instances, can also reduce flooding duration and/or provide for flooding reduction above existing impoundments through increased conveyance of flood waters. Potential projects can be identified from the Nature Conservancy's Road and Stream Crossing Assessment completed in for Suffolk County and the Seatuck Environmental Association's [*Long Island Diadromous Fish Restoration Strategy*](#).¹⁰⁸

Outcome 6.2 – Monitoring Systems are in Place to Report Health and Resilience of Estuary Systems

Action 6.2.1: Review existing estuary monitoring programs and identify additional monitoring needs

A key component to understanding change over time and measuring the health of natural systems or success of restoration projects is long-term monitoring. Often, funds for monitoring are limited and might only cover a few years, which means that monitoring may be inconsistent or insufficient to evaluate change or success over time. A long-term, continuous monitoring framework will help inform better decision-making in the Reserve. An assessment of existing monitoring efforts and additional monitoring needs of priority resources should be undertaken by the Council and partners, including federal, state, local, or non-profit organizations.

Action 6.2.2: Identify resources and candidates to support, conduct, and oversee monitoring programs and data management

Once there is a better understanding of monitoring gaps and needs, funding can be identified to continue, improve or initiate monitoring efforts. Data should be collected in a consistent manner over time. To supplement rigorous technical data collection, or where funds are not available, volunteers can support monitoring on a citizen-science level. Citizen-based science can help complement formal technical data and analysis and engage citizens to become strong stewards with “eyes and ears” on the ground and in the estuary. Data management should allow for easy input and recording of collected data, as well as analysis of trends over time. Data management should also align with and, where possible, integrate ongoing efforts through the Coordinated Water Resources Monitoring Strategy.

Outcome 6.3 – Shoreline Management Options are Understood and Appropriate Management Approaches are Applied

Action 6.3.1: Develop a shoreline typology that describes current shoreline type, energy regime, and adjacent land use type

An understanding of upland land use, current shoreline type or treatment, adjacent shoreline types and existing (or potential future) forces acting upon the shoreline (e.g., wind and wave action) is needed to identify appropriate shoreline management measures. An example of a shoreline typology that considers external forces and land use types can be seen in the *NYC Planning Urban Waterfront Adaptive Strategies Guide*.¹⁰⁹ NOAA also completed an analysis of shoreline types for Long Island in 2009 as part of their Environmental Sensitivity Index (ESI) mapping program.¹¹⁰

Action 6.3.2: Identify areas for nature-based feature application utilizing shoreline typology

Nature-based features are only appropriate for shoreline stabilization under certain conditions, such as low to moderate wave and wind energy, and where features are given room to adapt over time, such as wetlands that can migrate upland with sea level rise. A shoreline typology will help to identify areas where hardened features are good candidates for removal, such as bulkheads in sheltered coastal areas. This has the potential to expedite decision-making and permitting processes.

Action 6.3.3: Assemble case studies of successful restoration and use of nature-based features within the Reserve

Property owners are more likely to implement nature-based features or restore natural features for risk reduction if there is readily available information on similar projects that have successfully reduced risk

from erosion and flooding. A collection of case studies, compiled in a database or other accessible format, should provide standardized information about project location, funding source(s), existing site conditions, project goals, project elements, public access and monitoring. These case studies can be used as educational material during shoreline management workshops (Action 6.3.4).

Action 6.3.4: Plan and hold one or more shoreline management workshops for local government officials and landowners

Property owners and local officials could have the opportunity to come together to discuss regional approaches to shoreline management measures. Education on the benefits, drawbacks, lifecycle costs, and resiliency of a variety of shoreline management measures will allow landowners and local government decision-makers to make more informed decisions about appropriate techniques. Information on approaches such as living shorelines or bioengineered solutions, can be shared as new knowledge is acquired.

Outcome 6.4 – Resources and Tools to Assist Consideration of Flood Risk, Sea Level Rise and Other Natural Hazards are Available to Reserve Communities

Action 6.4.1: Facilitate the incorporation of CRRA products into municipal planning decisions, permit requirements, and regulatory codes

Guidance on implementation of CRRA includes sea level rise projections, natural resiliency measures guidance, flood risk management guidelines, model local laws and others. These products are designed to help better understand and mitigate future physical climate risk due to sea level rise, storm surge and flooding. Utilization of these guidance documents on the local level will promote consistency with State agencies directed to conform with CRRA. Model local laws are specifically aimed at local governments.

Action 6.4.2: Support development and publication of updated FEMA floodplain maps and encourage resilient land use planning measures

Existing Flood Insurance Rate Maps (FIRMS) do not consider climate change, nor do they take into account erosion rate, changes in the amount of impervious surfaces due to development or deterioration in flood defense structures. Recommendations for FEMA include utilization of the most updated topographic data and new hydrology and hydraulics (H&H) modeling. While updated maps for an entire region can take a substantial amount of time to complete, there are opportunities to make updates through a Letter of Map Revision (LOMR), which reflect physical changes in a community and the extent of flood hazards. Risks in the Reserve due to flooding can be lessened where resilient land use planning measures are applied, both regulatory and non-regulatory. Areas outside of a FEMA special flood hazard area should also incorporate resilient land use by considering changes in sea level and precipitation patterns. More resilient land use planning can accomplish many goals, such as conservation of open space through transfer of development rights (TDR); avoidance of development in hazardous areas through restrictions on development, such as through overlay zoning and increased setbacks; or resilient construction through establishment of a design flood elevation (DFE) that goes above a FEMA base flood elevation (BFE).

Action 6.4.3: Support research on local climate change projections (downscaled projections) or other adaption strategies

Climate projection downscaling is taking climate information known at large scales to make predictions at local scales. The 2014 NYSERDA ClimAid Report includes regional projections based on global

climate models, but there is a need for more localized projections.¹¹¹ There is also a need for improvements in year-to-year and decade-to-decade climate variability predictions. Gaps in our understanding of climate adaptation strategies can be filled through research efforts directed towards understanding novel strategies as well as performance of existing strategies under a wide range of climate change scenarios.

Action 6.4.4: Assemble a record of regionally characteristic shoreline processes and storm or flooding events and correlate processes and events with shoreline areas

Local expert knowledge or local records of processes such as shoreline erosion/accretion and storm or flooding events can greatly enhance official regional or state historical records. Records of storm impacts to shoreline management measures, such as bulkheads, or repetitive flooding impacts to a property, can influence management decisions. These records can also build a case for the performance of alternative shoreline management measures, such as living shorelines.

Outcome 6.5: Improved Measures for Addressing Upland Stormwater Quantity and Groundwater Flooding

Action 6.5.1: Utilize green infrastructure solutions for stormwater quantity management based on design criteria from the NYSDEC 2015 Stormwater Design Manual

Stormwater quantity reduction through green infrastructure solutions include techniques that act to capture and slowly release water or assist in infiltration utilizing soils, vegetation and engineered materials instead. Green infrastructure on the landscape scale includes conservation and restoration of natural features (Outcome 6-1). Green infrastructure includes practices such as installation of swales and porous pavement. Green infrastructure helps to protect downstream water resources and provide ecosystem services such as water quality and habitat improvements. Reduction of impervious surfaces (Action 6-5-3) and conversion to open green space or other porous pavement will help reduce stormwater runoff and localized flooding.

Action 6.5.2: Consider elevation of critical utility and wastewater infrastructure in areas of increasing groundwater level or flooding hazard

Utilities that are more flood resilient can withstand an event with minimal damage and have a faster recovery time from service disruptions. Electrical components installed below base flood elevation (BFE) are at increased risk of flood damage and electrical outages. Components of wastewater treatment systems can be armored, floodproofed, elevated or relocated to reduce risk of damage, loss of services and other negative impacts such as nutrient pollution.¹¹²

Action 6.5.3: Identify avoidable or underutilized impervious surfaces and convert them to permeable surfaces or open space

Impervious surfaces can exacerbate flooding because instead of infiltrating into the ground, water runs off the surface into a water body, collecting pollutants along the way. Analyses can be undertaken to identify unnecessary or underutilized impervious surfaces, such as road medians and parking spaces, with the greatest potential for open space conversion or installation of green stormwater infrastructure. Municipal parking supply and demand analyses do not typically include stormwater management or green infrastructure practices.

Action 6.5.4: Support development of groundwater flood modeling as well as United States Geological Survey (USGS) installation of stream gauges to model riverine flooding from increased precipitation

There are four existing stream gauges located within the Reserve boundaries providing real-time data critical in the development of riverine flood models. USGS needs sponsor communities to help support installation of new gauges and conduct modeling that will improve understanding of riverine flooding. USGS partners with local communities on their flood inundation mapping program, which delivers flood inundation maps along with real-time streamflow data, flood forecasts and potential loss estimates. Given increasing intensity and frequency of extreme rainfall and storm events, coupled with sea level rise and storm surge events on the coast, modeling of current and future groundwater flooding is a pressing need.

Action 6.5.5: Undertake identification, assessment and replacement of undersized or deteriorating culverts to reduce flood risk

Culverts act to carry runoff or stormflow under roadways. Undersized culverts exacerbate flooding and contribute to erosion, particularly when heavy storm events overwhelm the culvert. Studies can be undertaken to identify whether culverts are functioning properly or need an upgrade or resizing to adequately convey stormwater. Studies that assess the capacities of existing culverts under projected future precipitation conditions would be an ideal next step.¹¹³

Action 6.5.6: Encourage the elevation and floodproofing of homes on pilings, rather than concrete foundations, in flood zones.

The solutions selected should minimize displacement of flood waters, alteration /interference with natural flooding and drainage patterns, and risk of property and structure damage on neighboring unarmored properties.

Outcome 6.6 – Incorporate Resilience into Existing Strategies and Plans

Action 6.6.1: Assess and update local and regional comprehensive plans to include consideration of climate change and resilience issues relevant to the Reserve

As comprehensive or other management plans are updated or revised, consideration of the latest climate change projections and their implications should be incorporated to develop climate adaptation strategies for the Reserve. It is critical that comprehensive plans are updated with the most current information on projections and impacts and recognize that changes in the climate have implications for land use regulation, management of resources and other elements vital to community functioning.

Action 6.6.2: Integrate CMP resilience issues with NYSDEC Climate Smart Community climate adaptation actions

Several local governments within the Reserve have passed the Climate Smart Communities Pledge as a municipal resolution. The pledge is a commitment to reduce greenhouse gas emissions and adapt to climate change. The pledge elements related to adaptation overlap with several of the issues identified in the CMP. Local governments that begin the certification process should consider how actions identified in the CMP overlap with actions identified through the certification process to ensure efforts are complementary.

Action 6.6.3: Support the Long Island Regional Economic Development Council (LIREDC) strategies for developing more resilient strategic economic plans

The Long Island REDC recognizes the importance of protecting natural resources and investing in sewer infrastructure, tourism, agriculture and fishery industries. A healthy and resilient economy is one in which industries and businesses can thrive and quickly recover given changes in the climate and natural hazard events or disturbances. A wide range of industries are affected by climate change. The next update to the Strategic Economic Development Plan for Long Island should identify industries affected by climate change and integrate resiliency principles into economic development plans. This is consistent with the CRRA and opportunities exist to support CRRA-aligned projects that improve resilience over time.

Chapter 7: Increase Education, Outreach and Stewardship



Overview

While residents living on or near the water have an inherent interest in the Reserve, everyone living on Long Island and in much of the metropolitan area, along with many tourists, benefit from its fine attributes. To enlist their aid and support and that of the Council members, we must communicate effectively to achieve an environmentally educated citizenry. Although well known to town and county officials after almost 25 years (the South Shore Estuary Reserve was established in 1993), the Reserve remains relatively unknown to the public. Outreach is necessary not only to maintain relationships with the various governmental offices but also to instill in the public a knowledge of, appreciation for, and desire to protect the Reserve.

Issues Faced

As pointed out in previous chapters, the south shore bays are one of the most popular recreational areas of Long Island. The waters of the Reserve are home to a broad array of plants, animals and unique habitats that collectively form an ecosystem of ecologic, economic and social significance. Few residents and visitors perceive the full extent of the Reserve. This is significant, because while factors such as demographics, geology and ecology may vary throughout the reserve, each part of the Reserve is related to, and contributing to, the whole. Fish, birds, boats and humans freely travel from one area to another, and a broader sense of identity and stewardship can be gained by relating to the Reserve as a holistic unit.

While there was an initial period of public outreach and corroboration with the Reserve's educational community at its inception, the Council has not pursued such a strategy in recent years. Because of this, the Reserve remains unknown to most Long Island residents and invisible to visitors from other regions.

Formal Education

Although tremendous changes have taken place in the availability of information since the first CMP was written, formal education has changed relatively little. Long Island high school students still take the same courses with minimal changes, and several schools offer Marine Science, Marine Biology, Ecology or Oceanography as electives in the high schools. One new course at the high school level, Advanced Placement Environmental Science, is a new pathway for students to study the Reserve. Another pathway is through the Science Research programs which have become even more popular and sophisticated in recent years. Many students are choosing to do projects related to the estuary.

Nearly half (60) of the 124 public school districts on Long Island responsible for primary and secondary level education are in whole or in part within the Reserve. These districts serve a major portion of the approximately 423,000 school-age children on Long Island.

The internet and the availability of smart phones, tablets, and computers has expanded the accessibility of information. What must be accomplished is the formatting of the learning experience in such a way that students are guided to make use of this overwhelming amount of information in a productive manner.

Elementary, middle, and high school teachers must work around various constraints in trying to raise student consciousness about the environment outside their classrooms. State learning standards for mathematics, science and technology are supportive of environmental education. Yet when teachers want to incorporate local topics such as estuarine ecology, they must first gain the support of local administrators and then expend time finding and adapting teaching materials and obtaining training for themselves.



Photo 13 - Environmental education field trip

Taking students out into the field poses additional challenges for teachers, such as limited transportation budgets and other restrictions that prevent travel to more distant sites. Nature center managers' report that some teachers come back year after year without prodding, but many others never respond to invitations.

Informal Education

Educating the public on the history and benefits of a healthy South Shore Estuary is important to its protection. However, the lack of a strong public presence in the Reserve limits the ability to share the significance and history of the estuary. Residents living in the Reserve may be unaware of the South Shore Estuary Reserve designation and of how a healthy Reserve directly benefits them by providing recreational opportunities, supporting the local economy and protecting them from severe storms such as Superstorm Sandy. There is both an urgent need and abundant opportunity to foster this deeper sense of identity and connection with the Reserve.

Many entities provide informal educational services within the Reserve, including several historical and natural history institutions that provide programs onsite or in the classroom for students and the public. Many also produce materials which are available online.

Many groups organize events, lectures, or field trips in cooperation with the towns, villages and institutions. Citizens Campaign for the Environment, The Nature Conservancy (TNC) and Operation SPLASH, to name a few, are organizations that champion many environmental issues including several which directly affect the Reserve. These groups include information about their efforts to improve the Reserve on their websites. In addition to the traditional groups such as the Audubon Society, Boy Scouts, fishing groups, Coast Guard Auxiliary and local libraries, new online organizations, including those on Facebook and with their own websites, have become very popular.

To protect the South Shore Estuary into the future, the Council will need to develop the necessary outreach and education tools and form key partnerships with organizations throughout the Region. Together, these actions will ensure that the history and significance of the estuary resonates throughout the Reserve.

Current Efforts to Address the Issues

Outreach

People in the Reserve learn about their environment from a variety of information sources. Mass media outlets, including newspapers, magazines, television, internet and radio reach the broadest audience. A dozen or so dailies and a multitude of non-daily papers carry stories about Reserve issues. In addition, special releases such as Newsday's annual "Fun Book" provide detailed recreation information on Long Island's coastal environment.

The NYSDOS hosts the Reserve Website (<https://dos.ny.gov/long-island-south-shore-estuary-reserve-program>) which includes current announcements, a discussion of relevant issues and past reports and documents. The NYSDOS also has data available through the NYSDOS Geographic Information Gateway (Gateway) (<http://opdgig.dos.ny.gov/#/focus/SouthShore>) focusing on GIS data and information relevant to the Reserve.

Numerous public and private organizations also reach out to the public and various target audiences. These groups often rely heavily on social media to share information. These organizations include: environmental groups; sports and recreation clubs; neighborhood and civic groups; business and industry groups; academic institutions; and, State and federal agencies. In on-going efforts to capture the interest of all kinds of people, these organizations use many avenues of outreach, including: newsletters, brochures, guide books, websites, videos and slide shows, exhibits, trade shows, workshops and conferences, and a variety of programs for adults and children.

To promote Long Island estuaries, the Reserve office has partnered with the Long Island Sound Study and the Peconic Estuary Partnership to host the annual "Long Island Estuary Day" outreach event during National Estuaries Week each September.

Stewardship



Photo 14 - Reserve beach cleanup

Many organizations on Long Island and elsewhere are moving beyond simple education and outreach activities and are striving to motivate individuals to become active stewards of the environment. At the community level, local governments and neighborhood, civic and environmental groups are bringing citizens together in collective efforts to improve the environment. They are spearheading a variety of activities in the Reserve such as harbor clean-up cruises organized by Operation SPLASH and a variety of beach clean-ups, conferences, lectures and fairs. The New York State Marine Education Association ran the South Shore Estuary Learning Facilitator (SSELF) Program, which instructed students

and community members on how to take simple chemical and physical measurements of air and water. A Day in the Life of a River program also works with local schools to conduct sampling events in several Reserve tributaries and bays. The NYS Department of Environmental Conservation has a Water Stewardship Program that encourages organizations to adopt a wetland, stream or even an entire watershed. These efforts are aimed at attracting volunteers of all sorts -- concerned citizens, representatives of civic organizations, local businesses, school children, and teachers.

The Reserve Office

The website for the Reserve (<https://dos.ny.gov/long-island-south-shore-estuary-reserve-program>) is maintained by the Reserve office and includes announcements, a discussion of the relevant issues and past reports, and documents about the Reserve. The Reserve office is also responsible for a bi-monthly newsletter that highlights efforts of stakeholders in the Reserve.

K-12 Schools

There is no central source of information on what public schools and teachers are doing to educate elementary, middle, and high school students about the Reserve. Some high schools are actively promoting classroom and extracurricular programs related to the estuary, incorporating estuary-related components into their regular classroom work, teaching techniques for monitoring environmental conditions, and taking their students out into the field to learn from field biologists at nature preserves in the Reserve and to work on restoration projects. “A Day in the Life of a River” organized by Brookhaven National Laboratory, the Pine Barrens Commission, and the NYS Department of Environmental Conservation provides the opportunity for teachers and students to monitor local waterbodies and incorporate the data into regular curricula.

Today, teachers have many sources of information about estuaries and the Reserve at their disposal, including traditional sources like the NYS Marine Education Association, the NYS Outdoor Education Association, and the National Science Teachers Association. Online resources are also available, such as those provided by the NYS Department of Environmental Conservation, National Oceanic and Atmospheric Administration, National Science Foundation, the Smithsonian Institution, and the National Park Service. Finally, there are many opportunities for training, including specialty training from various academic and non-profit organizations like the Suffolk County Organization for the Promotion of Education (SCOPE) and Project WET/Wild/Wild Aquatic, and Colleges and Universities

Several colleges on Long Island conduct programs pertaining to the Reserve. They include: State University of New York at Stony Brook SoMAS and the new waterfront Southampton Campus Marine Station; Hofstra, Adelphi and Long Island University; and Molloy College, which has its own waterfront lab, The Center for Environmental Research and Coastal Oceans Monitoring (CERCOM) in West Sayville. In addition to providing classroom and field training for future environmental scientists, they sponsor research in a wide range of coastal topics. The State University of New York, in cooperation with Cornell University, administers the Sea Grant Program. One of the prime responsibilities of the program is the transfer of coastal science-based information to environmental managers and the public.

Not-for-Profit Organizations

Several groups are doing an excellent job of educating and reaching out to tell the story of the Reserve. Among these are: Fire Island Lighthouse, Seatuck Environmental Association, Citizens Campaign for the Environment, Fire Island Association, Oceanside Marine Nature Study Area, Long Island Traditions and Operation SPLASH (Stop Polluting, Littering and Save Harbors).

A number of nature education centers and museums in the Reserve are operated by local, state or federal government agencies, academic institutions or non-profit organizations that offer field programs for school groups. These include the Oceanside Marine Nature Study Area, The Roosevelt Center at Jones Beach, Seatuck Environmental Center, the Long Island Maritime Museum, Quogue Wildlife Refuge, Wertheim National Wildlife Refuge, Tackapausha Museum and Preserve and the Tanglewood Preserve. The Nassau and Suffolk County Boards of Cooperative Educational Services (BOCES) operate several nature programs including shoreline and boat trips in the Reserve. Several “fishing

boats” offer class trips with or without a BOCES educator onboard. BOCES will offer reimbursement for trips within the Reserve; the amount varies depending upon the demographics of the district. Preserve managers are quick to add that their own funding is often tenuous and that they would not be able to accommodate a sudden surge in interest. They also must be concerned about protecting the natural resources in their care.

One way of augmenting regular curricula is to bring special activities into the classroom. Various organizations offer such programs. Long Island Traditions offers several programs including one which introduces students to Long Islanders who are knowledgeable about local maritime traditions and another which offers tours of bay houses. Trout Unlimited runs a program called Trout in the Classroom where they work with classes to grow and release trout each year.

Explanation of the Outcomes and Implementation Actions

In keeping with Article 46 of Executive Law, the Council established as one of its goals the need to emphasize the importance of education and outreach in building a citizenry that can play an effective role in shaping the future of the estuary. In keeping with this sentiment, the following recommendations focus on educating and inspiring young people; reaching out to the public to raise awareness and engagement; and motivating citizens to become active stewards of the Reserve. To maximize the effectiveness of these actions, the many organizations currently engaged in education, outreach and stewardship activities will need to reinforce their cooperative ties. Some of the organizations to help with this effort include Southampton High School, SUNY Southampton, Quogue National Wildlife Refuge, Wertheim National Wildlife Refuge, SEATUCK, CERCOM-Molloy College, Hofstra University, Adelphi University, Center for Science Teaching and Learning at Tanglewood Preserve, Long Island Maritime Museum, Roosevelt Nature Center at Jones Beach State Park and Oceanside Marine Nature Study Area. The Council can serve as a promoter and facilitator, but successful outreach depends on a wide range of partners. The South Shore Estuary Reserve Act created the Citizens Advisory Committee and gave it responsibility for integrating citizen and user group concerns into the Reserve CMP planning and implementation. The CAC encourages public education and involvement through coordinating with partners, having presence at meetings and events, and reaching out to the public. It is important for the CAC to continue this vital role to build and enhance a strong stewardship ethic in the Reserve.

The Council offers the following outcomes and implementation actions to maintain and improve outreach, education and stewardship in the Reserve. Action 7.1.1 will focus on reestablishment of the Formal Education Workgroup. Actions 7.2.1 through 7.3.8 focus on the development of outreach materials and promotion of the Reserve to expand visibility. Actions 7.4.1 through 7.5.2 will continue the expansion of citizen science opportunities in the Reserve and enhance the use of science research and technology in local schools. The efforts will provide residents of the Reserve with an opportunity to better understand the important resources and history of the Reserve.

Outcomes and Implementation Actions

Outcome 7.1: Establish a Group to Guide the Education and Outreach of the Reserve

Action 7.1.1: Reactivate the [Formal] Education Workgroup

In the past, the Council's Education Work Group consisted of members of the Council and Citizens Advisory Committee, formal and informal educators and other interested parties. The group would advise and guide the full Council on development of the interpretive system, education, outreach and stewardship activities in the Reserve. This group should be reactivated.

Outcome 7.2: Develop Materials that Would Encourage Visitation and Facilitate Interpretation of the Reserve

Action 7.2.1: Develop a program designed for the computer, tablet or smart phone featuring all aspects of the Reserve Interpretive System

A Reserve Interpretive System (RIS) would include natural, historical and recreation sites in the Reserve that would be delivered in digital format complimenting other educational materials on the Reserve. This platform should make use of the latest computer technology available for smartphones, tablets or desktop computers. The RIS would present a unified picture of the estuary that encourages people to travel throughout the Reserve to learn about, preserve and enjoy its many features. Work previously done on the Bayway project should be incorporated when possible. This would be developed in cooperation with the Long Island Convention and Visitors Bureau, and I Love New York and Discover Long Island programs. Signage should be created to inform the public about the historic and natural features of the area and provide a QR code to be scanned by smartphones and tablets to access additional information about the Reserve.

Action 7.2.2: Curate existing and develop new digital outreach materials

Digital outreach materials would include Reserve-specific materials to be used on the website, social media, and the NYSDOS Gateway.

Action 7.2.3: Produce a guide to the Reserve identifying educational, recreational, natural and historical sites

Maps, tours and directories of Reserve educational, recreational, and historical and natural history sites should be made available for both formal education visitors as well as the general public at hotels, rest areas, schools, parks and other visitor destinations in the Reserve. The guide can include local, state and federal assets and attractions with information on contacts, parking, fees and hours of operation. The guide can also include a map highlighting major routes and destination locations.

Action 7.2.4: Provide teachers and community members with in-service or pre-service courses and/or an annual conference highlighting the value of the estuary

Expand opportunities for teachers to obtain training in content and teaching methods in estuarine ecology for both classroom and field settings. Support materials should be solicited from existing training providers. To inspire teachers to seek additional training, work with school districts to provide in-service credits and work with training organizations to make courses relevant to Reserve teachers available at annual conferences.

Outcome 7.3: Increase the Visibility of the Reserve

Action 7.3.1: Design a logo for the Reserve

The Reserve has never had a formal logo, and one should be designed as a way for visitors and residents to identify with the Reserve and build brand continuity.

Action 7.3.2: Develop communication plan for the Reserve

A communication plan must be developed to effectively communicate the history and significance of the Reserve. The Reserve office working with the Reserve's Citizen Advisory Committee should develop and carry out this plan.

Action 7.3.3: Establish relationships with local news media to cover issues and events in the Reserve

Working with the NYSDOS Press Office, press releases should be sent out for activities such as fairs, concerts, fishing tournaments, boat races, beach cleanups, boat trips, nature walks, classes and various stewardship activities, etc.

Action 7.3.4: Compile and maintain a contact list of Reserve partners

A list with contact information for Reserve Partners can be used for outreach.

Action 7.3.5: Encourage and work with coalitions of public and private sector entities to organize and sponsor events

Coordinate with and assist local, regional, state and national events that will raise awareness about estuaries and the coastal environment.

Action 7.3.6: Explore with the Long Island Maritime Museum the designation of a flagship vessel for the Reserve

Opportunities exist to partner with the LI Maritime Museum to identify and designate a vessel as a flagship for the Reserve. A flagship vessel would travel throughout the Reserve to educate, increase visibility, and encourage stewardship. The Priscilla, a 60-foot oyster sloop built in Patchogue in 1888, is currently used for private charters, educational and public sails and already travels to several waterfront events during the year. A second vessel, the 35-foot Modesty, is an oyster and scallop dredge built on Long Island in 1923 that needs further restoration. Both vessels are designated as National Historic Landmark Vessels by Congress.

Action 7.3.7: Coordinate education and outreach activities in the Reserve

Environmental education activities are vital to implementation of the Reserve's Comprehensive Management Plan. The Reserve Office will work with communities, program directors at the DOS, NYSDEC, New York Sea Grant, and local environmental groups to coordinate and assure that education and outreach materials of the Reserve are widely available, as well as to raise public awareness of pollution issues, and engage citizens in stewardship activities. Materials that are produced should be shared throughout the Reserve and kept up to date.

Action 7.3.8: Improve and develop relationships with New York estuary programs and consider partnering with other National Estuary Programs throughout the country.

Many estuary programs throughout New York State and the country are facing many of the same problems. Improved coordination on issues would help with the management of key priorities for the Reserve.

Outcome 7.4: Increase and Encourage Citizen Science Conducting Biological, Chemical, Physical and Social Science Research

Action 7.4.1: Work with local groups to extend citizen science programs within the Reserve

Support programs in the Reserve sponsored by groups that annually monitor the biological, chemical and physical state of a tributary. Brookhaven National Laboratory, the Central Pine Barrens Commission, and NYSDEC along with several local high schools conduct the “A Day in the Life of a River” program for several tributaries in the Reserve including Carmans River, Connetquot River and Greens Creek. The CAC has suggested “A Day in the Life of the Reserve” to include the entire Reserve. NYSDEC has several existing citizen monitoring programs that may be applicable in the Reserve, including Water Assessments by Volunteer Evaluators (WAVE) for streams and NY iMapInvasives for reporting terrestrial and aquatic invasive species.

Action 7.4.2: Develop a system of citizen scientists monitoring the estuary on an ongoing basis

The SSELF program of the New York State Marine Education Association, Sierra Club Sentinels, and the Long Island Sound Study citizen monitoring network are all models which could be used to develop a citizen monitoring network in the Reserve. The Long Island Nitrogen Action Plan (LINAP) program will also include a Citizen Science component that the Reserve should participate in. These efforts should be complementary to the Reserve’s Coordinated Water Resource Monitoring Strategy and coordinated with LINAP, Peconic Estuary Partnership and Seatuck Environmental Association.

Action 7.4.3: Develop centralized database and standard methodology and protocols for citizen scientists

The Reserve office should Coordinate with Peconic Estuary Partnership, Long Island Sound Study, Seatuck Environmental Association, and other research institutions to establish a centralized database along with a standard methodology for citizen science programs throughout the Reserve to report their findings.

Action 7.4.4: Explore the development of an annual college student conference and/or research fair, in cooperation with other groups, that would be focused on the estuary

Working with other groups interested in the success of the Reserve, the Reserve office should develop a conference or research fair. Local colleges in cooperation with the New York State Marine Education Association have run these types of programs in the past.

Action 7.4.5: Continue the Reserve stewardship award and certificate programs to recognize citizens or organizations that have made significant contributions to the improvement of the estuary

Six awards have been distributed to citizens or groups and hundreds of certificates have been given to students and community groups recognizing their contributions to the estuary. These awards increase the visibility of the Reserve and reward partners who are working to preserve and improve it.

Outcome 7.5: The Science, Research, and Technology Used and Occurring within the Reserve is Incorporated into School Curriculums

Action 7.5.1: Use NYS STEM (Science, Technology, Engineering and Mathematics) education, as well as other curricula to integrate science, estuarine issues, research and projects that exist in the Reserve into the school curriculum.

Teachers can integrate the STEM principles into their curriculum by choosing from among the numerous projects that have been implemented within the Reserve. For example, the science of water quality impairments uses math, chemistry and physics; the installation of stormwater inserts, as well as designing stormwater retention basins, uses engineering and math; the installation of monitoring buoys uses technology, math and chemistry. The Reserve is a wealth of STEM examples and would be invaluable when used as a teaching tool. Curricula outside the STEM could also be expanded to highlight the stories, traditions, livelihoods and cultures of the Reserve.

With the recent adoption of the New York State Science Learning Standards, there is an opportunity to collaborate with local formal and informal educators to develop new place-based curriculum units focused on the SSER. Title 1 schools can apply for funding through the Office of Parks, Recreation and Historic Preservation's "Connect Kids to Parks" Transportation Grant Program to cover eligible field trip costs to facilitate experiential learning in the Reserve.

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