Friends of the Bay
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KEEPING THE OYSTER IN OYSTER BAY

Oyster Bay / Cold Spring Harbor
Watershed Action Plan

August 2011



Prepared by
FUSS & O'NEILL

RAUCH FOUNDATION

Long Island Sound Study
A Partnership to Restore and Protect the Sound

TOWN OF OYSTER BAY 1653 NEW YORK

Long Island Community Foundation

National Fish and Wildlife Foundation

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The Incorporated Village of Lloyd Harbor
Incorporated Village of Matinecock
Incorporated Village of Mill Neck
Incorporated Village of Muttontown
Incorporated Village of Old Brookville
Incorporated Village of Oyster Bay Cove
Incorporated Village of Upper Brookville

We would also like to recognize the Friends of the Bay staff and board members who contributed to the development of this plan. The work of previous Friends of the Bay staff and board members provided a platform from which to build the Watershed Action Plan. The staff of Fuss & O'Neill played an integral role in the development of this Watershed Action Plan. We are deeply indebted to all who have played a role in preserving, protecting and restoring the Oyster Bay/Cold Spring Harbor Estuary.

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Who We Are

Friends of the Bay (FOB) – a widely respected, not-for-profit organization with thousands of supporters – is dedicated to the protection of the Oyster Bay/Cold Spring Harbor estuary and the surrounding watershed. FOB's advocacy efforts enable the estuary to continue as an unsurpassed scenic, ecological and economically-productive resource.

Our Mission

FOB's mission is to protect, preserve and restore the ecological integrity and productivity of the Oyster Bay/Cold Spring Harbor estuary and the surrounding watershed.

What We Do

- Helping to maintain clean waters that sustain a vital ecosystem, a wide range of recreation and a thriving shellfishing aquaculture business
- Monitoring water quality within the estuary
- Creating awareness of the need to preserve water quality and marine life
- Confronting unsound development proposals
- Promoting responsible development and land use planning
- Partnering with residents, organizations, and local businesses
- Working with government at all levels

How We Are Perceived

Friends of the Bay has received the Region 2 Environmental Quality Award by the Environmental Protection Agency for its water quality monitoring program. This award recognizes individuals and organizations that have significantly contributed to improving environmental quality during the prior year; have demonstrated a high level of achievement; and have created unique or location-specific benefits, produced results that are sustainable or reproducible, or increased public involvement in environmental action.

In 1997, we became one of the few East Coast groups ever to receive the prestigious Walter B. Jones Memorial and NOAA (National Oceanic and Atmospheric Administration) Excellence Award in Coastal and Ocean Resource Management presented to the "Non-Governmental Organization of the Year." In 1999, the New York Chapter of the American Planning Association honored FOB with an Award for Meritorious Achievement. Friends of the Bay was selected in the "Best Environmental Organizations" category of the *Long Island Press'* Best of Long Island 2008 issue (Volume 7, Issue 2). (This is the third year the readers of the *Long Island Press* selected us as their choice in this category.)

More importantly, our cooperative planning efforts are models for local governments and other environmental groups around Long Island Sound that seek to prepare watershed plans to protect their embayments and reap the benefits of a cleaner Sound. Our Executive Director sits on the Long Island Sound Study Citizens Advisory Committee, the Town of Oyster Bay Eastern Waterfront Visioning Plan Steering Committee, the Oyster Bay/Cold Spring Harbor Protection Committee and the Northport Harbor Protection Committee.

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Executive Summary

The Harbor Complex – A Threatened Vital Resource

The Oyster Bay/Cold Spring Harbor Complex is the cleanest estuary in western Long Island Sound and is a vital ecological, economic, and recreational resource. The approximately 6,000-acre estuary, spanning approximately 40 linear miles of shoreline, is the site of one of the most economically important shellfisheries in the State, contains a National Wildlife Refuge, State-designated Significant Coastal Fish and Wildlife Habitats, and has been identified by New York State as an Outstanding Natural Coastal Area. Moreover, the Oyster Bay/Cold Spring Harbor Complex is connected to Long Island Sound, an Estuary of National Significance. Oyster Bay is among the 30-plus areas highlighted by the Long Island Sound Study Stewardship Initiative, in New York and Connecticut, for the ecological and/or recreational values that they support.

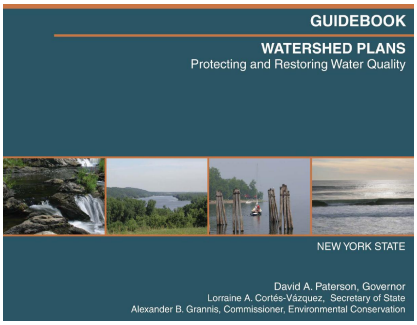
The Oyster Bay/Cold Spring Harbor estuary and its watershed have been facing increasing challenges in recent years. Illegal dumping and polluted stormwater threaten water quality, development pressure is reducing the amount of open space and increasing impervious surfaces in the watershed, and man-made dams and culverts inhibit fish passage along streams.

Defenders of Wildlife announced in October 2005 that the Oyster Bay National Wildlife Refuge (NWR) would be placed on their annual list of the ten most endangered Refuges in the country due to polluted stormwater runoff; habitat destruction; non-sustainable development; and human sewage associated with failing sewer infrastructure and inadequate on-site septic systems.

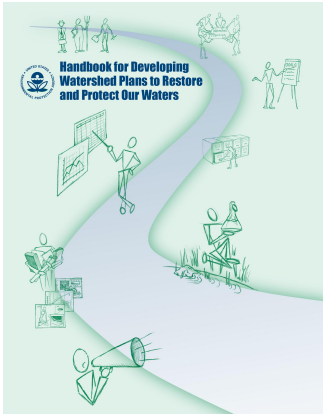
Portions of the Oyster Bay/Cold Spring Harbor watershed are located within the Oyster Bay Special Groundwater Protection Area, designated a Critical Environmental Area by the NYSDEC. The Oyster Bay Special Groundwater Protection Area is one of two such state-designated areas in Nassau County for the purpose of maintaining open space for aquifer recharge. The watershed also contains the West Hills Melville Special Groundwater Protection Area in Huntington, another important protection area for drinking water supply. Ongoing development, intensification of land use, and everyday activities within the watershed has the potential to adversely impact groundwater and public drinking water supplies.

The Oyster Bay/Cold Spring Harbor Complex is the site of one of the most economically-important shellfisheries in the State. The Frank M. Flower & Sons, Inc. shellfish company, along with more than 80 independent commercial baymen, annually harvests up to 90% of New York's oyster crop and up to 33% of the State's hard clam crop from the heart of the National Wildlife Refuge. Most of the waters of Oyster Bay are classified with the highest and best water quality determination for shellfishing – an unusual distinction given its proximity to New York City and the fact that the harbors to the west have been closed for several decades. The detrimental impact of degraded water quality on shellfishing in the estuary complex is evident as Oyster Bay Harbor, Mill Neck Creek, and its tidal tributaries are among the 69 waterbodies on the New York State list of impaired waters for shellfish harvesting, and the NYSDEC has decertified all shellfish harvesting areas in Mill Neck Creek and some shellfish harvesting areas in Oyster Bay.

The Need for a Comprehensive Watershed-Based Plan



Friends of the Bay, working with the Town of Oyster Bay and other governmental entities, stakeholder groups, and the general public, recognizes the need to address the water resource issues of the Oyster Bay/Cold Spring Harbor estuary complex using a watershed-based approach. A primary way to do this is by developing and implementing a comprehensive watershed management plan to protect and restore water resource conditions throughout the watershed.



This watershed management plan has been developed in two phases – a State of the Watershed Report and a Watershed Action Plan – following an approach endorsed by the U.S. Environmental Protection Agency (EPA), the NYSDEC, and the New York State Department of State (NYSDOS) Division of Coastal Resources for developing watershed-based plans.

The State of the Watershed Report, prepared on behalf of Friends of the Bay in November 2009 (Fuss & O'Neill, Inc.), summarized existing environmental and land use conditions within the Oyster Bay/Cold Spring Harbor watershed. The State of the Watershed Report integrated a variety of environmental indicators to assess the current health of the watershed and potential future threats. The report provided a baseline assessment of watershed conditions, which can be updated periodically to evaluate changes in the watershed and help direct watershed management planning. The State of the Watershed Report therefore serves as the basis for the Watershed Action Plan.

This Watershed Action Plan identifies prioritized action items to protect and improve the health of the Oyster Bay/Cold Spring Harbor watershed and estuary. The plan has been developed to address the priorities and issues identified in the State of the Watershed Report, with significant participation by a steering committee of interested stakeholders and the public. The Watershed Action Plan is designed to have the clear potential to affect on-the-ground change within the watershed by recommending specific, measurable actions to protect and improve water resource conditions.

Plan Development Process

The Watershed Action Plan has been developed consistent with State and Federal guidance for the development of watershed-based plans. Following this approach will enable implementation projects under this plan to be considered for funding under Section 319 of the Clean Water Act and improve the chances for funding through other State and Federal sources.

In addition to building on the baseline information provided in the State of the Watershed Report, development of the Watershed Action Plan consisted of the following major components:

- Project Steering Committee – A Project Steering Committee was formed to guide the development of the action plan, including a technical advisory committee consisting primarily of municipal and agency representatives and a larger project advisory committee representing additional stakeholder groups and interested members of the public. A series of workshop meetings were held with the Project Steering Committee to reach consensus on watershed planning goals and objectives and to discuss specific recommended actions. The steering committee also guided the plan development process by providing review comments on draft deliverables. The Watershed Action Plan reflects the combined efforts of Friends of the Bay and the Fuss & O'Neill project team, the Project Steering Committee including representatives of the watershed municipal entities and state/federal resource agencies, and other stakeholders. Members of the Project Steering Committee and others involved in the plan development process are listed in the Acknowledgments section at the beginning of this document.

- Plan Goals and Objectives – The project team developed a series of goals and objectives for the watershed based upon the findings of the State of the Watershed Report, the results of a watershed survey developed by Friends of the Bay, and a consensus-building exercise during the initial steering committee meeting.

- Recommended Actions – Potential management actions were identified for each of the plan goals and objectives and subsequently refined based upon input from the Project Steering Committee during and following the second workshop meeting. Management actions included short and long-term actions, as well as watershed-wide and site-specific actions. Site-specific retrofit and restoration concepts were developed based on the watershed field inventories and baseline assessments that were performed as part of the State of the Watershed Report. Recommended actions were further refined by considering technical feasibility, cost-effectiveness, potential for success (i.e., achievable), potential environmental impacts and benefits (including anticipated pollutant load reductions), and overall public acceptance, culminating in the plan recommendations that are presented in this document.

- Public Outreach – A variety of public outreach also occurred during the watershed planning process to enhance public understanding of issues affecting the watershed and to encourage early and continued participation in the development and implementation of the action plan. The public outreach events and activities included steering committee meetings open to the public, a web-based questionnaire inviting input from

the public, dissemination of project-related information though the Friends of the Bay website, and the formation of and collaboration with the Oyster Bay/Cold Spring Harbor Protection Committee.

Priority Actions for the Oyster Bay/Cold Spring Harbor Watershed

The actions in the following table are a subset of the recommended actions that have been identified in this Watershed Action Plan. These "priority" recommendations are actions that are most critical to the success of this watershed plan and will have the greatest benefit to water resource conditions in the Oyster Bay/Cold Spring Harbor Complex and its watershed. The table lists the related plan goals and includes references to specific objectives and actions in *Section 3* of this Watershed Action Plan for more detailed information on each recommendation.

Priority Action	Related Goal	For More Information
Develop and adopt an Oyster Bay/Cold Spring Harbor Protection Committee inter-municipal agreement.	Capacity Building	Action 1-4
Create an Information Resource Center to serve as a web-based clearinghouse and database of information about the watershed.	Capacity Building	Action 1-8
Improve the understanding of water quality conditions in the harbor complex and sources of impairments through the use of new science and innovative techniques.	Water Quality	Objective 1
Develop model municipal land use codes and regulations to better protect water quality and natural resources. Amend municipal land use codes and regulations based on these models.	Water Quality; Land Use and Open Space	Action 4-6 (Water Quality) Action 1-2 (Land Use)
Develop and implement Watershed Improvement Strategy pathogen reduction plans and stormwater retrofits to reduce pathogen loads and meet MS4 Permit requirements. Promote Low Impact Development (LID) and Green Infrastructure approaches for private development and municipal stormwater infrastructure.	Water Quality	Objective 3
Implement priority buffer restoration projects around streams and ponds, and adopt local riparian buffer regulations.	Water Quality	Action 4-1 Action 4-2
Strengthen local septic system regulations to require new and replacement systems to meet Nassau County standards and to require periodic septic system inspection and maintenance. Provide training to building inspectors on enforcement.	Water Quality	Objective 5
Protect and restore shellfish populations by establishing a public shellfish spawner sanctuary and restoring and expanding public shellfish production areas and methods.	Habitat Protection and Restoration	Objective 3
Protect and restore fisheries and wetland habitat by implementing priority fish passage and stream restoration projects, wetland restoration projects, and adopting alternatives to traditional shoreline hardening.	Habitat Protection and Restoration	Action 2-1 Action 2-2 Action 2-4 Action 4-3 Action 4-4
Preserve and protect open space and increase public access to open space and waterbodies. Create a water trail along the harbor to increase water-related recreational opportunities, public access to the waterfront, and public stewardship of the estuary complex.	Sustainable Land Use and Open Space	Objectives 2 and 3

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1 Introduction

1.1 Importance of the Estuary Complex

The Oyster Bay/Cold Spring Harbor Complex (which is comprised of Oyster Bay Harbor, Cold Spring Harbor, Mill Neck Creek, and Oyster Bay) is the cleanest estuary in western Long Island Sound and is a vital ecological, economic, and recreational resource. The approximately 6,000-acre estuary, spanning approximately 40 linear miles of shoreline, is the site of one of the most economically important shellfisheries in the State, contains a National Wildlife Refuge, State-designated Significant Coastal Fish and Wildlife Habitats, and has been identified by New York State as an Outstanding Natural Coastal Area. Moreover, the Oyster Bay/Cold Spring Harbor Complex is connected to Long Island Sound, an Estuary of National Significance. Oyster Bay is among the 30-plus areas highlighted by the Long Island Sound Study Stewardship Initiative, in New York and Connecticut, for the ecological and/or recreational values that they support.

The harbor complex watershed is an approximately 39 square-mile area located in Nassau and Suffolk Counties. Approximately 80 percent of the watershed is located within the Town of Oyster Bay and its incorporated villages and unincorporated hamlets. A small portion (less than 2 percent) of the watershed is located in Glen Cove, also in Nassau County. The remaining 18 percent of the watershed is within the Town of Huntington and its incorporated villages in Suffolk County. The Oyster Bay/Cold Spring Harbor Complex watershed consists of 14 smaller subwatersheds, from which surface runoff potentially enters the estuary (*Figure 1-1*).

1.2 Issues Facing the Estuary and Its Watershed

The Oyster Bay/Cold Spring Harbor estuary and its watershed have been facing increasing challenges in recent years. Polluted stormwater threatens water quality, development pressure is reducing the amount of open space and increasing impervious surfaces in the watershed, and man-made dams and culverts inhibit fish passage along streams. Use impairments to shellfishing, public bathing, fish consumption, habitat/hydrology, aquatic life, and recreation have been identified for parts of the harbor complex. Future uncontrolled development in the watershed would increase the quantity of stormwater runoff to Oyster Bay/Cold Spring Harbor, despite a 2003 New York State Department of Environmental Conservation (NYSDEC) report that highlighted urban runoff as the dominant source of pathogens to the estuary complex (NYSDEC, 2003).

In addition to these findings by the NYSDEC, Defenders of Wildlife announced in October 2005 that the Oyster Bay National Wildlife Refuge (NWR) was placed on their annual list of the ten most endangered Refuges in the country. The Refuges at Risk: America's Ten Most Endangered National Wildlife Refuges 2005 report explains that the Oyster Bay NWR has become threatened by polluted stormwater runoff; habitat destruction; non-sustainable development; and human sewage associated with failing sewer infrastructure and inadequate on-site septic systems. These human-induced impacts adversely affect the Oyster Bay/Cold Spring Harbor Complex.

Figure 1-1

Portions of the Oyster Bay/Cold Spring Harbor watershed are located within the Oyster Bay Special Groundwater Protection Area, designated a Critical Environmental Area by the NYSDEC. The Oyster Bay Special Groundwater Protection Area is one of two such state-designated areas in Nassau County for the purpose of maintaining open space for aquifer recharge. The watershed also contains the West Hills Melville Special Groundwater Protection Area in Huntington, another important protection area for drinking water supply. Long Island's drinking water system was designated as the nation's first Sole Source Aquifer, requiring special protection. Ongoing development, intensification of land use, and daily activities within the watershed have the potential to adversely impact groundwater and public drinking water supplies.

The Oyster Bay/Cold Spring Harbor Complex is also the most economically-important shellfishery in the State. The Frank M. Flower & Sons, Inc. shellfish company, along with more than 80 independent commercial baymen, annually harvests up to 90% of New York's oyster crop and up to 33% of the State's hard clam crop from the heart of the National Wildlife Refuge. Most of the waters of Oyster Bay are classified with the highest and best water quality determination for shellfishing – an unusual distinction given its proximity to New York City and the fact that the majority of the harbors to the west have been closed for more than 30 years. The detrimental impact of degraded water quality on shellfishing in the estuary complex is evident as Oyster Bay Harbor, Mill Neck Creek, and its tidal tributaries are among the 69 waterbodies on the New York State list of impaired waters for shellfish harvesting, and the NYSDEC has decertified all shellfish harvesting areas in Mill Neck Creek and some shellfish harvesting areas in Oyster Bay. The harbor complex is also a highly productive area for marine finfish and an important wintering area for a variety of waterfowl (Cashin Associates, P.C., 2002).

1.3 State of the Watershed

Land Use

Low-density residential land use is the predominant (approximately 64 percent) land use in the watershed (*Figure 1-2*). Approximately 10 percent of the watershed is considered open space, including conservation land and public parks. Transportation land use, including local and county roads and highways, comprises approximately 7 percent of the watershed land area. Commercial land use accounts for less than 2 percent of the watershed area, with the majority of the commercial areas concentrated in Oyster Bay Hamlet and along the Route 106/Pine Hollow Road/South Street corridor. Other isolated commercial areas are located along Forest Avenue in Locust Valley, in Laurel Hollow near the head of Cold Spring Harbor, along Main Street in Cold Spring Harbor, along Jericho Turnpike in Woodbury and West Hills, and the stands and Bridge Marine areas in Bayville. Current and former industrial land use account for a small percentage of the watershed area (0.1 percent) and are located primarily along the Oyster Bay waterfront and Oyster Bay Hamlet.

The harbor complex watershed is characterized by roughly equal amounts of forested and developed land. Approximately 45 percent of the watershed consists of deciduous and coniferous forest cover, which is associated with open space and wooded portions of low-density residential properties. Forest cover in each subwatershed ranges from approximately 15

percent in the White's Creek subwatershed to approximately 65 percent in the Tiffany Creek subwatershed.

Impervious surfaces cover approximately 12 percent of the harbor complex watershed (*Figure 1-3*). Impervious cover, which is one indicator of the cumulative effects of urbanization on receiving water quality and watershed ecology, is generally highest (30 to 70 percent) in the urbanized areas of Oyster Bay Hamlet, the City of Glen Cove, and the Villages of Bayville, Locust Valley, West Hills and the southern portion of Woodbury. The White's Creek subwatershed has the highest impervious cover (approximately 43 percent), which is consistent with the high-density development in Oyster Bay Hamlet. Several of the subwatersheds have significantly less than 10 percent impervious cover, including the Bailey Arboretum and Lloyd Neck subwatersheds.

The harbor complex watershed is largely built-out. There are relatively few vacant, undeveloped parcels with future development potential. Most of the undeveloped land in the watershed consists of protected or recreational open space. Overall, less than 3 percent of the watershed area has the potential for new development. The actual amount of land in the watershed that is subject to future development is likely even less since development on these parcels would be restricted by wetlands, steep slopes, and other physical factors, as well as maximum lot coverage, setbacks, and other zoning constraints. Most significant future development will most likely occur as infill or redevelopment. Redevelopment activities – such as new commercial development, residential tear-downs and construction of significantly larger homes, and other infill development – also pose a potential threat to water quality resulting from increased impervious cover, intensification of land use and new pollutant sources, and threats to natural resources such as wetlands and riparian buffers. The impacts of redevelopment can often be more challenging to address effectively given the isolated nature of most redevelopment projects, multiple municipal jurisdictions, and the frequent lack of land use regulations that apply to redevelopment projects.

Water Quality

Mill Neck Creek and parts of both Cold Spring Harbor and Oyster Bay Harbor do not meet water quality standards for shellfish harvesting due to elevated levels of pathogenic organisms. Consequently, water quality issues in the harbor complex have focused on elevated pathogen levels, which impact shellfish harvesting in the estuary. NYSDEC has developed Total Daily Maximum Loads (TMDL) for pathogens for the impaired waters in the Oyster Bay/Cold Spring Harbor complex. A TMDL determines the maximum amount or load of a pollutant from both point and non-point sources that a waterbody can receive and continue to meet applicable water quality standards. Several studies and water quality monitoring programs have identified likely sources of pathogens to the estuary, including:

- Domestic waste disposal using cesspools
- Stormwater discharges
- Wastewater treatment plants
- Freshwater streams
- Boats/marinas/mooring areas
- Wildlife and waterfowl
- Pets

Figure 1-2

Figure 1-3

Water quality monitoring data collected by Friends of the Bay and other groups suggests that the water quality in the harbor, particularly in near-shore areas, is strongly influenced by freshwater sources and activities on the land. One location, in particular, has been identified as a significant contributor of pollutants to the harbor complex. This site is located near the outflow of Mill Pond and the Mill River, which supports a substantial population of waterfowl, and Beekman Creek, which flows under West Shore Road and the Beekman Beach parking lot and eventually discharges to the Mill River and Oyster Bay Harbor. It is suspected that the outflow of Mill Pond and the Mill River, including stormwater discharges from West Shore Road to Beekman Creek, is contributing to elevated levels of bacteria and nutrients.

The projected increase in future pollutant loads is relatively small for the watershed as a whole since much of the watershed is already developed or consists of protected open space. However, several of the subwatersheds could experience significant increases in pollutant loads and loading rates under a watershed buildout scenario, including the Tiffany Creek, Mill River, Oyster Bay Harbor, and Kentuck Brook subwatersheds. The buildout conditions of the Mill River and Oyster Bay Harbor subwatersheds are projected to result in greater than 5 percent increase in pollutant loading rates for nitrogen, phosphorus and sediment loads.

Wetlands

Freshwater and tidal wetlands provide a multitude of functions including flood and stormwater control, pollution reduction, marine food production, wildlife habitat, recreational opportunities, open space, and aesthetic value. Freshwater wetlands comprise less than 2 percent of the harbor complex watershed. The majority of these wetlands are associated with ponds along Beaver Brook, Mill River, Tiffany Creek, and Cold Spring Brook. Approximately 1,000 acres of tidal wetlands exist within the harbor complex. Extensive areas of coastal shoals, bars, and mudflats occur along Mill Neck Creek, the western and southern shoreline of Oyster Bay Harbor, Inner Cold Spring Harbor, and the northeast shoreline of Centre Island. Most of the shoreline in the harbor complex is fringed by vegetated tidal wetlands of varying width, interrupted by man-made waterfront structures. The west shore of Oyster Bay has experienced significant erosion along the sea wall, which is scheduled for replacement with no plan for restoration of the grass marsh that once fringed the shoreline.

Fish and Wildlife

The Oyster Bay/Cold Spring Harbor Complex and its watershed provide abundant and significant habitat that supports a variety of fish and wildlife. The presence of diverse fish and wildlife habitats and species is indicative of the capacity of the harbor complex and its watershed to support these natural resources, despite the developed suburban landscape that makes up a large percentage of the watershed.

Various estuarine, palustrine, riverine, and upland areas provide habitat to finfish, shellfish, mammals, amphibians, reptiles and birds. The most notable tracts of protected or preserved land (including submerged or tidal areas) within the estuary and watershed include (*Figure 1-4*):

- Oyster Bay National Wildlife Refuge
- Charles T. Church/Shu Swamp Nature Preserve
- Sagamore Hill National Historic Site

Figure 1-4

- Planting Fields Arboretum
- Muttontown Preserve
- Bailey Arboretum
- Stillwell Woods Park
- Tiffany Creek Preserve
- Upland Farm (The Nature Conservancy)

Due to the importance of these habitats, the State of New York has designated some of them as Significant Coastal Fish and Wildlife Habitats (SCFWH), which provide living and feeding areas for animals and are also economically important. Three NYSDEC-designated SCFWH areas exist in the watershed: Mill Neck Creek, Cold Spring Harbor, and Oyster Bay Harbor.

The Oyster Bay National Wildlife Refuge (NWR) is a 3,200-acre refuge that is the largest in the Long Island National Wildlife Refuge Complex. Oyster Bay NWR includes the northern three-quarters of Oyster Bay Harbor, the northwestern quadrant of Cold Spring Harbor (approximately 1,000 acres), and all of Mill Neck Creek (*Figure 1-4*). The Oyster Bay NWR is well-sheltered from Long Island Sound and, as such, provides excellent winter habitat for a variety of water fowl and shorebirds. It also provides significant nursery and feeding habitat for finfish and substrate for shellfish (USFWS, 2009).

Silt carried by stormwater runoff can smother large areas of shellfish beds, inhibiting growth and rendering areas unproductive. Stormwater runoff therefore presents a significant threat to the shellfish industry, as well as water quality due to loss of filtering capacity of shellfish.

Water Supply

All of Long Island's drinking water is obtained from groundwater aquifers, and its drinking water system was designated as the nation's first Sole Source Aquifer. To protect these groundwater aquifers, the state designated nine Special Groundwater Protection Areas (SGPAs), as defined in Article 55 of the NYS Environmental Conservation Law. The Oyster Bay SGPA is one of two such state-designated aquifer recharge areas in Nassau County. The Town of Oyster Bay has an Aquifer Protection Overlay District (APO) in addition to the SGPA, adopted in 2004, which affords added protection to groundwater resources.

The Town of Huntington contains portions of two SPGAs, only one of which (West Hills/Melville in the western part of the Town) is located within the Oyster Bay/Cold Spring Harbor Complex watershed. Most of the Town of Huntington's public water supply wells are located outside of SPGAs. Unlike the Town of Oyster Bay, Huntington has not enacted aquifer protection overlay district regulations.

Wastewater

Oyster Bay Hamlet and portions of the Unincorporated Village of Upper Brookville are served by sanitary sewers that transport sanitary waste to the Oyster Bay Sewer District Sewage Treatment Plant (OBSD). The treatment plant is located in Oyster Bay Hamlet and discharges treated effluent to Oyster Bay Harbor east of the Mill River outlet.

The OBSD has been in service since 1926 and has been upgraded several times. The most recent upgrade occurred in 2006 to provide advanced treatment for nitrogen removal. Nitrogen has been identified as the primary pollutant causing low dissolved oxygen conditions, or hypoxia, occurring throughout much of Long Island Sound's bottom waters each summer. To address this water quality problem, NYSDEC imposed limits to reduce nitrogen discharged from the municipal treatment plants located on the north shore of Long Island. NYSDEC issued a revised discharge permit that required the OBSD to reduce nitrogen discharged to Oyster Bay from the treatment plant by 63.8 percent in three 5-year increments by August 2014. The OBSD advanced treatment facility is achieving the 2014 nitrogen limits imposed by NYSDEC permit, and the upgrade has reduced the daily nitrogen discharged by as much as 75%.

Much of the harbor watershed is served by individual on-site sewage disposal systems, including cesspools and septic tank systems. Cesspools were the most common method of on-site sewage disposal until about 1973, when the local development regulations were modified to require the installation of septic tanks and leaching systems.

Cesspools and septic systems are a potential source of pollution, including nitrogen, pathogens, and other contaminants, to surface waters and groundwater as a result of system failure (inadequately treating sewage or by creating potential for direct or indirect contact between sewage and the public) or malfunction (typically a slow loss of function that is difficult to detect). Since a large portion of the watershed was developed prior to 1973, failure or malfunction of cesspools and septic systems is believed to be a significant source of pollution to surface water and groundwater.

The Birches (also known as Continental Villas) is a residential subdivision located on the west side of Oak Neck Creek, in the Locust Valley area. This subdivision historically operated its own sewage treatment system, which suffered chronic problems due to cesspool overflows and inadequate treatment of waste, impacting low-lying wetlands and the adjacent creek. Failing and/or low-functioning individual on-site sewage disposal systems located in this area are also believed to have contributed to these chronic problems. Long-awaited upgrades to sewer and water infrastructure in this area are near completion, which will connect the homes in the Birches residential subdivision to the Glen Cove sewage treatment plant. This project will eliminate chronic cesspool overflows from this development to Mill Neck Creek.

Stormwater

The stormwater collection and drainage system within the harbor complex watershed consists of drainage infrastructure operated and maintained by the watershed municipalities, including the Town of Oyster Bay, the Town of Huntington, the associated villages, and Nassau and Suffolk Counties. All of these municipal entities are regulated small Municipal Separate Storm Sewer Systems (MS4s) under the NYSDEC State Pollution Discharge Elimination System Phase II stormwater program. Most of the smaller municipalities in the watershed lack the resources to properly address the Phase II program requirements.

Stormwater within the watershed is discharged to surface waters and to groundwater. A large portion of the watershed drains to surrounding surface waters through numerous outfalls and as overland flow (*Figure 1-5*).

Increased infiltration of stormwater runoff by use of basins or sumps has been practiced on Long Island since the 1930s to recharge collected stormwater back to the groundwater system. In the 1950s, Nassau and Suffolk Counties adopted regulations requiring stormwater to be retained and infiltrated onsite if feasible. Subsequently, the use of drywells, recharge basins, and drainage reserve areas became common practice to retain and infiltrate stormwater runoff from roadways in residential, commercial, and industrial areas. Recharge basins are most prevalent in eastern Nassau County and western Suffolk County. Most of these facilities have overflow structures that direct stormwater resulting from extreme rainfall events to either other recharge basins or to drainage facilities that ultimately discharge to surface waters. These recharge basins lose function if not regularly maintained (although high groundwater levels may cause standing water in some basins all or part of the year), resulting in increased flows to surface waters. Many recharge basins in the watershed are in need of maintenance.

Since much of the watershed was developed prior to the adoption of stormwater quality regulatory requirements, most of the existing drainage infrastructure that does not discharge to recharge basins consists of traditional storm drains/catch basin and storm pipes that discharge directly to surface waters without treatment, other than detention to maintain peak rates of discharge. Uncontrolled stormwater runoff from impervious surfaces is a significant source of potential impacts to surface waters within the harbor complex watershed, groundwater supplies, benthic habitat of streams, lakes, ponds, and estuaries, and the water quality of the harbor complex itself.

Through their Phase II stormwater management programs and other planning initiatives, the watershed municipal entities, including Nassau and Suffolk Counties, have developed and implemented a variety of Best Management Practices to address stormwater quality and quantity issues associated with land development and redevelopment projects. The municipalities have also begun to address historical development and nonpoint source pollution impacts in the watershed by identifying potential sites for stormwater retrofits and have begun installing retrofits, including hydrodynamic separators and storm drain inserts. However, stormwater runoff continues to be a significant threat to the water quality and overall health of the Oyster Bay/Cold Spring Harbor Complex and its watershed. The current NYSDEC Phase II stormwater permit contains requirements specific to Long Island pathogen impaired watersheds, including Oyster Bay, Cold Spring Harbor, and Mill Neck Creek, to reduce pathogen loads through an inter-municipal, watershed-based approach.

Climate Change

Changes in climate are anticipated to occur over the next century. The magnitude of changes in temperature, sea level, and the timing and intensity of rainfall will depend upon future emissions of carbon dioxide and other greenhouse gases driving climate change. Climate change in the Northeastern U.S. is anticipated to result in an increase in the extent and frequency of coastal flooding, a rise in the frequency of severe storms and related damages, and sea level rise of 2 to 6 feet (Frumhoff et al., 2007). Increases in sea level and frequency of severe storms will result in more inundation of coastal areas, and subsequent increases in shoreline erosion and wetland loss. Inundation of low-lying areas will result in the potential for saltwater to infiltrate into freshwater surface waters and aquifers. Increased flooding and erosion has the potential to impact transportation infrastructure and sewage and septic systems.

Figure 1-5

Coastal wetlands are vulnerable to the effects of sea-level rise, increasing water temperatures, and increased nutrients. If accretion of river-borne sediment and organic matter is unable to keep pace with the combined affects of sea-level rise and land subsidence, coastal marshes will be reduced or disappear. This will impact the ecological services provided by these areas including buffering coastal areas from waves and erosion, filtering nutrients and pollutants, providing wildlife habitat, and providing nursery areas for fisheries. Because hard-clams and oysters depend on wetland-based food chains, impacts to coastal wetlands are anticipated to impact those fisheries (Frumhoff et al., 2007).

Subwatershed Analysis and Restoration Potential

A comparative subwatershed analysis was performed for the Oyster Bay/Cold Spring Harbor subwatersheds to identify the subwatersheds with the greatest restoration potential (i.e., subwatersheds that have the greatest problems, combined with the potential to address these problems). Subsequent field assessments were performed in priority subwatersheds to evaluate potential pollutant sources and environmental problems, as well as possible locations where restoration opportunities and mitigation measures can be implemented. The findings of these and other related assessments identified a number of key findings and common issues throughout the watershed, including:

- Overall in-stream habitat in the assessed reaches was mixed, although many of the stream reaches assessed appear to be either supporting biological communities (fish, frogs, birds, etc.) or sufficient to support such communities.

- Many potential barriers to fish passage were observed throughout the watershed. The impacts of these obstructions on fish passage and the feasibility of fish barrier removal efforts in the harbor complex watershed have been evaluated through a study led by the Long Island Chapter of Trout Unlimited, Environmental Defense, and Friends of the Bay. These groups are currently pursuing options for watershed restoration projects based on the results of this study.

- Segments of some streams in the watershed are buried in underground conduits, providing potential opportunities for daylighting and stream restoration to enhance aquatic and wildlife habitat, improve aesthetics, and provide educational opportunities.

- Stream buffer encroachments are prevalent along stream corridors in or near areas of residential, commercial, and industrial development and roads. Education, signage, stream buffer regulations, and stream cleanups are potential approaches for improving buffer management.

- Residential roofs and driveways appear to contribute significant quantities of stormwater runoff to the storm drainage system. Opportunities exist to disconnect residential rooftop runoff from the storm drainage system through the use of rain barrels, rain gardens, and pervious driveways.

- Redevelopment activities such as residential tear-downs and infill development are a major potential threat to water quality. The potential negative impacts of redevelopment are most effectively addressed through revised land use regulations applied consistently by the watershed municipalities. Opportunities exist to strengthen land use regulatory controls through model land use codes and regulations for use by the watershed municipalities.

- Lawn-care maintenance practices in residential areas are typically high. Opportunities exist to educate the public about the impacts of lawn care practices on the water quality of the harbor complex and to encourage the use of residential lawn care best management practices.

- Most of the development in the watershed employs traditional curb and gutter storm drainage collection systems with little, if any, stormwater management beyond water quality inlets and detention basins for peak flow control. Parking lots associated with existing commercial development, municipal and institutional land uses, and commuter parking areas are potential candidates for stormwater retrofits to reduce site runoff and improve water quality through the use Low Impact Development (LID) and green infrastructure retrofits.

- Opportunities exist for stormwater retrofits at roadway stormwater outfalls throughout the watershed. Opportunities also exist for incorporating LID practices into existing roadway upgrades and retrofit projects (i.e., "green streets") to promote stormwater infiltration, streetscape improvements, and traffic calming.

- Relatively isolated areas of moderate to severe streambank erosion were observed along Beaver Brook, Mill River, Cold Spring Brook, Tiffany Brook, and White's Creek, providing opportunities for bank stabilization projects.

- Hotspot land uses and facilities, including several commercial shopping centers, the Town of Oyster Bay highway yard, the LIRR Maintenance Yard, Commander Oil Terminal, and municipal parking lots, discharge stormwater directly to receiving waters with no treatment or attenuation. Opportunities exist for improved pollution prevention and source controls at these facilities, or even relocation of facilities in sensitive areas to more appropriate locations.

1.4 Plan Development Process

Friends of the Bay, working with the Town of Oyster Bay and other governmental entities, stakeholder groups, and the general public, recognizes the need to address the water resource issues of the Oyster Bay/Cold Spring Harbor estuary complex using a watershed-based approach. A primary way to do this is by developing and implementing a comprehensive watershed management plan to protect and restore water resource conditions throughout the watershed.

This watershed management plan has been developed in two phases – a State of the Watershed Report and a Watershed Action Plan – following an approach endorsed by the U.S. Environmental Protection Agency (EPA), the NYSDEC, and the New York State Department of State (NYSDOS) Division of Coastal Resources for developing watershed-based plans.

State of the Watershed Report

The State of the Watershed Report, prepared on behalf of Friends of the Bay in November 2009 (Fuss & O'Neill, Inc.), summarized existing environmental and land use conditions within the Oyster Bay/Cold Spring Harbor watershed. The State of the Watershed Report integrates a variety of environmental indicators to assess the current health of the watershed and potential future threats. The report provides a baseline assessment of watershed conditions, which can be updated periodically to evaluate changes in the watershed and help direct watershed management planning. The State of the Watershed Report therefore serves as the basis for the Watershed Action Plan. A copy of the State of the Watershed Report is provided on CD in *Appendix A* of this plan.

Watershed Action Plan

The Watershed Action Plan, which is the subject of this document, identifies prioritized action items to protect and improve the health of the Oyster Bay/Cold Spring Harbor watershed and estuary. The plan has been developed to address the priorities and issues identified in the State of the Watershed Report and previous watershed planning documents including the Mill River Watershed Study and Public Stewardship Program (Cashin Associates in association with Friends of the Bay, December 2007) and the Oyster Bay/Cold Spring Complex Harbor Management Plan (Cashin Associates, June 2002), with significant participation by a steering committee of interested stakeholders and the public. The Watershed Action Plan is designed to have clear potential to affect on-the-ground change within the watershed by recommending specific, measurable actions to protect and improve water quality, habitat, and other watershed resources.

The Watershed Action Plan has been developed consistent with State and Federal guidance for the development of watershed-based plans. The EPA guidance outlines nine key elements that establish the structure of the plan, including specific goals, objectives, and strategies to protect and restore water quality; methods to build and strengthen working partnerships; a dual focus on addressing existing problems and preventing new ones; a strategy for implementing the plan; and a feedback loop to evaluate progress and revise the plan as necessary (EPA, 2008). State-level watershed planning guidance developed by the NYSDOS Division of Coastal Resources also reinforces the EPA watershed planning process (NYSDOS, 2009). Following this approach will enable implementation projects under this plan to be considered for funding under Section 319 of the Clean Water Act and improve the chances for funding through other State and Federal sources.

In addition to building on the baseline information provided in the State of the Watershed Report, development of the Watershed Action Plan consisted of the following major components:

- Project Steering Committee – A Project Steering Committee was formed to guide the development of the action plan, including a technical advisory committee consisting

primarily of municipal and agency representatives and a larger project advisory committee representing additional stakeholder groups and interested members of the public. A series of workshop meetings were held with the Project Steering Committee to reach consensus on watershed planning goals and objectives and to discuss specific recommended actions. The steering committee also guided the plan development process by providing review comments on draft deliverables. The Watershed Action Plan reflects the combined efforts of Friends of the Bay and the Fuss & O'Neill project team, the Project Steering Committee including representatives of the watershed municipal entities and state/federal resource agencies, and other stakeholders. Members of the Project Steering Committee and others involved in the plan development process are listed in the Acknowledgments section at the beginning of this document.

- Plan Goals and Objectives – The project team developed a series of goals and objectives for the watershed based upon the findings of the State of the Watershed Report, the results of a watershed survey developed by Friends of the Bay, and a consensus-building exercise during the initial steering committee meeting.

- Recommended Actions – Potential management actions were identified for each of the plan goals and objectives and subsequently refined based upon input from the Project Steering Committee during and following the second workshop meeting. Management actions included ongoing, short, medium and long-term actions, as well as watershed-wide and site-specific actions. Site-specific retrofit and restoration concepts were developed based on the watershed field inventories and baseline assessments that were performed as part of the State of the Watershed Report. Recommended actions were further refined by working with the Technical Advisory Committee, culminating in the plan recommendations that are presented in *Section 3* of this document.

1.5 Public Outreach

A variety of public outreach occurred during the watershed planning process to enhance public understanding of issues affecting the watershed and to encourage early and continued participation in the development and implementation of the action plan. The public outreach events and activities included:

- Steering Committee Meetings – Workshop meetings were held with the technical and project advisory committees to develop management objectives and priorities, review and evaluate potential management actions, and select the action plan recommendations. A cardstorming exercise was conducted during the initial steering committee workshop to help reach consensus on the issues that should be addressed in the Watershed Action Plan. The cardstorming results assisted in developing clear watershed planning goals and objectives.

- Watershed Questionnaire – A web-based questionnaire was developed by Friends of the Bay at the start of the project to identify concerns, issues, and priorities for the watershed; desired outcomes of the action plan; and to request assistance and participation in the plan development process. The questionnaire was distributed to the Project Steering Committee and other interested members of the public.

- Project Website – The Friends of the Bay website (friendsofthebay.org) was used to disseminate project-related information during the plan development process and to serve as the long-term home of the Watershed Action Plan and future implementation efforts. Social media tools such as Facebook and Constant Contact are also incorporated into the website and were used during the plan development process.

- Oyster Bay/Cold Spring Harbor (OBCSH) Protection Committee – A watershed-wide inter-municipal committee was formed in 2010 to coordinate the watershed protection activities of the various watershed municipalities. Seventeen of the eighteen municipalities located within the watershed have agreed to join the protection committee. The protection committee, working collaboratively with Friends of the Bay, is responsible for implementing the Watershed Action Plan recommendations.

FUSS & O'NEILL

2 Watershed Management Goals and Objectives

This section presents overall management goals for the watershed and specific objectives to achieve these goals. The goals and objectives were developed in conjunction with the project Steering Committee based upon the findings of the State of the Watershed Report, the results of a watershed survey developed by Friends of the Bay, and through discussions and consensus-building during the Steering Committee meetings. Recommended actions to achieve these goals and objectives are presented in *Section 3* of this plan.

Capacity Building for Plan Implementation

Goal: Build a foundation for successful implementation of the Watershed Action Plan by the watershed municipalities, non-governmental organizations (environmental groups and non-profits), residents, local businesses, and other stakeholders.

- Objective 1: Promote Inter-municipal Coordination. Since the Oyster Bay/Cold Spring Harbor watershed crosses municipal boundaries and includes numerous governmental entities, the support of and coordination between the watershed municipalities (towns, cities, villages, and counties) is critical to successful plan implementation.

- Objective 2: Identify and Secure Funding to implement the recommendations outlined in this plan.

- Objective 3: Promote Regional Collaboration with other watershed organizations on and around Long Island Sound to share ideas and strengthen regional watershed management efforts.

- Objective 4: Continue Watershed Field Assessments to document future changes in watershed conditions, evaluate previously unassessed areas, identify additional retrofit/restoration opportunities, and involve the public and volunteers as a form of outreach.

Water Quality

Goal: Preserve, protect, and enhance water quality in the Oyster Bay/Cold Spring Harbor Complex and its watershed. Consistently meet water quality standards, maintain and expand areas open to shellfishing, and maintain and improve the health of the watershed tributaries and groundwater resources.

- Objective 1: Improve Understanding of Estuary and Watershed Conditions to refine the current understanding of water quality impairments in the estuary complex, particularly pollutants for which previous monitoring results have demonstrated the potential for water quality impairment but which are not currently listed as a cause of impairment, and to identify potential sources of contaminants through DNA and microbial source tracking techniques.

- Objective 2: Reduce Impacts from Hotspot Land Uses, which are land uses with higher potential pollutant loads due to the nature of the activities and pollutant sources associated with these land uses.

- Objective 3: Reduce Impacts of Stormwater Runoff, on the water quality and ecology of the estuary complex by implementing pathogen reduction plans and stormwater retrofits and through the use of Low Impact Development (LID) and Green Infrastructure approaches for private development and municipal stormwater infrastructure.

- Objective 4: Protect and Restore Riparian and Wetland Buffers in the watershed to protect and improve water quality.

- Objective 5: Reduce the Impacts of On-Site Wastewater Disposal. Much of the watershed is served by on-site wastewater disposal systems, including septic systems and cesspools. Many of these systems are old and not inspected frequently or maintained properly, and failing systems have a high potential to impact surface water and groundwater quality.

- Objective 6: Reduce Nuisance Waterfowl such as mute swans and Canada geese, which are a nonpoint source of pollution, particularly pathogens and nutrients. Reducing these populations could improve water quality by reducing pathogen and nutrient loads to the estuary complex.

Habitat Protection and Restoration

Goal: Protect and restore native habitat, fisheries and stream corridor habitat, shellfish populations, wetland habitat and shorelines, and forests and watershed tree canopy to maintain and increase the watershed's diversity of floral and faunal species.

- Objective 1: Protect and Restore Native Habitat. Manage or remove invasive plant and animal species that threaten local biodiversity and ecosystem function in the watershed.

- Objective 2: Protect and Restore Fisheries and Stream Corridor Habitat to maintain and restore naturally reproducing fish populations in the watershed by removing barriers to fish passage as well as restoring or enhancing in-stream and riparian habitat.
- Objective 3: Protect and Restore Shellfish Populations to preserve a healthy shellfishery and shellfish aquaculture industry, which is a significant contributor to the local economy, provides a sustainable source of fresh seafood, improves water quality, and provides other ecological benefits.

- Objective 4: Protect and Restore Wetland Habitat and Shorelines by restoring tidal and freshwater wetlands throughout the estuary complex and its watershed and promoting alternative approaches to traditional shoreline hardening where appropriate.

- Objective 5: Protect and Restore Forests and Watershed Tree Canopy. Despite the healthy forest cover that exists in the watershed, homeowner clearing of residential

properties and land development/redevelopment activities continue to threaten forests and watershed tree canopy.

- Objective 6: Plan for Climate Change and Sea Level Rise by promoting climate change adaptation strategies to address anticipated sea level rise and associated impacts on human and natural communities in the estuary complex.

Sustainable Land Use and Open Space

Goal: Ensure that development within the watershed is sustainable, promote sustainable land use practices to protect natural resources, and expand access to upland and aquatic open spaces without adversely impacting water quality and natural resources.

- Objective 1: Promote Sustainable Development. Promote sustainable growth principles in ongoing and future development and redevelopment, and ensure that growth is appropriate and incorporates measures to minimize impacts to water resources.

- Objective 2: Maintain and Improve Open Space. Manage, maintain, and improve existing open space and continue to protect/acquire open space that meets resource protection and recreational goals.

- Objective 3: Increase Public Access to waterways and open space in the watershed to enhance public appreciation and stewardship of the estuary complex while balancing the interests of competing uses and ensuring that public access does not adversely affect sensitive resources.

Education and Outreach

Goal: Promote stewardship of the Oyster Bay/Cold Spring Harbor estuary complex and watershed through education and outreach.

- Objective 1: Improve Awareness of Marina and Boating Practices. Ongoing education of boater owners, marinas, and related waterfront boating facilities, which can directly impact the water quality of the estuary complex, is a critical element in promoting stewardship of the estuary and its watershed.

- Objective 2: Expand School and Institutional Educational Programs. Current educational programs of the Town of Oyster Bay school system, the WaterFront Center, and Theodore Roosevelt Audubon Sanctuary should be used as a model for new or expanded educational programs for schools and similar institutions throughout the Oyster Bay/Cold Spring Harbor watershed that don't currently provide comprehensive, watershed-based programs.

- Objective 3: Conduct Outreach for Golf Courses, Parks, and Institutional Land Owners since management and maintenance practices at these facilities can have a significant

impact on the water quality within the Oyster Bay/Cold Spring Harbor watershed and estuary.

- Objective 4: Conduct Homeowner Outreach. Build awareness of land stewardship and management practices and reduce nonpoint source impacts associated with residential land use, which comprises approximately 64 percent of the watershed land area.

- Objective 5: Provide Outreach to the Business Community. Advance the business community's awareness of the estuary and its watershed through targeted education and outreach.

- Objective 6: Improve Awareness of Municipal Practices. Improve the awareness of municipal employees about the potential impact of their operations on the water quality and environmental resources of the estuary complex and its watershed.

3 Recommended Actions

This section describes recommended actions to meet the watershed management goals and objectives outlined in *Section 2*. The recommendations include watershed-wide and targeted actions:

- Watershed-wide Actions are those recommendations that can be implemented throughout the Oyster Bay/Cold Spring Harbor watershed. These basic measures can be implemented in each of the watershed municipalities, are applicable in most areas of the watershed, and are intended to address nonpoint source pollution through municipal land use regulations and planning, green infrastructure and smart growth, public education and outreach, urban watershed forestry, and watershed monitoring. The water quality and natural resource benefits of these measures are primarily long-term and cumulative in nature resulting from runoff reduction, source control, pollution prevention, and improved stormwater management for new development and redevelopment projects.

- Targeted Actions are tailored to address issues within specific subwatersheds or areas, rather than watershed-wide. Targeted recommendations also include actions to address common types of problems that were identified at representative locations throughout the watershed, but where additional studies or evaluations are required to develop site-specific recommendations. Targeted recommendations can have both short and long-term benefits. The subwatershed maps in *Appendix B* show the locations of many of the targeted actions recommended in this plan.

Additional site-specific watershed retrofit and restoration concepts are described in *Section 4* of this plan.

The recommendations presented in this section are classified according to their timeframe and overall implementation priority. Recommendations can be viewed as ongoing, short-term, mid-term, and long-term actions:

- Ongoing Actions are actions that should occur annually or more frequently such as routine water quality monitoring, as well as actions that occur on an ongoing basis such as fundraising, education and outreach, and coordination between watershed stakeholders.

- Short-Term Actions are initial actions to be accomplished within the first one to two years of plan implementation. These actions have the potential to demonstrate immediate progress and success and/or help establish the framework for implementing subsequent plan recommendations. Such actions include adoption of an inter-municipal agreement; development of model codes and ordinances and subsequent revisions to local land use regulations; development of watershed improvement strategies and stormwater retrofit plans to address MS4 requirements and pathogen reduction goals; outfall inventories and illicit discharge investigations; and field inventories within

previously unassessed subwatersheds. Small demonstration projects could be completed during this phase, with volunteer service events. Construction of larger retrofits and restoration projects requiring extensive design, engineering, and permitting should be planned for later implementation.

- Mid-Term Actions involve continued programmatic and operational measures, delivery of educational and outreach materials, and construction of larger retrofit and/or restoration projects over the next two to five years. Progress on land conservation, especially the protection of headwaters and unique landscapes, LID and green infrastructure implementation, and discharge investigation follow-up activities should be completed during this period, as well as project monitoring and tracking. Sustainable funding mechanisms for watershed-wide green infrastructure programs and implementation of stormwater retrofits should be investigated through the Oyster Bay/Cold Spring Harbor Protection Committee and regional collaboration.

- Long-Term Actions consist of continued implementation of any additional projects necessary to meet watershed objectives, as well as an evaluation of progress, accounting of successes and lessons learned, and an update of the watershed management plan. Long-term recommendations are intended to be completed during the next 5- to 10-year timeframe and beyond, consistent with the pathogen reduction timeframes established in the MS4 Permit. The feasibility of long-term project recommendations, many of which involve significant infrastructure improvements, depends upon the availability of sustainable funding programs and mechanisms.

The groups with responsibility for implementing the recommendations are also identified in this section of the plan. Each action has a designated lead group, which is best suited to obtain the necessary funding for, and organize the necessary resources to implement an action. The lead group is assigned based on the organization or entity whose mission or responsibilities best align with the action and, in the case of a government entity, have jurisdiction over the action or associated geographic area. In cases where the Oyster Bay/Cold Spring Harbor Protection Committee is identified for implementation, the member municipalities will provide essential guidance on an ongoing basis.

The remainder of this section describes the recommended actions presented in this Watershed Action Plan. The recommended actions are categorized (and color-coded) according to the five major goals of this plan – (1) capacity building for plan implementation, (2) water quality, (3) habitat protection and restoration, (4) sustainable land use and open space, and (5) education and outreach.

3.1 Capacity Building for Plan Implementation

Goal: Build a foundation for successful implementation of the Watershed Action Plan by the watershed municipalities, non-governmental organizations (environmental groups and non-profits), residents, local businesses, and other stakeholders.

Summary – Capacity Building for Plan Implementation

Timeframe:
C = completed
O = ongoing
S = short-term
M = mid-term
L = long-term

Responsibility: (subject to change)
● lead ○ assist

Estimated Cost (thousands):
$ = 0 – 10
$$ = 10 – 50
$$$ = 50 – 100
$$$$ = 100+

	Timeframe	Protection Committee	Nassau County	Suffolk County	Town of Oyster Bay	Town of Huntington	City of Glen Cove	Villages	Friends of the Bay	Conservation Districts	Citizens & Volunteers	Other Partners	Estimated Cost
Objective 1: Promote Inter-municipal Coordination													
Action 1-1: Form a Protection Committee	C[3]		○	○	●	●	○	○	○				$
Action 1-2: Hire a Protection Committee Coordinator	C[3]	●											$$
Action 1-3: Develop Mission Statement and Work Plan	S	●	○	○	○	○	○	○	○				$
Action 1-4: Develop and Enter Into an Inter-municipal Agreement	S	●	○	○	○	○	○	○					$
Action 1-5: Develop Protection Committee Web Site	C[3]	●	○	○	○	○	○	○	○				$
Action 1-6: Create Information Resource Center	S	○							●				$$
Objective 2: Identify and Secure Funding													
Action 2-1: Pursue Grant Funding	O	○							●				Varies
Action 2-2: Secure Long-Term Funding for Water Quality Monitoring	M	○							●				$
Action 2-3: Develop Environmental Restoration Bond Fund	L	●	●	●	●	●	●	○					$$
Action 2-4: Lobby for State/Federal Funding	O	●							○				Varies
Objective 3: Promote Regional Collaboration													
Action 3-1: Organize Regional Meeting Series	M	○		●	●				●			○[1]	$
Action 3-2: Improve Consistency in Water Quality Monitoring	L			●	●				●		○	○[2]	$
Objective 4: Continue Watershed Field Assessments													
Action 4-1: Assess Additional Areas	S	○							●	○	○		$$
Action 4-2: Perform Ongoing Assessments	O	●	●	●	●	●	●	●	●	○	○		$$$

Summary – Capacity Building for Plan Implementation														
Timeframe: C = completed O = ongoing S = short-term M = mid-term L = long-term Estimated Cost (thousands): $ = 0 – 10 $$$ = 50 – 100 $$ = 10 – 50 $$$$ = 100+	Responsibility: (subject to change) ● lead ○ assist	Timeframe	Protection Committee	Nassau County	Suffolk County	Town of Oyster Bay	Town of Huntington	City of Glen Cove	Villages	Friends of the Bay	Conservation Districts	Citizens & Volunteers	Other Partners	Estimated Cost
Action 4-3: Involve the Public		O	○							●		○		-

[1]NYSDEC, Long Island Sound Study
[2]Other Water Quality Monitoring Groups
[3]Protection Committee formed in 2010 with NFWF grant funding. Protection Committee Coordinator hired in 2011

Objective 1: Promote Inter-municipal Coordination

Because the Oyster Bay/Cold Spring Harbor watershed crosses municipal boundaries and includes numerous governmental entities, the support of and coordination between the watershed municipalities (towns, cities, villages, and counties) is critical to successful plan implementation. Inter-municipal watershed committees have proven to be an effective means for coordinating municipal watershed and stormwater management activities in other watersheds on Long Island. An inter-municipal approach is consistent with watershed-based planning through the support and participation of the local governments within the watershed. Watershed-based plans are also most cost-effective and effective in protecting water quality when they are implemented on an inter-municipal basis. The Hempstead Harbor and Manhasset Bay Protection Committees are examples of inter-municipal organizations on Long Island that have successfully implemented water quality planning recommendations on a watershed basis.

Action 1-1: Form a Protection Committee

A watershed-wide inter-municipal committee – Oyster Bay/Cold Spring Harbor Protection Committee – was formed in 2010 to coordinate the watershed protection activities of the various watershed municipalities. The eighteen municipalities located within the watershed have agreed to join the Protection Committee. The Oyster Bay/Cold Spring Harbor Protection Committee's mission is to establish a sustainable, cooperative partnership among the municipalities within the watershed with input from the public and other stakeholders to efficiently protect and improve water quality through a holistic and integrated watershed-wide approach. The Protection Committee, working collaboratively with Friends of the Bay, is responsible for facilitating the implementation of the Watershed Action Plan recommendations.

Action 1-2: Hire a Protection Committee Coordinator

The Town of Oyster Bay has received grant funding through the National Fish and Wildlife Foundation Long Island Sound Futures Fund to hire a coordinator for the Protection

Committee and develop a work plan to help implement the recommendations of this Watershed Action Plan. To date, a coordinator for the Protection Committee has been hired. The coordinator will take a lead role in many of the short-term and ongoing actions described in this section.

Action 1-3: Develop Mission Statement and Work Plan

The Protection Committee has developed a formal statement describing its vision, mission, and core values, which is consistent with the goals and objectives of the Watershed Action Plan.

Develop a work plan that will assign priorities and responsibilities for recommended actions and work tasks. The work plan should be updated regularly as responsibilities and priorities change and actions are completed.

Action 1-4: Develop and Adopt Inter-municipal Agreement

Develop and adopt an inter-municipal agreement for the Oyster Bay/Cold Spring Harbor Protection Committee member municipalities. The Protection Committee coordinator should take the lead in developing a draft inter-municipal agreement, using successful models from Hempstead Harbor, Northport Harbor, and Manhasset Bay. The Protection Committee should also evaluate various options for and select a preferred legal structure, decision-making, funding mechanisms, and administrative procedures, which would be reflected in the inter-municipal agreement.

Action 1-5: Develop Protection Committee Web Site

A web site and social media page have been developed for the Protection Committee to disseminate information, present meeting schedules, solicit feedback, and facilitate education and outreach. The use of social media tools is also recommended to enhance the online presence.

Action 1-6: Create an Information Resource Center

Create an Information Resource Center for the Oyster Bay/Cold Spring Harbor watershed. The Information Resource Center would serve as a web-based clearinghouse and database of information about the watershed. Visitors to the site could access Friends of the Bay's water quality monitoring data and annual report, view maps of the watershed, search literature, and browse a directory of information regarding the Oyster Bay/Cold Spring Harbor Complex. The resource center would include Friends of the Bay's reports and studies, as well as reports prepared by the Town of Oyster Bay, Town of Huntington, Nassau and Suffolk County, State and Federal studies as well as other academic or environmental studies of the area. Among the reports to be included are Friends of the Bay's State of the Watershed Report, studies on the Mill River watershed, stormwater analyses, historic maps, biological inventories, water quality monitoring data, and annual water quality monitoring reports, including the reports produced annually by Friends of the Bay and the long term *Water Quality Data Evaluation* written in 2009. The Information Resource Center would be accessible from the Friends of the Bay website www.friendsofthebay.org. In addition, it would serve as a resource for municipal managers for information regarding the Municipal Separate Storm Sewer (MS4) regulations.

The Information Resource Center would use professional information specialists to set up an expandable information platform. The creation and maintenance of the site would utilize graduate interns from the Palmer School of Library and Information Science at CW Post Campus of Long Island University. Students from the local high schools and community volunteers would also be invited to lend their assistance to this program.

This digital resource center would make available the specialized knowledge of the Friends of the Bay and would provide a gateway to other resources for persons interested in the Oyster Bay/Cold Spring Harbor watershed. The resource center would use GIS technology, providing search capability by subject or by location within the watershed.

When designed and implemented, the database could serve as a model for other non-profit agencies and watershed managers to use as an easily accessible and complete source for watershed information. This information could be used by municipal managers and government agencies to guide decision-making and implement actions to improve the water quality of the harbor complex. It would also provide information to residents and nonprofit groups on environmental conditions and factors affecting the environment within the watershed.

Objective 2: Identify and Secure Funding

Many actions in this plan are only achievable with sufficient funding and staffing. Therefore, a variety of funding opportunities should be pursued to implement the recommendations outlined in this plan. Potential local, state, and federal funding sources for implementation of the plan recommendations are identified in *Section 6* of this plan.

Action 2-1: Pursue Grant Funding

Review and prioritize potential funding sources that have been preliminarily identified in this Watershed Action Plan (see *Section 6*), and prepare and submit grant applications for projects identified in this plan on an ongoing basis.

Action 2-2: Secure Long-Term Funding for Water Quality Monitoring

Identify and secure long-term, ongoing funding for continuation of the Oyster Bay/Cold Spring Harbor water quality monitoring program, which was historically a government responsibility but more recently has been led by Friends of the Bay with grant funding through the National Fish and Wildlife Foundation Long Island Sound Futures Fund.

Action 2-3: Develop Environmental Restoration Bond Funds

Encourage the watershed municipalities and counties to develop "Environmental Restoration Bond Fund" programs similar to the Town of Oyster Bay SEA Fund and Nassau County Environmental Bond Act. Funds would be primarily for restoration projects and would be used as seed money for securing state and federal grants.

Action 2-4: Lobby for State and Federal Funding

Actively advocate for state and federal funding, working jointly with other watershed organizations, inter-municipal protection committees, and the Long Island Sound Study.

Objective 3: Promote Regional Collaboration

Many watershed organizations and municipalities on Long Island are involved in watershed management planning to meet common resource protection objectives and are faced with similar water quality issues such as compliance with the NYSDEC MS4 Permit and watershed improvement strategies to address impaired waters. Lessons learned from other watershed planning efforts on Long Island and throughout Long Island Sound can help to improve the effectiveness of the Oyster Bay/Cold Spring Harbor Watershed Action Plan. This objective is to strengthen coordination of water quality planning activities with those of other watershed organizations on and around Long Island Sound to share ideas and strengthen regional watershed management efforts.

Action 3-1: Organize Regional Watershed Meeting Series

Coordinate with other watershed organizations on Long Island (including the South Shore watersheds) and in Connecticut to share information on ongoing activities, new advances in science and technology, and outreach materials, and to discuss lessons learned. Such a regional collaboration could complement the work of the Long Island Sound Study Citizens Advisory Committee and other existing groups with a similar regional focus.

Action 3-2: Improve Consistency in Regional Water Quality Monitoring

Improve consistency between the Friends of the Bay water quality monitoring program in Oyster Bay and Cold Spring Harbor and the other water quality monitoring programs on the North Shore of Long Island and throughout Long Island Sound. Greater consistency in monitoring methods, equipment, and standard procedures between the various water quality monitoring programs would allow for more useful comparisons of conditions in different waterbodies and areas of Long Island Sound. Comparable data collection efforts would also enhance the usefulness of the water quality data to track regional trends in water quality throughout Long Island Sound and better meet the needs of the Long Island Sound Study. Oyster Bay/Cold Spring Harbor watershed managers could also assist the Long Island Sound Study in developing a Sound-wide coordinated water-quality monitoring program with a regular source (i.e., non-competitive grant) of funding.

Objective 4: Continue Watershed Field Assessments

Watershed field assessments are a screening level tool for locating potential pollutant sources and environmental problems in a watershed along with possible locations where restoration opportunities and mitigation measures can be implemented. Field assessments, including stream corridor and upland assessments, were performed in selected areas of the watershed by Fuss & O'Neill in 2009 and by Cashin Associates in 2007, as described in the State of the Watershed Report. The targeted and site-specific project concepts presented in this plan are based, in part, on the findings of these assessments.

The field assessments that have been performed to date within the watershed were not exhaustive and did not address all potential pollutant sources or retrofit/restoration opportunities. Conditions in the watershed also change over time. Therefore, ongoing field assessments are recommended to document future changes in watershed conditions, evaluate

previously unassessed areas and identify additional retrofit/restoration opportunities, and involve the public and volunteers as a form of outreach.

Action 4-1: Assess Additional Areas

Not all of the Oyster Bay/Cold Spring Harbor subwatersheds were assessed as part of the development of this watershed-based plan. In some watersheds that were assessed, not all reaches, neighborhoods, and potential hotspots were examined. As time and funding becomes available, field assessments could be extended into these areas to identify new potential retrofit or restoration projects and areas to target for outreach activities. Target areas for additional field assessments include portions of the following subwatersheds:

- Cold Spring Brook
- Cold Spring Harbor
- Oyster Bay Harbor
- Mill Neck Creek
- Centre Island
- Lloyd Neck

Action 4-2: Perform Ongoing Assessments

Perform ongoing field assessments to document future changes in watershed conditions during implementation of the Watershed Action Plan. Stream corridor, neighborhood, and hotspot assessments should be updated every five to ten years to help guide plan implementation activities. Annual field assessments could be performed on a rotating basis for selected subwatersheds.

Action 4-3: Involve the Public

Involve the public in future watershed field assessments by encouraging citizen volunteers to assist individuals trained and experienced in watershed and stream assessment methods, possibly in collaboration with Trout Unlimited or local soil and water conservation districts.

3.2 Water Quality

Goal: Preserve, protect, and enhance water quality in the Oyster Bay/Cold Spring Harbor Complex and its watershed. Consistently meet water quality standards, maintain and expand areas open to shellfishing, and maintain and improve the health of the watershed tributaries and groundwater resources.

Summary – Water Quality

Timeframe:
C = completed
O = ongoing
S = short-term
M = mid-term
L = long-term

Responsibility: (subject to change)
● lead ○ assist

Estimated Cost (thousands):
$ = 0 – 10
$$ = 10 – 50
$$$ = 50 – 100
$$$$ = 100+

	Timeframe	Protection Committee	Nassau County	Suffolk County	Town of Oyster Bay	Town of Huntington	City of Glen Cove	Villages	Friends of the Bay	Conservation Districts	Citizens & Volunteers	Other Partners	Estimated Cost
Objective 1: Improve Understanding of Estuary and Watershed Conditions													
Action 1-1: Continue and Expand In-Harbor Monitoring Program	S/O	○							●		○		$$
Action 1-2; Continue and Expand Stream and Outfall Monitoring Program	S/O	○							●		○		$$
Action 1-3: Survey and Map Benthic Habitat	M	○							●			○[1]	$$$
Action 1-4: Evaluate Other Potential Water Quality Impairments	M	○							●			○[2]	$$$$
Action 1-5: Conduct Harmful Algal Bloom Monitoring	M/O	○	○	○	○	○	○		●			○[3]	$$$
Objective 2: Reduce Impacts from Hotspot Land Uses													
Action 2-1: Improve BMP Implementation	S	●	○	○	○	○	○	○	○			○	$$
Action 2-2: Review and Enforce Compliance of Regulated Facilities	M/O	○	●	●	●	●	●	●					$$
Action 2-3: Cleanup and Promote Sustainable Re-use of Contaminated Sites	L	●	○	○	○	○	○	○	○				$$$$
Objective 3: Reduce Impacts of Stormwater Runoff													
Action 3-1: Implement MS4 Stormwater Management Programs	S/O	●	●	●	●	●	●	●					$$
Action 3-2: Develop Watershed Improvement Strategy Pathogen Reduction Plans	S	●	●	●	●	●	●	●					$$$
Action 3-3: Implement Stormwater Retrofits and Other WIS Requirements	L/O	●	●	●	●	●	●	●					$$$$
Action 3-4: Enhance Municipal Understanding and Implementation of Green Infrastructure	S	●			○	○	○	○		○			$$
Action 3-5: Incorporate Green Infrastructure into Land Use Plans	S	○			●	●	●	○					$
Action 3-6: Modify Municipal Land Use Regulations to Require LID and GI	M	●	○	○	○	○	○	○	○				$$$
Action 3-7: Encourage Municipalities to Apply NYSDEC Standards to Smaller Sites	S	●	○	○	○	○	○	○	○				$

Summary – Water Quality													
Timeframe: C = completed O = ongoing S = short-term M = mid-term L = long-term Estimated Cost (thousands): $ = 0 – 10 $$$ = 50 – 100 $$ = 10 – 50 $$$$ = 100+	Responsibility: (subject to change) ● lead ○ assist	Timeframe	Protection Committee	Nassau County	Suffolk County	Town of Oyster Bay	Town of Huntington	City of Glen Cove	Villages	Friends of the Bay	Conservation Districts	Citizens & Volunteers	Other Partners	Estimated Cost
Action 3-8: Review Existing Recharge Basins		S		●	●	●	●	●						$$$
Action 3-9: Explore and Pursue Long-Term Funding for Municipal Stormwater Programs		M	●	○	○	○	○	○	○					$$$
Action 3-10: Implement Recognition and Awareness Initiatives		M/O	●	○	○	○	○	○	○			○		$$
Objective 4: Protect and Restore Riparian and Wetland Buffers														
Action 4-1: Implement Priority Buffer Restoration Projects		L	●	○	○	○	○	○		●	○	○	○[4]	$$$$
Action 4-2: Adopt Riparian Buffer Regulations		M	●	○	○	○	○	○	○	○	○			$$$
Action 4-3: Provide Education and Outreach		S/O	●	○	○	○	○	○	○	●	○			$$
Objective 5: Reduce the Impacts of On-Site Wastewater Disposal														
Action 5-1: Identify and Map Problem Areas		M	●	○	○	○	○	○	○					$$$
Action 5-2: Improve System Design, Inspection, and Maintenance		M	○	●	●	●	●	●	●			○		$$$$
Action 5-3: Expand Sewer Service in Targeted Areas		L	○	●	●	●	●	●	●					$$$$
Objective 6: Reduce Nuisance Waterfowl														
Action 6-1: Continue Existing Programs to Reduce Nuisance Waterfowl		S/O	●	●	●	●	●	○	○	●				$$

[1]University research programs
[2]NYSDEC (listing for other water quality impairments) and University research programs (hydrodynamic study)
[3]NYSDEC Bureau of Marine Resources Shellfisheries Section and University research programs
[4]Resource agencies, grant funding programs, and University research programs

Objective 1: Improve Understanding of Estuary and Watershed Conditions

The water quality monitoring efforts of Friends of the Bay and other organizations are a vital source of baseline information on current and past conditions within the Oyster Bay/Cold Spring Harbor estuary complex. Continuation of these programs is essential to monitor changes in harbor conditions as a result of changing watershed conditions and implementation of plan recommendations. Additional data collection is also recommended to refine the current understanding of water quality impairments in the estuary complex, particularly pollutants for

which previous monitoring results have demonstrated the potential for water quality impairment but which are not currently identified by NYSDEC as a listed cause of impairment (e.g., sediment, nutrients, dissolved oxygen), and to identify potential sources of contaminants through DNA and microbial source tracking techniques.

Action 1-1: Continue and Expand In-Harbor Monitoring Program

Continue the current Friends of the Bay citizen water quality monitoring program at the in-harbor monitoring locations to continue collecting baseline water quality information and to assess the effectiveness of plan implementation over time.

- Most of the existing in-harbor water quality monitoring locations are located along the shoreline or in mid-harbor areas. There are currently no water quality monitoring locations in open water near Long Island Sound. In some estuaries of Long Island Sound, studies have shown that Sound waters can have a significant influence on the water quality within the estuary. Expansion of the existing monitoring program towards Long Island Sound would provide additional information on the potential influence of Sound water quality on the water quality within the Oyster Bay/Cold Spring Harbor estuary complex. The additional monitoring could consist of additional locations sampled by citizen monitoring personnel on a weekly basis, or deployment of a water monitoring buoy with water quality sensors and remote data acquisition similar to the MYSound marine water quality installations operated by the University of Connecticut and other groups throughout Long Island Sound. Understanding the source of water quality impairments, both within the watershed and from external sources (i.e., Long Island Sound) is critical to developing effective water quality protection strategies.

- The existing in-harbor monitoring program consists of weekly monitoring between April and October. Winter monitoring has not been feasible due to challenges associated with sample collection during cold-weather conditions and limited availability of citizen monitoring personnel. Collection of limited (i.e., monthly) winter monitoring data is recommended to address this information gap and allow Friends of the Bay to monitor in-harbor conditions year-round. The Town of Oyster Bay has offered to work with Friends of the Bay to perform winter water quality monitoring.

Action 1-2: Continue and Expand Stream and Outfall Monitoring Program

Continue the current Friends of the Bay stream and outfall monitoring program, focusing on priority outfalls and discharges to the estuary complex.

- The Friends of the Bay outfall monitoring program could augment the illicit discharge detection and elimination efforts of the watershed municipalities through the

NYSDEC MS4 Permit program. The MS4 Permit requires the watershed municipalities to conduct an outfall reconnaissance inventory addressing every outfall within the municipality's jurisdiction and conduct regular field investigations to detect the presence of ongoing and/or intermittent on-site sanitary discharges to the storm sewer system.

- The MS4 Permit also requires municipalities to reduce pathogen loads to the impaired portions of the estuary complex by implementing stormwater retrofits. Municipalities should identify the sources of the pathogens and the relative contribution of the major sources of pathogen loads to develop effective retrofits and estimate pathogen load reductions. Outfall pathogen monitoring is recommended to assist in identifying priority outfalls and drainage areas for pathogen load reduction. Outfall pathogen monitoring should consider the use of microbial source-tracking methods (also known as DNA fingerprinting, DNA source-tracking, or qPCR source-tracking), consisting of fecal Bacteroides analysis (identification and quantification of human Bacteroides and human enterococci for genetic fingerprinting). Bacteroides analysis, in conjunction with enterococci analysis for genetic fingerprinting, can be useful for identifying contamination sources because distinct categories of Bacteroides have been shown to be detected predominately in humans rather than livestock or birds. The major value in using microbial source-tracking methods is the ability to differentiate between human and non-human sources, which can help identify specific pathogen sources and better target controls to address those sources.

Action 1-3: Survey and Map Benthic Habitat

Although many users of the harbor have a working knowledge of the various types of marine habitats within portions of the estuary complex, information is limited regarding the actual quality and distribution of benthic (i.e., bottom-dwelling) communities and habitats throughout Oyster Bay/Cold Spring Harbor. A benthic habitat mapping survey is recommended to identify and assess the quality of benthic habitats and biological communities, including those habitats and biological communities that are threatened, missing, or have been extirpated by human activity. This type of information would be used to identify and guide restoration projects such as a shellfish sanctuary, eelgrass restoration, and restoration of diamondback terrapin nesting areas.

Action 1-4: Evaluate Other Potential Water Quality Impairments

Current efforts at improving water quality concentrate on reducing pathogen loads to the estuary complex, based on the pathogen Total Maximum Daily Load (TMDL) that was developed for portions of Oyster Bay and Mill Neck Creek. While pathogens are a major threat to water quality, as well as to recreation and the shellfish industry, they are just one of many. Water quality monitoring data collected by Friends of the Bay indicates that low dissolved oxygen and elevated nitrogen concentrations are common in areas of the estuary complex during the summer. Although low dissolved oxygen levels in Oyster Bay/Cold Spring Harbor

are not as pronounced as in Long Island Sound and other North Shore embayments, hypoxic and anoxic conditions have been measured in the estuary.

Due to the limitations of the existing water quality data, it is unclear if the low dissolved oxygen (DO) levels are due to the hypoxia that occurs in Long Island Sound as a result of the transport of low-DO water into the estuary, or if the low dissolved oxygen levels in the estuary are influenced primarily by nutrient inputs from the contributing watershed. If the low dissolved oxygen levels are due to the hypoxia that occurs in Long Island Sound, this issue would be addressed largely through implementation of the Long Island Sound nitrogen TMDL. However, additional actions may be required beyond those occurring under the Long Island Sound nitrogen TMDL to address the nutrient-related water quality concerns within the estuary.

In addition to pathogens and dissolved oxygen-related issues, silt from stormwater runoff can smother otherwise productive shellfish beds and nutrients such as nitrogen and phosphorus can result in harmful algal blooms (HABs). Watershed activities are known sources of significant sediment and nutrient loads to the estuary complex, which contributes to water quality impairments.

Specific recommended actions to evaluate other potential water quality impairments include:

- Coordinate with the NYSDEC regarding the potential inclusion of Oyster Bay/Cold Spring Harbor for water quality impairments other than pathogens (i.e., low dissolved oxygen, nutrients, sediment) on the next impaired waters (303d) list in 2012.
- As a long-term project, develop a linked hydrodynamic and water quality model of the estuary complex to assess the relative influence of watershed sources and Long Island Sound circulation on the water quality of the estuary. In addition to pathogen load reductions, the model could be used to predict the affect of reduced nutrient loads from the watershed on harbor water quality, focusing on specific water quality concerns, such as dissolved oxygen. The model could also be used to predict the impact of other changes on water quality, such as increased rainfall resulting from climate change.
- Ensure that future management efforts address the full range of water quality parameters and potential sources of water quality impairments.

Action 1-5: Conduct Harmful Algal Bloom Monitoring

Harmful algal blooms (HABs) and marine biotoxins are a part of the marine ecological community in New York State marine waters. Within the past twenty-five years HABs, such as the brown tide bloom in the 1980s and 1990s, have devastated areas of New York coastal waters, threatening important habitat, disrupting food chains for many marine species, and impacting economically viable fisheries (NYSDEC, 2011).

One species of phytoplankton has made a strong appearance in Long Island waters, *Alexandrium* spp. This dinoflagellate produces saxitoxin, the neuromuscular toxin that causes Paralytic Shellfish Poisoning (PSP). The toxin accumulates in the tissues of animals that eat the dinoflagellate and may be present in high concentrations in shellfish. Eating shellfish that may have consumed *Alexandrium* may pose a health threat for animals and humans (NYSDEC, 2011).

Alexandrium spp. has been present in Long Island waters since the 1970s and made its first harmful bloom on Long Island in 2005, causing large shellfishing closures in Northport and Huntington Harbors. Researchers studying the waters of Northport Harbor recently detected a second type of harmful algae, *Dinophysis acuminata*, which produces a toxin that could cause stomach sickness in humans who ingest infected shellfish.

The NYSDEC Bureau of Marine Resources Shellfisheries Section conducts marine biotoxin monitoring of local waters to identify the occurrence of toxic HABs. Several monitoring sites are located in Northport and Huntington Harbors due to the occurrence of toxic HABs in these waters. In addition, the Suffolk County Bureau of Environmental Management performs harmful algal bloom monitoring for brown tide (*Aureococcus anophagefferens*), *Cochlodinium polykrikoides* (a form of red tide), and Cyanobacteria (a potentially toxic blue-green algae). A number of local government and university researchers are also investigating the occurrence, biology, ecology, and genetics of HABs on Long Island, including researchers at Stony Brook University's School of Marine and Atmospheric Science.

Systematic HAB monitoring has not been performed in Oyster Bay/Cold Spring Harbor, despite its close proximity to the Northport and Huntington embayments and the potentially significant risk that toxic HABs pose to economically-important shellfisheries and other marine resources, recreation, and public health. HAB monitoring should be conducted within Oyster Bay/Cold Spring Harbor to address these risks and guide water quality management approaches. Specific recommendations include:

- Coordinate with NYSDEC to expand the NYSDEC Bureau of Marine Resources Shellfisheries Section marine biotoxin monitoring program and/or the Suffolk County HABs monitoring program to Oyster Bay/Cold Spring Harbor
- Coordinate HABs monitoring efforts between state, county, and municipal health departments and marine monitoring efforts
- Incorporate periodic HAB monitoring into the Friends of the Bay water quality monitoring program and compile results in the proposed Information Resource Center.
- Coordinate with local government and university researchers regarding ongoing research findings on HABs and implement related water quality management approaches

Objective 2: Reduce Impacts from Hotspot Land Uses

Hotspot land uses are land uses with higher potential pollutant loads due to the nature of the activities and pollutant sources associated with these land uses. As described in Sections 5 and 6 of the State of the Watershed Report, hotspot land uses within the Oyster Bay/Cold Spring Harbor watershed include commercial land use, existing and former industrial sites, golf courses,

horse stabling facilities, municipal public works facilities, marinas and boating storage/repair facilities, gas stations, and high-use parking lots.
An objective of this Watershed Action Plan is to reduce the threat to water quality from land uses with higher potential pollutant loads through good housekeeping and pollution prevention, improved compliance at regulated facilities, and cleanup and sustainable re-use of contaminated (i.e., brownfield) sites. Related education and outreach recommendations are addressed in *Section 3* of this action plan.

Action 2-1: Improve BMP Implementation at Hotspot Land Uses

Opportunities exist for improved pollution prevention and source controls at hotspot land uses and facilities. The facilities that were observed during the watershed field inventories exhibited examples of both good pollution prevention practices and opportunities for improvement. Specific recommended actions include:

- The watershed municipalities and other public entities (e.g., school districts, fire districts, water districts, state agencies, etc.) should review the current compliance of their respective facilities (public works/maintenance facilities, parks, schools, public safety facilities, etc.) in the watershed with pollution prevention best management practices and applicable regulatory requirements. "Good housekeeping" at municipal facilities should serve as demonstration sites for comparable private operations, many of which are also subject to stormwater pollution prevention and other similar state and federal regulatory programs (oil pollution prevention, hazardous waste, air emissions). Examples of good practices should be recognized and modeled. The municipalities, working cooperatively with the Protection Committee, should provide guidance (e.g., visits, group training, and/or printed materials) and develop incentives to encourage local businesses to adopt these model practices.

- The Town of Oyster Bay Lake Avenue Highway Yard, which is located along Mill River adjacent to the Oyster Bay National Wildlife Refuge, has been identified by the Mill River Watershed Study and Public Stewardship Program for operational improvements, structural mitigation, and potential relocation. The Town of Oyster Bay should implement the BMPs and structural mitigation measures recommended in the Mill River Watershed Study and Public Stewardship Program. The Town should also consider relocating the highway yard to a less sensitive location and re-use of the site to provide needed stormwater treatment (e.g., regional bioretention basin, stormwater pond, or constructed wetland) for area road runoff. The Town should explore the opportunity for an environmental bond purchase of a more appropriate property for a re-located highway yard facility, thereby restoring and protecting the current site, which is located in an environmentally-sensitive location along the Mill River corridor.

- Limit the use of fertilizers and pesticides at golf courses, parks, and other large intensively managed lawn areas within the watershed by promoting integrated pest management (IPM), the use of stormwater BMPs, and wetland and riparian buffer restoration and protection. Limiting fertilizer and pesticide use is most critical in areas within several hundred feet of a stream, pond, wetland, or the harbor.

- Implement stormwater BMPs at marinas and boat storage and maintenance facilities in the watershed following guidance contained in New York Stormwater Runoff Best Management Practices for Marinas: A Guide for Operators developed by Suffolk County and the New York Sea Grant Extension Program, Cornell Cooperative Extension and similar guidance documents.

- Require the installation of stormwater quality BMPs at new marinas, marinas that are proposing significant expansions, and marinas that request variances or exemptions from a municipal land use board.

- Implement manure management and other horse-related BMPs for commercial and residential horse pastures and stables in the watershed. Horses produce large amounts of manure that can threaten local water quality. Good housekeeping practices for horses are similar to those applied successfully to small dairy farm operations, and involve the close control of manure, limiting the use of spreading, careful construction of composting areas, preventing horse traffic or grazing over small streams, and similar measures (Battelle, 2007).

Action 2-2: Review and Enforce Compliance of Regulated Facilities

A number of facilities in the watershed have NYSDEC State Pollution Discharge Elimination System (SPDES) discharge permits. Although NYSDEC routinely evaluates facility compliance with SPDES permit requirements, the permits and associated facility compliance should be reviewed during permit reissuance. SPDES discharge permits should contain provisions for TMDL implementation, runoff volume reduction using LID or green infrastructure approaches, and water quality protection. The permits should accurately reflect the areas of the estuary and the associated subwatersheds covered under the pathogen TMDL.

Action 2-3: Cleanup and Promote Sustainable Re-use of Contaminated Sites

As described in the State of the Watershed Report, there are several contaminated former commercial and industrial sites in the watershed that are either inactive or undergoing remediation. Re-use or re-development of these sites presents an opportunity to cleanup historic contamination, which posed a long-term threat to the estuary, and to implement LID and green infrastructure stormwater management approaches to further reduce potential water quality and overall environmental impacts of these sites on the estuary complex. Redevelopment of the Jakobson Shipyard site as a passive waterfront park is an example of the type of sustainable re-use that should be considered for other contaminated or former industrial sites in the watershed including Mill Neck Bay Marina, Commander Oil Terminal, Cold Spring Harbor Terminal, and the Bayville Village Cleaners site.

Objective 3: Reduce Impacts of Stormwater Runoff

Since much of the watershed was developed prior to the adoption of stormwater quality regulatory requirements, most of the existing drainage infrastructure that does not discharge to recharge basins consists of traditional storm drains/catch basin and storm pipes that discharge directly to surface waters without treatment, other than detention to maintain peak rates of discharge. Uncontrolled stormwater runoff from impervious surfaces is a significant source of impacts to surface waters and water quality within the harbor complex and its watershed.

The stormwater collection and drainage system within the harbor complex watershed consists of drainage infrastructure operated and maintained by the watershed municipalities, including the Town of Oyster Bay, the Town of Huntington, the associated villages, and Nassau and Suffolk Counties. Nassau and Suffolk County are responsible for the drainage infrastructure associated with county roadways. All of these municipal entities are regulated small Municipal Separate Storm Sewer Systems (MS4s) under the NYSDEC State Pollution Discharge Elimination System General Permit for Stormwater Discharges from MS4s (MS4 Permit).

Through their MS4 Permit stormwater management programs and other planning initiatives, the watershed municipal entities, including Nassau and Suffolk Counties, have developed and implemented a variety of Best Management Practices to address stormwater quality and quantity issues associated with land development and redevelopment projects. The municipalities have also begun to address historical development and nonpoint source pollution impacts in the watershed by identifying potential sites for stormwater retrofits. However, stormwater runoff continues to be a significant threat to the water quality and overall health of the Oyster Bay/Cold Spring Harbor Complex and its watershed. An important objective of this Watershed Action Plan is therefore to reduce the impacts of stormwater runoff on the water quality and ecology of the estuary complex.

Action 3-1: Implement MS4 Stormwater Management Programs

The watershed municipal entities should continue to work cooperatively through the Nassau County Stormwater Coalition and the recently formed Oyster Bay/Cold Spring Harbor Protection Committee to implement municipal stormwater management programs for their regulated MS4s as required by the MS4 Permit. The six minimum control measures of the MS4 Permit include public education, public involvement, illicit discharge, detection and elimination, construction site runoff control, post-construction runoff control, and pollution prevention and good housekeeping.

Inter-municipal coordination is critical to cost-effectively achieve pathogen load reductions required by the MS4 Permit and associated pathogen TMDLs. The MS4s should continue to work cooperatively to satisfy the following basic minimum control measure requirements of

the MS4 Permit, in addition to the enhanced pathogen reduction requirements described in Actions 3-2 and 3-3:

- Public education and outreach programs
- Street sweeping and catch basin cleaning through resource sharing
- Outfall mapping and reconnaissance inventories
- Development and implementation of model codes and regulations for construction and post-construction runoff controls for new development and redevelopment, including procedures for plan reviews, inspections, and enforcement
- Good housekeeping and pollution prevention

Action 3-2: Develop Watershed Improvement Strategy Pathogen Reduction Plans

The MS4 Permit, which became effective in May 2010, also requires the regulated MS4s in the watershed to develop Watershed Improvement Strategies (WIS) to achieve the pathogen load reductions specified in the permit and in the pathogen TMDLs. These enhanced requirements include:

- Additional non-structural BMPs, including targeted public education and outreach, heightened illicit discharge detection and elimination programs including septic system inspection and maintenance, and targeted pollution prevention and good housekeeping, that focus on reducing pathogen sources in the watershed
- Plan and schedule for implementation of structural stormwater retrofits to reduce pathogen loads using green infrastructure and traditional stormwater management practices

Working through the Oyster Bay/Cold Spring Harbor Protection Committee, the watershed MS4s should develop and submit to NYSDEC five-year WIS and retrofit plans by the deadlines specified in the MS4 Permit. The WIS should include:

Public Education:

- Plan and conduct an ongoing public education and outreach program designed to describe the impacts of pathogens on the harbor complex and other waterbodies.
- The program must identify potential sources of pathogens in stormwater runoff and describe steps that contributors can take to reduce pathogens in stormwater runoff.
- Dissseminate educational material dealing with sources of pathogens in stormwater and pollutant reduction practices. The educational material should address the following topics: where, why, and how pathogens pose threats to the environment and to the community; septic systems, geese and pets as a source of pathogens.
- Disseminate educational materials/surveys to households/businesses in proximity to the impaired waterbodies.
- Disseminate education for horse-stabling facilities regarding manure BMPs.

Illicit Discharge Detection and Elimination:

- Develop, implement, and enforce a program to detect and eliminate discharges to the storm sewer system from on-site sanitary systems in areas where factors such as

shallow groundwater, low infiltrative soils, historical on-site sanitary system failures, or proximity to pathogen-impaired waterbodies, indicate a reasonable likelihood of system discharge.

- In such areas, ensure that on-site sanitary systems designed for less than 1,000 gallons per day are inspected at a minimum frequency of once every five years and, where necessary, maintained or rehabilitated.
- Conduct regular field investigations/inspections in accordance with the most current version of the EPA publication entitled "Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessment", to detect the presence of ongoing and/or intermittent on-site sanitary discharges to the storm sewer system.
- Develop and maintain a map showing the entire small MS4 conveyance system.

Pollution Prevention/Good Housekeeping:

- Develop, implement and enforce a local law prohibiting pet waste on municipal properties and prohibiting goose feeding.
- Develop and implement a pet waste bag program for collection and proper disposal of pet waste.
- Develop and implement a program to manage goose populations.
- Develop and implement a turf management practices and procedures policy to address proper fertilizer application on municipally-owned lands and the planting of native plant material to lessen the frequency of mowing and reduce the use of chemicals to control vegetation.

The stormwater retrofit plans should be developed using the following general approach:

Stormwater Retrofit Plans: Develop and implement a retrofit program that addresses runoff from sites to correct or reduce pathogen pollutant loading problems.

- Establish procedures to identify sites with pathogen loading problems. A phased approach is recommended. The first phase would consist of prioritizing subwatersheds that pose the greatest risk of pathogen loading. The next phase would consist of developing subwatershed plans to further identify and mitigate pathogen sources in the priority subwatersheds. A targeted outfall monitoring program is recommended in priority subwatersheds to assess relative pathogen loads and better identify potential pathogen sources in those subwatersheds. Outfall monitoring should include parameters such as surfactants, ammonia, *Enterococci* and DNA source tracking methods including fecal *Bacteroides* analysis (identification and quantification of Human *Bacteroidetes* and Human *Enterococci* for genetic fingerprinting). Additional field investigation is recommended to further isolate potential sources of the largest pathogen loads and develop site-specific pathogen reduction strategies to address those loads.
- Establish policy and procedures for project selection, based on the pathogen reduction potential of the specific retrofit being constructed/installed; the ability to use standard, proven technologies; and the economic feasibility of constructing, installing, and maintaining the retrofit. A range of traditional and innovative pathogen load reduction approaches should be evaluated including end-of-pipe stormwater filtration and

infiltration, bioretention and other green infrastructure and LID approaches (pervious pavement, roof runoff disconnection, green streets).

- Establish policy and procedures for project permitting, design, funding, construction and maintenance.
- Develop and submit to NYSDEC approvable plans and schedules for completing retrofit projects.
- Demonstrate initial and ongoing compliance with the pathogen reduction requirements through pollutant load modeling or water quality monitoring.

Action 3-3: Implement Stormwater Retrofits and Other Watershed Improvement Strategy Requirements

The watershed MS4s should implement the five-year WIS and stormwater retrofits by the deadlines specified in the MS4 Permit. The pathogen load reductions required by the MS4 Permit must be achieved by 2021 and 2022 for stormwater MS4 pathogen loads to the impaired portions of Oyster Bay and Cold Spring Harbor, respectively.

Priority stormwater retrofits should be identified through the retrofit planning process described in Action 3-2. Opportunities for green infrastructure stormwater retrofits in the watershed generally include:

- Parking lot upgrades (bioretention, pervious pavement, vegetated buffers, water quality swales, and other measures). Area beaches are potential locations for implementing these measures.
- Athletic fields at parks and educational institutions (water quality swales, vegetated buffers, infiltration, bioretention, stormwater re-use for irrigation). Roosevelt Park is a potential location for this type of retrofit.
- Road repair/upgrade projects (green streets, including bioretention, water quality swales, tree planters, below-ground infiltration).

The following potential retrofit locations have been preliminarily identified through subwatershed field assessments performed as part of the State of the Watershed Report and by Nassau County as well as the Town of Oyster Bay. *Section 4* of this Watershed Action Plan provides examples of green infrastructure retrofits that could be implemented at these and other locations in the watershed.

Subwatershed	Potential Stormwater Retrofits
Bailey Arboretum	Revegetate swale along Factory Pond Lane at the River
Bailey Arboretum	Consider infiltration trench for drainage at Park Avenue from the southern end of small subdivision
Bailey Arboretum	Infiltrate stormwater prior to discharge to arboretum pond near Bayville Road

Subwatershed	Potential Stormwater Retrofits
Bailey Arboretum	Reconstruct swale to treat discharges to creek on Arboretum property
Bailey Arboretum	Better stormwater management at bus maintenance area next to Locust Valley Intermediate School
Bailey Arboretum	Infiltrate stormwater at Ann MacArthur Primary School
Beaver Brook	At ice skating facility, increase buffer and treat stormwater discharges near pond
Beaver Brook	Bioretention area to treat discharges to Shu Swamp
Beaver Brook	Replace concrete swale with water quality swale for discharges to Upper Francis Pond
Beaver Brook	Provide treatment for stormwater discharges at Beaver Brook Pond Dam
Cold Spring Brook	Provide treatment for Route 25A outfalls
Cold Spring Brook	Repair erosion and failing outfall from fish hatchery
Cold Spring Brook	Bioretention/infiltration practices at Cold Spring Harbor railroad station
Cold Spring Harbor	Green Street retrofit of Main Street through Cold Spring Harbor hamlet
Kentuck Brook	Replace concrete swale with water quality swale at Kentuck Lane
Kentuck Brook	Treat discharges from railroad embankment area
Kentuck Brook	Assess Oyster Bay Road crossing of brook for potential filtering treatment system
Kentuck Brook	Reshape and revegetate swale along Oyster Bay Road to stop erosion and provide treatment
Mill Neck Creek	Reconfigure end of Walton Avenue to accommodate stormwater wetlands
Mill River	Reconfigure Town of Oyster Bay highway yard to improve management practices
Mill River	Construct a bioretention basin near the intersection of Glen Cove Road and Mill River Road
Mill River	Provide treatment for Lake Avenue outfalls
Mill River	Assess series of recharge basins, include Basin #130, for capacity and effectiveness
Mill River	Install treatment for outfall at Muttontown Lane/Locust Ave; significant pollution was observed in the field.
Mill River	Provide treatment for Route 25A outfalls
Oyster Bay Harbor	Low Impact Development improvements at Town Hall, 74 Audrey Ave
Oyster Bay Harbor	Low Impact Development improvements at Oyster Bay High School, 150 E. Main Street
Oyster Bay Harbor / Beekman Creek	Implement LID principles as part of Beekman Creek restoration project
Oyster Bay Harbor / Spring Lake Creek	Capture and treat Cleft Road stormwater at West Shore Road prior to discharge
Tiffany Brook	Expand existing recharge basin at Yellow Cote Road / Woodland Drive
Tiffany Creek	Assess methods for treating runoff in Laurel Cove Road and Tiffany Road areas
White's Creek	Install hydrodynamic separator at major outfall from South Street
White's Creek	Install treatment catch basins along Elsie Avenue
White's Creek	Rehabilitate and reconfigure Recharge Basin #15 at Pinehollow Road and Route 106
White's Creek	Green Street retrofit project on East Main Street or South Street

Stormwater retrofit and other green infrastructure projects should be implemented by identifying "seed" funding for the initial design phases, followed by the development of subwatershed plans with conceptual designs for specific structural BMPs, which will increase the chances of state and federal funding for these projects, such as the Green Innovation Grant Program, the State Revolving Fund, and the NYSDEC Water Quality Improvement Projects program.

Action 3-4: Enhance Municipal Understanding and Implementation of Green Infrastructure

Low Impact Development (LID) and green infrastructure are the preferred approaches for stormwater management by NYSDEC and EPA, but are also relatively new and sometimes not well-understood by designers, municipalities, and the public.

LID is an approach to land development (or re-development) that works with nature to manage stormwater as close to its source as possible. LID principles include preserving and recreating natural landscape features, minimizing effective impervious cover (i.e., the impervious cover that is directly connected to the storm drainage system and/or receiving waters), and creating functional and appealing site drainage that treats stormwater as a resource. The goal of LID is to mimic a site's pre-development hydrology by using design techniques that infiltrate, filter, store, evaporate, and detain runoff close to its source. LID addresses stormwater through small, cost-effective landscape features located at the lot level. LID is a versatile approach that can be applied equally well to new development, urban retrofits, and redevelopment projects.

Green infrastructure is similar to LID and refers to systems and practices that use or mimic natural processes to infiltrate, evapotranspire, or reuse stormwater. Green infrastructure and LID include stormwater management practices such as rain gardens, permeable pavement, green roofs, green streets, infiltration planters, trees and tree boxes, and rainwater harvesting, for example. These practices capture, manage, and/or reuse rainfall close to where it falls, thereby reducing stormwater runoff and keeping it out of receiving waters.

In addition to reducing polluted runoff and improving water quality, green infrastructure has been shown to provide other social and economic benefits relative to reduced energy consumption, improved air quality, carbon reduction and sequestration, improved property values, recreational opportunities, overall economic vitality, and adaptation to climate change. For these reasons, many communities are

exploring the use of and are adopting green infrastructure within their municipal infrastructure programs.

Key to maximizing the effectiveness of LID and green infrastructure is an understanding of how to select and design LID and green infrastructure practices, including site planning techniques as well as structural practices. The NYSDEC Stormwater Management Design Manual includes a new 5-step process for planning and designing projects to maximize the benefits of LID and green infrastructure, including pollutant removal and runoff reduction. The NYSDEC 5-step process should be implemented in local land use reviews, and municipal land use staff and board members should receive training in this process.

Action 3-5: Incorporate Green Infrastructure into Land Use Plans

The watershed municipalities should incorporate green infrastructure approaches and strategies into their municipal land use plans. For example, the Town of Oyster Bay Eastern Waterfront Community Vision and Revitalization Plan could integrate green infrastructure approaches such as the concepts presented in *Section 4* of this Watershed Action Plan (green streets, LID retrofits of municipal parking lots, etc.).

Action 3-6: Modify Municipal Land Use Regulations to Require LID and Green Infrastructure

Watershed municipalities should modify local land use regulations and design standards to require the use of LID and green infrastructure for municipal projects and private development/redevelopment, consistent with the NYSDEC Stormwater Management Design Manual and MS4 Permit. The regulatory modifications could be based on model codes and regulations (see Sustainable Land Use and Open Space goal).

Action 3-7: Encourage Municipalities to Apply NYSDEC Standards to Smaller Sites

The NYSDEC construction and post-construction stormwater standards in the MS4 Permit apply to projects that disturb an acre or more of land. Municipalities should consider applying the NYSDEC stormwater standards and design requirements to projects that disturb less than an acre. The threshold for applicability of the standards could be based on land disturbance, impervious cover, or project type and could be established through local regulations or ordinances.

Action 3-8: Review Existing Recharge Basins

Stormwater recharge basins are prevalent in many areas of the watershed. Recharge basins are designed to capture and infiltrate stormwater, thereby replenishing groundwater aquifers and reducing the quantity of runoff that is discharged directly to surface receiving waters. Drainage areas that are served by existing recharge basin are believed to be self-contained by infiltrating their entire design volume. Most of these facilities have overflow structures that direct

stormwater resulting from extreme rainfall events to either other recharge basins or to drainage facilities that ultimately discharge to surface waters.

Several of the recharge basins maintained by Nassau County and the Town of Oyster Bay are overgrown and have large amounts of accumulated sediment and/or standing water, and a few are completely full. Although some of these deficiencies may be caused by high groundwater levels during all or part of the year, their performance may be compromised by accumulated sediment and reduced storage volume and infiltration capacity, which could potentially result in sediment resuspension and washout.

The counties and municipalities should review existing recharge basins to assess sediment accumulation, infiltration effectiveness, overflow mechanisms, and the need for maintenance and/or retrofit.

Action 3-9: Explore and Pursue Long-Term Funding for Municipal Stormwater Programs

In order to effectively manage and minimize stormwater runoff with green infrastructure, municipalities must establish sustainable, long-term funding sources to move beyond the pilot phase and create a comprehensive green infrastructure program (EPA, 2011). The watershed municipal entities, working through the Oyster Bay/Cold Spring Harbor Protection Committee, should assess potential funding options, including stormwater fees and loan programs.

Action 3-10: Implement Recognition and Awareness Initiatives

Implement green infrastructure demonstration projects at highly visible locations in the watershed to demonstrate the feasibility and multiple benefits of green infrastructure to the public and elected officials. The watershed municipalities and counties should take a leadership role by implementing green infrastructure retrofits at municipal/county facilities and in roadway projects using "green street" approaches. Private development projects that implement green infrastructure or LID should also be highlighted through a recognition program that could consist of public awards, websites, meetings, media, and other methods. Such a program could be led by the counties or the Oyster Bay/Cold Spring Harbor Protection Committee.

Provide education and outreach programs (seminars, training workshops, web resources, volunteer service events, etc.) for developers, designers, land use commissioners, municipal staff, and the public on green infrastructure and LID stormwater management approaches.

Objective 4: Protect and Restore Riparian and Wetland Buffers

Riparian buffers are naturally vegetated areas adjacent to streams, ponds, and wetlands. Vegetative buffers help encourage infiltration of rainfall and runoff, and provide absorption for high stream flows, which helps reduce flooding and drought. The buffer area provides a living cushion between upland land use and water, protecting water quality, the hydrologic regime of the waterway and stream structure. The naturally vegetated buffer filters out pollutants, captures sediment, regulates stream water temperature and processes many contaminants through vegetative uptake. The vegetative community of riparian buffers provides habitat for plants and animals, many of which are dependent on riparian habitat features for survival. Since, in many areas, riparian buffers are becoming reduced in size and impacted by roadways and development, many species of plants and animals that are dependent on the unique blend of characteristics that buffers provide are threatened or endangered species.

As discussed in the State of the Watershed Report, stream buffer encroachments are prevalent in the watershed along stream corridors in or near areas of residential, commercial, and industrial development and roads. Residential lawns and some commercial lawns extend down to the banks of the stream in many areas, particularly in residential back yards. Yard waste such as grass clippings, leaves, and brush and waste materials were also common occurrences in and near these areas where easy access exists to the streams.

An objective of this plan is to protect and restore degraded riparian and wetland buffers in the watershed to protect and improve water quality. Recommended actions for protection and restoration of riparian habitat, including in-stream habitat, are addressed under the Habitat Protection and Restoration Goal (*Section 3.3*).

Action 4-1: Implement Priority Buffer Restoration Projects

Priority buffer restoration projects identified during watershed field inventories are recommended to restore degraded stream and wetland buffers in the watershed. The most severely impacted riparian buffers are located in the White's Creek and Mill River subwatersheds. Impacted vegetated buffers also exist around many of the ponds and tidal areas. The following table lists several high-priority buffer restoration projects in the Oyster Bay/Cold Spring Harbor watershed.

Subwatershed	Potential Buffer Restoration Projects
Bailey Arboretum	Re-vegetate impacted buffer through Arboretum Grounds
Bailey Arboretum	Work with residents upstream of Factory Hollow Pond to reduce stream encroachment and implement proper waste management practices
White's Creek	Re-vegetate existing aboveground portions of White's Creek and incorporate vegetated buffers in the future design for daylighting of White's Creek
Beaver Brook	Increase buffer surrounding Beaver Lake, especially near livestock pastures.
Mill River	Work with residents along river north of Route 25A to replant impacted buffer, perhaps obtaining conservation easements along stream corridor
Mill River	Mill Pond Overlook Habitat Revitalization Project
Oyster Bay Harbor / Beekman Creek	Incorporate vegetated buffers in the future design for daylighting of Beekman Creek along the Beekman Beach parking lot

Subwatershed	Potential Buffer Restoration Projects
Tiffany Creek	Increase buffer to treat runoff with potential high pollutant loads upstream of Storrs Pond

In general, riparian buffers are most effective along smaller, headwater streams, although larger streams, ponds, and shoreline areas could also benefit from buffer enhancements. Potential buffer restoration approaches for the watershed include:

- Installation of new buffers
- Widening existing buffers
- Invasive species removal/management
- Tree planting/reforestation

The feasibility of buffer restoration at specific sites should be further evaluated based on consideration of site-specific factors including site access, available land area, land ownership, soil conditions, appropriate buffer width, and native plant species.

In general, priority buffer restoration projects should be implemented by identifying "seed" funding for the initial design phases, followed by the development of subwatershed plans with more detailed designs, which will increase the chances of state and federal funding for these projects.

Action 4-2: Adopt Riparian Buffer Regulations

Consider adopting local riparian buffer regulations, with the goal of establishing a contiguous vegetated riparian area on either side of the tributaries (rivers and perennial streams) of Oyster Bay, Cold Spring Harbor, and Mill Neck Creek. Riparian buffer model codes and regulations are addressed under the Sustainable Land Use and Open Space goal in *Section 3.4* of this plan. Recommended elements of a riparian buffer regulation include:

- Establish regulated riparian zones, which may vary in width depending on the resource type (stream, pond, or wetlands) and nature of the land use. Larger buffer widths could be required for land uses with the potential to contribute significant pathogen and nutrient loads to receiving waters such as horse stables and other hot spot land uses.

- Establish maximum disturbance and include vegetation replacement and mitigation for various activities.

- Limit the area of vegetation that can be disturbed for various regulated activities. A permit for activity involving disturbance of the riparian zone would be issued only if specific conditions are met, such as:
    - The basic purpose of the project cannot be accomplished on site without disturbing vegetation in the riparian zone.
    - Disturbance to the riparian zone is eliminated where possible and minimized where not possible by relocating the project, reducing the size of the project, or situating the project in portions of the riparian zone where previous development or disturbance has occurred.

  - Any temporarily cleared area of vegetation must be replanted with indigenous, non-invasive vegetation.
  - Limits on the amount of disturbance allowed for specific activities.

- Limit disturbance within specified distances from the top of bank for certain activities.

- Limit or restrict the use of fertilizer, herbicide, and pesticides within riparian buffers.

- Where the standards cannot be met, providing greater than 1:1 compensation in the form of re-vegetation and placing a deed restriction on the compensation area.

Action 4-3: Provide Education and Outreach

Educate designers, municipal staff, and the public about the value and importance of riparian buffers. Stress the importance of maintaining native vegetation within the riparian zone. Healthy vegetation adjacent to surface waters is essential for maintaining bank stability and water quality. The disturbance of such vegetation destabilizes the banks of channels and other surface waters, which leads to increased erosion and sedimentation that exacerbates the intensity and frequency of flooding. The loss of vegetation adjacent to surface waters also reduces filtration of stormwater runoff and thus degrades the quality of these waters. Such impacts adversely affect the health and habitat of fish and wildlife that depend upon clean surface waters and therefore disrupt the ecological balance that is necessary for life. Humans are ultimately affected by this imbalance, since clean water is essential for all life (New Jersey Department of Environmental Protection, Flood Hazard Area Control Act Rules, 2007). Specific education and outreach recommendations relative to riparian buffers are included in *Section 3.5*.

Objective 5: Reduce the Impacts of On-Site Wastewater Disposal

Much of the Oyster Bay/Cold Spring Harbor watershed is served by on-site wastewater disposal systems, including septic systems and cesspools. Many of these systems are old and not inspected frequently or maintained properly, and failing or malfunctioning systems have a high potential to impact surface water and groundwater quality. An objective of this plan is to reduce the water quality impacts of failing or malfunctioning on-site wastewater disposal systems in the watershed. Actions to achieve this objective will also address the MS4 Permit requirements to detect and eliminate discharges to the storm sewer system from on-site sanitary systems, and to inspect, maintain, and repair failing or malfunctioning systems.

Action 5-1: Assess Watershed to Identify and Map Problem Areas

Conduct an assessment of septic system function throughout the watershed or in specific subwatersheds to identify and map areas with failing or malfunctioning systems that could be resulting in system discharge to the storm sewer system or directly to surface waterbodies. The assessment should consider factors such as shallow groundwater, low infiltrative soils, system densities, historical system failures, and proximity to waterbodies, particularly pathogen-impaired waterbodies.

Action 5-2: Improve System Design, Inspection, and Maintenance

Nassau County Department of Health (NCDH) has jurisdiction over the construction of a new or replacement on-site wastewater disposal system for subdivisions of five lots or more. Systems associated with smaller subdivisions and single-family properties are regulated by the local municipalities (Village, Town, or City), which typically contain limited siting and design requirements or reference the NCDH or NYSDEC requirements.

The Suffolk County Department of Health Services (SCDHS) has jurisdiction over all sewage disposal facilities and maintains design standards documents for single family residences and non-single family residence properties. The design standards for the non-single family residence properties were revised in 2009, but design standards for the single-family residences were last revised in 1995. Both sets of standards contain vague or outdated elements, although the regulatory framework and authority provides an opportunity to improve system design and maintenance practices.

Many Villages have no written requirements for redevelopment and replacement of cesspools and septic systems and can allow property owners to replace existing systems at the discretion of the local building inspector, even if they do not meet current NCDH standards. Annual or periodic inspection of individual on-site wastewater disposal systems is not currently required, and there is no enforcement of maintenance standards.

The following actions are recommended to improve design, inspection, and maintenance of on-site wastewater disposal systems:

- Modify local regulations to include septic system replacement standards for new houses and major renovations, including thresholds requiring the installation of new systems to meet NCDH standards (e.g., percent of structure renovated) and minimum septic system setbacks and clearances for new or replacement systems based on NCDH standards. Such modifications could be based on the recommended model codes and regulations described in the Sustainable Land Use and Open Space goal of this plan.
- Prohibit in-kind replacement of existing non-conforming systems in the event of a failure or major renovation.
- Identify and require the use of innovative alternative septic system designs for lots that are too small or too constrained by groundwater and setbacks to be suitable for a standard system.
- Establish inspection and maintenance requirements consistent with the MS4 Permit. The MS4 Permit requires systems in problem areas (i.e., those areas identified by the assessment described in Action 6-1) designed for less than 1,000 gallons per day to be inspected at a minimum frequency of once every five years and, where necessary, to be maintained or upgraded. Consider requiring more frequent inspections in known problem areas. Consider requiring systems to pass an inspection and be pumped out when the properties that they serve are sold.
- NCDH staff should provide review assistance to building inspectors for larger projects, more complex system designs, or projects requiring a variance or waiver from design standards.

- SCDHS should consider revising both sewage disposal system design standards, or combining the two standards into one standard and improving minimum design standards, such as requiring baffled tanks for all systems, and siting standards.
- Incorporate septic system design and inspection in annual building inspector training programs, and require all building inspectors in the watershed to attend the training.
- Encourage regular maintenance of septic systems by homeowners by providing educational materials on how to identify improperly functioning systems and procedures to have systems inspected, cleaned, and repaired or reconstructed.
- Consider implementing a denitrification standard for new and replacement on-site sewage disposal systems in special groundwater protection areas and areas near surface waters.

Action 5-3: Expand Sewer Service in Targeted Areas

Consider expanding sewer service in targeted portions of the watershed that are densely-developed and currently served by outdated on-site sewage disposal systems, consistent with municipal land use planning objectives.

Objective 6: Reduce Nuisance Waterfowl

Fecal material from nuisance waterfowl such as mute swans and Canada geese is a source of nonpoint source pollution, particularly pathogens and nutrients. Reducing these populations could improve water quality by reducing bacterial and nutrient loadings to the estuary complex.

Action 6-1: Continue Existing Programs to Reduce Nuisance Waterfowl

Nassau County, Suffolk County, and the Town of Oyster Bay have ongoing programs to control and reduce populations of nuisance waterfowl. Nassau County has a goose management program to address the negative impacts that geese have on water quality and has participated in the GeesePeace program (oiling of eggs prevent hatching) along with the Town of Oyster Bay. Suffolk County has used border collies to control geese at selected areas. The Town of Oyster Bay has also used border collies and a boat to control geese at Town parks, beaches, and waterways. The watershed municipalities and counties should continue existing programs and efforts to reduce populations and nesting of nuisance waterfowl in the watershed, and ensure that ordinances are in place in each jurisdiction to prohibit waterfowl feeding. Existing regulatory controls prohibiting the feeding of waterfowl should be enforced through signage and the potential for fines. The watershed municipalities and counties should continue to implement appropriate nuisance waterfowl population control and habitat reduction measures on public property by assessing problem areas to determine the attraction to nuisance waterfowl and developing strategies to reduce the prevalence of these factors.

3.3 Habitat Protection and Restoration

Goal: Protect and restore native habitat, fisheries and stream corridor habitat, shellfish populations, wetland habitat and shorelines, and forests and watershed tree canopy to maintain and increase the watershed's diversity of floral and faunal species.

Summary – Habitat Protection and Restoration

Timeframe:
C = completed
O = ongoing
S = short-term
M = mid-term
L = long-term

Responsibility: (subject to change)
● lead ○ assist

Estimated Cost (thousands):
$ = 0 – 10
$$ = 10 – 50
$$$ = 50 – 100
$$$$ = 100+

	Timeframe	Protection Committee	Nassau County	Suffolk County	Town of Oyster Bay	Town of Huntington	City of Glen Cove	Villages	Friends of the Bay	Conservation Districts	Citizens & Volunteers	Other Partners	Estimated Cost
Objective 1: Protect and Restore Native Habitat													
Action 1-1: Develop Invasive Species Management Plan	M	○	○	○	○	○	○		●	○	○	○[1]	$$$
Action 1-2: Raise Awareness of Invasive Species	S	○	○	○	○	○	○		●	○	○	○[2]	$$
Objective 2: Protect and Restore Fisheries and Stream Corridor Habitat													
Action 2-1: Identify Priority Fish Passage and In-Stream Habitat Improvement Projects	S	●	○	○	○	○	○		○				$$
Action 2-2: Implement Fish Passage Improvement Projects	L	●	○	○	○	○	○		○				$$$$
Action 2-3: Avoid Creation of New Obstructions	S/O	○	●	●	●	●	○	○	○				$$
Action 2-4: Implement In-Stream Habitat Improvement Projects	L	●	○	○	○	○	○		○				$$$$
Action 2-5: Conduct Ongoing Stream, Shoreline, and Beach Clean-ups	O	○			○	○	○	○	●		○		$
Objective 3: Protect and Restore Shellfish Populations													
Action 3-1: Establish Public Spawner Sanctuary	L	○	○		●				○			○[3]	$$$
Action 3-2: Preserve and Expand Shellfish Seeding Program	M	○	○		●				○			○[3]	$$$$
Action 3-3: Identify and Restore Unproductive Shellfish Beds	L	○	○		●				○			○[3]	$$$$
Action 3-4: Continue and Expand Bay Management Area Program	M	○	○		●				○			○[3]	$$$
Action 3-5: Continue to Monitor and Manage Shellfish Predator Populations	M	●	○		○				○			○[3]	$$
Action 3-6: Investigate Reasons for Limited Natural Oyster Sets	M	●	○		○				○			○[3]	$$$
Action 3-7: Educate the Public About the Shellfish Industry	S/O	●	○		○				○			○[3]	$
Objective 4: Protect and Restore Wetland Habitat and Shorelines													
Action 4-1: Conduct Watershed-wide Freshwater Wetland Inventory	M	○							●		○	○[4]	$$

Summary – Habitat Protection and Restoration

Timeframe:
C = completed
O = ongoing
S = short-term
M = mid-term
L = long-term

Responsibility: (subject to change)
● lead ○ assist

Estimated Cost (thousands):
$ = 0 – 10
$$ = 10 – 50
$$$ = 50 – 100
$$$$ = 100+

	Timeframe	Protection Committee	Nassau County	Suffolk County	Town of Oyster Bay	Town of Huntington	City of Glen Cove	Villages	Friends of the Bay	Conservation Districts	Citizens & Volunteers	Other Partners	Estimated Cost
Action 4-2: Monitor Changes in the Extent of Tidal Wetlands	M/O	○							●		○	○[4]	$$
Action 4-3: Adopt Alternatives to Traditional Shoreline Hardening	L	●	●	●	●	●	●	●	○				$$$
Action 4-4: Develop and Implement a Strategy for Wetlands and Shoreline Restoration	L	●	○	○	○	○	○	○	●	○			$$$$
Action 4-5: Reduce Wildlife Predators	M	●	○	○	○	○	○	○	●				$$$
Objective 5: Protect and Restore Forests and Watershed Tree Canopy													
Action 5-1: Refine Watershed Tree Canopy Analysis	S	○							●		○		$$
Action 5-2: Establish Tree Canopy Goals and Protection Strategies	S	○							●				$$
Action 5-3: Implement Reforestation Projects	M	●	○	○	○	○	○	○	○		○		$$$
Action 3-6: Encourage Native Tree Species	S/O	●	○	○	○	○	○	○	○		○		$
Objective 6: Plan for Climate Change and Sea Level Rise													
Action 6-1: Identify At-Risk Resources & Areas	M	●	○	○	○	○	○	○	○			○[4]	$$
Action 6-2: Develop Climate Change Adaptation Strategies	M	○	●	●	●	●	●	●				○[4]	$$$

[1]U.S. Fish and Wildlife Service and The Nature Conservancy
[2]The Nature Conservancy, Long Island Invasive Species Management Area (LIISMA)
[3]Local shellfishing industry and University research programs
[4]University research programs
[5]The Nature Conservancy, NOAA, University research programs

As described in the State of the Watershed Report, the Oyster Bay/Cold Spring Harbor Complex and its watershed provide abundant and significant habitat that supports a variety of fish and wildlife. Various estuarine, palustrine, riverine, and upland areas provide habitat to finfish, shellfish, mammals, amphibians, reptiles and birds.

Notable tracts of protected or preserved land (including submerged or tidal areas) within the estuary and watershed include the Oyster Bay National Wildlife Refuge, Charles T. Church/Shu Swamp Nature Preserve, Sagamore Hill National Historic Site, Planting Fields Arboretum, Muttontown Preserve, Bailey Arboretum, Stillwell Woods Park, Tiffany Creek Preserve, and the Nature Conservancy's Uplands Farm. These tracts of privately and publicly owned land provide valuable habitat or unique natural resources in an otherwise developed suburban

watershed. Due to the importance of these habitats, the State of New York has designated some of them as Significant Coastal Fish and Wildlife Habitats (SCFWH).

The following objectives and recommended actions will serve to protect and restore the various habitats that exist within the estuary complex and its watershed.

Objective 1: Protect and Restore Native Habitat

Native vegetation plays an important role in ecosystem biodiversity. Invasive plants have displaced native species and threaten local biodiversity and ecosystem function in the watershed. Invasive plants and invasive aquatic plants have been identified in many areas of the watershed. The most common and visible plant species include *Phragmites australis*, purple loostrife, and Japanese knotweed. Invasive aquatic plants such as Water Chestnut are also prevalent in some waterbodies in the watershed such as Mill Pond. Efforts to eradicate Water Chestnut from Mill Pond are ongoing, through the joint efforts of Nassau County, the U.S. Fish and Wildlife Service, The Nature Conservancy, volunteers, and other groups.

Action 1-1: Develop Invasive Species Management Plan

A survey should be performed to identify the extents and locations of invasive plant and animal species in the watershed, as well as potential restoration sites. The survey could be performed for the entire watershed or for selected subwatersheds, starting with the Mill River subwatershed as recommended previously in the Mill River Watershed Study and Public Stewardship Program.

Following the surveys, an invasive species management plan (or separate plans for individual subwatersheds) should be developed for the watershed or targeted subwatersheds. The plan should include eradication and control methods, prevention and education efforts to preempt arrivals, early detection and citizen monitoring efforts, rapid response measures for successful eradication, and when a species cannot be eradicated, continued control efforts that are necessary to minimize ecological and economic impacts. The invasive species management plan should borrow from the successes of other local regional invasive species control programs elsewhere on Long Island.

Action 1-2: Raise Awareness of Invasive Species

Both Nassau and Suffolk Counties have passed legislation prohibiting the sale, introduction, and propagation of invasive, non-native plants as part of their long-term plans to slow the spread of invasive species. The prohibition went into effect January 2009 for most species. Both counties developed the same "Do Not Sell" list in collaboration with The Nature Conservancy, Long Island Invasive Species Management Area (LIISMA), the nursery industry, botanists, field scientists, and environmental agencies.

Local education and enforcement programs are essential to the success of these and other invasive species management efforts within the watershed. Ongoing education is recommended for residents, facility maintenance personnel, landscapers and local nurseries, and land use commissions about the negative effects of non-native invasive species, pathways of introduction, and alternatives to invasive ornamental plants.

Additionally, invasive species are not necessarily limited to plants. Aquatic and upland vertebrates and invertebrates can also be invasive. NYSDEC considers White Perch and Alewife to be invasive when introduced into landlocked and inland waters. Baitfish, including Rusty Crayfish, Fathead minnow, Goldfish, Red Swamp Crawfish, Banded Darter, Virile Crayfish, Red Wigglers, Rainbow Darter, and Nitro-worms can be invasive, and baitfish have also introduced Viral Hemorrhagic Septicemia into gamefish in New York. Ongoing education is also recommended for anglers and other target groups that influence the spread of faunal invasive species.

Objective 2: Protect and Restore Fisheries and Stream Corridor Habitat

Attempts in recent years have been made to open up fish passage throughout the watershed to anadromous fish (which spend most of their adult lives in coastal marine waters) such as river herring, sea lamprey, and sea-run brook trout and catadromous fish (which live in freshwater but spawn at sea) such as American eel (NYSDOS, 2005; Gomez & Sullivan, undated). A fish ladder has been constructed at the downstream end of Beaver Lake to open passage to sea-run trout and potentially other anadromous and catadromous fish (NYSDOS, 2005).

Fish passage feasibility studies have also been completed by the Long Island Chapter of Trout Unlimited, Environmental Defense, and Friends of the Bay to evaluate fish passage restoration of the Mill River and other areas of the harbor complex watershed. According to an evaluation conducted by NYSDEC, Region 1 Fisheries Bureau (Kozlowski, 2001), the fishery in the Oyster Bay/Mill River system is unusual for Nassau County (Gomez & Sullivan, undated) due to the documented presence of brown trout and brook trout.

The NYSDEC has determined that Mill River, upstream of Mill Pond, has a naturally reproducing brown trout population. It is one of only several known reproducing brown trout populations on Long Island, believed to have been from stockings of brown trout in Mill Pond. Brook trout are also believed to be using Mill River during various times of their life cycle. The presence of brook trout in Beekman Creek, a tributary of Mill River, is one of only two known spawning populations in Nassau County. In February 2008, for the first time,

natural reproduction of brook trout in Beaver Brook was documented by NYSDEC and Long Island Trout Unlimited (Gomez & Sullivan, undated).

An important objective of this plan is to protect and restore naturally reproducing fish populations in the watershed by removing barriers to fish passage as well as restoring or enhancing in-stream and riparian habitat.

Action 2-1: Identify Priority Fish Passage and In-Stream Habitat Improvement Projects

Trout Unlimited conducted a Stream Visual Assessment Protocol (SVAP) of the stream corridors in the watershed in 2008. The SVAP identified numerous barriers and potential fish passage and stream restoration projects throughout the watershed. Similar stream assessments performed by Nassau County, Friends of the Bay, and Natural Resources Defense Council identified other opportunities for fish passage restoration, as well as opportunities for stream restoration. The following tables summarize these potential opportunities.

Subwatershed	Potential Fish Passage Restoration Projects
Beaver Brook	Improve passage below Cleft Rd; provide passage at Beaver Pond dam
Beaver Brook	Install fish ladder or remove structures at Francis Ponds Dams; improve passage below Frost Mill Road
Beaver Brook	Facilitate passage through, or remove, Beaver Brook Pond Dam; Oyster Bay Road culverts are currently passible
Cold Spring Brook	Provide passage through USGS weir and St. Johns Pond Dam
Cold Spring Brook	Install fish ladder at Franklin Falls Pond Dam or install fish ladder
Cold Spring Brook	Re-design Stillwell road crossing and remove in-stream grade control structures
Factory Pond Creek	Remove Factory Pond Road dam or construct fish passage; improve culvert below road
Kentuck Brook	Remove Lower Kentuck Pond (Rake's Pond) dam or construct fish passage
Kentuck Brook	Install rock ramp at Upper Kentuck Pond Dan, improve habitat structure downstream from dam
Kentuck Brook	Remove Coffin Pond dam or construct fish passage
Mill River	Replace West Shore Road culvert (carrying Beekman Creek) with bottomless arch or clear span bridge
Mill River	Install fish bypass channel at Mill Pond Dam
Mill River	Install passage or remove small dam approximately 1/5 mile north of Mill River Road
Mill River	Replace Route 25A culvert with bottomless arch or clear span bridge
Oyster Bay Harbor / Beekman Creek	Daylight creek to restore passage and habitat
Oyster Bay Harbor / Spring Lake Creek	Replace culvert at West Shore Road
Oyster Bay Harbor / Spring Lake Creek	Remove dam at first pond south of Cleft Road, install passage at second pond (second pond may be historically significant)
Oyster Bay Harbor / Spring Lake Creek	Remove berm between wetlands upstream from Spring Lake Creek Mill Pond Dam
Tiffany Creek	Storrs Pond Dam removal or fish ladder
Tiffany Creek	Replace Cove Neck Road box culvert with bottomless culvert
Tiffany Creek	Assess seawall structure for effect on passage

Subwatershed	Potential Fish Passage Restoration Projects
Tiffany Creek	Replace undersized Laurel Cove Road culvert with bottomless arch
Tiffany Creek	Replace undersized Tiffany Road culvert with bottomless arch
Tiffany Creek	Culvert replacement, fish ladder or rock ramp at dam near Tiffany Road residence
Tiffany Creek	Replace culvert at abandoned path with footbridge near Tiffany Road residence
Tiffany Creek	Replace Tiffany Creek Mill Race culverts at Sunset Road and Morris Lane with bottomless arch culverts or clear span bridges
Tiffany Creek	Install rock ramps at two low-head dams on Mill Race, replace culvert at Oyster Bay Cove Road, remove dam at very small pond
Tiffany Creek	At Cove Road residence, remove dam at private pond or construct rock ramp
Tiffany Creek	At Cove Road residence, remove obsolete culvert
Tiffany Creek	Replace culvert at Oyster Bay Cove Road
Tiffany Creek	Install rock ramp or fish ladder at Held Pond

Subwatershed	Potential Stream Restoration Projects
Bailey Arboretum	Restoration of channelized banks through Arboretum Grounds
Beaver Brook	Improve habitat structure through Shu Swamp
Beaver Brook	Create deeper pools throughout Beaver Brook while avoiding impacts to cobble and gravel substrate
Cold Spring Brook	Remove invasive species in Lower Reaches and improve impacted channel geometry
Kentuck Brook	Improve habitat structure and width to depth ratio in reach surrounding Glen Cove-Oyster Bay Road
Oyster Bay Harbor / Beekman Creek	Improve stewardship with homeowners along Harborview Drive
Oyster Bay Harbor / Beekman Creek	Improve habitat structure upstream from section to be daylighted and restored and ensure that brook trout are not impacted
Mill River	Restore Mill River, including walking trails, in-stream enhancements, invasive species removal, fish passage provisions, LID stormwater retrofits, and educational signage.
Tiffany Creek	Upstream of Storrs Pond, improve habitat through in-stream structures such as lunkers
Tiffany Creek	Improve width to depth ratio, add habitat structure, remove invasive species, address eutrophication
Tiffany Creek	Remove invasive species near Tiffany Road residence
Whites Creek	Daylight Whites Creek and incorporate it as a keystone of the Eastern Waterfront Revitalization Project

Further evaluation is recommended to prioritize these potential fish passage and in-stream habitat improvement projects. The evaluation should consider overall site-specific feasibility (land ownership, upstream and downstream conditions, infrastructure constraints, construction access, etc.) and ecological benefits, and should include geomorphic assessments to identify specific stream reaches in need of habitat restoration.

Action 2-2: Implement Fish Passage Improvement Projects

Implement the priority fish passage improvement projects identified based on the outcome of Action 2-1 above. Provisions for fish passage (fish ladders, bypass channels, barrier removal, etc.) should be initially considered for the major impoundments immediately upstream of the estuary, including Beaver Pond, Mill Pond, and St. Johns Pond to allow fish passage into upstream areas.

Action 2-3: Avoid the Creation of New Obstructions

Local and county drainage design standards should be reviewed and modified, as necessary, to require the design of new or modified stream crossings to include provisions for passage, as well as the movement of semi-aquatic and terrestrial organisms along the stream corridor. The New York regional conditions of the U.S. Army Corps of Engineers Nation Wide Permit for Stream Crossings require the use of a bottomless arch culvert, bridge, or embedded culvert, and that the culvert meet minimum width and openness ratio criteria. Similar requirements should be considered for local and county stream crossing design.

Action 2-4: Implement In-Stream Habitat Improvement Projects

Implement the priority stream restoration projects identified based on the outcome of Action 2-1 above. Common stream restoration techniques that could be implemented in the watershed include:

- Slope stabilization
- Redirective or flow changing techniques
- Toe protection techniques
- Bioengineering techniques
- Grade control techniques
- Riparian buffer improvement

Friends of the Bay, in conjunction with the Town of Oyster Bay, is proposing a comprehensive, phased restoration of Mill River and Beekman Creek, including fish passage restoration, in-stream enhancements, riparian restoration, invasives removal, walking paths, education signage, stormwater retrofits, and other improvements. This project can serve as a model for future stream restoration efforts in the watershed.

In general, stream restoration and other habitat improvement projects should be implemented by identifying "seed" funding for the initial design phases, followed by the development of subwatershed plans with more detailed designs, which will increase the chances of state and federal funding for these projects.

Action 2-5: Conduct Ongoing Stream, Shoreline, and Beach Clean-ups

Continue to conduct regular stream, shoreline, and beach cleanup projects throughout the watershed. The cleanup events should be publicized to involve citizen volunteers. The amount and type of material removed should also be documented and publicized to reinforce the accomplishments of these efforts.

Objective 3: Protect and Restore Shellfish Populations

Healthy shellfish populations are critical to maintaining water quality. Shellfish are filter feeders that are capable of filtering large quantities of water each day and the high water quality in the Oyster Bay/Cold Spring Harbor estuary is largely attributed to a vibrant shellfishery and shellfish aquaculture industry. This industry is also a significant contributor to the local economy and provides a sustainable source of fresh seafood. Shellfish populations also serve other ecological functions, including providing nursery and essential habitat for fish and crustaceans, and protecting coastal marshes from wave erosion.

Action 3-1: Establish a Public Shellfish Spawner Sanctuary

Establish a public shellfish spawner sanctuary as a designated area for establishing a vibrant, self-sustaining oyster and clam population in public waters. The sanctuary would be established through existing oyster farmers growing juvenile clams and oysters that would then be transplanted to the proposed sanctuary as well as transplanting breeding sized clams from other areas of the harbor. The proposed sanctuary should be located in an area that is currently closed to shellfishing to avoid closure of existing open shellfishing areas and to help improve water quality in those areas. Also consider establishing oyster reefs to protect eroding shoreline areas and in conjunction with wetland restoration projects. Such reefs could also act as spawner sanctuaries.

Action 3-2: Preserve and Expand Shellfish Seeding Program

Modernize and increase the capacity of the floating upweller systems (flupsys) and increase the number of seeded clams and oysters. Consider relocating flupsys to areas of the bay with better tidal flow and higher water quality.

Action 3-3: Identify and Restore Unproductive Shellfish Beds

Many areas that were formerly productive beds have been impaired due to the accumulation of silt and mud. Mechanical cultivation of these areas and amendment of the substrate with clam and oyster shells should be considered to restore their productivity.

Action 3-4: Continue and Expand the Bay Management Area Program

The Bay Management Area (BMA) is manipulated for public shellfish production, including ensuring adequate spawning stock for natural sets throughout the estuary. The current BMA has been compromised by the accumulation of silt and mud. Improvements could be made with mechanical cultivation, shelling, and seeding. Consider creating additional BMAs in other areas of the estuary. Portions of the BMAs could be used for transplanting shellfish from uncertified waters for cleansing and re-harvest.

Action 3-5: Continue to Monitor and Manage Shellfish Predator Populations

Continue to monitor and control known shellfish predators such as sea stars, oyster drills, conch and crabs. Prepare a management plan to address population spikes of common shellfish predators.

Action 3-6: Investigate Reasons for Limited Natural Oyster Sets

A substantial population of oysters is maintained in the estuary though F.M. Flowers aquaculture operation. Despite the large population of spawning oysters, natural sets occur infrequently and in smaller numbers than would be expected. The reasons and underlying causes for the limited numbers of natural oyster sets in the estuary should be investigated through a collaborative effort between the local shellfish industry, government agencies, and university researchers.

Action 3-7: Educate the Public About the Shellfish Industry

Educate the public about the benefits that the shellfish industry provides to water quality, the economy and providing fresh, sustainable seafood, as well as the threats to the shellfish industry and how the public can help reduce these threats. Install interpretive signage at the Jakobson Shipyard pier and other public waterfront areas describing these benefits and other unique or interesting aspects of shellfishing in Oyster Bay and Mill Neck Creek.

Objective 4: Protect and Restore Wetland Habitat and Shorelines

Approximately 1,000 acres of tidal wetlands exist within the harbor complex. Extensive areas of coastal shoals, bars, and mudflats occur along Mill Neck Creek, the western and southern shoreline of Oyster Bay Harbor, Inner Cold Spring Harbor, and the northeast shoreline of Centre Island. Most of the shoreline in the harbor complex is fringed by vegetated (IM and HM) tidal wetlands of varying width, interrupted by man-made waterfront structures. Freshwater wetlands account for approximately 2 percent of the harbor complex watershed area, with the majority of these located in the Beaver Brook, Cold Spring Brook, and Mill River subwatersheds.

Tidal wetlands are a vital part of the estuary ecosystem, providing habitat for many bird, fish and invertebrate species, filtering sediment and reducing loadings of other pollutants, and buffering coastal areas from storm surge. Similar to most embayments on Long Island, tidal wetlands have been decreasing in the Oyster Bay/Cold Spring Harbor complex due to a number of factors including coastal development and shoreline hardening, boat wake, altered salinity due to stormwater discharges, and rising sea levels. Many of the remaining tidal wetland areas have experienced a shift from native salt marsh plants to non-native species, which provide significantly lower habitat value for many species. Freshwater wetlands in the watershed around streams and ponds have also been impacted by development, stormwater runoff, and the introduction and proliferation of invasive species.

A key objective of this plan is to protect and restore tidal and freshwater wetlands throughout the estuary complex and its watershed, including a shift away from traditional shoreline hardening approaches to non-structural and bioengineering techniques whenever possible.

Action 4-1: Conduct Watershed-Wide Freshwater Wetlands Inventory

Freshwater wetlands are regulated under the Freshwater Wetlands Act (under Article 24 of the Environmental Conservation Law) and are defined and mapped by NYSDEC. However, only wetlands 12.4 acres and larger are mapped and protected under the Freshwater Wetlands Act. Smaller wetlands, which are prevalent throughout the watershed, may be protected if they are considered of unusual local importance. The NYSDEC freshwater wetlands mapping should be augmented by conducting a watershed-wide wetlands inventory to identify and map smaller wetlands and stream corridors that are not currently protected (e.g., Mill River, Tiffany Creek and small wetlands along West Shore Road are some examples of wetlands that are not mapped by the NYSDEC). Developing detailed wetlands mapping for the watershed would also assist in establishing local riparian buffer regulations and providing increased protection of local wetlands and water quality.

Action 4-2: Monitor Changes in the Extent of Tidal Wetlands

Tidal wetlands and creeks can be significantly impacted by development and shoreline modifications (bulkheads and waterfront structures). Tidal creeks, such as Mill Neck Creek, are subject to significant sedimentation and decreased water depths due to discharges of stormwater runoff and other internal sources such as the deposition of algal cell material. Changes in the extents of tidal wetlands and the depth of tidal creeks should be monitored over time to identify at-risk areas and help prioritize restoration efforts. The aerial extent of tidal wetlands can be mapped and compared over time using aerial photography and field surveys, and the depth of tidal creeks can be monitored to assess sedimentation rates.

Action 4-3: Adopt Alternatives to Traditional Shoreline Hardening

Alternatives to shoreline hardening should be considered whenever possible for waterfront or shoreline redevelopment projects and in coastal restoration efforts. Traditional "hard" shoreline construction approaches have focused on using vertical concrete, metal, or wooden break-walls; gabions; and rip-rap to protect against storm surge and wave energy. However, instead of absorbing the energy of wave and water action like vegetated sloping shorelines do, these hardened vertical or near vertical structures reflect wave energy, worsening turbulence and increasing erosion in front of and adjacent to the structure. These factors have an adverse

impact on the chemical, biological, and physical condition of the waterbody and limit recreational opportunities (NYSDEC, 2011).

The NYSDEC Department of Fish, Wildlife and Marine Resources developed Staff Interpretative Guidance for Shoreline Protection, which provides recommended alternatives to bulkheading in New York State. The guidance recommends for new or replacement shoreline erosion projects, the project sponsor should be required to select the least structural or softest approach available to address the erosion problem and that, whenever possible, the character of the natural shoreline and riparian zones should be retained or restored.

Municipal and county jurisdictions within the watershed should also adopt the NYSDEC Interpretive Guidance and consider modifying existing codes and regulations to require alternatives to shoreline hardening, whenever feasible. Revitalization of the eastern waterfront and the ongoing West Shore Road seawall reconstruction project present immediate or near-term opportunities to implement such alternative approaches. A watershed-wide inventory of hardened shoreline areas should be performed to identify and prioritize areas for alternative shoreline stabilization and tidal wetland restoration.

Action 4-4: Develop and Implement a Strategy for Wetlands and Shoreline Restoration Projects

Develop and implement a strategy to identify and implement freshwater and tidal wetland and shoreline restoration projects within the watershed, first by identifying potential sites and then prioritizing the sites through a screening evaluation that considers ecological benefits, site challenges, potential stakeholders, funding sources, and successes and lessons learned from other similar restoration efforts on Long Island.

Subwatershed	Potential Wetland and Shoreline Restoration Projects
Oyster Bay Harbor	West Shore Road seawall reconstruction
Oyster Bay Harbor	Eastern Waterfront redevelopment
Beaver Brook	Shu Swamp Nature Preserve
Centre Island	Restoration of the Spartina intertidal zone between Centre Island Beach and Mill River Rod and Gun Club to create nesting and hatchling habitat for diamondback terrapins
Mill Neck Creek	Cleanup and re-use of former Mill Neck Bay Marina
Mill River/Oyster Bay Harbor	Mill River/Beekman Creek
Mill River	Mill Pond
Tiffany Creek	Tiffany Creek
Mill River	Muttontown Preserve, pond adjacent to Chelsea Mansion
Mill River	Site of the proposed Oaks at Mill River development

Subwatershed	Potential Wetland and Shoreline Restoration Projects
White's Creek	White's Creek
Mill River	Corner of Mill River Road and Glen Cove/Oyster Bay Road
Mill Neck Creek	Wetlands behind commercial area and amusement park on Bayville Avenue

The Coastal America Corporate Wetlands Restoration Partnership, through its New York Chapter, is one potential funding source for wetland restoration projects for which conceptual designs have been completed. The program is an innovative private-public initiative aimed at preserving, restoring, enhancing and protecting aquatic habitats throughout the United States by bringing together corporations, federal and state agencies, non-profit organizations and academia.

In general, priority wetland restoration projects should be implemented by identifying "seed" funding for the initial design phases, followed by the development of subwatershed plans with more detailed designs, which will increase the chances of state and federal funding for these projects.

Action 4-5: Reduce Wildlife Predators

Feral domestic species and wildlife predators can reduce populations of beach and ground-nesting birds and other marine and terrestrial organisms in shoreline and inland areas. Management recommendations should be developed to address common predators such as Norway Rats (a common predator of diamondback terrapins) and feral cats. Consider expanding Trap-Neuter-Return (TNR) programs for feral cats within the watershed municipalities in addition to the Keep-Your-Cat-Indoors program advocated by the Huntington-Oyster Bay Audubon Society. A TNR program is currently active in the Town of Oyster Bay.

Objective 5: Protect and Restore Forests and Watershed Tree Canopy

The Oyster Bay/Cold Spring Harbor watershed contains a relatively high percentage of forested land (approximately 45%) compared to other nearby coastal watersheds on Long Island. These lands consist of deciduous and coniferous forest cover, which is associated with open space and wooded portions of low-density residential properties. Forest cover provides numerous benefits at both the site and watershed scales. In addition to providing habitat for terrestrial and aquatic wildlife, watershed forest cover also reduces storm water runoff and flooding, improves regional air quality, reduces stream and channel erosion, improves soil and water quality, and reduces summer air and water temperatures (USDA Forest Service, 2005).

Despite the healthy forest cover that exists in the watershed and existing land clearing and tree protection ordinances of several of the watershed municipalities, homeowner clearing of residential properties and land development/redevelopment activities continue to threaten forests and watershed tree canopy. The following actions are recommended to protect and enhance forested areas and tree canopy within the watershed.

Action 5-1: Refine Watershed Tree Canopy Analysis

Tree canopy is defined as the layer of tree leaves, branches, and stems that cover the ground when viewed from above. Tree canopy is a useful parameter because it provides such benefits as rainfall interception, pollutant removal, and reduced temperatures due to shading of streams and impervious surfaces, and can be measured using remote sensing and/or field techniques. Many communities across the United States have assessed the tree canopy in their community and developed tree canopy goals as numerical targets to guide urban watershed forestry planning efforts.

A planning-level watershed tree canopy analysis was conducted for the development of the State of the Watershed Report. Forest cover was estimated based on relatively coarse-resolution satellite land cover data for the watershed, which is limited in its ability to capture individual trees or stands of trees which are common in developed areas. A refined tree canopy analysis should be conducted using high-resolution aerial imagery and GIS analysis techniques to refine the existing tree canopy estimates for the watershed and individual subwatersheds. The results of the refined analysis can assist in targeting target priority areas for additional tree protection and reforestation efforts.

Action 5-2: Establish Tree Canopy Goals and Protection Strategies

Quantitative tree canopy goals should be established for the watershed and individual subwatersheds based on the findings of the refined analysis described in Action 5-1. A plan to achieve those goals should be developed and could include:

- Land acquisition, conservation easements
- Revisions to site development regulations and zoning to encourage tree retention and maintenance, restrict tree removal, and require landscaping and parking lot shading
- Reforestation of public lands, beginning with priority sites
- Encouraging large trees wherever possible
- Encouraging reforestation of private land by developing education, stewardship and incentive programs. For larger parcels, work with a forester to developing specific goals and objectives specific to the subject property.
- Review existing municipal land clearing regulations and ordinances. Municipalities that do not currently have regulatory requirements for tree protection should amend their regulations for consistency with those that have specific requirements for removal permits, protection during construction, and replacement requirements. Model codes and regulations should be developed for this purpose (see Sustainable Land Use and Open Space goal).
- Encourage maintaining and improving native tree cover.

Action 5-3: Implement Reforestation Projects

Identify priority parcels for reforestation based on watershed field inventories and refined tree canopy analysis results. Work with the municipalities and property owners to implement priority reforestation projects in the watershed, which can demonstrate the importance of trees and vegetation for terrestrial and aquatic wildlife habitat and as a critical component of green infrastructure and related water quality benefits.

Action 5-4: Encourage Native Tree Species

Encourage native rather than non-native species, such as the Norway Maple and Ailanthus, and educate the public, municipalities, and landowners about the importance and identification of native tree species. Work with the municipalities to require the use of native tree species in land development and redevelopment projects and to use native tree species in municipal projects. The Cornell Cooperative Extension office in Nassau County can recommend native species for use in the watershed.

Objective 6: Plan for Climate Change and Sea Level Rise

Climate change in the Northeastern U.S. is anticipated to result in an increase in the extent and frequency of coastal flooding, a rise in the frequency of severe storms and related damages, and sea level rise. Climate change will produce a sea level rise around Long Island of up to 4.5 feet by 2080 (NYS Sea Level Task Force). Coastal wetlands are vulnerable to the effects of sea-level rise, increasing water temperatures, and increased nutrients. If accretion of river-borne sediment and organic matter is unable to keep pace with the combined affects of sea-level rise and land subsidence, coastal marshes will be reduced or disappear. This will impact the ecological services provided by these areas including buffering coastal areas from waves and erosion, filtering nutrients and pollutants, providing wildlife habitat, and providing nursery areas for fisheries. Because hard-clams and oysters depend on wetland-based food chains, impacts to coastal wetlands are anticipated to impact those fisheries (Frumhoff et al., 2007).

An objective of this plan is to promote climate change adaptation strategies to address anticipated sea level rise and associated impacts on human and natural communities in the estuary complex.

Action 6-1: Identify At-Risk Resources and Areas

The Nature Conservancy is leading a coastal resilience project that intended to provide planners and other decision-makers on Long Island with tools to assess reasonable future impacts of flooding from sea level rise and storms. The mapping tool developed for the project is an interactive decision support tool that explores future flooding scenarios and anticipated impacts on ecological resources (such as tidal wetlands, bird habitat, and submerged aquatic vegetation), infrastructure, and socioeconomic resources. A watershed-wide assessment is

recommended to identify resources and areas within the watershed that are potentially at-risk from predicted sea level rise and storm surge scenarios.

Action 6-2: Develop Climate Change Adaptation Strategies

The watershed municipalities and counties should develop climate change adaptation strategies to guide decision-making regarding natural resource protection and land use management. The impacts of sea level rise and coastal hazards should be considered in future coastal planning and restoration efforts. Appropriate local strategies should be guided by the recommendations of the New York State Sea Level Rise Task Force Final Report issued in December 2010. Watershed municipalities and counties should consider organizing a workshop series, such as the Groton, Connecticut Coastal Climate Adaptation Workshops, which was supported by USEPA's Climate Ready Estuaries Program.

3.4 Sustainable Land Use and Open Space

Goal: Ensure that development within the watershed is sustainable, promote sustainable land use practices to protect natural resources, and expand access to upland and aquatic open spaces without adversely impacting water quality and natural resources.

Summary – Sustainable Land Use and Open Space

Timeframe:
C = completed
O = ongoing
S = short-term
M = mid-term
L = long-term

Responsibility: (subject to change)
● lead ○ assist

Estimated Cost (thousands):
$ = 0 – 10
$$ = 10 – 50
$$$ = 50 – 100
$$$$ = 100+

	Timeframe	Protection Committee	Nassau County	Suffolk County	Town of Oyster Bay	Town of Huntington	City of Glen Cove	Villages	Friends of the Bay	Conservation Districts	Citizens and Volunteers	Other Partners	Estimated Cost
Objective 1: Promote Sustainable Development													
Action 1-1: Remove Potential Barriers to Sustainable Development	S/M	○	○	○	●	●	●	●	○				$$
Action 1-2: Develop and Implement Model Codes and Regulations	S/M	●	○	○	●	●	●	●	○				$$$
Action 1-3: Incorporate WAP into Municipal Plans	S	○			●	●	●	●	○				$
Objective 2: Maintain and Improve Open Space													
Action 2-1: Preserve or Protect Additional Open Space	O	●	●	●	○	○	○	○	○			○[1]	$$$$
Action 2-2: Work with Owners to Protect Undeveloped Private Property	O	○	○	○	○	○	○	○	●	○		○[1]	$$$
Action 2-3: Pursue Multiple Sources of Financing	O	●	○	○	○	○	○	○	○			○[1]	$$
Action 2-4: Ensure Consistency with County Acquisition Criteria	C	●	○	○					○				$
Action 2-5: Create a "Green" Map	M	○			●	●			●		○	○[3]	$$
Objective 3: Increase Public Access													
Action 3-1: Encourage Water Related Use of Theodore Roosevelt Park and the Western Waterfront	O	○			●				○				Varies
Action 3-2: Create a Water Trail	M	○			●	●			●			●[2]	$$$$
Action 3-3: Delineate and Enforce Watercraft Low-Speed Zone	M	○			●	●			●				$
Action 3-4: Include Public Access In Waterfront Redevelopment	S	○			●	●	●	●	○			○	$$$
Action 3-5: Incorporate Outreach Signage	S	●			○	○	○		○			○	$$

[1]North Shore Land Alliance, The Nature Conservancy, private property owners
[2]Hempstead Harbor Protection Committee
[3]Long Island North Shore Heritage Area

Objective 1: Promote Sustainable Development

Sustainable development or smart growth includes a range of development and conservation strategies that help protect natural resources and make communities more attractive, economically stronger, and more socially diverse. Sustainable development practices have a number of benefits including lessening the environmental impacts of development with techniques that include compact development, reduced effective impervious surfaces and runoff generation, safeguarding of environmentally sensitive areas, mixing of land uses, transit accessibility, and better pedestrian and bicycle amenities. Sustainable or smart growth approaches can benefit developed areas through infill redevelopment and redevelopment of underutilized sites.

An objective of this plan is to promote sustainable principles in ongoing and future development and redevelopment in the watershed, and to ensure that growth is appropriate and incorporates measures to minimize impacts on surface and groundwater resources.

Action 1-1: Remove Potential Barriers to Sustainable Development

The watershed municipalities should consider modifying local land development codes, ordinances, and land use plans to remove common barriers to implementing sustainable development principles. General recommendations include:

- Adjust parking requirements to reduce unnecessary impervious cover
- Modernize street standards
- Designate and support preferred growth areas and development sites
- Use green infrastructure to manage stormwater
- Establish a water budget based on site conditions before development

Action 1-2: Develop and Implement Model Codes and Regulations

Municipal land use codes and regulations can shape the development patterns within a watershed and play a significant role in protecting water quality and other natural resources at the watershed scale. These commonly include municipal comprehensive plans, zoning regulations, subdivision regulations, and stormwater regulations, all of which influence the type and density of development that can occur within a watershed. Local land use regulations often vary by municipality within a watershed, and regulations are periodically revised in response to development pressure, shifts in attitude toward natural resource protection, and political and socioeconomic factors. Communities in urbanized areas are also faced with a mandate to meet State and Federal Phase II stormwater permit requirements.

An opportunity exists for the municipalities within the Oyster Bay/Cold Spring Harbor watershed to strengthen existing regulatory mechanisms and go beyond the required MS4 stormwater management requirements, while also updating and improving upon existing land use regulations and land use planning strategies to help protect and restore water quality and other valuable natural resources in the estuary complex and its watershed.

The Oyster Bay/Cold Spring Harbor Protection Committee, working with Nassau and Suffolk Counties, should develop model codes and regulations to strengthen local land use regulatory

controls and better protect water quality and related natural resources within the Oyster Bay/Cold Spring Harbor watershed. The models should be developed by building upon the many successful example local regulations that already exist on Long Island, elsewhere in New York State, and nationally. Specifically, local model codes and regulations should be developed for:

- Stormwater Management – New York State requirements generally do not mandate a stormwater management permit for site disturbances involving less than one acre, except for certain projects involving other environmental permits. However, municipalities can regulate site disturbances involving less than one acre due to the cumulative, adverse impacts to water quality from unmanaged runoff on smaller sites. The following construction and post-construction stormwater management standards should be addressed, beyond those currently required by NYSDEC:

    - Construction stormwater runoff:
        - Thresholds for requiring an erosion and sediment control plan
        - Recommended erosion and sediment control methods
        - Pre-construction inspection for all erosion control, tree protection and limits of disturbance protection
    - Post-construction stormwater management:
        - Applicability and exemptions
        - Low Impact Development (LID) standards, incentives, and design calculations
        - Green infrastructure approaches and standards
        - Redevelopment/retrofit standards, including applicability and exemptions
        - Impervious cover limits

- Septic System Replacement and Maintenance – The watershed municipalities rely on the County Health Departments for design guidelines and the approval of on-site wastewater disposal systems. Once constructed and operational, on-site wastewater disposal systems are no longer regulated by the County Health Department and are only inspected if a failure complaint is submitted to the County. The Towns and Villages also do not have requirements for ongoing inspection or maintenance of existing systems. The following issues should be addressed by the model codes and regulations:

    - Septic System replacement standards (new houses and major renovations)
        - Thresholds for requiring new systems to meet county standards
        - Block structures
    - Setbacks and clearances (County Department of Health Standards)
    - Piping standards (size, green pipe)
    - Inspection and maintenance requirements

- Municipal and Private Roadway Standards – The design, construction, and maintenance of municipal and private roads can have a major impact on the water quality of the harbor complex and its watershed. The model codes and regulations should address the following issues related to municipal and private roads:

- Private roadway standards
  - Minimum design standards
  - Minimum maintenance standards
    - Sweeping
    - Catch basin cleaning
    - Pothole repair
    - Repaving
    - Provisions for municipality to intervene
- Municipal roadway standards
  - Design
    - Stormwater standards
  - Maintenance
    - Drainage
    - Sweeping
    - Snow removal and de-icing

- Steep Slopes, Tree Removal and Protection – Disturbance of long, steep slopes tends to cause soil erosion. The potential for soil erosion is significantly increased on slopes of 25% or greater. Development on steep slopes also results in a larger disturbance footprint than development on flatter slopes. Development on steep slopes should be avoided where feasible. Similarly, removal of trees can have a cumulative adverse effect on watershed hydrology, water quality, and other important factors. Limiting development on steep slopes and preservation and protection of trees and the urban tree canopy can be accomplished through regulatory mechanisms. The model codes and regulations should address the following issues:
  - Steep slopes
    - Area subtracted from lot area
    - Prohibition of development on slopes
    - Retaining wall standards and limits
      - Permit requirements
      - Height setback limitations
  - Trees
    - Removal permit
    - Protection during construction
    - Replacement requirements

- Model Code and Regulation Implementation – Recommendations should be provided for each of the above topics relative to the implementation of model codes and regulations within a municipality. The recommendations for implementation should include:
  - Site plan requirements
    - Erosion control plan
      - Limits of disturbance on site plan
      - Prepared by qualified professional
      - Tree removal and protection
    - Stormwater management plan

        - Drywells
        - Connections
        - LID components
      - Septic systems
        - Assessing proposed expansions to existing systems
        - Threshold of expansion/renovation for replacing entire system with county compliant system
    - Inspection schedules and checklists
      - Pre-construction inspection for erosion control, tree protection and limits of disturbance
      - Site plan review checklist
    - Development of permit application forms, instruction sheets, and review procedures (checklist and flowchart)

A guidance document should also be developed on how to implement the model codes and regulations, including how to incorporate the models into existing codes and regulations, adopting new codes or regulations based on the models, responsibilities for administering and enforcing new or modified regulatory mechanisms, and other administrative procedures.

Other topics that could be addressed through model codes and regulations include riparian and wetland buffer protection, fish passage design provisions, aquifer protection, and reducing the presence of feral domestic species and wildlife predators on beach and ground-nesting birds.

The models would provide the watershed municipalities with a set of effective, uniform example codes and regulations that are consistent with the existing state and county regulatory and legal framework, but can also be tailored to the individual characteristics and needs of each municipality. The models would also promote consistency between overlapping and adjacent jurisdictions, which is consistent with a watershed-based approach. Once the models are developed, the watershed municipalities should undertake the process of reviewing their municipal land use regulations, identifying barriers and opportunities for implementing the recommended models, and incorporating the models into their land use regulations.

Action 1-3: Incorporate WAP into Local Land Use Plans

The watershed municipalities should incorporate this Watershed Action Plan into their respective local land use planning documents.

Objective 2: Maintain and Improve Open Space

Open space plays a critical role in protecting and preserving the health of a watershed by limiting development and impervious coverage, preserving natural pollutant attenuation characteristics, and supporting other planning objectives such as farmland preservation, community preservation, and passive recreation. Open space includes preserved natural areas as well as lightly developed parks and playgrounds.

As described in the State of the Watershed Report, approximately 10% of the harbor complex watershed consists of protected open space that is primarily conservation land and public parks

(see *Figure 3-1*). In addition, recreational open space (golf courses, beaches, and private institutional open space) accounts for another 5% to 10% of the watershed area. Additional privately-held natural open space exists on already subdivided parcels and large estates.

A goal of this plan is to manage, maintain, and improve existing open space and continue to protect/acquire open space that meets resource protection and recreational goals. Critical to achieving this goal is collaboration between the counties and municipalities, the North Shore Land Alliance, The Nature Conservancy, and state and federal agencies with open space responsibilities.

Action 2-1: Preserve or Protect Additional Open Space

There are several common methods that undeveloped land can be preserved and protected as open space. These include outright purchase through Municipal Bond Acts or other means, conservation easements, restrictive covenants, purchase or transfer of development rights, tax lien procedures, and land donations. Regardless of the mechanism, critical to the success of protecting open space land is the ability to readily leverage financing when windows of opportunity arise to acquire or preserve significant parcels.

The watershed municipalities, Nassau and Suffolk Counties, NYSDEC, and the North Shore Land Alliance have identified specific properties within the watershed for acquisition or preservation. These priority parcels are summarized and shown in *Figure 3-1*. The figure also identifies parcels targeted for potential acquisition or preservation in the event that these parcels become available in the future. As shown in *Figure 3-1*, the priority parcels and parcels targeted for potential future acquisition or preservation would significantly enhance the existing protected open space in the watershed by creating larger, more contiguous tracts of protected open space land.

The watershed municipalities, counties, NYSDEC, and the North Shore Land Alliance should continue ongoing efforts to preserve and/or acquire unprotected open space as recommended in this plan and by local, county, and state-wide open space plans. Recommended actions include:

- Open space acquisitions should protect natural resources, protect water quality, preserve farmland, and provide for active recreational uses, historic sites and parks.

- Proposed open space acquisitions should be evaluated based on a set of criteria that considers the environmental and physical characteristics of each property proposed for acquisition. In general, priority for open space protection should be given to properties that meet one or more of the following environmental criteria, in addition to multiple public benefits:
    - Size – Larger parcels provide greater opportunity for contiguous undeveloped areas to benefit wildlife, water quality and provide recreation.
    - Water Resources – Parcels that provide buffers for rivers and streams and associated riparian communities, headwater streams, and coastal areas.

Figure 3-1

- Wetlands and Wildlife Habitat – Parcels that provide upland buffers around high quality wetlands and habitat areas that supports, enhances or protects biodiversity.
- Floodplain Protection – Parcels in floodplain areas to provide habitat, protect or improve water quality, and preserve natural flood storage or function (to the 500-year flood level).
- Streamflow Protection – Parcels that provide protection of groundwater recharge areas and headwater streams or parcels whose protection would prevent fragmentation of large forest tracts.
- Recreation – Parcels that provide water and land-based recreational opportunities including swimming, fishing, boating, hunting, other water-access, or could accommodate multi-use trails as part of an existing or planned greenway, trail or linear park or provide connectivity of existing trail systems.

- Plan and provide for public access to open space areas, and connect existing open spaces to avoid open space fragmentation.

- Assess, improve, and restore parcels already acquired. Develop management plans for the use of acquired parcels.

- Update open space planning documents at least every five years.

- Ensure that citizens and elected officials are aware of the difference between properties acquired for public access and those acquired for preservation of natural resources.

Action 2-2: Work with Property Owners to Protect Undeveloped Private Property

Friends of the Bay and the Protection Committee should continue working with large property owners to permanently protect more sensitive portions of their properties with conservation easements, which can qualify for a state tax credit under Title 3 of Article 49 of the Environmental Conservation Law (See Action 1-2 of the Habitat Protection and Restoration goal).

Action 2-3: Pursue Multiple Sources of Financing

A variety of open space preservation techniques should be pursued. Financing for open space acquisitions should be leveraged through a coordinated effort between the public and private sectors. Seek alternative funding sources and approaches for open space acquisition such as state grants, limited market rate development on a parcel to help fund the acquisition of the remainder of the parcel as open space, and transferring development rights from sensitive locations to locations better suited for development.

Action 2-4: Ensure Consistency with County Acquisition Criteria

The Nassau County and Suffolk County open space and parkland acquisition evaluation factors were reviewed for consistency with the environmental criteria identified in this plan. The County evaluation factors and acquisition criteria are consistent with the criteria identified in

this plan. Future updates to the County open space planning documents and policies should remain consistent with the goals of this plan.

Action 2-5: Create "Green" Map

Work with the Long Island North Shore Heritage Area (LINSHA) to create a watershed-wide "green" map of environmental features as well as related cultural and historical amenities. Promote awareness and appropriate use of existing open space by publicizing parks, trails, community gardens, and historic landscapes as well as educational events on open space parcels.

Objective 3: Increase Public Access

An objective of this Watershed Action Plan is to increase public access to waterways and open space areas in the watershed to enhance recreational opportunities as well as public appreciation and stewardship of the estuary complex, while balancing the interests of competing uses. General recommendations to achieve this objective are:

- Where appropriate, enhance access to the harbor and waterways at existing public open spaces
- Public access areas should not adversely affect sensitive resources
- Incorporate LID and other sensitive design elements into access area designs, and include these recommendations in local comprehensive planning documents

Action 3-1: Encourage Water Related Use of Theodore Roosevelt Park and the Western Waterfront

Encourage water dependent or water related uses of Theodore Roosevelt Memorial Park and the Western Waterfront area. These areas are ideal yet under-utilized locations for public access to the waterfront. Water-dependent or water-related uses could include additional recreational opportunities such as boating or fishing, which should be coordinated with the proposed water trail (see Action 3-2 below) and local land use plans including the Town of Oyster Bay Eastern Waterfront Community Vision and Revitalization Plan.

Action 3-2: Create a Water Trail

The Town of Oyster Bay, in cooperation with Friends of the Bay, and the Hempstead Harbor and Oyster Bay/Cold Spring Harbor Protection Committees, proposes to create a blueway or water trail that would extend from Hempstead Harbor to Oyster Bay Harbor and Cold Spring Harbor. The blueway will increase water-related recreational opportunities within Oyster Bay/Cold Spring Harbor and along the shoreline, and increase public access to the waterfront. The blueway will also provide new facilities for hand-launched boats (canoes, kayaks, etc.).

A blueway, also known as a blue trail or water trail, is the on-water equivalent of a hiking trail. It is intended to provide kayakers and small boats such as sailboats, rowboats and canoes with information on routes, points of interest, destinations and amenities. One of the primary goals of the blueway is to connect the harbor to the surrounding land by including information on land-based destinations and points of interest such as historical landmarks, parks, walking trails, restaurants and local businesses. Ultimately, the Oyster Bay/Cold Spring Harbor Blueway will connect to a series of blue trails throughout Long Island and is specifically intended to connect to the planned Hempstead Harbor Blueway.

The project will identify trail heads for kayakers and small boats. Some of the potential sites for trailheads in the area include the Town of Oyster Bay municipal parks on Long Island Sound, village beaches in Bayville and Sea Cliff as well as in Glen Cove, Theodore Roosevelt Park and Tappen Marina, and various private marinas located throughout the area. Trailheads and access points should incorporate environmentally-sensitive design elements. The project will also include appropriate signage and maps indicating the historic, cultural and ecological significances in the trail areas and vicinity.

Action 3-3: Delineate and Enforce Watercraft Low-Speed Zone

A low-speed zone currently exists along the harbor, limiting watercraft speeds to 5 miles per hour within 200 feet of the shoreline. Delineation of the existing 200-foot low-speed zone is recommended using buoys or similar markers. Buoys could be installed as part of the proposed water trail project. Enforcement and boater education regarding the importance of adhering to low speeds along the shoreline is also recommended.

Action 3-4: Include Public Access in Waterfront Redevelopment

Waterfront development and redevelopment projects should include public access where feasible, with the goal of providing continuous land-side public access along the waterfront from Beekman Beach to White's Creek and beyond. Permanent shore-side easements should be encouraged for waterfront development and redevelopment projects.

Action 3-5: Incorporate Educational Signage

Educational signage, interpretive stations, maps, and online resources should be included in the design of new or modified public access to waterways and open space areas. Educational signage and informational resources should provide information about the history and natural environment, including water quality and ecological resources, of the estuary complex. Public spaces provide multiple opportunities for education, such as the Western Waterfront, which includes native plantings, LID elements, brownfields cleanup, and water access.

3.5 Education and Outreach

Goal: Promote stewardship of the Oyster Bay/Cold Spring Harbor estuary complex and watershed through education and outreach.

Summary – Education and Outreach

Timeframe:
C = completed
O = ongoing
S = short-term
M = mid-term
L = long-term

Responsibility: (subject to change)
● lead ○ assist

Estimated Cost (thousands):
$ = 0 – 10
$$ = 10 – 50
$$$ = 50 – 100
$$$$ = 100+

	Timeframe	Protection Committee	Nassau County	Suffolk County	Town of Oyster Bay	Town of Huntington	City of Glen Cove	Villages	Friends of the Bay	Conservation Districts	Citizens & Volunteers	Other Partners	Estimated Cost
Objective 1: Improve Awareness of Marina and Boating Practices													
Action 1-1: Enforce No Discharge Zone and Educate Boaters	S/O	●	●	●	●	●		○	○				$$$
Action 1-2: Maintain Funding for Pumpout Facilities and Programs	O	○			●	●		○	○			●[1]	$$$
Action 1-3: Provide Education on Marina and Boating-Related BMPs	O	●	○	○	●	●		●					$$$
Objective 2: Expand School and Institutional Education Programs													
Action 2-1: Identify Target Schools for Educational Programs	S	○			●	●	●		○				$
Action 2-2: Develop a Watershed Curriculum	M	○			●	●	●		○			●	$$
Action 2-3: Develop a Place-Based Toolkit	M	○			●	●	●		○				$$
Action 2-4: Establish a Stewardship Work Program	M	●			○	○	○		○				$$
Action 2-5: Support Institutional Watershed Education Programs	S	●							●		●	●	
Objective 3: Conduct Outreach for Golf Courses, Parks, and Institutional Land Owners													
Action 3-1: Develop and Host Workshop Series	M	●	○	○	○	○	○	○	○				$$
Action 3-2: Promote Golf Course Environmental Stewardship Certification	M	●	○	○	○	○	○	○	○				$
Objective 4: Conduct Homeowner Outreach													
Action 4-1: Provide Outreach on Septic System Maintenance	M/O	●	●	●	●	●	●	●	○				$$
Action 4-2: Promote Rooftop Disconnection	M/O	●	○	○	●	●	●	●	○		○		$$
Action 4-3: Promote Sustainable Lawn and Landscape Maintenance	M/O	●	●	●	●	●	●	●	○	○			$$
Action 4-4: Promote Backyard Habitat	M/O	●							●	○	○		$$
Action 4-5: Foster Neighborhood Stewardship and Homeowner Incentives	L	●	○	○	○	○	○	○	○		○		$$

Summary – Education and Outreach

Timeframe: C = completed, O = ongoing, S = short-term, M = mid-term, L = long-term Responsibility: (subject to change) ● lead ○ assist Estimated Cost (thousands): $ = 0 – 10, $$ = 10 – 50, $$$ = 50 – 100, $$$$ = 100+	Timeframe	Protection Committee	Nassau County	Suffolk County	Town of Oyster Bay	Town of Huntington	City of Glen Cove	Villages	Friends of the Bay	Conservation Districts	Citizens & Volunteers	Other Partners	Estimated Cost
Action 4-6: Provide Outreach and Education for Horse Owners	M	●							●	○			$$
Action 4-7: Increase Watershed Stewardship Signage	M	●	○	○	○	○	○	○	●		○		$$
Objective 5: Provide Outreach to the Business Community													
Action 5-1: Conduct Outreach for Targeted Businesses	M/O	●							○				$$
Objective 6: Improve Awareness of Municipal Practices													
Action 6-1: Develop Watershed-Wide Drainage Infrastructure Mapping	M	●	○	○	○	○	○	○	○				$$$
Action 6-2: Encourage Inter-Municipal Coordination and Sharing of Resources for Street Sweeping and Stormwater System Maintenance	O	○	●	●	●	●	●	●					$$
Action 6-3: Improve Municipal Facility Housekeeping	S/O	○	●	●	●	●	●	●					$$$$
Action 6-4: Provide Annual Municipal Pollution Prevention Training	O	●	○	○	○	○	○	○		○			$$
Action 6-5: Provide Training for Designers and Municipal Reviewers	S/O	●	○	○	○	○	○	○		●			$$
Action 6-6: Require Training for Municipal Building Inspectors	S/O	●	○	○	○	○	○	○		●			$$

[1]New York State Environmental Facilities Corporation and NYSDEC

Six primary target audiences were identified as having the greatest potential to affect long-term change and protect/improve water resource conditions in the estuary complex – school-age children; marinas and boaters; golf courses, parks, and institutional land owners; homeowners and the general public; businesses; and municipalities.

Education and outreach recommendations that are tailored to each of these audiences are described in the following sections. The recommended education and outreach actions are intended to capitalize on the wealth of resources and programs that already exist within the watershed and elsewhere on Long Island. Watershed public outreach and educational programs should therefore coordinate with existing local, county, and state-sponsored educational programming. Public education and outreach is also a key required element of the MS4 stormwater management programs of the watershed municipalities.

The Friends of the Bay website for the Watershed Action Plan and proposed Information Resource Center (see *Section 3.1*) will continue to serve as a clearinghouse for watershed

information, watershed-based education and outreach materials, past and upcoming events, and opportunities for public involvement.

Objective 1: Improve Awareness of Marina and Boating Practices

Marina and boating-related activities, including vessel waste disposal, boat maintenance and storage, and stormwater runoff from marinas, can directly impact the water quality of the estuary complex. Ongoing education of boater owners, marinas, and related waterfront boating facilities is a critical element in promoting stewardship of the estuary and its watershed.

Action 1-1: Enforce No Discharge Zone and Educate Boaters

In October 2008, The Oyster Bay/Cold Spring Harbor complex was declared a federal No-Discharge Zone (NDZ) for vessel sewage. The federal designation, in addition to the related Town Code, prohibits the discharge of sewage (whether treated or untreated) from vessels, providing an additional level of protection to address water quality issues associated with sewage contamination in marine waters. The Town of Oyster Bay provides floating pumpout stations (barges), stationary (dockside) pumpout stations, and a pumpout boat at several locations throughout the estuary complex for vessel sewage disposal.

Friends of the Bay and the Oyster Bay Power Squadron maintain signs at local marinas. The signs contain contact information for the pumpout boat, the locations of pumpout stations, and a notice that the harbor complex is a NDZ. Continued enforcement of the No Discharge Zone and public education regarding the effects of boat waste on local waterbodies are essential if the water quality benefits of the NDZ designation are to be realized. Recommended actions include:

- Maintain reminders of the NDZ and pumpout facility locations at existing boat launches, and install reminders at future boat launches associated with the proposed Oyster Bay/Cold Spring Harbor water trail (see Sustainable Land Use and Open Space goal). Create a Smartphone or Web App indicating pumpout facility locations.
- Consider, with the approval of the Coast Guard, installing buoys in mooring areas and at the mouth of the harbor noting the requirements of the NDZ and the locations of pumpout facilities
- Provide links on the Watershed Action Plan website and proposed Information Resource Center to websites with boating-related BMPs and information on the NDZ designation
- Provide links to the Watershed Action Plan website and proposed Information Resource Center from the websites of local boating groups, such as the WaterFront Center, Oyster Bay Marine Center, Sagamore Yacht Club, Bridge Marina, Seawanhaka Yacht Club, and watershed municipalities

Action 1-2: Maintain Funding for Pumpout Facilities and Programs

Maintain funding for the Town of Oyster Bay vessel sewage pumpout facilities and program.

Action 1-3: Provide Education on Marina and Boating-Related BMPs

- Disseminate educational messages concerning the proper use and maintenance of marine sanitation devices and the implementation of other boating and marina operational pollution prevention practices to boaters and marina operators.
- Promote the use of stormwater BMPs at marinas and boat storage and maintenance facilities in the watershed following guidance contained in New York Stormwater Runoff Best Management Practices for Marinas: A Guide for Operators developed by Suffolk County and the New York Sea Grant Extension Program, Cornell Cooperative Extension and similar guidance documents. Encourage these facilities to join a Green Marina program.

Objective 2: Expand School and Institutional Education Programs

The Town of Oyster Bay Environmental Resources Department has developed comprehensive educational programs for school-age children in the Town of Oyster Bay, providing environmental education to between 3,000 and 5,000 children annually, including several schools in the watershed. Such programs should be used as a model for new or expanded educational programs for schools throughout the Oyster Bay/Cold Spring Harbor watershed that don't currently provide comprehensive, watershed-based programs.

Action 2-1: Identify Target Schools for Educational Programs

Work with the Town of Oyster Bay Environmental Resources Department and the various watershed school districts to identify specific schools and grade levels that would benefit from new or expanded watershed or related environmental education programs.

Action 2-2: Develop a Watershed-Based Curriculum

Using existing educational materials available through the Long Island Sound Study, New York Sea Grant, NYSDEC, the NY-NJ Harbor Estuary program, County Soil and Water Conservation Districts, and other groups, develop a watershed-based K-12 curriculum that emphasizes the ecology of the estuary complex and the inter-relationship between the estuary complex and its watershed. Ensure that the curriculum builds on the previous years' lessons and is aligned with New York State education standards.. The curriculum could combine lessons, field activities, classroom experiments, and regional networking into learning activities that build shared scientific knowledge and stewardship experiences. Individual curricula could be tailored to specific age groups. The program should focus on issues of relevance in the watershed, including public education requirements of the MS4 permit and pathogen TMDL such as the impacts of pathogens and other point and nonpoint source pollutants on waterbodies and management/restoration techniques to address these problems.

Action 2-3: Develop a Place-Based Toolkit to Accompany the Curriculum

Work with K-12 educators within the watershed as well as with area higher-education teacher training programs to build a place-based educational "toolkit" to accompany the watershed-based curriculum. The "toolkit" could include recommendations for field research and documentation (photographs and GIS mapping) that can link into an online network, allowing for both internal and external (public) postings. Activities would provide opportunities for students to experience the watershed resources first-hand by getting their feet wet and hands dirty during each school year. Guidelines for learning activities would conform to state curriculum standards.

Action 2-4: Establish a Stewardship Work Program

Establish a formal program for high school and college students to participate in watershed stewardship efforts such as beach and stream cleanups, invasive species removal, trail and park maintenance, and ecological restoration projects.

Action 2-5: Support Institutional Watershed Education Programs

Support watershed and related educational programs by existing and new educational and recreational institutions, such as the Theodore Roosevelt Sanctuary, Cold Spring Harbor Fish Hatchery, Cold Spring Harbor Whaling Museum, The WaterFront Center, and the Long Island North Shore Heritage Area.

Objective 3: Conduct Outreach for Golf Courses, Parks, and Institutional Land Owners

Management and maintenance practices at golf courses, parks, and institutional facilities with large intensively managed lawn areas can have a significant impact on the water quality within the Oyster Bay/Cold Spring Harbor watershed and estuary. Large institutional land owners, like homeowners in the watershed, therefore play an important collective role in protecting water quality.

Action 3-1: Develop and Host Workshop Series

Friends of the Bay or the Oyster Bay/Cold Spring Harbor Protection Committee should develop and host a series of seminars or hands-on workshops to discuss best practices and local resources regarding management and maintenance practices at golf courses, parks, and institutional facilities. Topics could include:

- Integrated Pest Management (IPM)
- Turf management and low fertilizer usage
- Grass clippings management
- Leaf/brush waste management
- Parking lot and road maintenance (deicing, snow management)
- Drainage system maintenance (catch basins, storm drains, stormwater BMPs)
- Water quantity and flooding issues
- LID and green infrastructure approaches

A wealth of local, state, county, and national resources and educational materials already exists on many of these topics. Workshop content should be developed in coordination with the SUNY Old Westbury green campus initiatives, the Sustainability Institute at Molloy College, NYSDEC, New York Sea Grant, Long Island Sound Study, and the County Soil and Water Conservation Districts.

Provide funding and/or project assistance incentives for facility managers who complete the program. Also encourage awareness and involvement of students and faculty in campus management decisions, including annual or bi-annual volunteer service events.

Action 3-2: Promote Golf Course Environmental Stewardship Certification

As recommended in the Mill River Watershed Study and Public Stewardship Program, encourage and work with area golf courses to obtain certification in the Audubon Cooperative Sanctuary Program for Golf Courses, which is an education and certification program that helps golf courses protect the environment but preserve the heritage of the game of golf. Using existing educational materials and resources developed by Cornell University Extension Service, the U.S. Golf Association, and others, provide education and outreach to golf course members, boards, and superintendents.

Objective 4: Conduct Homeowner Outreach

An objective of the Watershed Action Plan is to build awareness of land stewardship and management practices and reduce nonpoint source impacts associated with residential land use, which comprises approximately 64 percent of the watershed land area. Homeowner education and outreach efforts should be tailored to the most common types of residential activities in the watershed that pose a risk to water quality. These activities include failing or malfunctioning septic systems, lawn and landscape maintenance, fertilizer and pesticide use, alteration of backyard riparian areas, rooftop runoff connections to the storm drainage system, pet waste, and horse stabling activities.

Action 4-1: Provide Outreach on Septic System Maintenance

Much of the watershed area is served by on-site wastewater disposal systems, including septic systems and cesspools. Many of these systems are old and not inspected frequently or maintained properly, and failing systems have a high potential to impact surface water and groundwater quality. Maintenance of these systems is the responsibility of the homeowner, which emphasizes the need for homeowner education on the importance of septic system maintenance.

As required by the MS4 Permit, local municipalities should disseminate educational materials and messages for septic systems including homeowner responsibility for septic system maintenance, how septic systems function and proper care, specific septic system maintenance procedures and recommended frequencies, and action to take when system failure or malfunction are suspected. The NYSDEC, Cornell Extension Service, USEPA, and the County Soil and Water Conservation Districts have extensive educational materials on septic management.

In addition to public education, a successful septic management program also requires strengthened local septic system regulations to require new and replacement systems to meet minimum design standards and to require periodic septic system inspection and maintenance. Training for municipal building inspectors on enforcement of septic system regulations and design standards is also recommended. These related recommendations are described in *Section 2* of this plan.

Action 4-2: Promote Rooftop Disconnection

Residential areas in the watershed contribute significant quantities of rooftop runoff to the storm drainage system. Opportunities exist to disconnect residential rooftop runoff from the storm drainage system and reduce the quantity of runoff by redirecting the runoff to pervious areas or through the use of rain barrels or rain gardens.

Downspout disconnection (also referred to as "roof leader disconnection") is a cost-effective on-site option for reducing the volume and cost of stormwater that requires public management. Downspout disconnection has a number of economic and environmental benefits to the municipality and the property owner. The major benefits include:

- Reduces volumes of flows conveyed and resulting loads to watercourses
- Reduces the volume of flow to the municipal storm drainage system (MS4)
- Increases infiltration and groundwater recharge
- Provides options to reuse rainwater

Individual rooftop retrofits target a small area, requiring the participation of many homeowners to make a measurable difference across a watershed. As a result, a coordinated effort is required for widespread participation in such a program, which typically includes a combination of targeted education, technical assistance, and financial subsidies to homeowners or the business community. Examples of effective local downspout disconnection programs are presented in *Urban Stormwater Retrofit Practices* (CWP, 2007).

Recommended actions include:

- Encourage disconnection of rooftop runoff from the storm drainage system and impervious areas to reduce the quantity of runoff by redirecting the runoff to pervious areas, through the use of dry wells, compost-amended soils (in areas with poorly-drained soils), or through the use of rain barrels or rain gardens.
- Disseminate educational materials on designing, constructing or installing, and maintaining residential rain gardens and rain barrels. The Nassau County Soil and Water Conservation District has developed brochures and has installed two rain gardens and barrels at the Town of Oyster Bay Animal Shelter.

- Consider rain barrel incentive program options for residents and business owners for those who purchase a rain barrel or subsidized give-away programs, through grant funding or other revenue sources.

Action 4-3: Promote Sustainable Lawn and Landscape Maintenance

Promote sustainable lawn care and landscape maintenance practices. Educate homeowners about the impacts of lawn care practices on water quality and encourage the use of residential lawn care BMPs such as reducing or eliminating fertilizer and pesticide usage through the use of slow release fertilizers and fertilizer application timing; utilizing alternative landscaping that decreases maintenance; soil testing and non-chemical lawn care measures; as well as increased awareness of the fertilizer laws in effect in Nassau and Suffolk Counties.

Extensive educational materials are available on these topics, including a local brochure developed by the New York State Department of State, in conjunction with New York Sea Grant, entitled "A Guide to Sound Gardening in the Oyster Bay-Cold Spring Harbor Outstanding Natural Coastal Area." Other sources of information include the New York State IPM Program, county IPM programs, the County Soil and Water Conservation Districts, and the EPA GreenScape program. The North Shore Land Alliance and Sustainability Institute are other sources of information and educational materials on sustainable lawn and landscape maintenance practices. Homeowner lawn and landscaping outreach programs could be integrated with the Good Water Citizen program for organic gardening.

Also work with and provide outreach to local landscapers regarding alternative landscaping and lawn care practices. Potential outreach programs could include:

- Identifying and promoting sustainable landscape provider certification programs
- Developing a placard campaign to identify lawns that implement preferred practices
- Develop a sustainable lawn care recognition program, with landscapers and homeowners highlighted on a rotating basis, or institute an alternative landscape competition

Action 4-4: Promote Backyard Habitat

Encourage the creation of backyard habitat in residential areas near stream corridors, including the importance of maintaining healthy vegetated buffers to streams, ponds, and wetlands, and recognize the efforts of the public. Take advantage of existing programs, such as Audubon's backyard program and Together Green program, programs from the Long Island Sound Study and New York Sea Grant.

Action 4-5: Foster Neighborhood Stewardship and Homeowner Incentives

Foster a neighborhood approach for the restoration and conservation of streams, ponds, and shoreline areas by providing educational materials and technical guidance. A neighborhood stewardship approach encourages neighbors to "self-organize" around shared interests, such as removing invasive species and restore native vegetation that serves as habitat for migratory birds. Homeowners are often willing to undertake environmental improvement projects – and assist with the labor – yet recognize the need for technical guidance.

Consider homeowner incentive programs such as the BLUE® Certification Program, which certifies peoples' homes as watershed-friendly after the owner agrees to follow a handful of simple practices that reduce stormwater runoff and pollutant sources. BLUE® incentivizes and motivates people to take action and includes follow-ups to ensure that they continue to follow the practices. The BLUE® program has been implemented successfully for Lake Champlain, Vermont.

Action 4-6: Provide Outreach and Education for Horse Owners

Provide educational materials developed by the NYS Soil & Water Conservation Committee's Agricultural Environmental Management program on BMPs for commercial and residential horse pastures and stables in the watershed. Consider the formation of a Horseowner's Advisory Council to help disseminate educational information on manure management and other horse-related BMPs, as recommended in the Mill River Watershed Study and Public Stewardship Program. Alternatively, the Protection Committee could assume this responsibility.

Action 4-7: Increase Watershed Stewardship Signage

Stewardship signage can be an effective way of educating the public on the importance of preserving natural resources and common ways in which they may be impacting these resources. The general public is often unaware of the cumulative effects of their every-day activities. Signage can play an important role in making the connection between every-day activities and their sometimes harmful results. Educational signage can take the form of kiosks in public areas, storm drain markers or stencils, anti-dumping signs, proper pet waste management signs, and roadside/stream side signage (examples include "adopt a stream/roadway" programs).

Storm drain marking and other watershed stewardship signage is already present in many areas of the watershed. Storm drain marking or other forms of stewardship signage could be expanded to other areas of the watershed, targeting commercial and additional residential areas that are currently under-served. Interpretive educational signage is also recommended in highly-visible public areas of the watershed such as municipal facilities (schools, town offices, parks, libraries, etc.), in public access areas along the harbor, and along the proposed water trail.

Objective 5: Provide Outreach to the Business Community

Advance the business community's awareness of the estuary and its watershed through targeted education and outreach.

Action 5-1: Conduct Outreach for Targeted Businesses

Focus education and outreach efforts on the types of businesses in the watershed whose activities have the potential to impact water quality (e.g., light industry, commercial retail centers, landscaping companies, restaurants, golf courses, and commercial equine facilities). The education and outreach programs could consist of a variety of printed and electronic media, seminars and workshops, and training opportunities such as a training and certification program for local landscapers in the use of environmentally-sensitive lawn care practices.

Objective 6: Improve Awareness of Municipal Practices

Municipal operations and facilities such as public works yards, street and bridge maintenance, winter road maintenance, stormwater system maintenance, vehicle and fleet maintenance, parks and open space maintenance, municipal building maintenance, and marine operations can impact water quality by contributing pollutants to the storm drainage system or directly to surface waters or groundwater. Improving the awareness of municipal employees about the potential impact of their operations on the water quality and environmental resources of the estuary complex and its watershed is also a key objective of this plan.

Action 6-1: Develop Watershed-Wide Drainage Infrastructure Mapping

Develop GIS mapping of the drainage infrastructure throughout the entire watershed. While each municipality/MS4 is required to map their respective stormwater outfalls and associated drainage infrastructure, a single consistent drainage infrastructure map does not exist for the entire watershed. The mapping should identify municipal jurisdictions, traditional and non-traditional MS4 areas; areas that drain directly into surface waters with no treatment; areas where stormwater treatment or infiltration occur via recharge basins, dry wells or leaching catch basins; and areas that drain directly to sensitive resources, such as shellfish beds and unique habitat areas. The drainage infrastructure maps would provide a tool for enhanced inter-municipal coordination relative to the MS4 stormwater management requirements.

Action 6-2: Encourage Inter-Municipal Coordination and Sharing of Resources for Street Sweeping and Stormwater System Maintenance

Improve municipal street sweeping, catch basin cleaning, and overall stormwater infrastructure maintenance programs in the watershed through inter-municipal coordination and sharing of resources, such as street sweeping and catch basin cleaning equipment. These efforts could be coordinated through the Oyster Bay/Cold Spring Harbor Protection Committee.

Action 6-3: Improve Municipal Facility Housekeeping

The watershed municipalities should review the current compliance of their respective facilities (public works/maintenance facilities, parks, schools, public safety facilities, etc.) in the watershed with pollution prevention BMPs and applicable regulatory requirements. "Good housekeeping" at municipal facilities should serve as demonstration sites for comparable private operations, many of which are also subject to stormwater pollution prevention and other similar state and federal regulatory programs (oil pollution prevention, hazardous waste, air emissions). Examples of good practices should be recognized and modeled. The Protection Committee should provide guidance (e.g., visits, group training, and/or printed materials) and develop incentives to encourage local businesses to adopt these model practices.

Action 6-4: Provide Regular Municipal Pollution Prevention Training

Municipalities should provide regular pollution prevention and good housekeeping training for all municipal employees whose activities potentially impact stormwater and water quality. The training should include municipal personnel with responsibility for public works, parks and recreation, building maintenance, marine operations, and water/wastewater. Training should be performed for employees as specified in the MS4 permit and for new hires as necessary. Municipalities should also consider periodic refresher training.

Action 6-5: Provide Training for Designers and Municipal Reviewers

Implementation of the proposed model codes and regulatory modifications described under the Sustainable Land Use and Open Space goal of this plan requires effective education and outreach to both designers (developers, architects, engineers, contractors, etc.) and reviewers (municipal land use commissions and boards, planners, etc.) of land development projects. Suggested training topics include construction erosion and sediment control and post-construction stormwater standards, LID and green infrastructure, and the NYSDEC's 5-step process for designing, reviewing, approving, and inspecting development projects of an acre or more. The NYSDEC, County Soil and Water Conservation Districts, and programs such as Nonpoint Education for Municipal Officials (NEMO) are existing or potential sources of outreach training for municipalities and designers.

Action 6-6: Require Training for Municipal Building Inspectors

Building inspectors in New York State must complete 24 hours of continuing education each year. Existing training programs typically do not address stormwater, LID, green infrastructure or erosion and sedimentation control methods. Watershed municipalities should consider establishing a required watershed-wide training program to address these topics. Additionally, training should also be required on septic system inspections, design standards for new and replacement systems, and enforcement of septic system regulations.

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4 Site-Specific Project Concepts

Site-specific restoration or retrofit concepts were developed to address issues at selected sites that were identified during the watershed field inventories. These concepts meet many of the goals, objectives, and specific actions identified in previous sections of this plan. The site-specific project concepts presented in this section are intended to serve as potential on-the-ground projects for future implementation. They also provide examples of the types of projects that could be implemented at similar sites throughout the watershed. It is important to note that the concepts presented in this section are examples of potential opportunities, yet do not reflect site-specific project designs. Property owners and other affected parties are responsible for evaluating the ultimate feasibility of these and similar site-specific concepts.

Preliminary, planning-level costs were estimated for the site-specific restoration concepts presented in this section. These estimates are based upon unit costs derived from published sources and the proposed concept designs. Capital (construction, design, permitting, and contingency) and operation and maintenance costs were included in the estimates, and total annualized costs are presented in 2011 dollars based on the anticipated design life of each restoration concept. A range of likely costs is presented for each concept, reflecting the inherent uncertainty in these planning-level cost estimates. A more detailed breakdown of the cost estimates is included in *Appendix C*.

4.1 South Street Greening

South Street Greening	
Objectives:	Runoff reduction Infiltration Pollutant reduction Public outreach Streetscape
Estimated Cost:	$420,000 –$ 890,000

The segment of South Street that continues north from its intersection with Audrey Avenue and East Main Street to Bay Avenue, is lined with a variety of land uses, including dense downtown commercial uses at the southern end near the intersection, residential uses along the east side, light industrial uses along the west side, and heavy industry at the northern end. The area is densely developed and highly urbanized with sparse tree canopy and high impervious cover. During large storms, the storm drainage system in parts of the downtown are overwhelmed, and stormwater runs off along the roadways in uphill (upgradient) areas to this segment of South Street, and ultimately discharging to White's Creek across from the Long Island Railroad rail yard. This mixed-use, heavily-developed area is likely a significant source of stormwater pollutant loads. Streetscape improvements have been recommended for South Street in the Town of Oyster Bay Eastern Waterfront Community Vision and Revitalization Plan.

A "green street" retrofit of South Street would address stormwater management and streetscape improvement objectives. One potential concept (*Figures 4-1 and 4-2)* consists of reducing the amount of effective impervious cover along South Street to reduce runoff volumes, pollutant loads, and peak flow rates, as well as infiltrating and treating stormwater through the use of other green infrastructure practices. This concept maintains on-street parking and integrates stormwater management and streetscape improvements using green infrastructure approaches.

Figure 4-1. South Street Green Street Retrofit Concept Plan

The proposed South Street green street retrofit concept includes the following elements.

Pervious pavement at the intersection of South Street, Audrey Avenue, and East Main Street. Pervious pavement could be installed in the intersection to reduce impervious cover and to intercept and infiltrate some of the stormwater that may bypass roadway catch basins during large storms. Pervious pavement has also been shown to treat stormwater, removing sediment, metals, and nutrients. Pavement materials that could be used include pervious asphalt and pervious concrete. Open-jointed block pavers could also be considered, but may not be appropriate given the high traffic volumes at the intersection.

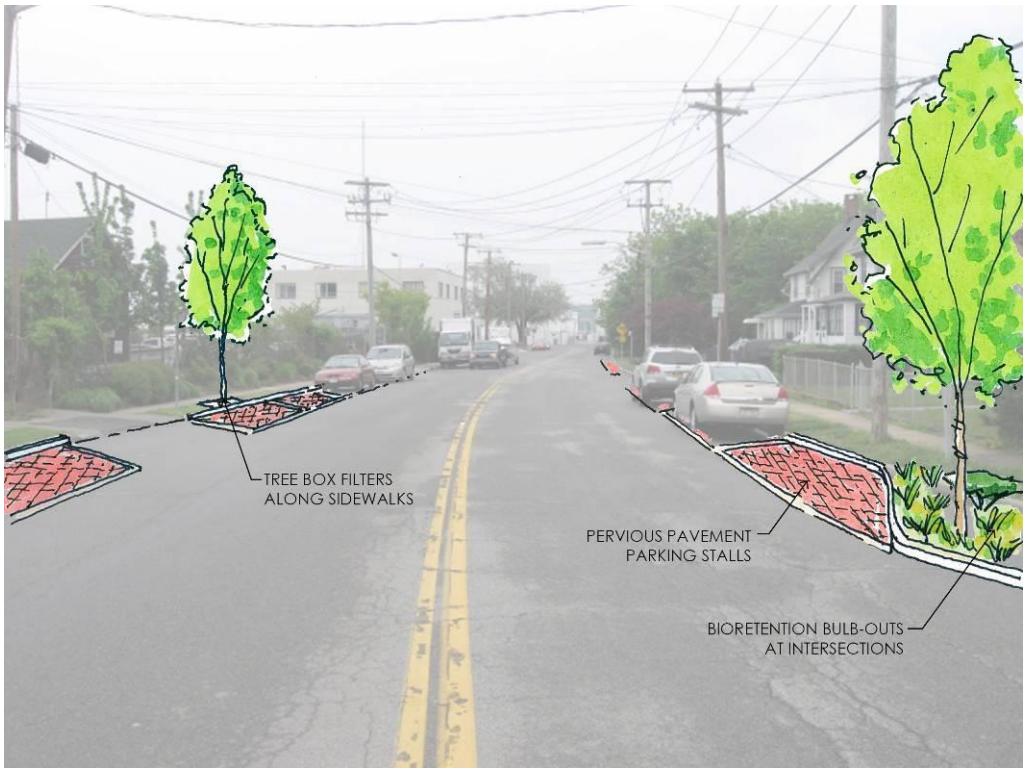

Figure 4-2. South Street Green Street Retrofit Concept Visualization

Pervious pavement in on-street parking stalls. South Street is approximately 45 feet wide with one travel lane in each direction and the remainder used for on-street parking. The outer 10-feet of roadway width between intersections could be replaced with pervious pavement, such as pervious concrete, pervious asphalt, or open-jointed block pavers. These areas would be available for parking but, unlike conventional asphalt pavement, would reduce infiltrate stormwater and reduce roadway runoff volumes and pollutant loads. *Figure 4-3* shows a typical detail of a green street parking bay.

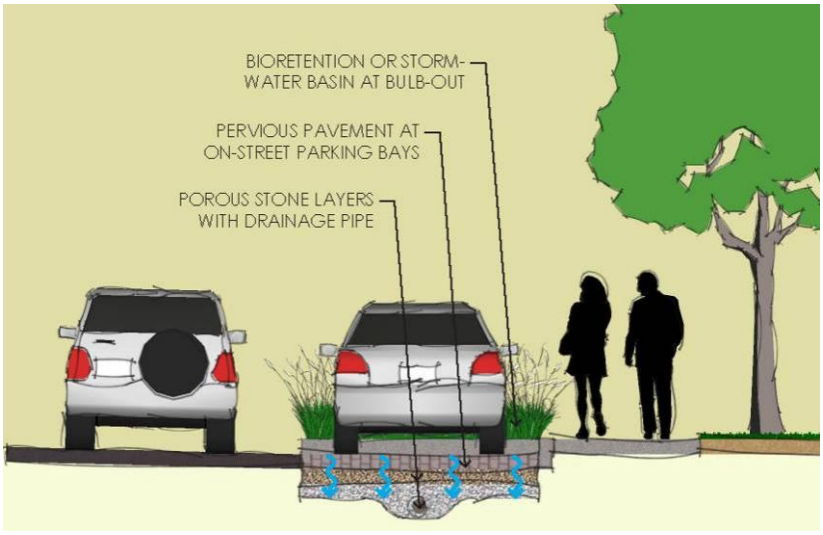

Figure 4-3. Typical Green Street Parking Bay

Bioretention bulb-outs at intersections. Near intersections, where on-street parking is discouraged to maintain site distance for turning vehicles, bioretention bulb-outs could be used to capture, treat, and infiltrate or filter stormwater from remaining impervious portions of South Street. Bulb-outs at intersections can also serve to provide traffic calming. A typical bioretention bulb-out detail is presented in *Figure 4-4*. These bioretention areas would have a soil media layer to temporarily store and treat runoff prior to infiltration into underlying soils or discharge to the storm drainage system in areas with high groundwater or poor soils. The bulb-outs could be planted with attractive, low-growing and low-maintenance native landscape plants with a mulch layer.

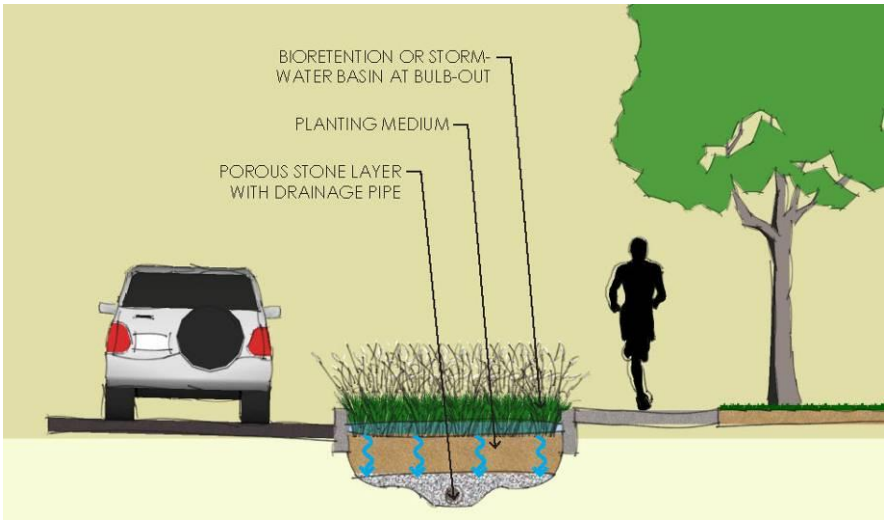

Figure 4-4. Typical Bioretention Bulb-out

Sidewalk tree box filters. Tree box filters could be installed at regular intervals along the South Street sidewalk to accommodate street trees and provide infiltration and treatment of stormwater runoff from adjacent impervious surfaces during small storms. Tree box filters are a form of bioretention, consisting of precast concrete planters with tops that install flush with the sidewalk to provide a continuous walking surface and a side inlet that replaces the curb along the street. The majority of the device is below ground and includes a soil media to support tree growth and for pollutant removal via filtration. The curb inlet allows stormwater to enter the tree box filter. Trash and debris is deposited on top of the soil media and can be removed, while stormwater is treated as it passes through the soil media. The system can be configured to infiltrate the treated stormwater depending on soil and groundwater conditions. A typical schematic of a tree box filter is shown in *Figure 4-5*.

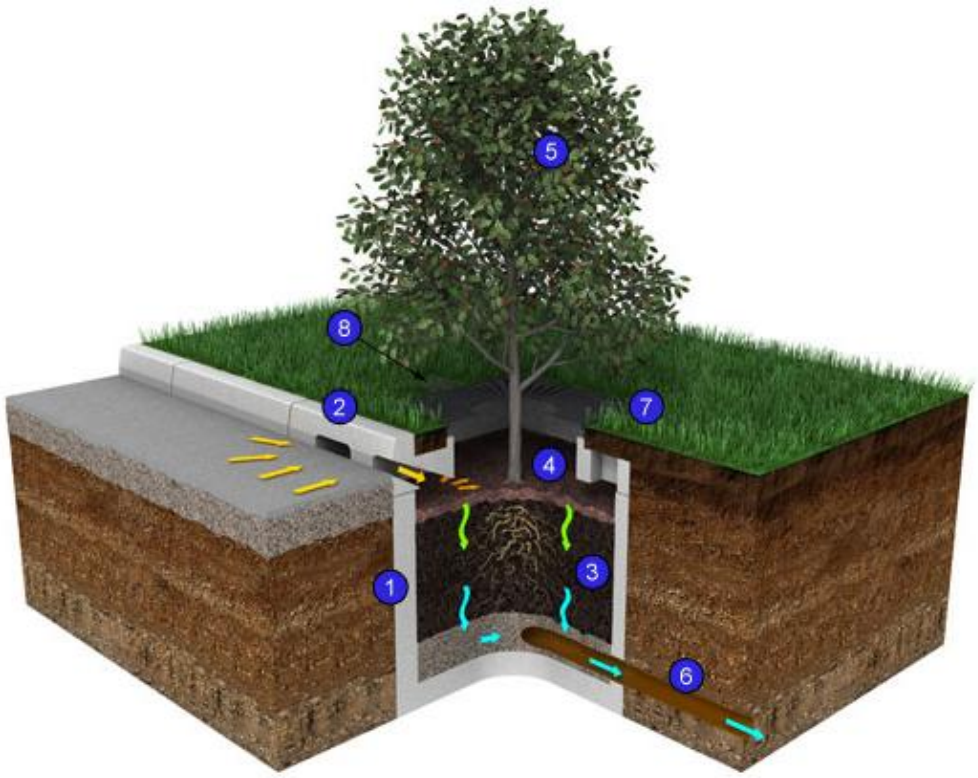

Figure 4-5. Typical Tree Box Filter (Source: Hydro International, Inc.)

4.2 Oyster Bay Railroad Museum LID Improvements

Oyster Bay Railroad Museum LID Improvements	
Objectives:	Runoff reduction Infiltration Pollutant reduction Public outreach
Estimated Cost:	$270,000 – $570,000

The Oyster Bay railroad station was in service for the Long Island Rail Road from 1889 to 1999, and has since been designated a New York State Landmark and has been listed in the National Register of Historic Places. The Oyster Bay Railroad Museum is working to restore the structure to house exhibits and become a feature of its facilities. The area south of the former station consists of a poorly-configured impervious area at the intersection of Maxwell, Audrey, Hamilton, and Railroad Avenues and provides parking for the adjacent residences and businesses. Two walking entrances to Theodore Roosevelt Memorial Park (Roosevelt Park) are also located in this area. These entrances formerly provided direct access to the park from the train station, but now are underused. Improvements to this area have been recommended in the Town of Oyster Bay Eastern Waterfront Community Vision and Revitalization Plan.

Low Impact Development (LID) elements could be integrated into this area, building on the existing concept design proposed in the Eastern Waterfront Community Vision and Revitalization Plan. The proposed enhancements include reconfiguring the railroad museum plaza to formalize parking spaces and pedestrian access, while introducing tree canopy and stormwater quality controls and reducing impervious cover (*Figures 4-6 and 4-7*).

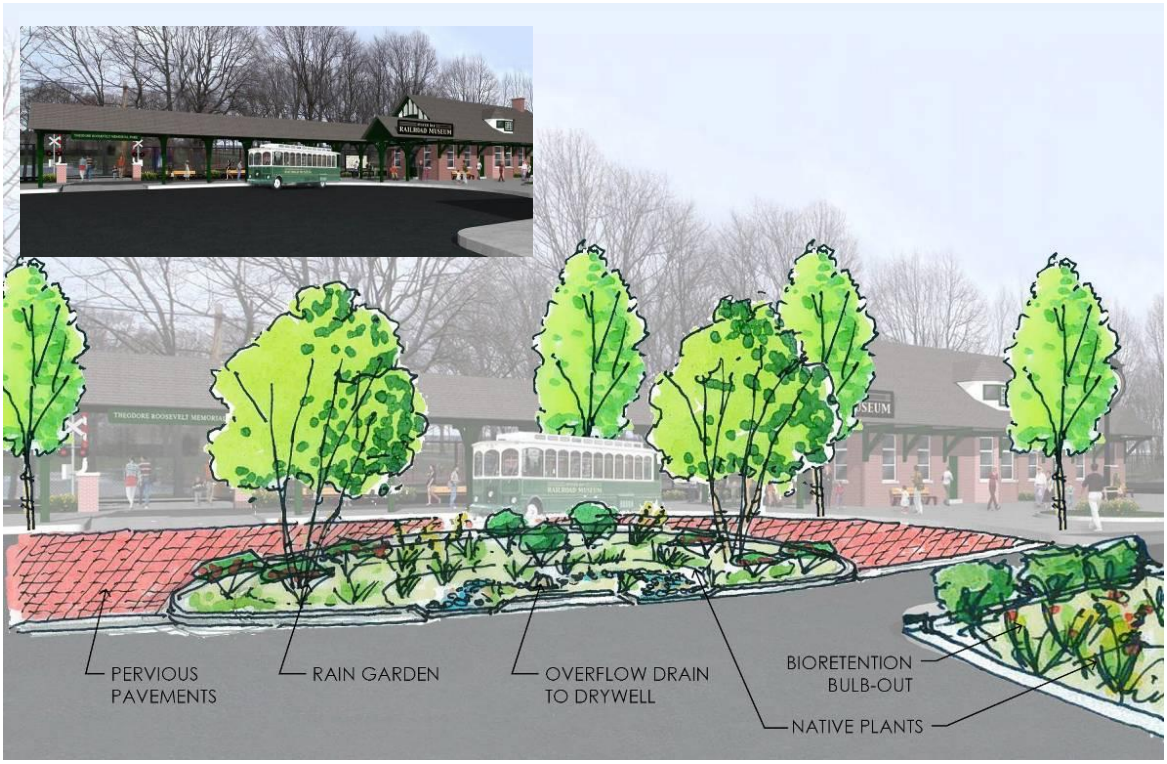

Figure 4-6. Railroad Museum Retrofit Concept Visualization

The parking spaces along the old station platform could be relocated to the south and the existing pavement removed and replaced with pervious asphalt, pervious concrete, or open-jointed block pavers. A rain garden could be incorporated into the island associated with the proposed circular trolley drop-off/turn-around area.

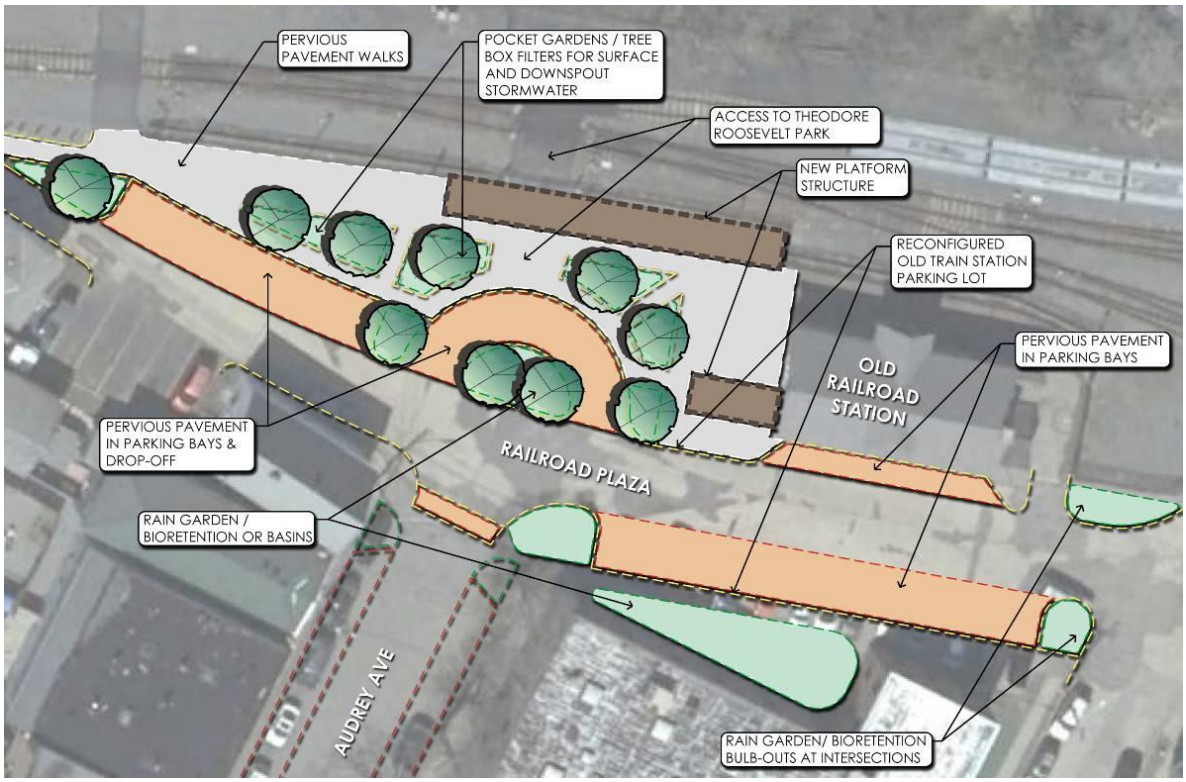

Figure 4-7. Railroad Museum Retrofit Concept Plan

Pervious materials could be used for the walkways surrounding the proposed station platform canopies. Contrasting materials could be used for these areas to represent the newer uses, such as pervious asphalt for the driving areas, and the older configurations, such as pervious concrete or open-jointed block pavers for the walkways. The walkways around the station would connect to the Roosevelt Park entrances.

The proposed enhancements could also include stormwater bulb-outs at the end of parking stalls and bioretention basins at other locations that receive runoff from adjacent roofs and other impervious surfaces. Pocket rain gardens could also be located between walking path areas to provide visual interest. These areas would serve as bioretention areas to manage stormwater and reduce pollutant loads.

4.3 Cold Spring Harbor Municipal Parking Lot LID Retrofit

The municipal parking lot located on the south side of Route 25A in the hamlet of Cold Spring Harbor (Huntington) is a potential candidate for a Low Impact Development retrofit, similar to many of the municipal parking lots in the watershed that ultimately drain to the harbor. The center rows of parking spaces are separated by a center island that consists only of painted hatching on the conventional asphalt surface of the lot. A raised island that contains a sidewalk and shade trees separates the parking lot from Route 25A.

The proposed concept would integrate LID features into the parking lot, without reconfiguring the parking layout or loss of parking spaces. The concept, shown in *Figures 4-8 and 4-9),* consists of retrofitting conventional asphalt parking bays with pervious paving materials, such as pervious concrete, asphalt, or interlocking block pavers, to reduce effective impervious cover and infiltrate stormwater.

Cold Spring Harbor Municipal Parking Lot LID Retrofit

Objectives:	Runoff reduction Infiltration Pollutant reduction Public outreach
Estimated Cost:	$310,000 – $640,000

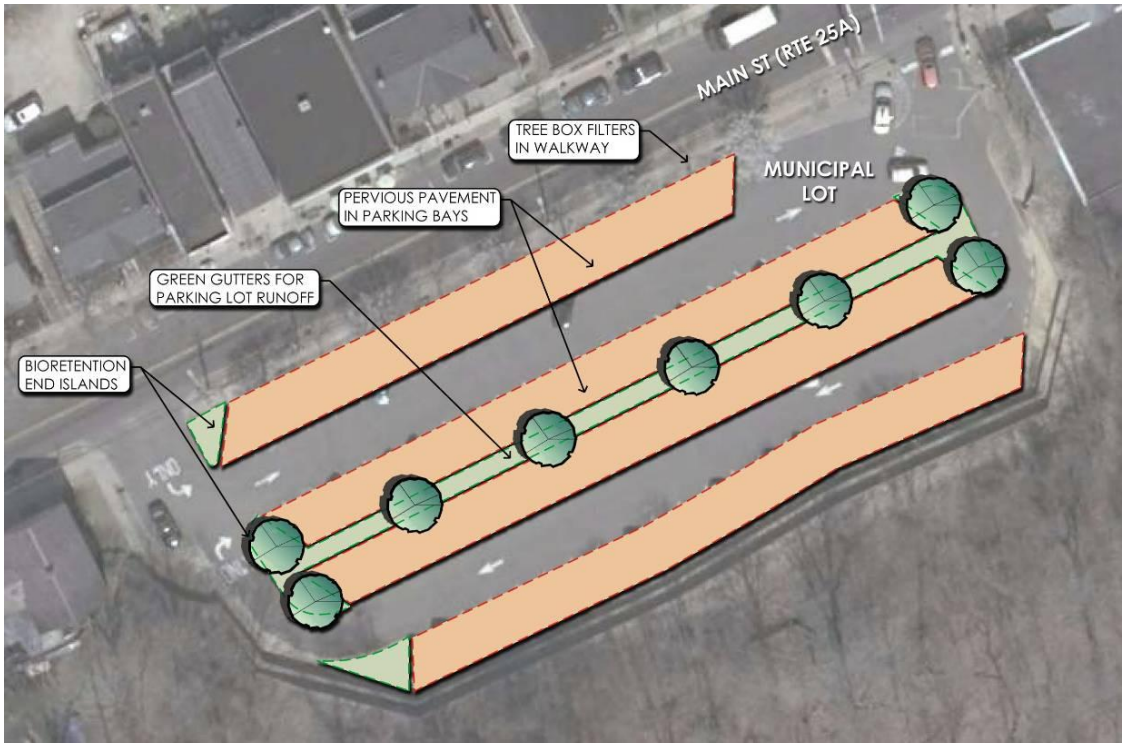

Figure 4-8. Cold Spring Harbor Municipal Lot Retrofit Concept Visualization

The existing painted center island could be converted into a green gutter, and two traffic islands on the downhill side of the parking lot (the west side) could be converted to bioretention areas to manage stormwater runoff. Trees could also be planted within these areas to increase shading of the parking lot and add to the watershed tree canopy.

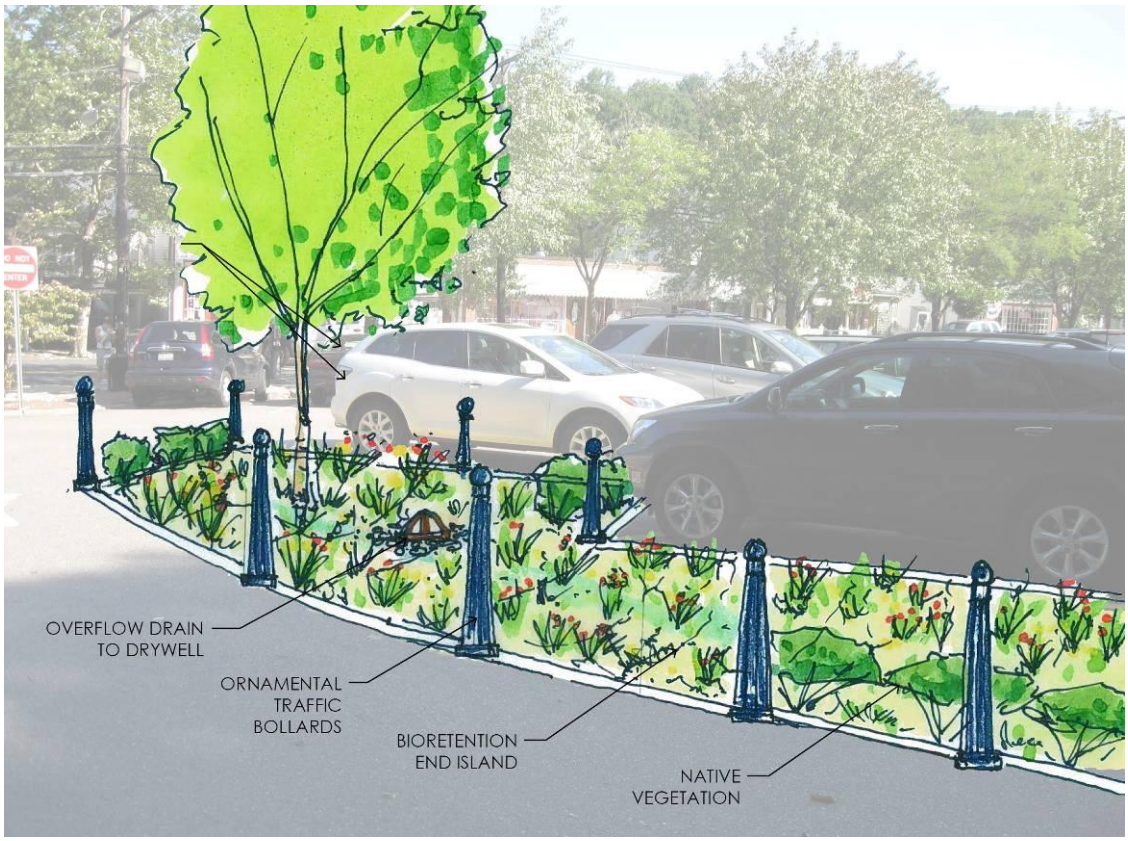

Figure 4-9. Bioretention Parking Island Concept for Cold Spring Harbor Municipal Lot

Green gutters (*Figure 4-10*) help capture and slow stormwater runoff within very narrow and shallow landscaped areas in parking lots or along a street's edge. Green gutters are designed to be very shallow with little or no water retention. The primary purpose of using green gutters is to provide a site design measure using strip of landscaping to help filter out pollutants and slow the flow of water. If underlying soils are slow-draining, an underdrain can be installed below green gutters and other bioretention areas to convey filtered stormwater to the storm drainage system.

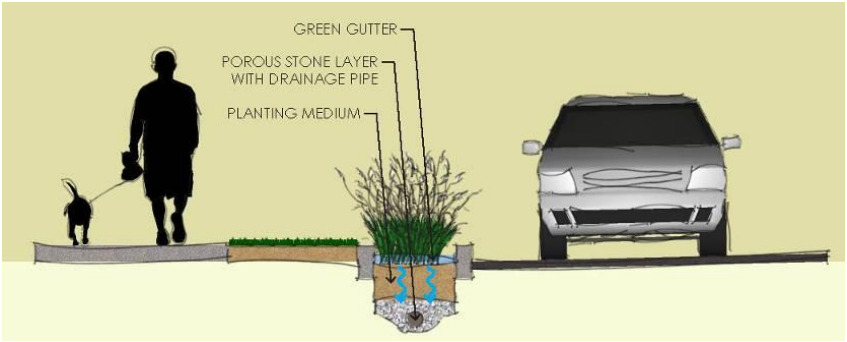

Figure 4-10. Typical Green Gutter Cross Section

4.4 Audrey Avenue Green Street

Audrey Avenue Green Street	
Objectives:	Runoff reduction Pollutant reduction Public outreach
Estimated Cost:	$770,000 – $1,600,000

The area surrounding Audrey Avenue and Shore Avenue in the Oyster Bay Hamlet is one of the busiest and most densely-developed areas in the watershed. The east-west segment of Audrey Avenue is heavily-traveled and closed every Tuesday evening during the summer for Cruise Night, a popular event where classic and unique cars are showcased. Audrey Avenue is lined with shade trees that are removed and replaced periodically to avoid interfering with the overhead utility lines along the street. This downtown district has high levels of impervious cover and on-street parking throughout. The concept developed for this area (*Figures 4-11 through 4-14*) would maintain on-street parking while reducing impervious cover and providing stormwater treatment.

Figure 4-11. Green Street Retrofit Concept Plan for Audrey Avenue

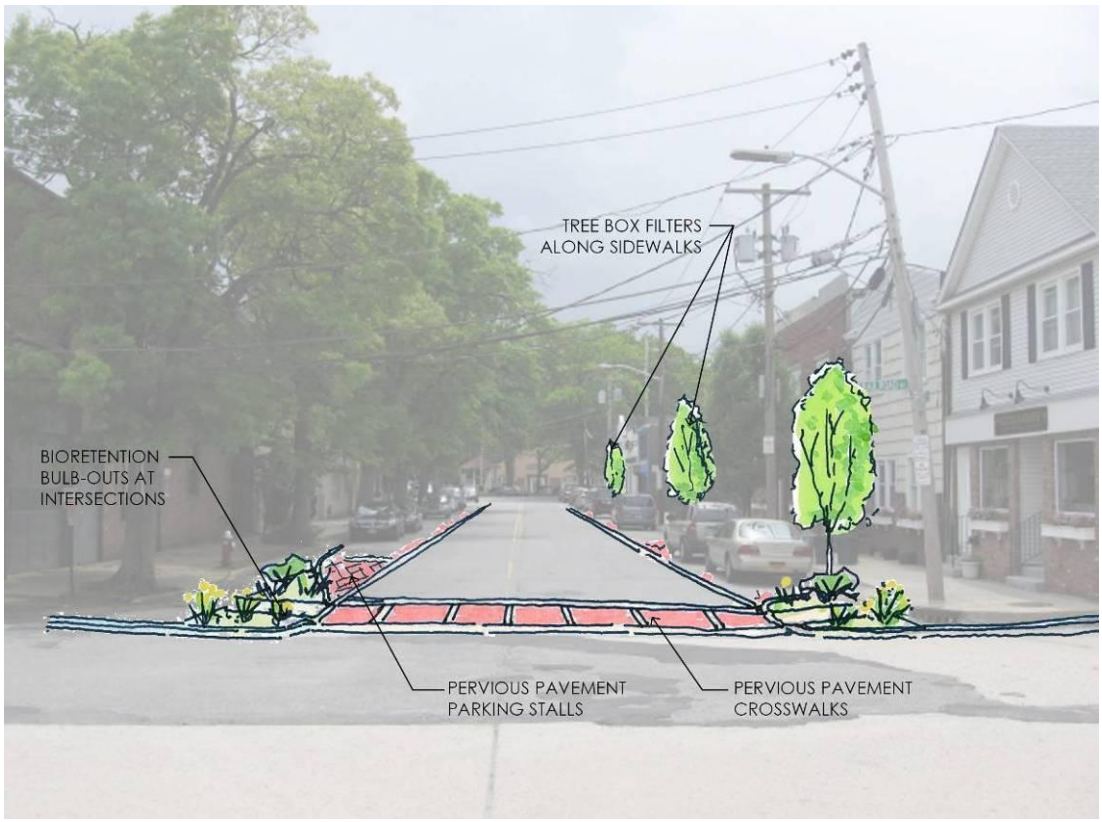

Figure 4-12. View of Proposed LID Measures on Audrey Avenue

Figure 4-13. Green Street Retrofit Concept Plan for Audrey and Shore Avenues

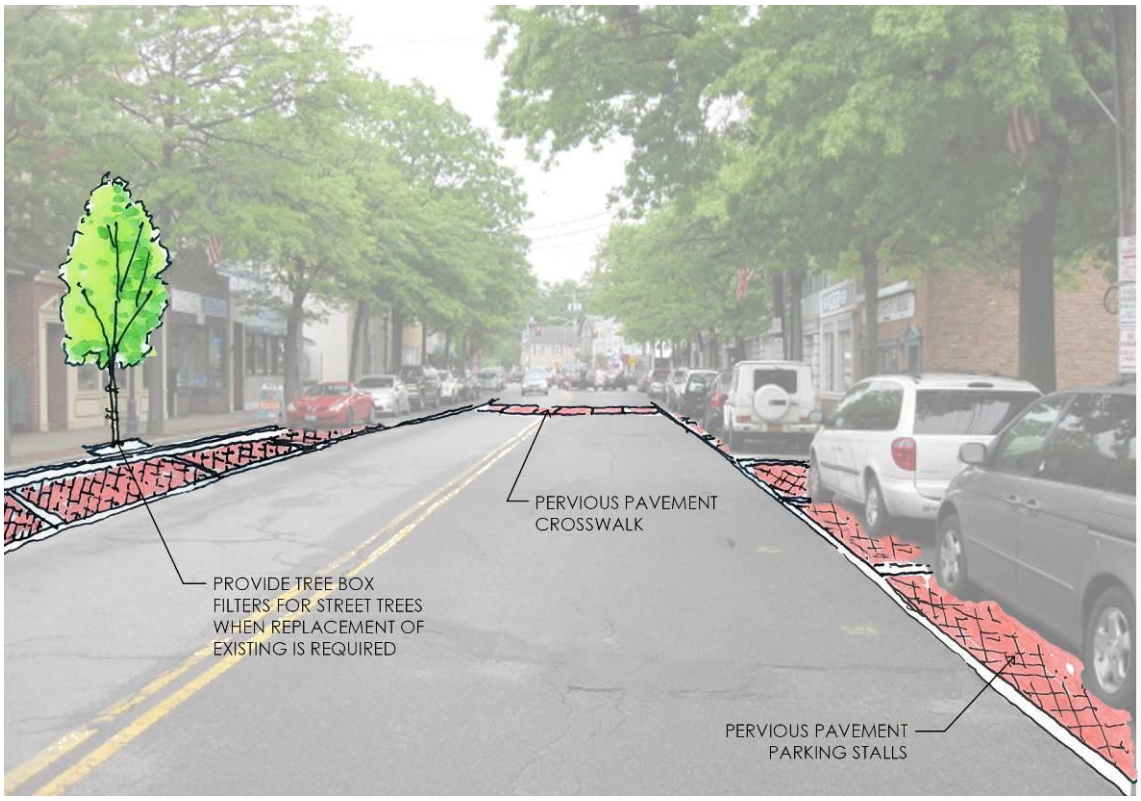

Figure 4-14. View of Proposed LID Measures along Audrey and Shore Avenues

The conventional asphalt on-street parking stalls, consisting of the ten-foot wide outer portion of the street, could be retrofitted with pervious pavement, pervious concrete, or open-jointed block pavers to reduce effective impervious cover and provide stormwater treatment. Curbside areas adjacent to intersections, which are currently marked to prohibit parking, could be converted to bioretention areas. Tree box filters could also be integrated into the sidewalk as the existing trees are replaced.

Other types of curbside LID measures (i.e., green gutters, stormwater planters, bioretention) may not be appropriate due to the heavy pedestrian traffic that occurs during special events (such as cruise night) and likely damage to the vegetation, which would require significant ongoing maintenance.

4.5 Beekman Creek Restoration

Beekman Creek Restoration	
Objectives:	Stream Restoration Riparian Restoration Runoff reduction Pollutant reduction Public Access Public Outreach
Estimated Cost:	$1.2 – $2.5 million

Beekman Creek is a small tributary of the Mill River located west of West Shore Road. The headwaters of this creek are located adjacent to a driveway that serves three private residences. These headwaters include deep, well-shaded pools that support a reproducing population of native brook trout. The creek flows west, crosses below the Long Island Rail Road embankment in a large stone arch culvert and then flows east to West Shore Road. The creek then enters a culvert that carries it for the rest of its length. The culvert passes below West Shore Road, the Beekman Beach parking lot, and discharges to the Mill River. Friends of the Bay has proposed a comprehensive, phased restoration of Beekman Creek and the outflow of the Mill River. The proposed restoration plan (Shown in part in *Figure 4-15*) includes the following elements:

Phase 1 – Beekman Creek Restoration. During this phase, the Beekman Beach parking lot would be reduced in size to accommodate a new aboveground stream corridor for Beekman Creek along the railroad embankment. The project would also include an educational and public outreach component. The stream corridor would include a stream channel created from a combination of boulders, cobbles, and gravel, with deep pools at intervals for habitat and a restored riparian area to provide shading and upland habitat.

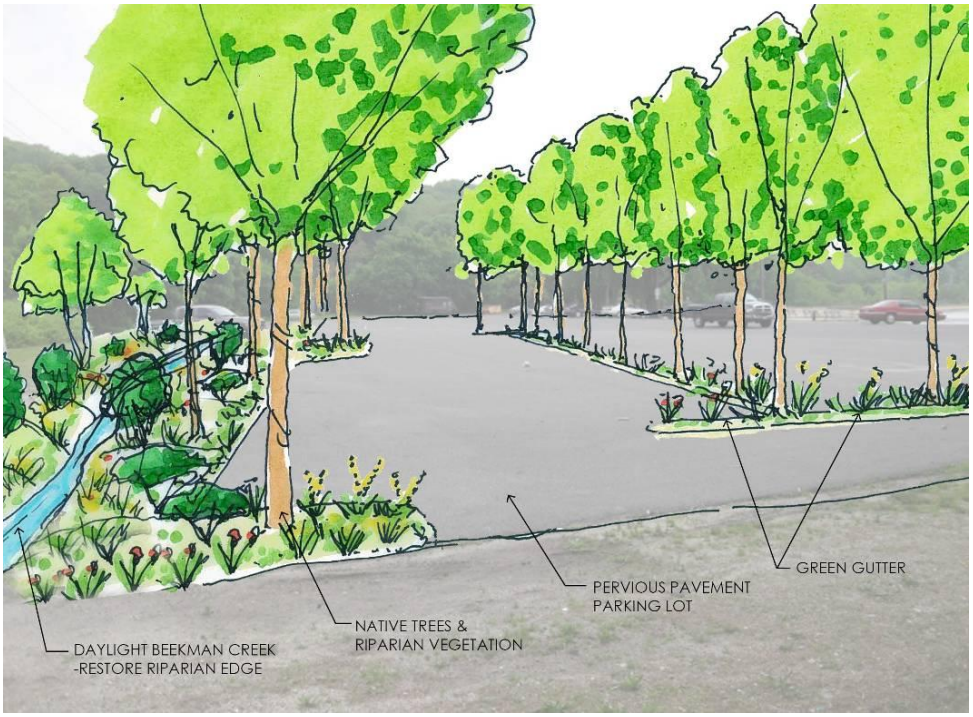

Figure 4-15. View of Proposed Beekman Creek Restoration and LID Concept

LID stormwater management measures could also be implemented in the Beekman Beach parking lot, including a combination of pervious pavement, a green gutter separating parking rows, bioretention areas at the ends of the parking rows, and a water quality swale, all to capture, treat, and infiltrate stormwater runoff. The water quality swale could be constructed as a shallow swale and include a reinforced grass paving system to allow overflow parking during special events. The swale would be separated from the lot with a removable fence. *Figure 4-16* depicts one potential concept for some of the proposed Phase 1 enhancements.

This phase of the project could also include installation of a bottomless arch culvert to convey the creek below West Shore Road to allow for fish and wildlife passage. The project could also include replacement of the private driveway culvert that connects the two headwater ponds. West Shore Road is currently being reconstructed, and stormwater from the road will be directed away from Beekman Creek and treated prior to discharge to the harbor. Phase 1 also includes the first leg of the walking trail.

These improvements would significantly expand the in-stream and riparian habitat available along this watercourse, while also reducing stormwater runoff and pollutant loads to the harbor.

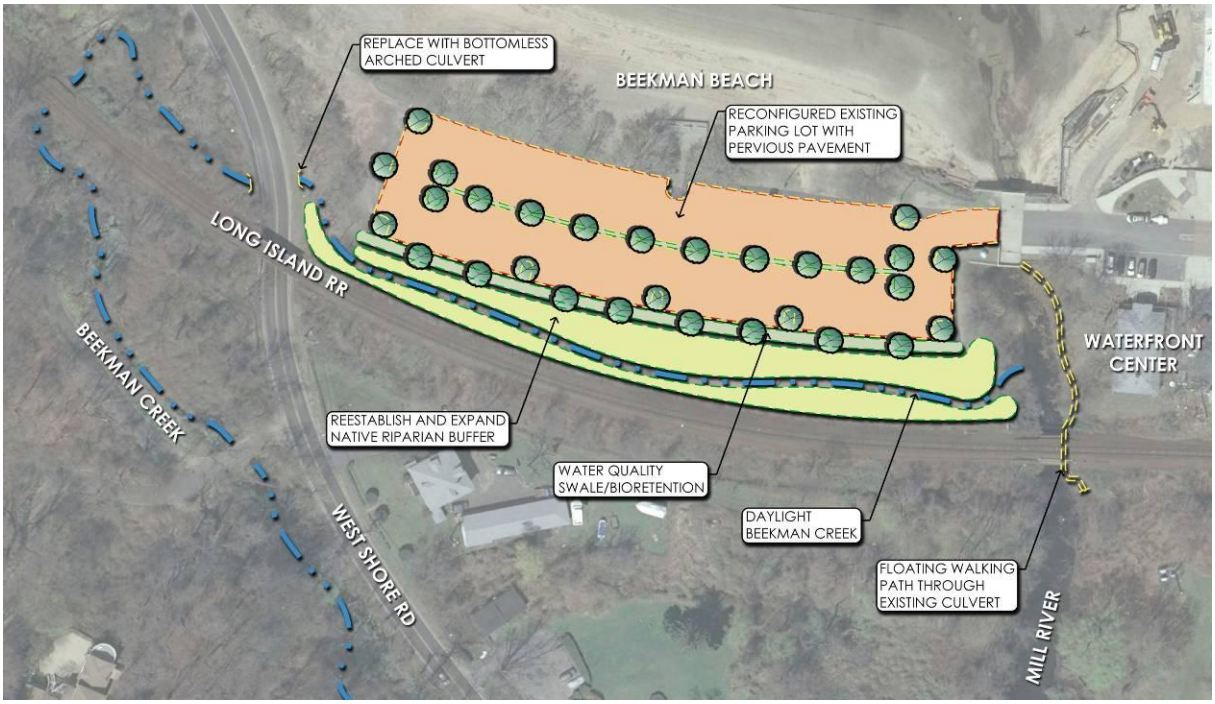

Figure 4-16. Beekman Creek Restoration Concept Plan

Phase 2 – Mill River Outflow. This phase would focus on improving conditions in the outflow from Mill Pond. A walking trail would be established along the lower Mill River that would provide access for the Waterfront Center to the grounds of the old mill and the Mill Pond Dam. The trail would cross below the railroad embankment through the existing culvert on floating platforms. The stream channel would also be improved to provide better in-stream habitat, and invasive species in the riparian area would be removed. Provisions for fish passage

are proposed for Mill Pond Dam. One option is to provide a bypass channel around the entire Mill Pond that would carry a portion of Mill River, such that fish travelling up or down the river would not be impacted by warm water conditions within Mill Pond. The remnants of the old mill could also be preserved as part of the project.

Phase 3 – Mill Pond to Glen Cove Road. This final phase would focus on improvements south of Mill Pond. The trail developed during Phase 2 would be extended south to the protected Mill Pond Overlook property. Treatment would be provided for stormwater discharges to Mill River and Mill Pond, and habitat conditions in the pond and river would be improved through stream restoration, dredging of sediment that has accumulated in the pond, and improved management of water chestnut, an aquatic invasive species that has impacted the pond.

4.6 Pine Hollow Shopping Center LID Retrofits

Pine Hollow Shopping Center LID Retrofits	
Objectives:	Runoff reduction Pollutant reduction Public Outreach
Estimated Cost:	$610,000 – $1,300,000

A shopping center along Route 106 was selected as a representative commercial LID retrofit that could be applied in similar commercial districts throughout the watershed. The shopping center consists of a main entrance along Route 106, north of which is a commercial shopping plaza and south of which is a chain supermarket. Stormwater runoff leaves the site through a combination of overland flow toward Route 106 and catch basins located in the parking lots. A portion of the area may drain into the recharge basin located directly to the south. Several of the catch basins may be leaching catch basins or drywells that infiltrate untreated stormwater directly into the ground. The proposed concept for this site, shown in *Figure 4-17,* incorporates LID retrofits into the limited available site without adversely impacting the commercial uses of the site. Because the site is privately-owned, implementation of the proposed retrofits would only occur at the time of future redevelopment of the site, as part of the local and county regulatory approval process, or by providing other incentive mechanisms. The proposed concept includes the following:

Tree box filters in the walkway along Route 106. Tree box filters could be installed at regular intervals to accommodate street trees and provide infiltration and treatment of stormwater runoff from adjacent impervious surfaces during small storms. The tree box filters could be oriented to receive runoff from the parking lots, Route 106, or both.

Pervious pavement in parking stalls. The existing conventional asphalt pavement within the parking stalls in the parking lots could be retrofitted with pervious pavement, pervious concrete, or open-jointed block pavers to reduce effective impervious cover and provide stormwater treatment. A typical pervious parking stall is shown in *Figure 4-18*.

Green gutters and bioretention areas along parking stalls. The thin strip between the parking rows could be converted into a green gutter, and the wider island areas at the row ends could be converted to bioretention areas for stormwater treatment and infiltration. Trees could also be planted along the strip to increase shading of the parking lot.

Figure 4-17. Retrofit Concept Plan for a Commercial Shopping Center

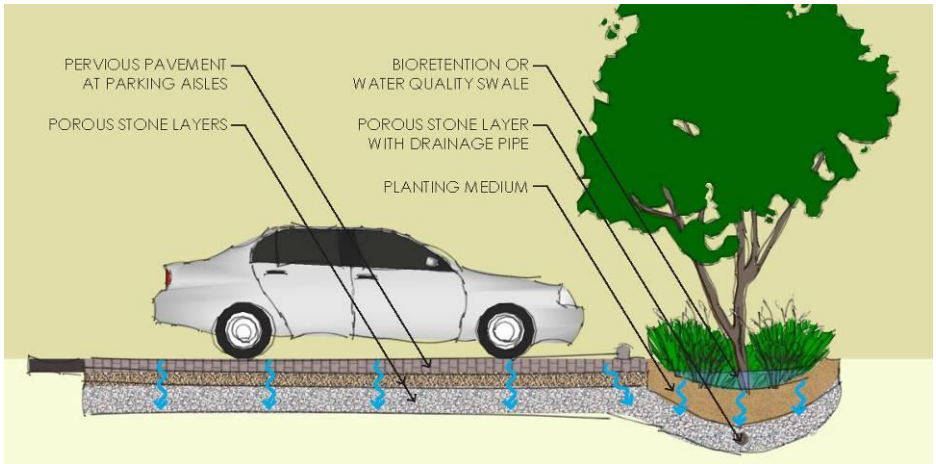

Figure 4-18. Typical Pervious Parking Row Cross Section

Water quality swale. A water quality swale could be integrated along the southern end of the supermarket parking lot to capture, treat, and infiltrate stormwater and convey overflow to the proposed bioretention areas. Water quality swales are grassed, gradually-sloping channels that convey and infiltrate stormwater.

4.7 Fireman's Field Greening

Fireman's Field Greening	
Objectives:	Runoff reduction Pollutant reduction Public Outreach
Estimated Cost:	$940,000 – $2,000,000

Fireman's Field is a large paved parking lot and firefighter training area located adjacent to the current Oyster Bay Railroad Station and between Shore Avenue and Maxwell Avenue. The parking lot is lightly used except during special events. The large impervious area generates significant stormwater runoff, resulting in known drainage problems. Improvements to the area have been proposed, including better-defined parking and improved drainage and landscaping.

Figure 4-19 expands on the existing proposed concept for Fireman's Field by incorporating additional LID stormwater management measures similar to those proposed for other concepts that are described in this section.

Figure 4-19. LID Retrofit Concept for Fireman's Field

4.8 Hernan Avenue/Mill Neck Bay Marina Reuse

The former Mill Neck Bay Marina, a listed Class 2 New York State superfund site, is situated at the end of Hernan Avenue along Mill Neck Creek and adjacent to the Oyster Bay National Wildlife Refuge. Few remnants of the marina remain, and soils at the site are contaminated with copper, mercury, arsenic, zinc, lead, and organic compounds from historic site activities. Environmental remediation is necessary before redevelopment of the site can occur.

Hernan Avenue/Mill Neck Bay Marina Reuse	
Objectives:	Runoff reduction Pollutant reduction Public Outreach
Estimated Cost:	$150,000 – $320,000

Figures 4-20 depicts a retrofit concept for this site and the adjacent Hernan Avenue. Future redevelopment or reuse of the site should incorporate conservation areas, wetland restoration, and LID stormwater controls. A portion of Hernan Avenue could also be retrofitted with LID stormwater management measures to capture, treat, and infiltrate roadway runoff, which currently discharges directly to Mill Neck Creek without treatment. Since Hernan Avenue is steeply-sloped, a bioretention area along the road's edge could be constructed of multiple cells separated by stone check dams. The existing stormwater outfall pipe at the end of Hernan Avenue could be retrofitted with an underground hydrodynamic separator or similar structural treatment practice.

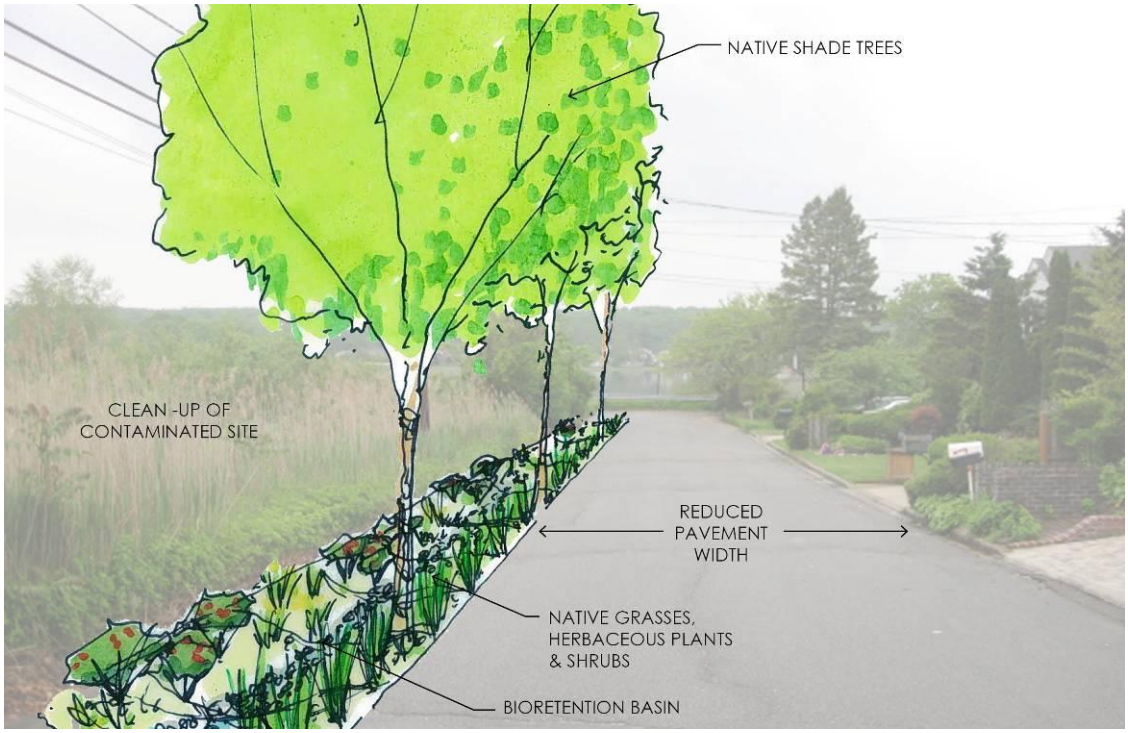

Figure 4-20. Hernan Avenue Bioretention Retrofit Concept

4.9 White's Creek Restoration

White's Creek is a tributary of Oyster Bay Harbor that flows within underground pipes for most of its length. The creek emerges from an underground culvert at Elsie Avenue in Oyster Bay Hamlet and flows in a well-shaded channel for approximately 160 feet. It then enters another culvert, passes below a driveway for a paved outdoor boat storage lot, continuing in the culvert for approximately 200 feet to its final outlet adjacent to the Commander Oil Terminal facility.

White's Creek Restoration	
Objectives:	Stream Restoration Riparian Restoration Runoff reduction Pollutant reduction Public Outreach
Estimated Cost:	$860,000 – $1,850,000

The Oyster Bay Eastern Waterfront Community Vision and Revitalization Plan (Eastern Waterfront Plan) calls for converting the outdoor boat storage lot to a public parking facility with drainage improvements and a pedestrian bridge. The Plan also shows a new channel being provided for White's Creek along the north side of the parking lot, replacing the final 200-foot section of culvert. Further upstream, no remnants of the stream's former channel remain, and further daylighting would require significant adverse property impacts and expense.

Additionally, during large storms, the storm drainage system in parts of Oyster Bay Hamlet is overwhelmed, and stormwater runs off along the roadways from upgradient areas, ultimately discharging to White's Creek across from the Long Island Railroad rail yard. A small, undeveloped, triangular-shaped grassed area is located adjacent to where stormwater overflows enter White's Creek during large storms. This grassed area is part of the same parcel as the outdoor boat storage lot but separated from the lot by the creek.

A proposed concept (*Figure 4-21*) was developed to meet the goals presented in the Eastern Waterfront Plan while incorporating additional elements to include stormwater infiltration and treatment, stream restoration, and riparian buffer restoration. The proposed concept consists of the following elements:

Daylight White's Creek. The approximately 200-foot section of culvert below the parking lot driveway could be removed to its end and replaced with a restored stream channel to carry White's Creek. The channel could be created from a combination of boulders, cobbles, and gravel, with deep pools at intervals for habitat and a restored riparian area to provide shading. The existing access to the parking lot could be maintained through the use of a bridge or by maintaining a limited section of the existing culvert. Additionally, the riparian buffer surrounding the creek in the existing aboveground section next to the oil terminal could be reestablished and expanded where possible.

Bioretention for flow from South Street. The triangular grassed area at the intersection of Elsie Avenue and South Street could be converted into a bioretention basin. The existing curb along South Street could be removed to direct runoff into the bioretention basin. The basin could be designed to overflow into White's Creek during larger storms. The bioretention basin could be designed in conjunction with the other LID and green infrastructure concepts proposed along South Street.

South Street greening. As discussed previously, green street retrofits of South Street could significantly reduce stormwater runoff and pollutant load to White's Creek from South Street and upgradient areas.

Parking lot improvements. The existing parking lot could be retrofitted with pervious pavement and bioretention to capture, treat, and infiltrate stormwater. These improvements could effectively eliminate the stormwater contribution of this parking lot to White's Creek during most storms. A pedestrian walk and bridge over the daylighted White's Creek channel could also be incorporated into the design.

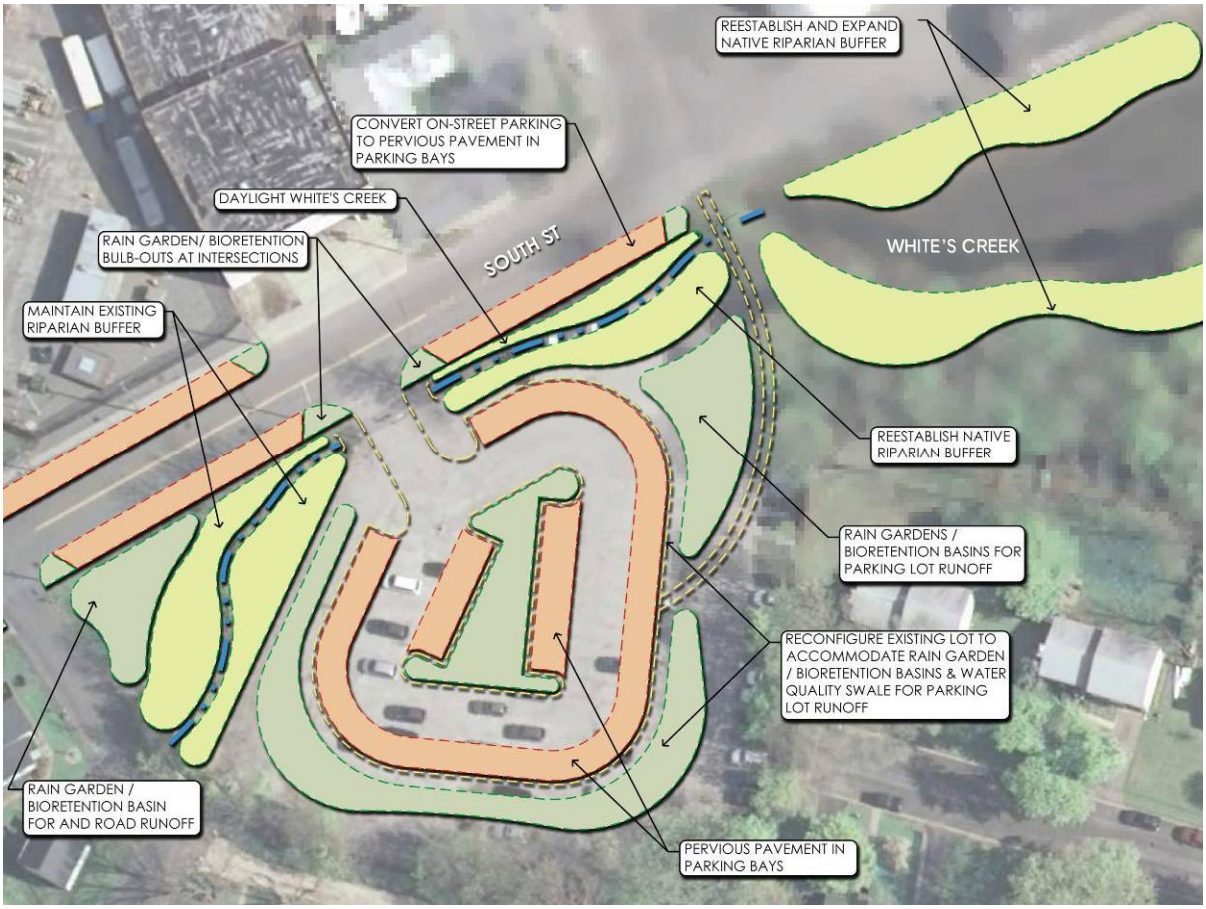

Figure 4-21. White's Creek Restoration Concept

4.10 Oyster Bay Municipal Parking Lot LID Retrofit

The Town of Oyster Bay municipal parking lot located behind a row of buildings on the east side of South Street provides a valuable LID retrofit opportunity (*Figure 4-22*). Currently, the parking lot contains 120 parking spaces along five driving aisles and an additional 45 to 50 parking spaces around the lot's perimeter. The lot currently has parking islands at the end of the rows, which were added to better define the parking configuration. The lot has a gentle downward slope toward the west, with drainage received by two catch basins.

Oyster Bay Municipal Parking LID Retrofit

Objectives:	Runoff reduction Pollutant reduction Public Outreach
Est. Cost:	$440,000 – $950,000

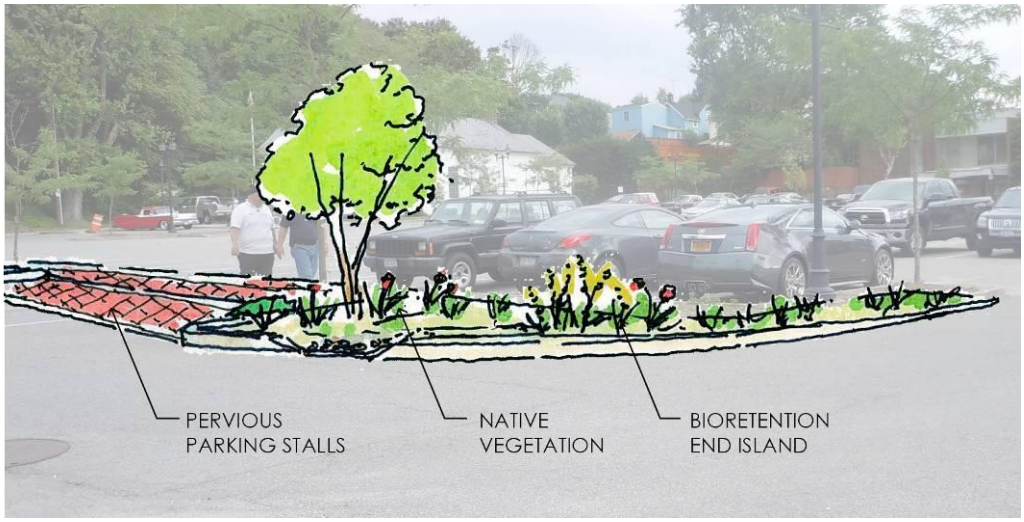

Figure 4-22. LID Retrofit Concept for Oyster Bay Municipal Parking Lot

Water has been observed flowing through the drainage system that passes through these catch basins even during dry weather, suggesting that the drainage system serves as the culvert that carries White's Creek. The parking lot is accessed by pedestrians from South Street through an alley between the Townsend Square building and a commercial building to the south. The alley is wide and consists of a traditional brick walkway. The proposed retrofit concept for this municipal lot, shown in plan view in *Figure 4-24*, includes the following elements:

Pocket gardens in the alley. Pocket gardens could be installed along the brick walkway in the alley connecting the parking lot to South Street (*Figure 4-23*). These pocket gardens would be constructed as bioretention areas, although smaller and perhaps with a more formal planting structure. The gardens would receive runoff from the surrounding walkway and roof leaders. Benches and other landscaping amenities could be included in the design. Educational signage is also recommended at this highly-visible public location, which is located adjacent to the Friends of the Bay office, which could emphasize the connection between stormwater runoff and its impact on White's Creek (flowing below the parking lot) and the estuary complex.

Figure 4-23. Proposed Pocket Gardens and Educational Signage

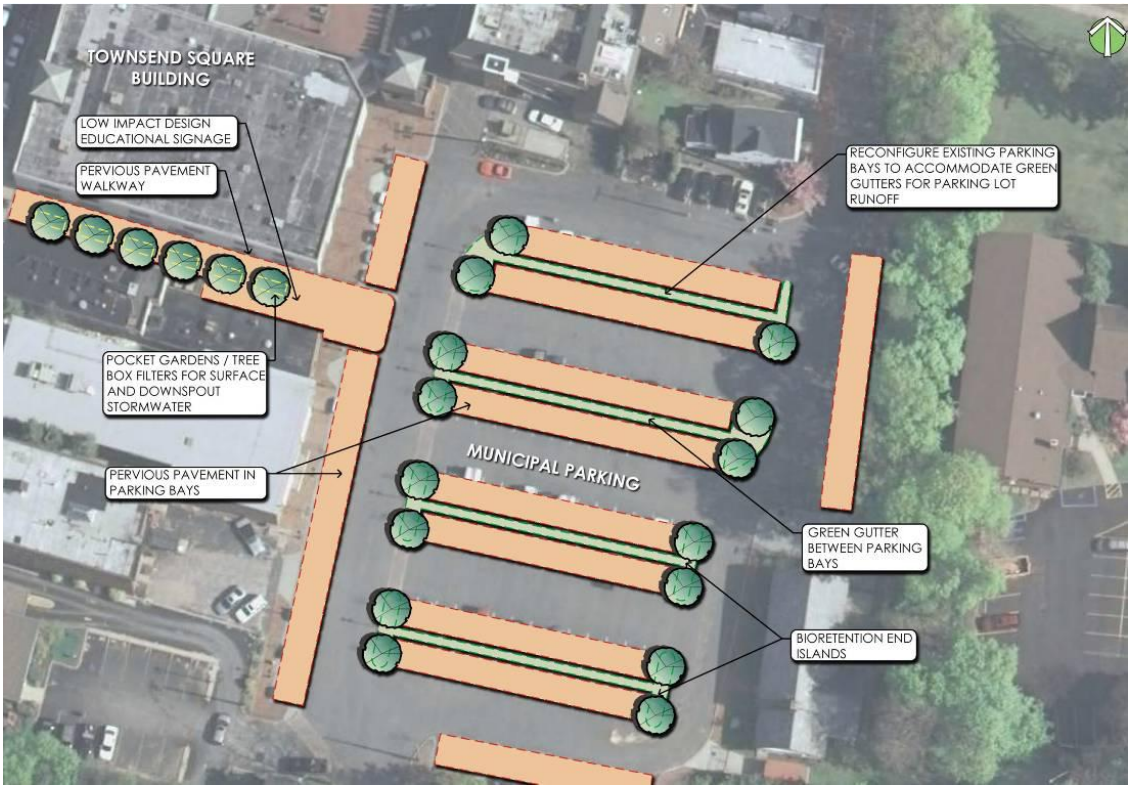

Figure 4-24. LID Retrofit Concept Plan for Oyster Bay Municipal Parking Lot

Pervious pavement in parking stalls. The existing conventional asphalt pavement within parking stalls in the parking lots could be replaced with pervious pavement, pervious concrete, or open-jointed block pavers to reduce effective impervious cover and provide stormwater treatment.

Green gutters and bioretention areas along parking stalls. A thin strip between the parking rows could be converted into a green gutter or similar stormwater planters, and the island areas at the row ends could be converted to bioretention areas for stormwater treatment and infiltration. Trees could also be planted along the green gutter strip to increase shading of the parking lot.

5 Pollutant Load Reductions

Pollutant load reductions were estimated for the watershed management plan recommendations using the Watershed Treatment Model (WTM) pollutant loading model. WTM is a planning-level spreadsheet loading model that was used in the development of the shellfish pathogen TMDL for Oyster Bay Harbor and Mill Neck Creek. WTM is also one of the models recommended by the NYSDEC to verify anticipated load reductions associated with stormwater retrofits required by the MS4 Permit Watershed Improvement Strategy.

Anticipated pollutant load reductions were modeled using WTM for the following Watershed Action Plan recommendations. Other recommended actions identified in this plan could not be quantified due to inherent limitations of WTM and/or the lack of reliable input data or information on the pollutant removal effectiveness of certain practices.

1. Stormwater Retrofits Using Green Infrastructure/Low Impact Development. Stormwater retrofits are recommended throughout the watershed and are required by the MS4 Permit to reduce pollutant loads to the estuary complex. Specifically, MS4 pathogen loads to portions of Oyster Bay and Cold Spring Harbor must be reduced between 20% and 95% to meet the requirements of the shellfish pathogen TMDLs that are in place for these waterbodies (NYSDEC, 2003; Battelle, 2007; NYSDEC, 2010). Green infrastructure and Low Impact Development (LID) retrofits were modeled, including bioretention and infiltration, as these are among the more effective stormwater management practices for pathogen reduction. Multiple scenarios were modeled to estimate the effect of varying levels of retrofit implementation across the watershed, including estimates for retrofitting 5%, 25%, 50%, 75%, and 100% of the watershed impervious area (excluding areas served by recharge basins).

2. Stormwater Management Practices (SMPs) for New Development and Redevelopment. The Watershed Action Plan promotes effective stormwater management for future development and redevelopment through land use regulatory mechanisms requiring stormwater management practices. Pollutant load reductions were estimated for implementation of stormwater management practices for all future new development and redevelopment in the watershed based on a watershed buildout scenario. The target effectiveness of the proposed stormwater controls were estimated from the *Rhode Island Stormwater Design And Installation Standards Manual* (RIDEM, 2010) as a 30% reduction in nutrients (TN and TP), an 85% reduction in TSS, a 60% reduction in bacteria, and a 25% reduction in runoff volume. The effectiveness reflects system maintenance and design inefficiencies and assumes that 80% of new development requires stormwater management practices.

3. Riparian and Wetland Buffer Restoration. Potential pollutant load reductions were estimated for restoration of impacted riparian and wetland buffers in the watershed. The total length of streams within each subwatershed with impacted buffers was estimated based on the vegetated or forested riparian land cover from the land cover data set described in the State of the Watershed Report. Under the modeled restoration scenario, a 100-foot vegetated riparian buffer was assumed for those areas currently with impacted buffers.

4. Reforestation. The Watershed Action Plan promotes preservation and enhancement of forest areas and tree canopy. Potential pollutant load reduction benefits were estimated for a watershed reforestation scenario, using the tree canopy goals presented in the State of the Watershed Report as a future target. The reforestation scenario was modeled by converting targeted parcels having institutional and municipal land use, as well as some commercial and residential land use, to forest in the future condition.

5. Public Education. Pet waste, lawn care, and other nonpoint source education programs can change behaviors that affect pollutant loads. Pollutant load reductions were estimated for pet waste and lawn care education programs based on the number of dwellings, average fraction of pet-owners, pet-owners who already clean up after their pets, and average fraction willing to change their behavior. Conservative model assumptions were used to avoid over-estimating the load reduction benefits of these programs.

6. Illicit Discharge Detection and Elimination, Septic System Repairs, and Additional Sewering. Illicit stormwater connection removal and septic system and cesspool repairs were considered in each subwatershed based on the existing estimated number of households served by septic systems and estimated numbers of illicit connections associated with commercial and residential land uses. The illicit connection removal scenario assumes that 20% of the existing illicit discharges are detected and eliminated. The septic system repair scenario assumes an 80% inspection rate and a 60% repair rate. Although these rates may seem high, the pollutant load reductions are not based on a finite time period, but rather ongoing implementation of the action plan recommendations. If, for example, codes are passed in all jurisdictions requiring inspection and compliance of septic systems at the time of sale of a property, system upgrades would be required as residential properties are sold and implementation rates may well approach these levels. In addition to the septic system repairs and upgrades throughout the watershed, the scenario also included extension of sanitary sewers to Bayville, which is believed to have high failure rates for on-site septic systems considering the high density of development and use of non-conforming cesspools.

A large portion of the watershed is served by recharge basins, which are designed to retain and infiltrate stormwater runoff from developed areas. The recharge basins effectively eliminate the contribution of stormwater runoff to the estuary complex from the areas served by the recharge basins. Therefore, the approximately 1,800 acres of the watershed currently served by recharge basins was excluded from the pollutant loading analysis and load reduction estimates.

Annual average pollutant loads of fecal coliform indicator bacteria (pathogens), total suspended solids (TSS), phosphorus (P), and nitrogen (N) and average annual runoff volume were estimated for 1) existing conditions, 2) future buildout of the watershed without the proposed watershed management recommendations, and 3) future buildout assuming implementation of the proposed watershed management recommendations described in the above scenarios. Note that the existing condition scenario and future buildout scenario (without the proposed watershed management measures) are similar since the watershed is almost completely developed.

Table 5-1 summarizes the anticipated pollutant load reductions for the Watershed Action Plan recommendations for which pollutant loads can be reasonably quantified. The load reduction estimates presented in *Table 5-1* are for the entire Oyster Bay/Cold Spring Harbor Complex watershed. Load reduction summaries by subwatershed are provided in *Appendix D*.

Table 5-1. Anticipated Annual Pollutant Load Reductions

Watershed Management Recommendation	N	P	TSS	Fecal Coliform	Runoff Volume	N	P	TSS	Fecal Coliform	Runoff Volume
	lb/yr	lb/yr	lb/yr	billion/ yr	(ac-in/ year)	%	%	%	%	%
Stormwater Retrofits										
Retrofit 5% of Impervious Area	2,723	905	127,955	44,842	567	2.9%	2.9%	1.9%	3.5%	3.3%
Retrofit 25% of Impervious Area	13,617	4,527	639,777	224,211	2,836	14.4%	14.7%	9.4%	17.3%	16.4%
Retrofit 50% of Impervious Area	27,234	9,054	1,279,555	448,422	5,672	28.9%	29.4%	18.9%	34.6%	32.8%
Retrofit 75% of Impervious Area	40,850	13,581	1,919,332	672,633	8,507	43.3%	44.1%	28.3%	52.0%	49.1%
Retrofit 100% of Impervious Area	54,467	18,108	2,559,109	896,844	11,343	57.8%	58.9%	37.7%	69.3%	65.5%
Stormwater Management Practices for New Development and Redevelopment	203	39	4,473	11,351	9	0.2%	0.1%	0.1%	0.9%	0.1%
Riparian & Wetland Buffer Restoration	795	280	46,041	8,855	134	0.8%	0.9%	0.7%	0.7%	0.8%
Reforestation	478	93	6,362	17,625	41	0.5%	0.3%	0.1%	1.4%	0.2%
Public Education	951	50	0	294	0	1.0%	0.2%	0.0%	0.0%	0.0%
IDDE/Septic System Repairs	25	14	20,949	7,776	0	0.0%	0.0%	0.3%	0.6%	0.0%
Total (with Retrofit 50% of Impervious Area Scenario)	*29,685*	*9,532*	*1,357,380*	*494,322*	*5,856*	*31.5%*	*31.0%*	*20.0%*	*38.2%*	*33.8%*

The estimated pollutant load reductions presented in *Table 5-1* represent the difference in future loads with and without the proposed watershed management controls. The total estimated pollutant load reductions are the sum of the estimated load reductions associated with each of the individual recommendations, including the stormwater retrofit scenario that assumes retrofitting of 50% of the impervious area within the contributing watershed to the estuary complex.

As indicated in *Table 5-1*, retrofitting of 50% of the impervious area in the contributing watershed with green infrastructure/LID practices, in combination with other nonpoint source controls, has the potential to reduce nitrogen and phosphorus loads by approximately 31%, total suspended solids by approximately 20%, fecal coliform by approximately 38%, and runoff volume by approximately 34%. *Table 5-2* provides a summary comparison of predicted pollutant loads and load reductions for the entire watershed, with and without implementation of the watershed management recommendations.

As shown in the pie charts in *Figures 5-1 through 5-5*, stormwater retrofits account for the majority of the anticipated pollutant load reductions for the watershed. Other watershed

management recommendations are estimated to have a much smaller effect on pollutant load reductions. The effectiveness of the proposed watershed management recommendations varies by pollutant, although the largest percent reductions are predicted for total suspended solids and fecal coliform.

It is important to note that these pollutant load reductions are presented on a watershed-wide basis. The pollutant load reduction benefits of specific recommendations could be greater in more localized areas. For example, although the predicted impact of illicit discharge detection and elimination, septic system repairs, and extension of sanitary sewers to Bayville is small on a watershed-wide basis, the impact in the Mill Neck Creek subwatershed would be significantly greater, with the recommendation resulting in a predicted 6% load reduction in bacteria in this subwatershed. It should be further noted that a consistent watershed-wide septic system failure rate was used in the model, whereas systems in Bayville could be failing at a higher rate as a result of the small residential lot sizes in the Bayville area and high groundwater..

Table 5-2. Summary of Modeled Pollutant Loads and Load Reductions

Pollutant	Existing Loads	Future Loads without Controls	Future Loads with Controls	Load Reduction
Nitrogen (lb/yr)	92,766	94,246	64,561	31.5%
Phosphorus (lb/yr)	30,475	30,764	21,232	31.0%
Total Suspended Solids (lb/yr)	6,764,959	6,782,458	5,425,078	20.0%
Fecal Coliform (billion/yr)	1,237,987	1,294,292	799,970	38.2%
Runoff Volume (acre-in/year)	17,188	17,314	11,458	33.8%

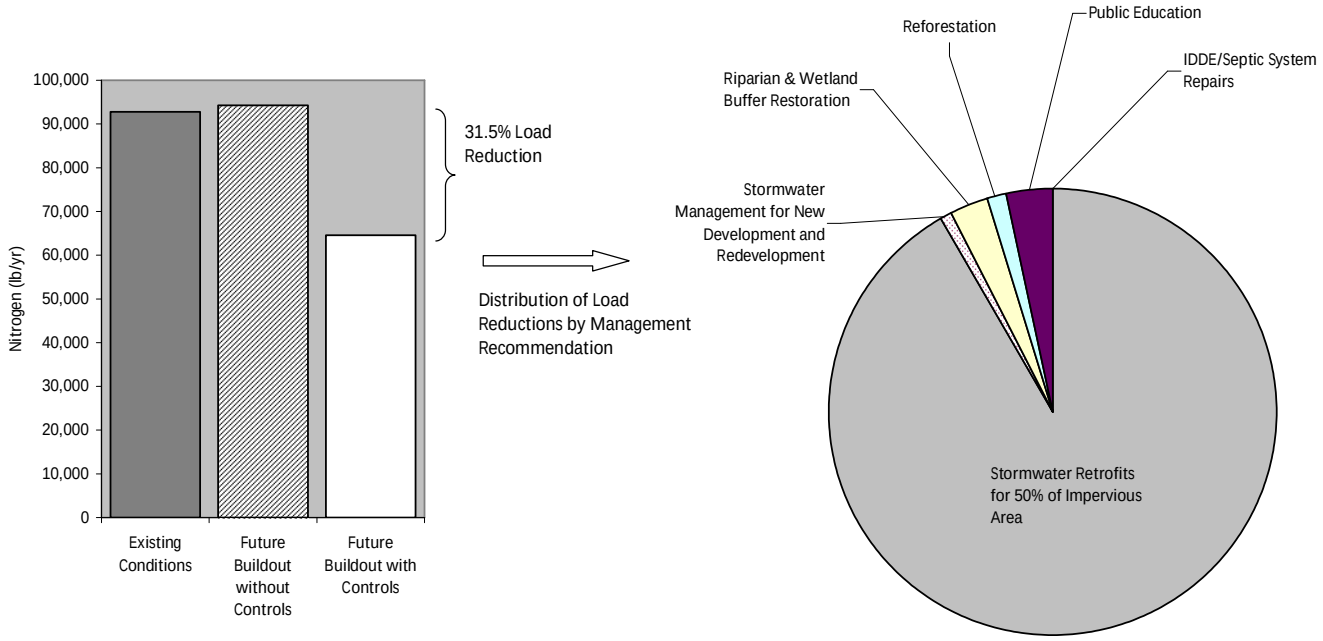

Figure 5-1. Anticipated Existing and Future Nitrogen Loads and Load Reductions

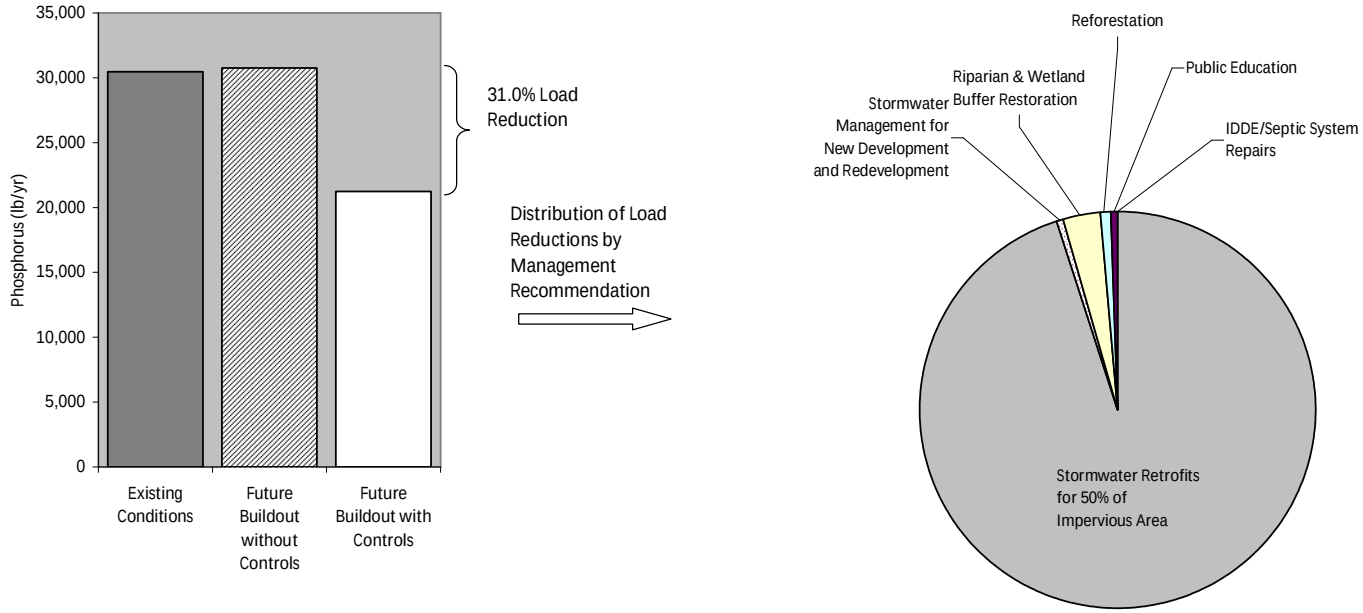

Figure 5-2. Anticipated Existing and Future Phosphorus Loads and Load Reductions

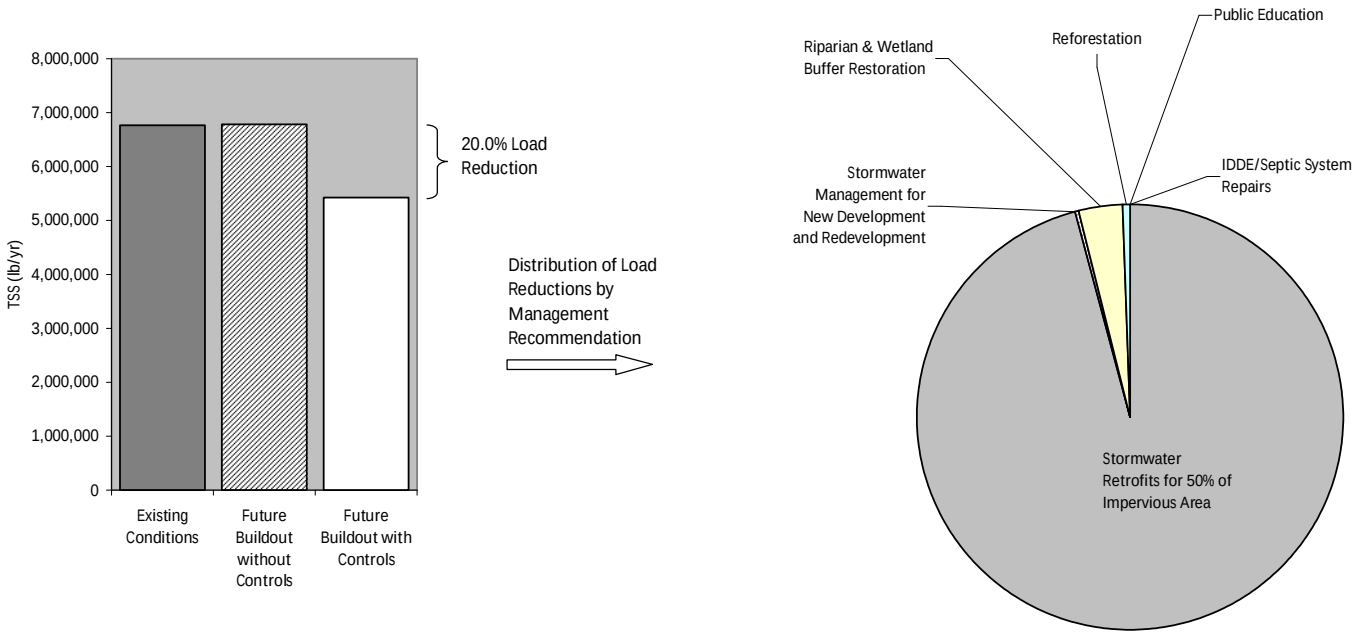

Figure 5-3. Anticipated Existing and Future Sediment (TSS) Loads and Load Reductions

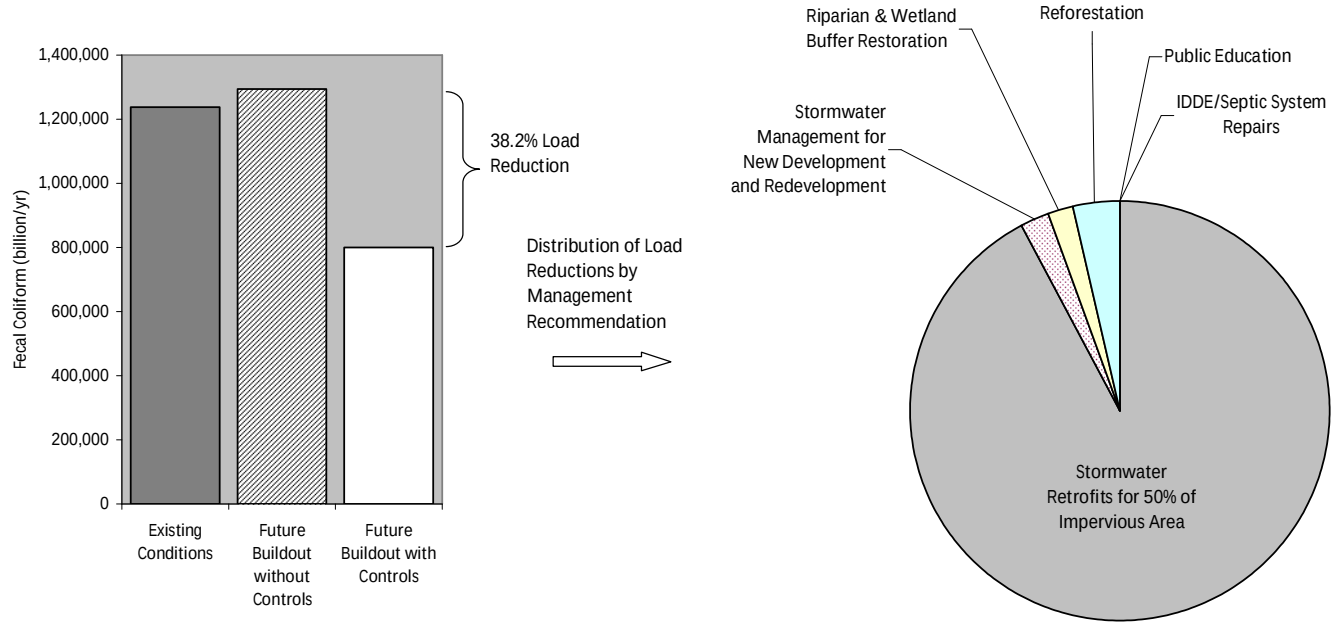

Figure 5-4. Anticipated Existing and Future Fecal Coliform Loads and Load Reductions

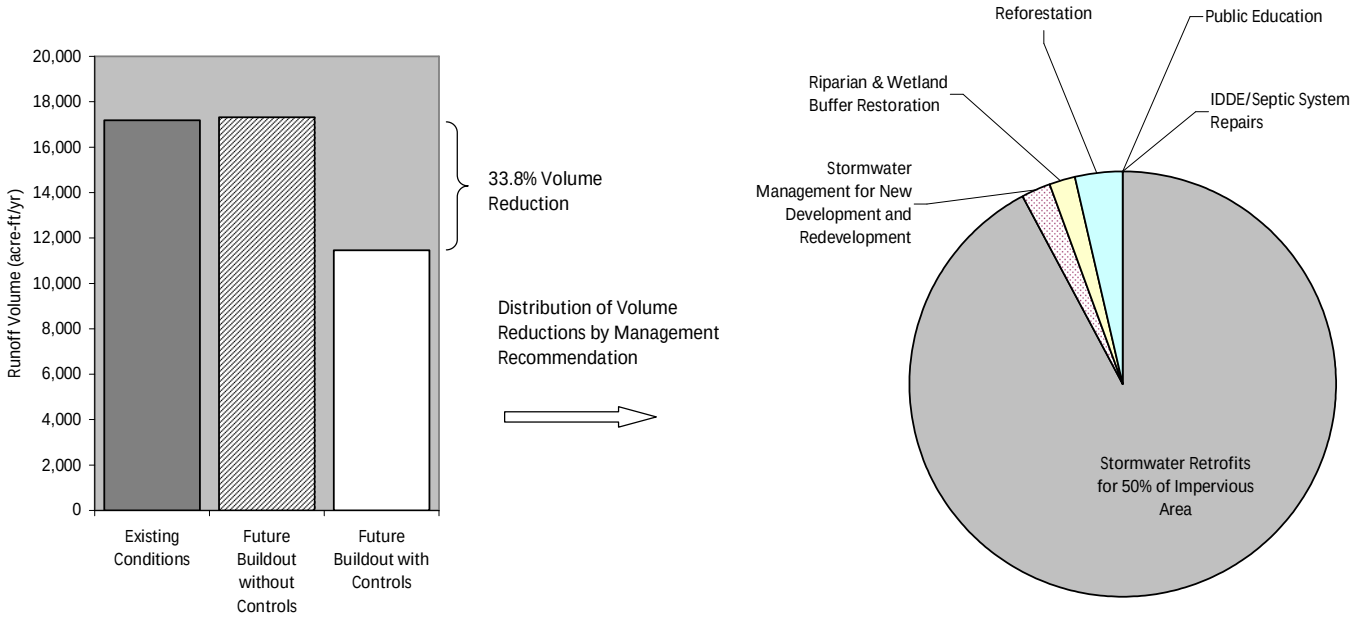

Figure 5-5. Anticipated Existing and Future Runoff Volumes and Volume Reductions

MS4 Permit Target Pathogen Reductions

The SPDES General Permit for Stormwater Discharges from Municipal Separate Storm Sewer Systems (MS4 Permit) requires municipalities in the Oyster Bay/Cold Spring Harbor watershed to meet pathogen reduction targets for their regulated MS4s.

Table 5-3. Pathogen Load Reductions for Pathogen Impaired Waters

MS4 Permit Watershed	MS4 Permit Required Pollutant Load Reduction	MS4 Permit Pollutant Load Reduction Deadline	Contributing Subwatersheds (Watershed Action Plan)
Oyster Bay (Harbor 2)	20	03/09/2021	Mill Neck Creek, Center Island
Oyster Bay (Harbor 3)	90	03/09/2021	Oyster Bay Harbor, Mill River
Cold Spring Harbor, and tidal tributaries, Inner	95	09/30/2022	Cold Spring Harbor, Cold Spring Brook
Cold Spring Harbor, Eel Creek	90	09/30/2022	Cold Spring Harbor, Cold Spring Brook

The required pathogen load reductions specified in the MS4 Permit are derived from the *Pathogen Total Maximum Daily Loads for Shellfish Waters in Oyster Bay Harbor and Mill Neck Creek* (NYSDEC, 2003) and the *Final Report for Shellfish Pathogen TMDLs for 27 303(d)-listed Waters* (Battelle, 2007). The subwatersheds identified in this Watershed Action Plan generally correspond to the MS4 Permit watersheds listed in *Table 5-3*.

Table 5-4. Comparison of MS4 Permit Required and Estimated Pathogen Load Reductions

Contributing Subwatersheds	MS4 Permit Pathogen Impaired Watershed	Required Pathogen Load Reduction	Estimated Pathogen Load Reduction (50% Retrofit)	Estimated Pathogen Load Reduction (100% Retrofit)
Mill Neck Creek	Oyster Bay (Harbor 2)	20%	43%	78%
Center Island	Oyster Bay (Harbor 2)	20%	38%	73%
Oyster Bay Harbor	Oyster Bay (Harbor 3)	90%	36%	70%
Mill River	Oyster Bay (Harbor 3)	90%	37%	68%
Cold Spring Harbor	Cold Spring Harbor, and tidal tributaries, Inner Cold Spring Harbor, Eel Creek	90 – 95%	37%	74%
Cold Spring Brook	Cold Spring Harbor, and tidal tributaries, Inner Cold Spring Harbor, Eel Creek	90 – 95%	44%	80%

Table 5-4 compares the pathogen load reductions required by the MS4 Permit and the estimated pathogen load reductions under the 50% and 100% stormwater retrofit scenarios. As indicated in the table, the predicted load reductions exceed the required 20% load reductions for Oyster Bay (Harbor 2), and in fact would meet the required load reductions under a 25% retrofit scenario. However, predicted pathogen load reductions are well below the required load reductions (90-95%) for Oyster Bay (Harbor 3) and Cold Spring Harbor.

There are several limitations to making comparisons between the required pathogen load reductions in the MS4 Permit and the estimated pathogen load reductions for the proposed watershed management recommendations, including:

- The pathogen load reductions required by the MS4 Permit are for stormwater contributions from the MS4 only (i.e., the point source or waste load allocation in the TMDL), and not from other nonpoint sources in the watershed. The planning-level drainage system mapping that was available for this study does not allow an accurate delineation of the limits of the contributing MS4 to the harbor. The predicted pathogen loads, and therefore load reductions, are based on the entire watershed area (excluding areas served by recharge basins), and are not only attributable to the MS4.

- The watershed boundaries used to generate the pollutant load estimates in the TMDLs are similar, but slightly different, than the subwatersheds delineated for this Watershed Action Plan.

- The inputs, assumptions, and parameters used in the pollutant loading models for the development of the TMDLs may differ from those used in this pollutant load modeling analysis.

- The future condition scenario for the proposed Watershed Action Plan recommendations includes modest development and redevelopment assuming future buildout of the watershed. The required load reductions derived from the TMDL do not appear to explicitly account for future increases in pollutant loads, although a required Margin of Safety is assumed.

Other pathogen reduction technologies or measures may be necessary to meet the pathogen load reductions required by the MS4 Permit. Additional use of treatment train approaches (multiple controls used in series) or design of stormwater treatment practices to meet larger water quality design storms and volumes may also be necessary. Use of a more detailed pollutant loading model such as SWMM or SUSTAIN is recommended to further evaluate anticipated pathogen load reductions under various retrofit scenarios and for different combinations of stormwater management practices.

6 Funding Sources

A variety of local, state, and federal sources are potentially available to provide funding for the implementation of this plan, in addition to potential funds contributed by local grassroots organizations and concerned citizens. *Appendix E* contains a list of potential funding sources. The table is not intended to be an exhaustive list but can be used as a starting point to seek funding opportunities for implementation of the recommendations in this Watershed Action Plan. The information presented in this plan and the associated documentation will support future grant proposals by demonstrating a comprehensive, scientifically-based approach for addressing identified concerns consistent with state and federal watershed planning guidance. The table of potential funding sources is intended to be a living document that should be updated periodically to reflect the availability of funding or changes to the funding cycle, and to include other funding entities or grant programs.

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Appendix A

State of the Watershed Report (on CD)

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Appendix B

Maps of Subwatershed Recommendations

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Appendix C

Site-Specific Project Cost Estimates

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Appendix D

Pollutant Load Reduction Model Results

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Appendix E

Potential Funding Sources