Reclaim Our Water

SUFFOLK COUNTY SUBWATERSHEDS WASTEWATER PLAN

"We are in a county that will no longer allow our water quality crisis to go unaddressed, but will come together to Reclaim Our Water"

Suffolk County Executive Steve Bellone
2014 State of the County

Suffolk County
Department of Health Services
July 2020

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CDM Smith

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Introduction

> "We are a county that will no longer allow our water quality crisis to go unaddressed, but will come together to Reclaim Our Water."
>
> - Suffolk County Executive Steve Bellone

In accordance with Suffolk County's Reclaim Our Water initiative and the Long Island Nitrogen Action Plan (LINAP), Suffolk County is pursuing proactive measures to reduce nitrogen pollution to the County's surface waters and groundwater. In Suffolk County, approximately 74 percent of homes are unsewered and discharge sanitary wastewater containing elevated nitrogen levels to the underlying groundwater that provides the sole source of potable supply for County residents and groundwater baseflow to the County's surface water features. Nitrogen conveyed to discharge in coastal receiving waters via groundwater baseflow has been linked to a number of undesirable conditions in Suffolk County's surface waters including decreased water clarity due to excessive algal growth, hypoxic episodes, as a contributing factor to the presence of harmful algal blooms ("HABs"), and the loss of eelgrass along shorelines. HABs have also been identified as a primary contributor to the destruction of the once great shellfishing industry including a devastating reduction in the annual harvest of hard clams and scallops. The impacts to the coastal communities of Suffolk County from SuperStorm Sandy in 2012 underscored the connection between excess nitrogen and associated loss of submerged aquatic and coastal vegetation that provides a critical role in reducing wave energy from coastal storms.

Nitrogen concentrations linked to negative consequences in surface waters are significantly lower than the 10 milligrams per liter (mg/L) drinking water Maximum Contaminant Level (MCL) that is protective of human health. Nitrogen contamination associated with discharge of sanitary wastewater and other sources has been evaluated and documented in dozens of historical studies in Suffolk County including the ***Long Island Comprehensive Waste Treatment Management Plan*** (208 Plan, 1978), the ***1987 Suffolk County Comprehensive Water Resources Management Plan*** and the ***2015 Suffolk County Comprehensive Water Resources Management Plan*** *(Comp Water Plan, 2015)*. Several additional studies have been completed by non-governmental organizations including The Nature Conservancy and estuary program initiatives. The underlying conclusion of all recent studies is the same: the majority of nitrogen reaching Suffolk County's surface water bodies emanates from onsite sanitary systems that are not designed to remove nitrogen. While many of the studies evaluate the sources and impact of nitrogen pollution to the major estuaries of the County; an integrated, holistic, evaluation that delineates all of the County's subwatersheds and provides a common platform of assumptions and boundary conditions had not been completed.

The Suffolk County Subwatersheds Wastewater Plan ("SC SWP") was identified as the platform to fulfill this need and provide a recommended Countywide wastewater management road map targeting the reduction of nitrogen loading from wastewater sources. Implementation of the recommendations of the SWP will support the arrest and reversal of the nutrient-related ecosystem degradation observed in Suffolk County which is primarily attributable to nitrogen over-enrichment, with wastewater as the dominant nitrogen source. A reduction in nitrogen loading will establish the conditions necessary to support restored ecosystems, increased biodiversity and provide numerous economic benefits and protection of human health. A subset of the potential environmental and socioeconomic benefits anticipated to result from restoration and protection of our surface water resources includes:

- Reduction of harmful algal blooms;
- Clearer waters and fewer beach closures;
- Enhanced shellfish and finfish stocks;
- Stronger recreation, tourism, and commercial fishing economies;
- Increased property values;
- Increased dissolved oxygen concentrations and reduction in the intensity and frequency of hypoxic episodes resulting in healthier ecosystems and increased biodiversity; and,
- Protection from storm surge by improved health of submerged aquatic and wetland vegetation that anchor the shoreline and also utilize nitrogen providing further nitrogen load mitigation.

In addition to the above, implementation of a Countywide wastewater management program will result in a significant reduction in the concentration of nitrogen to our sole source aquifer and will result in a decrease in the concentrations of contaminants of emerging concern (CECs). As shown on **Figure 1-1**, the model-predicted nitrogen concentration in the shallow upper glacial aquifer under current land use and wastewater management practices exceeds the New York State MCL of 10 mg/L in select developed geographic regions in Suffolk County and exceeds the Suffolk County Sanitary Code Article 6 density goals of 4 mg/L (Groundwater Management Zones III, V, and VI) and 6 mg/L (Groundwater Management Zones I, II, IV, VII, and VIII) in a large portion of the developed areas of Suffolk County. The model results underscore that existing areas with advanced wastewater treatment and land preservation have significant benefit to the concentration of nitrogen in the underlying groundwater (e.g., low predicted concentrations in the central Pine Barrens region and in the Southwest Sewer District) but that in areas with smaller developed parcels that existed prior to enactment of the Article 6 density requirements, the predicted nitrogen concentrations can far exceed the groundwater concentration targets set forth in the Article 6 Groundwater Management Zones.

By comparison and as shown on **Figure 1-2**, the model-predicted nitrogen concentrations after implementation of a Countywide wastewater upgrade program are significantly reduced in the upper glacial aquifer. Not only does the model simulated concentration fall below the MCL in the

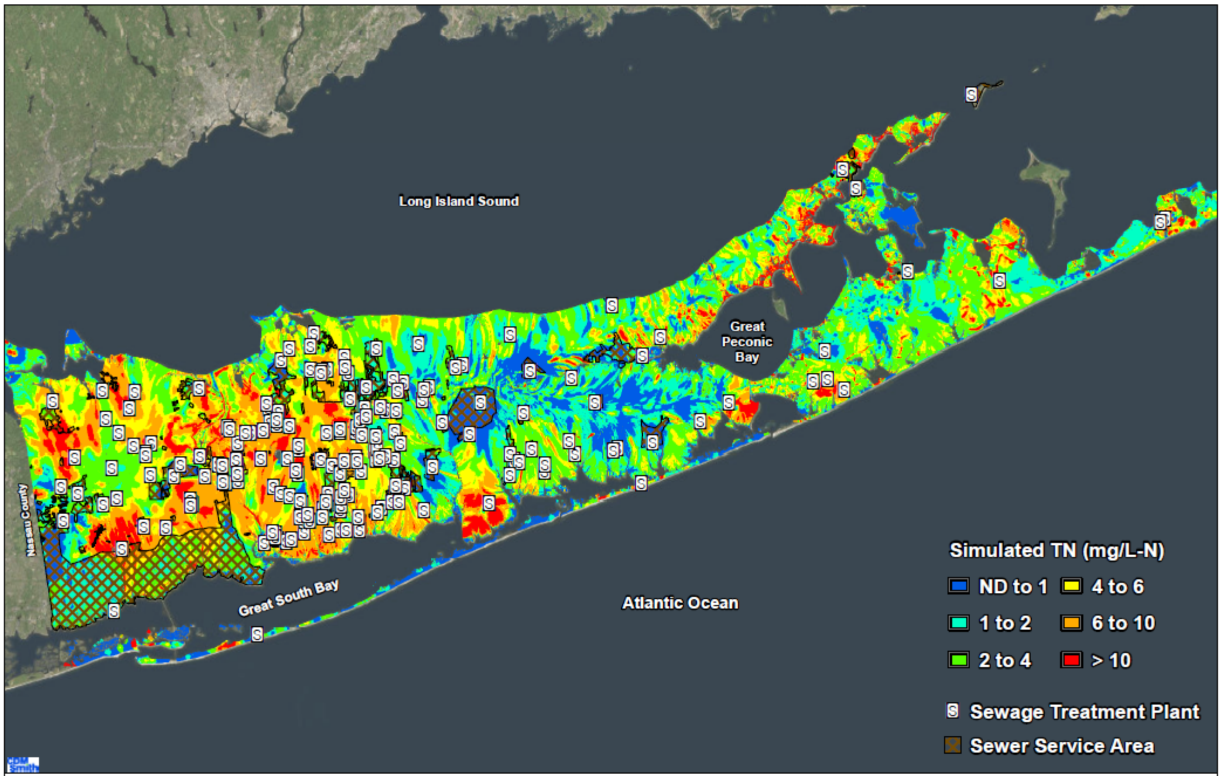


Figure 1-1 Model-Simulated Nitrogen Concentration in the Shallow Upper Glacial Aquifer after 50 Years of Existing Land Use and Wastewater Management

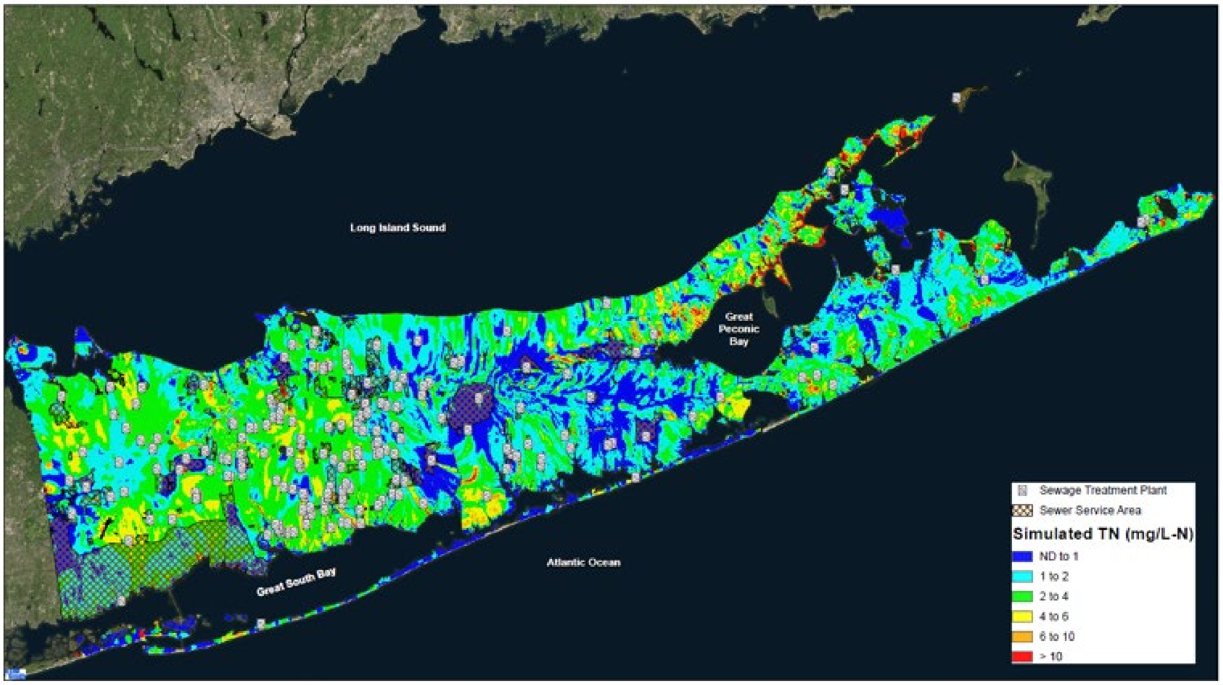


Figure 1-2 Model-Simulated Nitrogen Concentration in the Shallow Upper Glacial Aquifer after SWP Implementation

majority of Suffolk County, the estimated concentration falls below 4 mg/L in almost all areas across the County underscoring the significant benefit to groundwater that could be realized through program implementation. In addition to providing recommendations for wastewater management, the SC SWP provides the foundation for the advancement of nitrogen reduction strategies from non-wastewater sources through companion projects such as the Long Island Nitrogen Action Plan (LINAP), individual estuary programs, and Town/Village led initiatives. To that end, the SWP includes one aspect of a Countywide program to reduce nitrogen from all sources in Suffolk County. Suffolk County remains dedicated to tracking implementation of the program and to working with local jurisdictions and other programs (e.g., estuary programs, the LINAP, Long Island Commission on Aquifer Protection or LICAP, etc.) to ensure that a Countywide implementation strategy that addresses all nitrogen sources is advanced.

Finally, Suffolk County understands the existing financial burdens faced by the residents of Suffolk County. As such, the recommendations provided in the SWP will not be advanced unless a stable, recurring revenue source is established that makes the cost of wastewater upgrades affordable to the residents of Suffolk County.

1.1 Background and Purpose

Suffolk County New York is approximately 912 square miles and is bounded by Nassau County to the west, the Atlantic Ocean to the east and south, and the Long Island Sound to the north. In 2013, the estimated population of Suffolk County was approximately 1.5 million (with 568,943 housing units), larger than the population of 11 states. The groundwater and surface water resources in the County are extremely valuable to residents, businesses, and visitors. The US EPA designated sole source aquifer provides a source of fresh water to meet our potable drinking water, irrigation, and grey water needs. Surface water resources provide recreational opportunities such as swimming and boating, a flourishing tourist industry, a once great fishing and shell fishing industry, and coastal protection from storm surges. While all sources of water pollution are concerning, nitrogen pollution from septic systems has clearly emerged as the most widespread and least well addressed of the region's growing list of water pollutants. In Suffolk County, the predominant source of nitrogen pollution is from wastewater from on-site cesspools and septic systems ([Vaudrey, 2016], [Lloyd, 2016], and [Kinney and Valiela, [2011]). While the source of nitrogen to individual water bodies varies, it is estimated that 63.6 percent of the nitrogen reaching groundwater in Suffolk County subwatersheds originates from onsite wastewater systems (**Figure 1-3**).

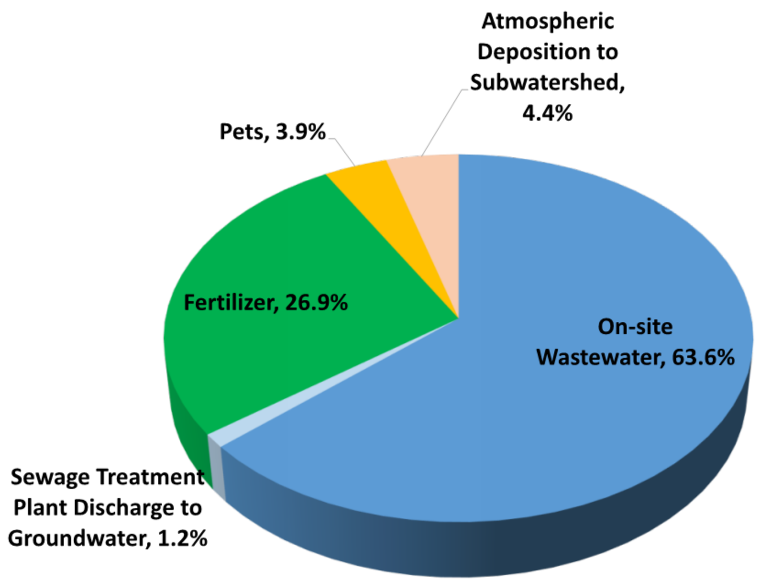
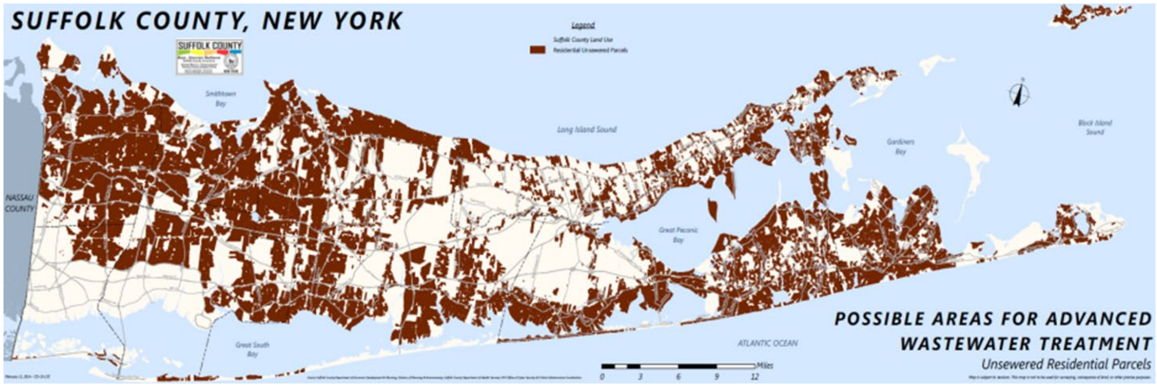


Figure 1-3 Nitrogen Load Components from Groundwater to Suffolk County Subwatersheds

The source of nitrogen from onsite wastewater systems originates from the estimated 360,000 residential on-site wastewater disposal systems ("OSDS") and the estimated 11,798 commercial OSDS that are not designed to remove nitrogen. The existing sewer districts throughout Suffolk County have been very effective in reducing groundwater contamination within their respective district boundaries; however, it is not economically feasible or practical to connect all existing parcels with OSDS to existing or new sewer districts. Ultimately, while sewering provides significant environmental benefit, the use of Innovative and Alternative On-site Wastewater Treatment Systems ("I/A OWTS") represents the most feasible wastewater management option in most locations of Suffolk County. Similar to conventional wastewater treatment plants, I/A OWTS rely on biological processes to treat wastewater and remove nitrogen. Finally, an ancillary benefit of treating and disposing of wastewater through onsite systems is the local recharge of water back into Suffolk County's groundwater system so that the integrity and volume of Suffolk County's sole source aquifer is maintained.

1.1.1 Comp Water Plan Recommendations and Reclaim Our Water

In response to mounting water quality concerns and the findings of the 2015 Suffolk County Comprehensive Water Resources Management Plan ("Comp Water Plan"), County Executive Steve Bellone tagged nitrogen pollution as environmental "public water enemy number one" and announced Suffolk County's Reclaim Our Water initiative, a multifaceted program established to arrest the mounting nitrogen crisis. The Comp Water Plan included a comprehensive documentation of the significant adverse impacts associated with nitrogen pollution on dissolved oxygen, HABs, eelgrass and other submerged aquatic vegetation, wetlands, shellfish, and, ultimately, coastal resiliency. In addition, the Comp Water Plan established the first integrated framework including a detailed list of program objectives and recommendations to address the legacy problem of onsite wastewater disposal systems in a meaningful manner.



A fundamental basis of all wastewater management recommendations set forth in the Comp Water Plan was the recommendation for development and implementation of a Countywide wastewater management plan to limit the impacts of nitrogen from wastewater and other emerging wastewater constituents (personal care products, pharmaceuticals, etc.). Specific goals quoted in the Comp Water Plan included:

> "Nitrogen loading should be reduced for the protection of current and future drinking water supplies and to restore/maintain ecological functions in streams, lakes, estuaries and marine waters. Arrest and reverse the trend of increasing nitrogen concentrations in ground and surface waters to the greatest extent feasible and practical by decreasing the nitrogen loading from septic systems and fertilizers." (p. 3-137); and,

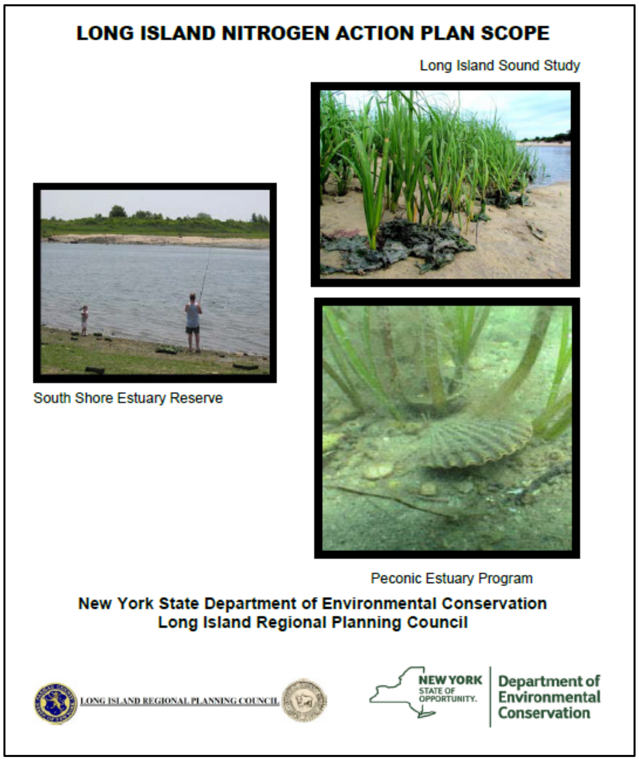
> "Groundwater nitrogen inputs to the County's surface waters should be reduced, consistent with the goals of the Long Island Sound Study (LISS), Peconic Estuary Program (PEP) and the South Shore Estuary Reserve (SSER) programs – that is to protect, preserve, and restore the estuaries for long term sustainability of the resource and to support coastal resiliency." (p. 5-40)

In addition, the Comp Water Plan includes the following four general recommendations:

- Establishment of nitrogen loads for watersheds,
- Improvement of onsite sewage disposal technologies,
- Expansion and/or creation of new Suffolk County operated sewer districts, and
- Creation of privately-run decentralized sewer districts.

The majority of these recommendations have been addressed through new programs and wastewater regulations that have been implemented subsequent to the Comp Water Plan, are included in the recommendations of this SWP, or are provided as a roadmap to completion in this SWP.

Addressing nitrogen pollution and shifting the paradigm of wastewater management have gained historic momentum at the State, County, and local levels. In 2015, New York State appropriated $5 million to develop the Long Island Nitrogen Action Plan ("LINAP"). Long Island's legislative delegation, with support from local environmental organizations, successfully championed funding for LINAP, which will be one of the most significant environmental initiatives since the preservation of the Pine Barrens. LINAP is a multi-year initiative to reduce nitrogen in Long Island's surface and ground waters by New York State Department of Environmental Conservation ("NYSDEC"), the Long Island Regional Planning Council (LIRPC), and Suffolk and Nassau counties, with input from multiple partners and stakeholders. The primary goals of LINAP are to:

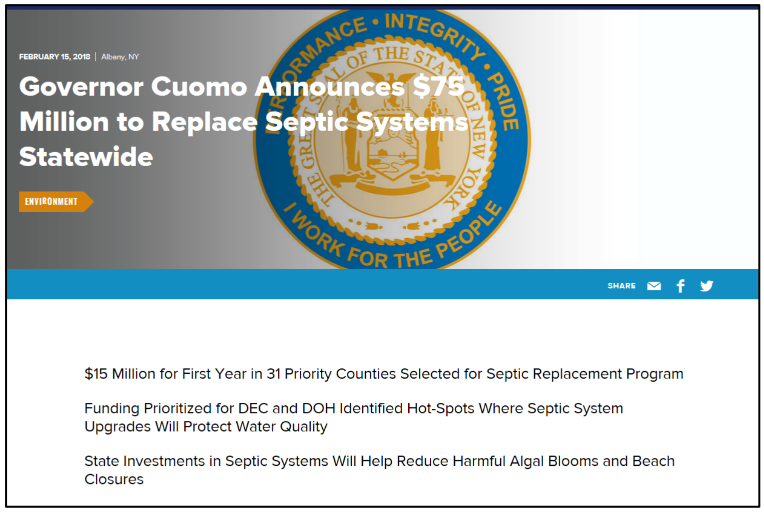


- Identify sources of nitrogen to surface waters and groundwater,
- Establish nitrogen reduction endpoints, and
- Develop an implementation plan to achieve reductions.

The LINAP identified the preparation of Subwatershed Wastewater Plans ("SWPs") for Nassau and Suffolk County as critical stepping stones for the overall success of the LINAP. The SWPs will identify the sources of nitrogen on Long Island, characterize the water quality and ecological sensitivity to nitrogen of all water bodies, and provide a recommended strategy to address nitrogen from wastewater sources. Furthermore, the SWPs will establish initial load reduction goals, and, of critical importance, identify water resources where wastewater management alone may not result in sufficient nitrogen removal to protect the environment and human health. The identification of these water bodies will pave the way for future evaluations of alternate means for nitrogen mitigation such as permeable reactive barriers, in-water aquaculture/bioharvesting, hydromodification, and fertilizer management to address legacy pollution.

In 2017, New York State extended its commitment to restoring and preserving water quality through adoption of the $2.5 Billion Clean Water Infrastructure Act. Shortly after announcing the Clean Water Infrastructure Act, Governor Cuomo announced that $75 Million of funding would be dedicated to the New York State Septic Replacement Program. The State Septic Replacement Program includes a five-year investment of $15 Million per annum to fund prioritized hot spots where septic system upgrades are needed to protect water quality. In recognition of the dire need to reduce nitrogen from onsite wastewater systems in Suffolk County and acknowledgement of

Suffolk County as a leader in the movement to replace antiquated septic systems, the State awarded Suffolk County over $10 Million of the available $15 Million during the first round of grants awards.



Finally, individual Towns and Villages have begun taking proactive measures to phase out conventional septic systems and require I/A OWTS. Town/Village I/A OWTS mandates have already been established in eight jurisdictions within Suffolk County. In addition, East End Towns that receive Community Preservation Funds have voted and approved the use of up to 20 percent of these funds towards water quality improvement projects. A portion of this funding has already been dedicated towards Town-led septic replacement grants to promote the use of I/A OWTS and foster environmental stewardship. Additional details regarding individual Town/Village programs are provided within subsequent sections of this SWP.

1.1.2 Summary

This SWP has been prepared in fulfillment of the recommendations of the Comp Water Plan, in response to the needs of the LINAP, and as an overall support tool that can be used by individual Town/Village and estuary program water quality initiatives. The SWP provides a roadmap of wastewater management recommendations through suggested wastewater upgrades to every parcel in Suffolk County. Wastewater management options and recommendations explored include connection of parcels to community sewers by expanding existing sewer districts or creating new sewer districts where possible, upgrading cesspools or conventional onsite sewage disposal systems to I/A OWTS, and requiring nitrogen reducing technology on all new construction countywide. The SWP also includes expanded recommendations to overcome the ever-changing nature of wastewater management concerns to provide a sustainable platform of adaptive implementation. Additional recommendations include, but are not limited to, recommendations for developing/researching new technologies to better reduce nitrogen and emerging contaminants of concern, initial evaluation of funding options for the establishment of a stable and recurrent revenue source, recommendations for providing a central administrative structure to oversee implementation of the plan, as well as initial recommendations on how to manage the inevitable impacts of global warming and sea level rise.

A detailed summary of nitrogen's detrimental impacts to Suffolk County's water quality and ecosystems is provided below followed by a summary of demonstration case studies which document unequivocal evidence of the environmental benefits that can be achieved through successful nitrogen mitigation programs. In short, if Suffolk County acts purposefully and with clear direction to reverse the nitrogen pollution crisis, WE CAN Reclaim Our Water.

1.1.3 Nitrogen's Impact on Suffolk County Water Resources

Suffolk County's fresh and marine surface water resources are diverse and abundant; coastal waters form the County's boundaries to the north, east and south. In fact, the County's surface water features largely define the County's identity as a desirable location to live, work and play. In addition, Suffolk County's groundwater has been designated as a sole source aquifer by USEPA, which denotes and acknowledges that Suffolk County's sole source of drinking water is derived from its groundwater system. The Long Island Sound, Peconic Estuary and south shore bays have been the subjects of focused studies for years and their water quality has been documented extensively by the Suffolk County Department of Health Services ("SCDHS"), US Geological Survey ("USGS"), NYSDEC, Stony Brook University School of Atmospheric and Marine Sciences ("SoMAS"), Long Island Sound Study ("LISS"), Peconic Estuary Program ("PEP"), South Shore Estuary Reserve ("SSER") and several others. Surface water quality is the compilation of the physical and chemical parameters that make up the water and an imbalance or inappropriate level of certain parameters can result in ecosystem disrupting effects, such as the problems further discussed within this section.

As documented in the Comp Water Plan, Suffolk County's 1.5 million residents live directly on top of the County's sole source aquifer. Since almost all groundwater in Suffolk County eventually reaches various supply wells (e.g., drinking water, irrigation wells, etc.) or our surface water bodies, it is not surprising that the impacts of human activities above ground are observed in the groundwater below and in our coastal ecosystems. Suffolk County witnessed a population explosion between the 1950s and 1960s (see **Figure 1-4**) as the population increased from 276,129 in 1950 to 1,127,030 by 1970, according to U.S. census data. This was an increase of approximately 308 percent over a 20-year period. Between 2000 and 2017 the population of Suffolk County grew modestly with a population growth of 4.3 percent.

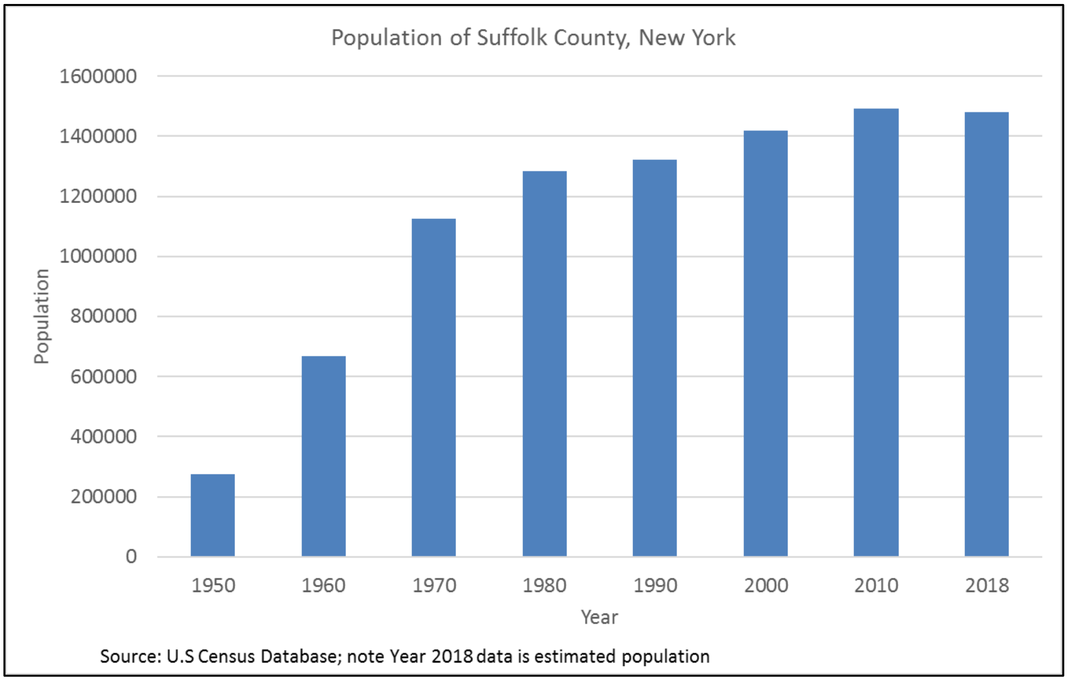


Figure 1-4 Population Growth in Suffolk County

As the population has grown in Suffolk County, so has the concentration of nitrogen within our groundwater system, along with an explosion in the number of documented surface water impairments. **Figure 1-1** which showed the predicted nitrogen concentration in the upper glacial aquifer based upon 2016 land use and current wastewater management practices depicts the significant portion of Suffolk County with predicted shallow groundwater concentrations above New York State's drinking water quality standard of 10 mg/L.

As described in the following subsections, Suffolk County surface waters are currently experiencing unprecedented numbers of HABs, frequent fish kills, and uncontrolled algal growth that is impacting our economy, recreational use of water bodies, and our natural buffering systems against storm surges. While nitrogen enrichment is not the sole factor in water quality degradation and other factors such as global warming, ocean acidification, and disease can also play a role in water quality degradation, it is the single greatest factor that the residents of Suffolk County can manage. Sobering statistics of nutrient related impacts to Suffolk County waters include:

- 51.4 percent increase in nitrogen concentrations in untreated water samples collected from the same set of 137 wells screened in the upper glacial aquifer from 2.51 mg/L in 1987 to 3.80 mg/L in 2017 (well below the drinking water maximum contaminant level of 10 mg/L);
- 94 percent increase in nitrogen in untreated water samples collected from the same set of 180 wells screened in the Magothy aquifer from 0.92 mg/L 1987 to 1.785 mg/L in 2017 (well below the drinking water maximum contaminant level of 10 mg/L) as nitrogen introduced to the upper glacial aquifer travelled vertically down to the underlying Magothy;
- 10 percent increase in nitrogen concentrations in Suffolk County marine waters in the past 10 years, and more specifically:
  - 45.7 percent increase in nitrogen concentrations in Long Island Sound harbors;
  - 53.8 percent increase in nitrogen concentrations in Peconic Estuary enclosed bays;
  - 60.4 percent increase in nitrogen concentrations in the far eastern south shore bays, and
  - 30 percent increase in nitrogen concentrations in eastern Great South Bay;
- Increased nitrogen levels have been one of the factors contributing to the following:
  - HAB events have been documented in each of the three major estuaries every year for the past 10 years. There have been more than 180 documented individual HAB events in marine waters, and more than 50 HAB events in freshwaters within the last 10 years alone;
  - Over half of the 124 sampled marine water bodies within Suffolk County had dissolved oxygen hypoxic events over the past 10 years;
  - 13.1 percent of native vegetated tidal wetlands have been lost in Suffolk County since 1974;

- More than 85 percent of eelgrass beds have been lost in the Peconic Estuary since 1930: these observations are corroborated by the predicted unit nitrogen loads exceeding acceptable published values by one to two orders of magnitude within many water bodies in Suffolk County;

- Hard clam harvests in the Great South Bay have fallen by greater than 93 percent over the past 25 years (increased nitrogen concentration being one of the factors, overfishing being one of the primary causes of the hard clam harvest reduction, and HABs are preventing their recovery); and

- Up to 12,233 acres of waterways have been closed (seasonal or permanent) to shell fishing in recent years due to PSP biotoxins associated with HABs.

- Dozens of beaches are closed after rain events due to the presence of pathogen indicators, primarily from stormwater runoff.

A summary of nitrogen trends and impacts to Suffolk County water quality is provided in the following sections.

1.1.3.1 Nitrogen Trends in Surface Waters

As previously discussed, high nitrogen levels can negatively impact marine and fresh water ecological resources by causing algal blooms that can result in a variety of ecological impairments. While nitrogen trends in surface waters vary geographically throughout the County due to a variety of factors (e.g., the creation of new natural inlets such as the Hurricane Sandy breach near Bellport, sewering of areas such as the Southwest Sewer District, elimination of duck farms and related remediation), the following general observations are made, particularly for locations that are most vulnerable to nitrogen loading from groundwater (e.g., enclosed harbors and lagoons). These observations are consistent with the observed increasing nitrogen trend in the shallow upper glacial aquifer which feeds our surface water bodies and include:

- Nitrogen concentrations in Suffolk County marine monitoring stations located within the enclosed harbors of Long Island Sound have increased 45.7 percent over the past 10 years;

- Nitrogen concentrations in Suffolk County marine monitoring stations located in Peconic Estuary enclosed bays and harbors have increased 53.8 percent over the past 10 years;

- Nitrogen concentrations in Suffolk County marine monitoring stations located within the far eastern south shore bays and contributing water bodies (Quantuck Canal to Shinnecock Bay) have increased 60.4 percent over the past 10 years;

- Nitrogen concentrations in Suffolk County marine monitoring stations located from Narrow Bay to Moriches Bay East in the SSER have increased 20.8 percent over the past 10 years.

- Nitrogen concentrations in Suffolk County marine monitoring stations located within the Great South Bay have increased as follows:

  - Great South Bay East (Connetquot River to boundary of Narrow Bay) have increased 30 percent over the past 10 years. This includes four years with the new breach in the Fire

Island National Seashore property that provides increased flushing of the Bay with water from the Atlantic Ocean.

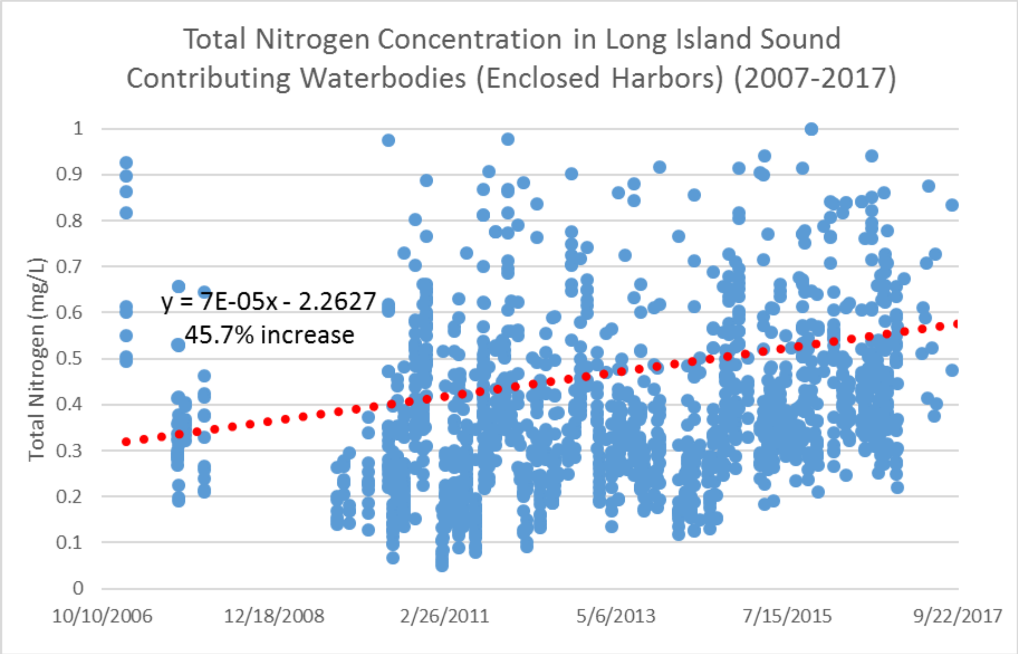
- Great South Bay Middle (Great Cove area, representing partially sewered area) have increased 26.7 percent over the past 10 years.
- Great South Bay West (open water samples representing sewered area) have increased 23.7 percent over the past 10 years.

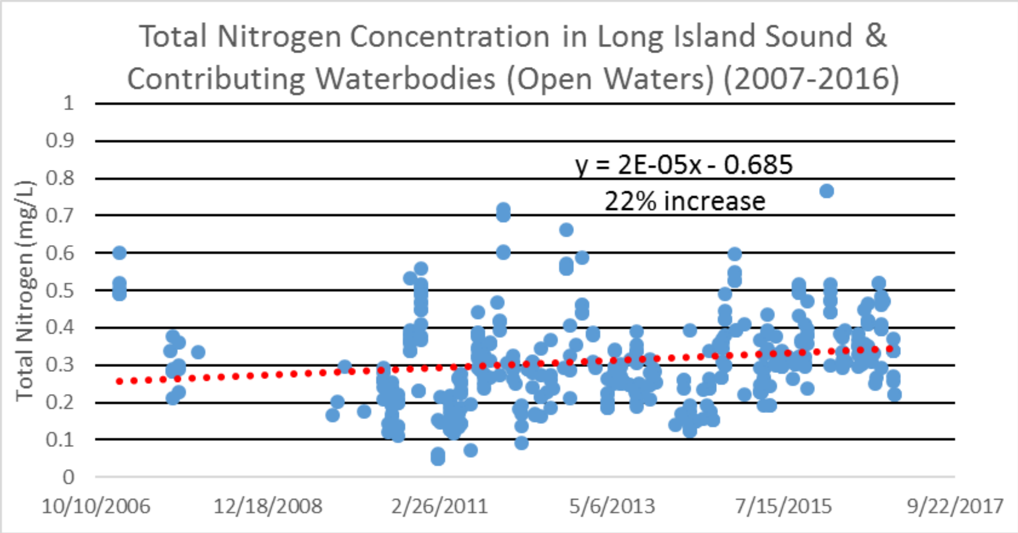
Concentration trend plots for each of the observations described above are provided in **Figures 1-5a** through **1-5h** respectively.

Combined, analysis of the data show increasing trends in nitrogen concentrations across the County. In addition, the greatest increases appear to be in locations with short groundwater travel times where the highest population growth has been observed over the past 10 years (e.g., East End Towns). Other notable observations included a reduction in the rate of increased nitrogen or a local decreasing nitrogen trend in sample stations in the vicinity of the breach in Eastern Great South Bay including reductions in rates within Great South Bay East, Great South Bay Middle, the Narrow Bay region, and the Forge River area. (It is also observed that sample stations located closest to the former duck farm at the northern tributary to the Forge River have also exhibited a significant declining trend since closure and remediation of the duck farm and waste.) Finally, review of data from the Long Island Sound documents higher nitrogen concentrations and rates of increased nitrogen in the enclosed harbors of Long Island Sound when compared to the open waters, suggesting the possible link between nitrogen-rich groundwater flowing into the rivers, streams and harbors from on-site wastewater disposal systems and the associated benefit of point source reductions realized through the LIS Total Maximum Daily Load (TMDL).

1.1.3.2 How Does Nitrogen Impact Surface Water Ecosystems?

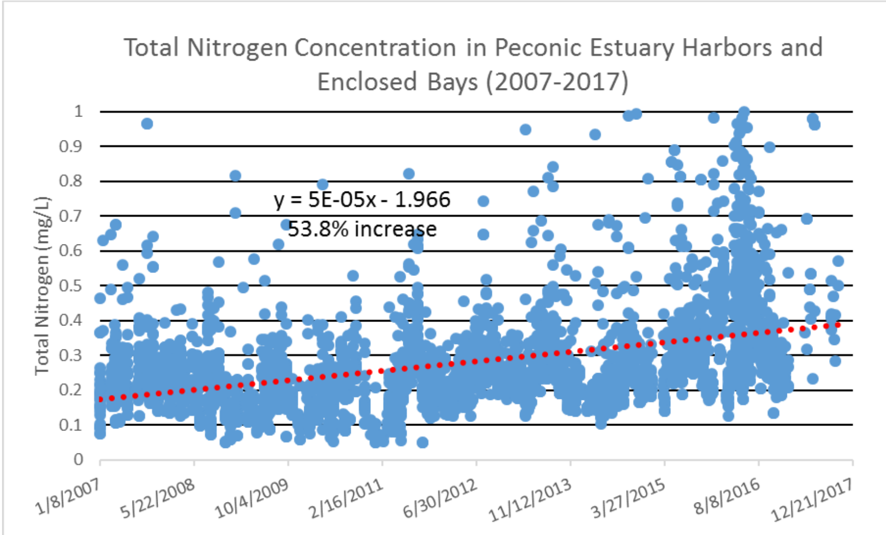
The direct unequivocal link between anthropogenic nitrogen and its devastating impacts on water quality and related ecosystems is well documented globally, nationally, and locally. In 2019, the United Nations Environment Programme identified human addition of excess nitrogen to the environment as one of five emerging issues of global concern, “Altogether, humans are producing a cocktail of reactive nitrogen that threatens health, climate and ecosystems, making nitrogen one of the most important pollution issues facing humanity” (Frontiers 2018/2019 Emerging Issues of Environmental Concern, United Nations Environment Programme, 2019). In the United States, the Environmental Protection Agency reports that about two thirds of the nation’s coastal areas and more than one-third of the nation’s estuaries showed impairment from nutrient pollution https://www.epa.gov/nutrientpollution/where-occurs-coasts-and-bays. EPA’s Fiscal Year 2014 National Water Program Guidance stated that “nitrogen and phosphorus pollution is one of the most serious and pervasive water quality problems in the United States” (USEPA 2013). In New York State, the LINAP was formed in 2015 in recognition of and response to Long Island’s nitrogen pollution crisis and the New York State Governor’s office has invested over $30 million dollars in funding to address nitrogen from aging onsite wastewater systems with an additional $428 million dollars to connect residences and businesses to sewers within critical environmental areas.

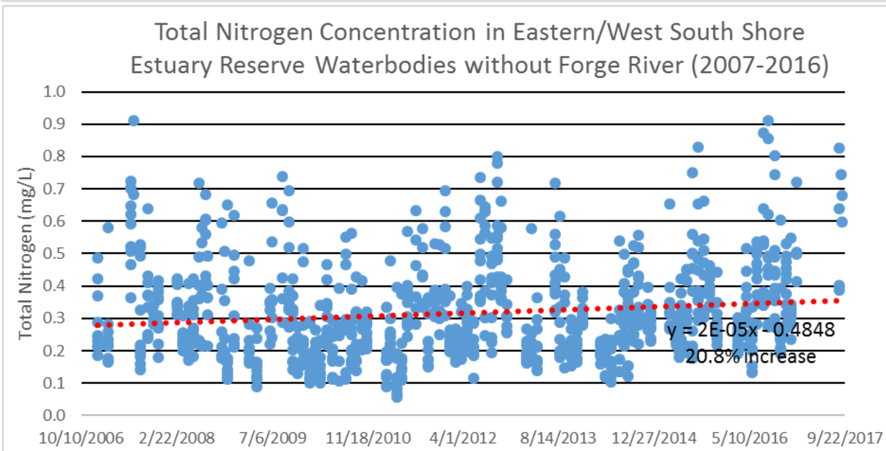


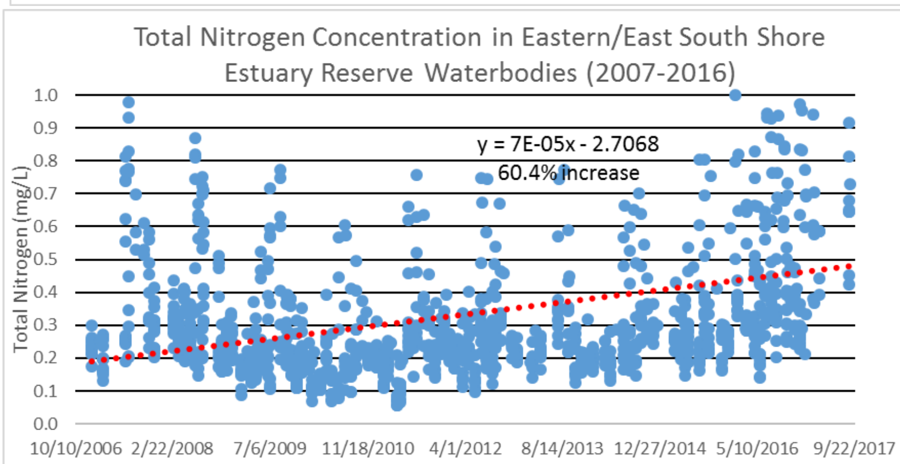


Figures 1-5a and 1-5b Nitrogen Trends in Long Island Sound Harbors and Long Island Sound Open Waters from 2007 through 2016

Note: The dataset is illustrative of the available data during the referenced time period. The data noise is a result of multiple variables including the number of stations sampled, number of samples collected, changes in sampling procedures and analytical techniques, variations in tidal cycle and weather conditions, etc.

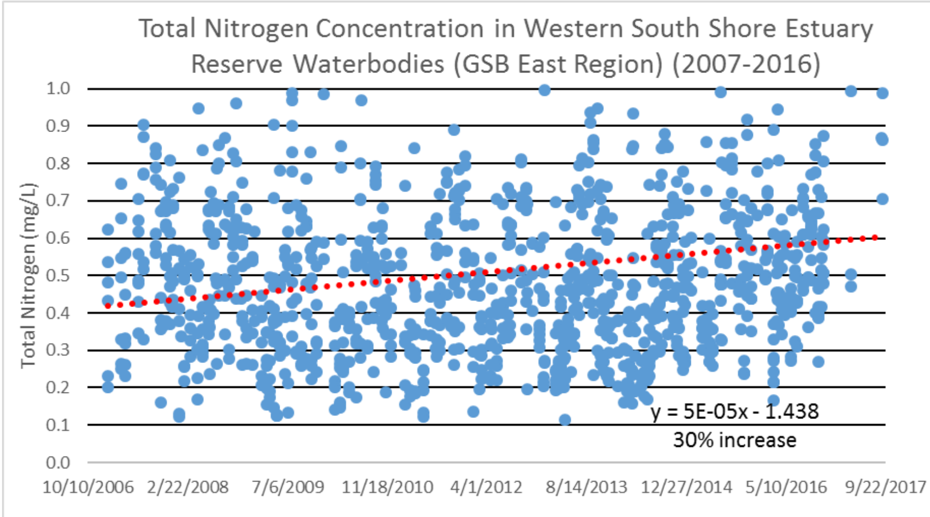


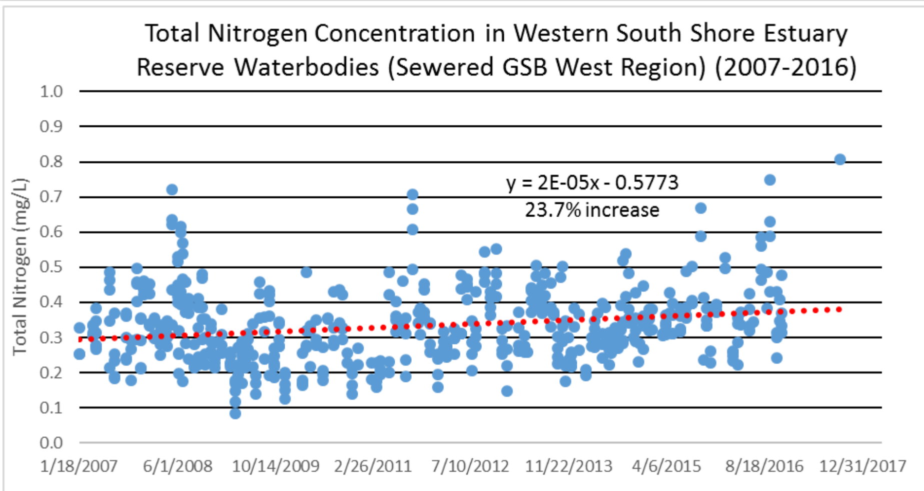


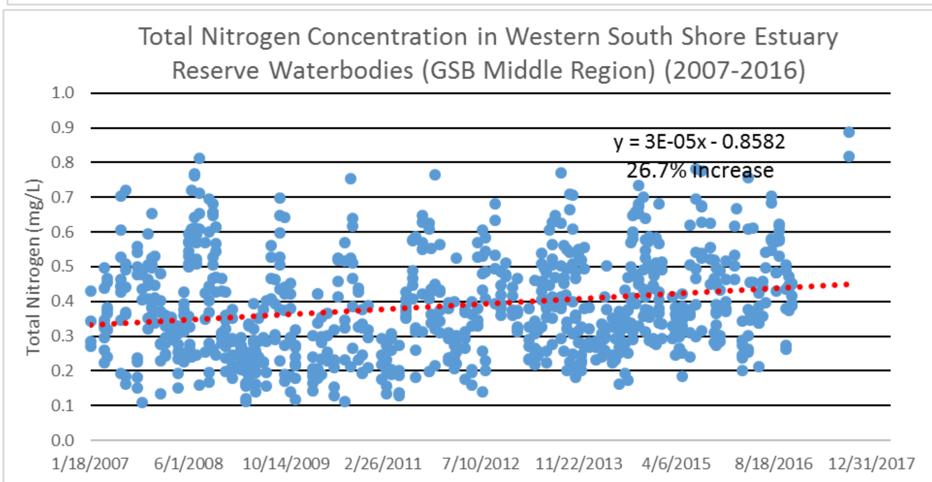


Figures 1-5c, 1-5d and 1-5e Nitrogen Trends in the Peconic Estuary, Eastern South Shore Estuary Reserve and Eastern/West South Shore Estuary Reserve Water Bodies from 2007 through 2016

Note: The dataset is illustrative of the available data during the referenced time period. The data noise is a result of multiple variables including the number of stations sampled, number of samples collected, changes in sampling procedures and analytical techniques, variations in tidal cycle and weather conditions, etc.







Figures 1-5f, 1-5g and 1-5h Nitrogen Trends in Great South Bay East, Great South Bay Middle and Great South Bay West (Sewered) Water Bodies from 2007 through 2016

Note: The dataset is illustrative of the available data during the referenced time period. The data noise is a result of multiple variables including the number of stations sampled, number of samples collected, changes in sampling procedures and analytical techniques, variations in tidal cycle and weather conditions, etc.

Locally, all three major estuary programs in Suffolk County identify addressing nutrient enrichment related eutrophication of its coastal waters as a top priority and identify nitrogen from wastewater sources as a primary cause of nutrient enrichment. Finally, as discussed within this SWP, local Towns and Villages have identified nitrogen from wastewater sources as a top water quality concern and have already adopted regulations requiring the use of I/A OWTS within environmentally sensitive areas. In summary, water quality degradation from nutrient enrichment, and specifically from onsite wastewater systems, is acknowledged as a top priority on Long Island and in Suffolk County at all levels of government and management.

The addition of excessive nutrients like nitrogen into surface water, also known as eutrophication, acts as a fertilizer and spurs the dense growth of algae and aquatic plants. Under natural conditions, the levels of nitrogen that fuel this growth allow for a sustainable source of food and habitat. However, when excessive amounts of nitrogen enter the aquatic environment, the algae utilize that nitrogen to grow to levels that the natural environment cannot sustain.

Excessive algal growth and decay cycles from eutrophication can lead to severe adverse impacts in surface water quality including hypoxia (low dissolved oxygen levels), shading of photosynthetic submerged aquatic vegetation like eelgrass (*Zostera marina*), and the proliferation of HABs. The NYSDEC has established ambient water quality standards for dissolved oxygen for Class SA, SB and SC waters at 4.8 mg/L, with allowable excursions to not less than 3.0 mg/L for certain periods of time. Hypoxic events defined under NYS 6 NY-CRR 703.3 include events when the daily average dissolved oxygen levels fall below 4.8 mg/l. Hypoxic waters can result in dead zones where dissolved oxygen levels are so low that aquatic life cannot survive. The loss of eelgrass habitat can lead to a loss of entire ecosystems that rely on the eelgrass beds for habitat, including scallops and other shellfish and some finfish. HABs have a cascading effect on overall ecosystems and represent a direct health hazard to human and animal life. Persistent HABs result in the ecosystem disruptions discussed previously (e.g., hypoxia, eelgrass loss, etc.); however, certain HAB species create toxins that bioaccumulate in shellfish. When HAB toxins bioaccumulate in shellfish, it can cause serious health problems including rashes, stomach illness, respiratory problems and neurological effects depending on the specific toxin ingested. Because of these threats, up to an estimated twelve thousand acres of shellfish beds are closed to harvesting in Suffolk County each year. In addition, some HABs produce toxins with direct exposure and/or consumption risks. These HABs can result in fish kills and/or animal kills when ingested. For example, in 2012 a small dog died after drinking water from Georgica Pond in East Hampton that had a toxic blue green algae bloom.

Excessive nutrients can also spur the uncontrolled growth of native and invasive macroalgae. Excessive macroalgae can severely affect the recreational use of impacted water bodies and its seasonal die-off can result in eutrophication. Finally, eutrophication also over-fertilizes wetland vegetation and weakens the root system, resulting in marsh that breaks apart from wave action. Marshes are a nursery for young fish and shellfish and are important habitat for marine birds.

1.1.3.3 Summary of Surface Water Ecosystem Impacts in Suffolk County

Suffolk County's coastal water quality and ecosystems have suffered disruption due to a combination of excess nutrients and poorly flushed water bodies. Specifically, the combination of excess nutrients from highly populated unsewered areas discharging to sheltered embayments with long surface water residence times creates a recipe for significant water quality degradation and associated destruction of ecosystems. The result is that almost all of the potential consequences associated with excess nutrients as described in Section 1.1.3 have been realized in Suffolk County waters. A summary of the major impacts observed in our invaluable surface water resources is provided below and illustrated by **Figure 1-6** and documented in **Table 1-1**.

Table 1-1 Average Water Quality Values for Marine Water Bodies by SWP Priority Rank

Subwatershed Priority Rank	Calculated Nitrogen Load (#/volume/yr)	Total Nitrogen in-water Concentration 90th percentile of last 10 years (mg/L)	Dissolved Oxygen 10th percentile for last ten years (mg/L)	HABs - Environmental and Human Health # of blooms in last 10 years	Chl-a 90th percentile for last 10 years (ug/L)	Clarity Average secchi depth for last 10 years (ft)
Priority Rank 1	0.070	1.36	4.60	5	29.1	4.1
Priority Rank 2	0.030	0.80	6.11	3	21.8	5.5
Priority Rank 3	0.013	0.74	5.81	1	9.4	6.1
Priority Rank 4	0.008	0.39	6.52	0	6.1	7.4

As shown in **Table 1-1**, water bodies in Suffolk County with significant water quality degradation (low dissolved oxygen or DO, high chlorophyll-*a* or chl-*a*, poor water quality, frequent HABs) present, on average, with significantly higher nitrogen concentrations and calculated nitrogen loads (as calculated in the SWP, see Section 2.1.5). Subwatersheds shown as priority rank 1 in red are the highest priority for nitrogen load reduction for water quality restoration, the priority rank shown as yellow is the second highest priority for nitrogen load reduction and the priority rank shown as green is the third highest priority for nitrogen load reduction, as determined in Section 2.17 of the SWP. The table clearly shows how water quality in the subwatersheds with the highest priority for nitrogen load reduction (shown as red) and the highest nitrogen loads exhibit the poorest water quality. Conversely, the subwatersheds with the priority rank shown as blue and the lowest nitrogen loads already exhibit water quality in compliance with water quality standards (e.g., dissolved oxygen criteria) and without impairments such as HABs.

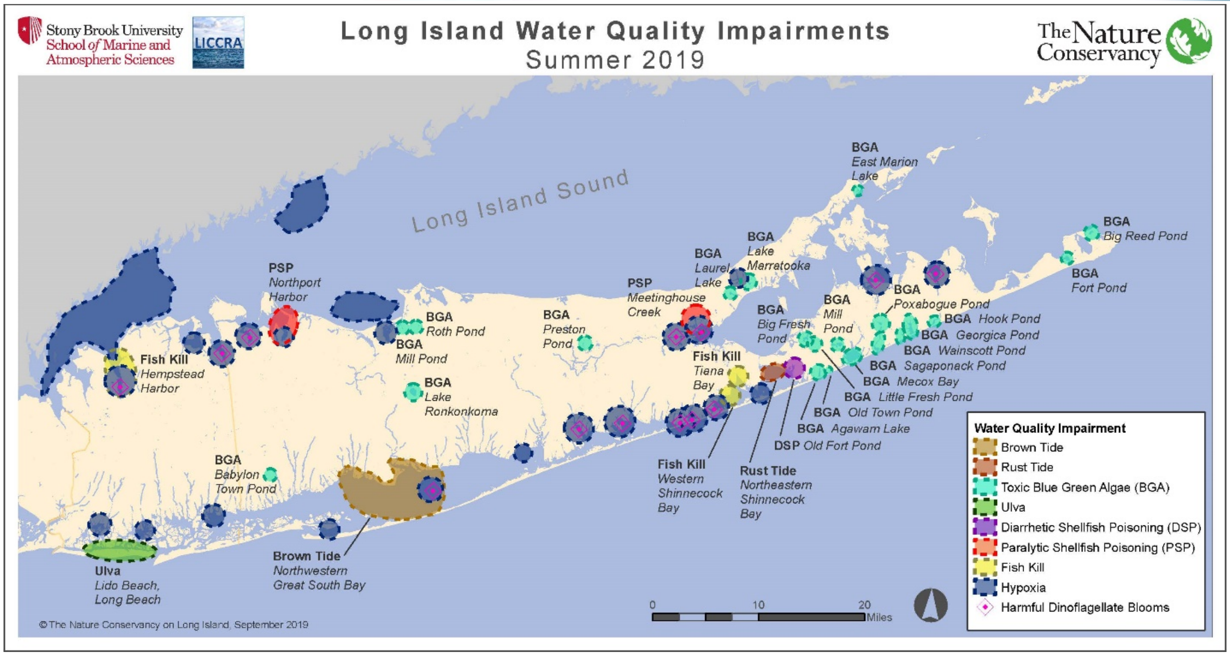


Figure 1-6 Summary of Documented Water Quality Impairments in 2019 Source: SUNY Stony Brook SoMAS

It is noted and acknowledged that a variety of factors impact water quality and marine ecosystems such as salinity, water temperature/global warming, and ocean acidification; and, that nitrogen loading from anthropogenic sources is not the sole causal role of the observed water quality degradation. However, Suffolk County data clearly show a direct gradation of increased nitrogen load and in-water nitrogen concentration with decreased water quality. Further, management of nitrogen from wastewater represents the single greatest factor the residents of Suffolk County can control to reduce nutrient enrichment related water quality degradation of our waters. Additional discussion of local water quality and ecosystem impacts is provided below.

1.1.3.3.1 Submerged Aquatic Vegetation and Wetlands

Loss of submerged aquatic vegetation like eelgrass (*Zostera marina*) resulting from an increase in algae populations and associated decrease in light availability is documented extensively in the literature ([Bintz and Nixon, 2001], [Hauxwell, Cebrian and Valiela, 2003], [Hauxwell, Cebrian and Valiela, 2006], [Dennison et. al, 1987], [Wear, 1999], [Lefcheck et. al., 2017], [Vaudrey, et. al., 2010], [Benson, Schlezinger and Howes, 2013], [Ochieng, Short and Walker, 2010]). The decrease in water clarity restricts light from reaching deeper into the water column, which results in the weakening and eventual die-off of photosynthesizing plants like eelgrass. In "**Establishing Restoration Objectives for Eelgrass in Long Island Sound**," Vaudrey states "the most important factor governing both the distribution and growth of *Z. marina* is the availability of light" (2008). According to a 1979 survey (Jones and Schubel 1980) and a 2002 National Oceanic and Atmospheric Administration Coastal Services Center regional aerial survey of the Great South Bay (NOAA 2002), south shore waters within the Town of Brookhaven lost approximately 5,000 acres of eelgrass beds. In the Peconic Estuary, the estimated seagrass coverage in the 1930s was approximately 8,720 acres (Cornell Cooperative Extension), but an analysis of 2000 aerials by the Peconic Estuary Program estimated 1,552 acres, an 80 percent decrease from the 1930s (New York State Seagrass Task Force, 2009). According to the 2015 **Peconic Estuary Program Ecosystem**

Status Report, a 2014 aerial survey of the Peconic Estuary found less than 1,000 acres of eelgrass beds, an additional 35 percent decrease since 2000 (PEP, 2015) as shown on **Figure 1-7**. United States Fish and Wildlife Service ("USFWS") surveys in the Long Island Sound found less than 1 percent of historic acreage of eelgrass in the Long Island Sound remained due to seagrass wasting disease and eutrophication, and 98 percent of New York's Long Island Sound seagrass is found around Fishers Island [(New York State Seagrass Task Force, 2009), (Tiner, R., H. Bergquist, T. Halavik, and A. MacLachlan, 2003, **Eelgrass Survey for Eastern Long Island Sound, Connecticut and New York**; U.S. Fish and Wildlife Service, National Wetlands Inventory Program, Northeast Region, Hadley, MA. National Wetlands Inventory report. 14 pp.)]. Overall, estimates from historic records suggest approximately 200,000 acres of eelgrass existed in New York waters during the 1930s, while as of 2009, only 21,803 acres currently remained, representing a 90 percent loss of submerged aquatic vegetation [(New York State Seagrass Task Force, 2009), (Simpson, L. and Dahl., S., 2007 **Eelgrass and Water Quality: A Prospective Indicator for Long Island Nitrogen Pollution Management Planning**)].

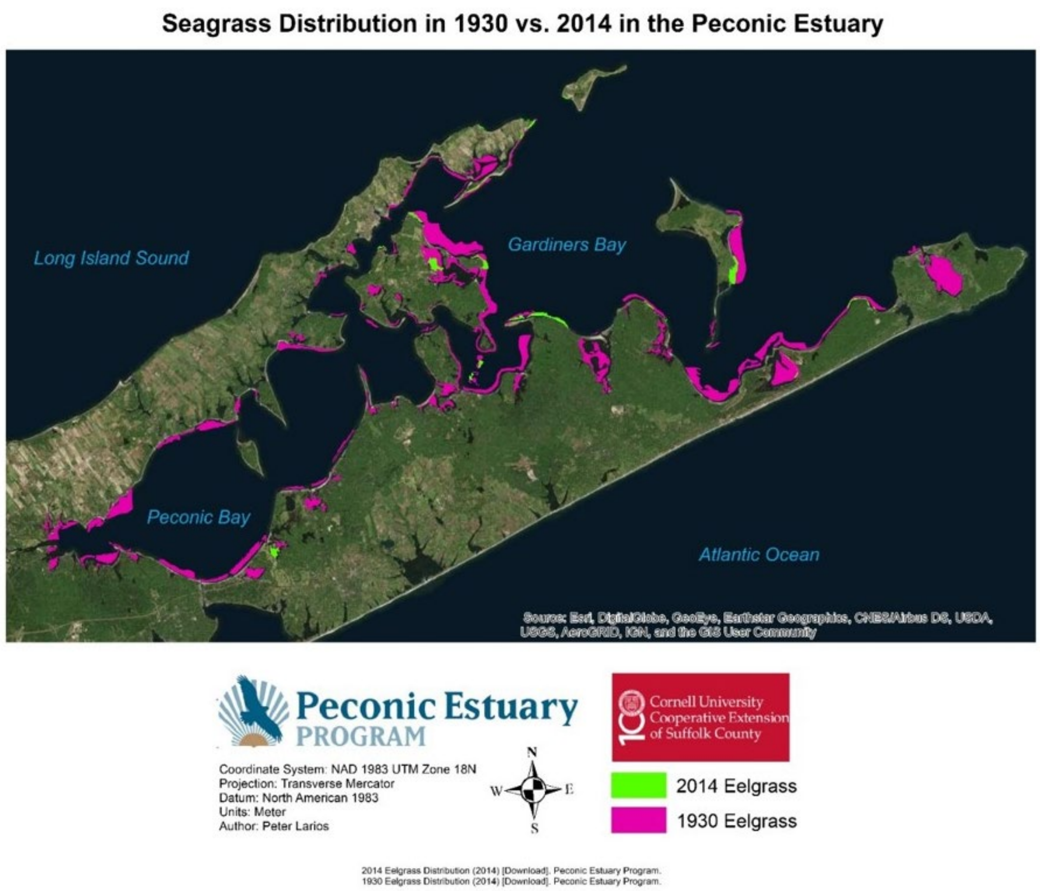


Figure 1-7 Seagrass Distribution in 1930 vs. 2014 in the Peconic Estuary Courtesy of Peter Larios, Peconic Estuary Program and Cornell Cooperative Extension of Suffolk County

Eelgrass beds are vitally important habitat for finfish and shellfish populations in Suffolk County and also play an important part in buffering shorelines from storm energy and other ecosystem services. Regionally, studies in New England have linked a reduced extent of eelgrass with increased loading of nitrogen to estuaries. Specifically, and as documented in **Empirical**

relationship between eelgrass extent and predicted watershed-derived nitrogen loading for shallow New England estuaries by Latimer and Rego, nitrogen input rates greater than 50 kg per hectare of receiving embayment per year are likely to have a significant deleterious effect on eelgrass habitat (Latimer, J.S. and S.A. Rego, 2010). Further, **The ecological effects of urbanization of coastal watersheds: Historical increases in nitrogen loads and eutrophication of Waquoit Bay estuaries** by Bowen and Valiela found that eelgrass meadows were virtually eliminated when Cape Cod nitrogen loads increased to 30 kg per hectare per year due to eutrophication from urban sprawl (Bowen, J. L., and I. Valiela, 2001).

A comparison of the nitrogen loading rates predicted within this Subwatersheds Wastewater Plan (SWP) to the 30 kg per hectare threshold published in regional studies (Bowen, J. L., and I. Valiela, 2001) indicate that many of the water bodies in Suffolk County significantly exceed the thresholds. While unit nitrogen loads to individual water bodies vary, predicted unit nitrogen loads for some water bodies exceed the published thresholds by one to two orders of magnitude. The comparison corroborates the observation of significant eelgrass loss in Suffolk County and provides another line of evidence underscoring the need for nutrient load reductions. A subset of predicted unit loads for water bodies within each of the major estuary programs is provided in **Table 1-2**.

Table 1-2 Nitrogen Inputs in Kg per Hectare in Suffolk County for Comparison to Published Studies

Subwatershed	Estuary	Unit Load (kg/ha)
Centerport Harbor	LISS	328
Conscience Bay and Tidal Tribs	LISS	117
Mt Sinai Harbor and Tidal Tribs	LISS	290
Nissequogue River Lower/Sunken Meadow Creek	LISS	679
Coecles Harbor	PEP	19
Flanders Bay, East/Center, and Tribs	PEP	176
Flanders Bay, West/Lower Sawmill Creek	PEP	1580
Great Peconic Bay and Minor Coves	PEP	38
Great South Bay, East	SSER	102
Great South Bay, Middle	SSER	24
Great South Bay, West	SSER	46
Harts Cove	SSER	100
Moriches Bay East	SSER	72
Moriches Bay West	SSER	204

Additional statistics indicate:

- Only 16 of 119 marine subwatersheds evaluated in the SWP have predicted nitrogen loading rates of less than 50 kg/ha/yr (13.4 percent);
- 85 of 119 marine subwatersheds evaluated in the SWP have predicted nitrogen loading rates above 100 kg/ha/yr (71.4 percent);

- 20 of 119 marine subwatersheds evaluated in the SWP have predicted nitrogen loading rates above 500 kg/ha/yr (16.8 percent); and,
- The average nitrogen loading rate for all marine water bodies is 410 kg/ha/yr.

Tidal wetlands are important and productive environments found along coastal shorelines that provide ecosystem services like storm and flood buffering, erosion control and sediment stabilization, carbon sequestration, water filtration and nutrient removal, as well as habitat for waterfowl and shorebirds, invertebrates and fish. Approximately 60 percent of commercially harvested finfish and shellfish depend on tidal wetlands (Harmon, John C. 1975. **Saving Our Tidal Wetlands**. The Conservationist. August-September). Vegetated tidal wetlands are being lost at a drastic rate due to sea level rise, dredging and shoreline hardening, and invasion of non-native plants, but also due to excess nitrogen (NEIWPCC, 2015. **Long Island Tidal Wetlands Trends Analysis**). Eutrophication of marshes results in weakening of the root system of the vegetation that holds the marsh together. The marsh cannot withstand wave action and begins to break apart, resulting in a significant loss of their buffering ability. Over the past forty years, native marsh degradation, fragmentation and severe acreage loss have been observed in several tidal wetland complexes throughout Suffolk County. A 2015 report comparing tidal wetlands in 1974 to 2005 and 2008 found that Long Island's estuaries have lost 13.1 percent of native marsh communities, equivalent to 85 acres per year or nearly 3,000 acres. More specifically, the Peconic Estuary has lost 10.4 percent or 356 acres of native marsh, the South Shore Estuary lost 11.6 percent or 1,692 acres of native marsh, and the Long Island Sound Estuary lost 22.6 percent or 654 acres of native marsh (NEIWPCC, 2015. **Long Island Tidal Wetlands Trends Analysis**). A comparison of wetlands existing in 1974 and 2005 in the Stony Brook Harbor area is shown on **Figure 1-8**.

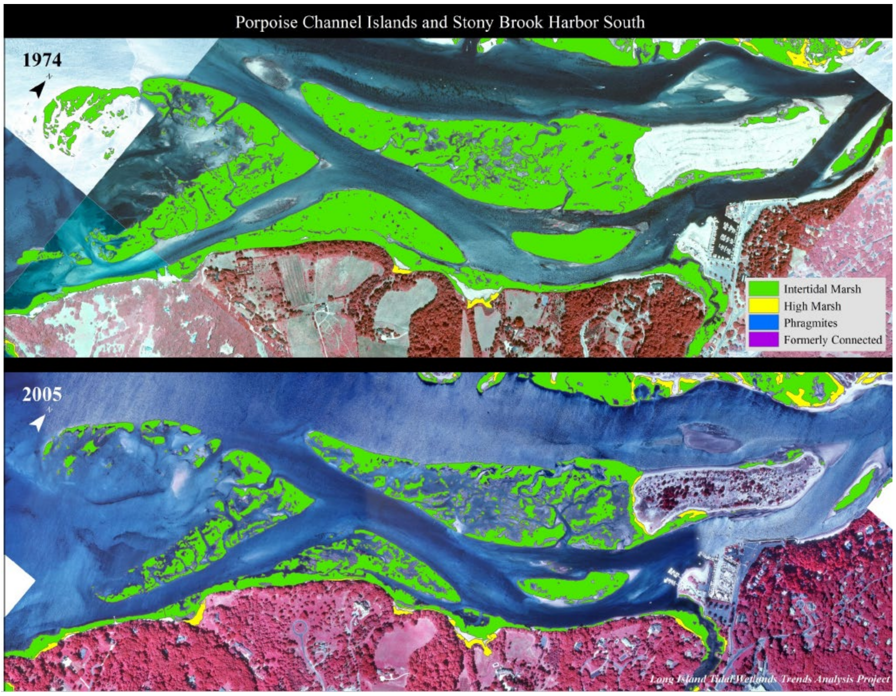


Figure 1-8 Comparison of Wetlands Extent in 1974 and 2005
Source NEIWPCC, 2015

1.1.3.3.2 Dissolved Oxygen

Hypoxic (low oxygen) and anoxic (no oxygen) conditions can result when oxygen is depleted by algal respiration, the decomposition of algae and organic materials and natural variations in temperature, wave action and mixing. Since the occurrence of hypoxic and anoxic conditions is primarily driven by microbial respiration, the relationship between excessive nitrogen, algae growth and low dissolved oxygen in estuaries is well known to be one of the major stressors to Suffolk's water bodies. Low oxygen levels lead to slower growth in fin fish and shellfish and periods of hypoxia and anoxia have resulted in fish kills and rapid die-offs of other aquatic wildlife. Based on the NYSDEC ambient water quality standard for dissolved oxygen, 70 percent of the water bodies monitored for dissolved oxygen by SoMAS were unfit for fish survival during the summers of 2014, 2015 and 2016, according to research by SBU SoMAS. In the lower Peconic River area, three fish kills involving Atlantic Menhaden (*Brevoortia tyrannus*) occurred in the spring of 2015 due to poor water quality and an influx of migrating fish in the area. Hundreds of thousands of fish were found dead and researchers at the SCDHS, NYSDEC and SoMAS determined that "rapidly rising water temperature, the timing and magnitude of algal blooms and an unusually large biomass of adult menhaden confined in the river were all contributing factors that resulted in prolonged periods of extremely low dissolved oxygen levels and ultimately caused large numbers of the menhaden to expire" (SCDHS, NYSDEC, and SoMAS at SBU. 2016. **Investigation of Fish Kills Occurring in the Peconic River – Riverhead, N.Y. Spring 2015**). Low dissolved oxygen levels result in negative effects on the environment but also on the economy by impacting commercial fisheries, recreation and tourism.

Newsday

By Jennifer Barrios. 10/22/2014

LONG ISLAND

More than two-thirds of LI's coastal waters lack enough oxygen for fish to survive, says Stony Brook researcher

More than two-thirds of Long Island's coastal waters did not contain enough oxygen this summer to enable fish to survive, according to research to be released Wednesday by Stony Brook University.

Results from 30 monitors placed in the waters surrounding Long Island over the summer showed poor or lethally low levels of oxygen at 21 of the sites, said Christopher Gobler, a professor at the university's School of Marine and Atmospheric Sciences, who conducted the research.

The Nature Conservancy analyzed USGS dissolved oxygen sensor data from the Great South Bay and found frequent chronic and acute violations throughout the growing seasons of 2016 and 2017. A chronic violation, shown as the orange bands in **Figure 1-9,** is when dissolved oxygen concentrations fall below 4.8 mg/L for an extended period of time. An acute violation, shown as the red dots in **Figure 1-9**, occurs when dissolved oxygen levels fall below 3.0 mg/L. Both types of violations were documented during the continuous monitoring event and both negatively impact fin fish and shellfish. Based upon evaluation of the predicted nitrogen loads, there are about two dozen subwatersheds that likely have similar dissolved oxygen violations. It is recommended that continuous sensors be installed in additional water bodies to obtain accurate dissolved oxygen data.

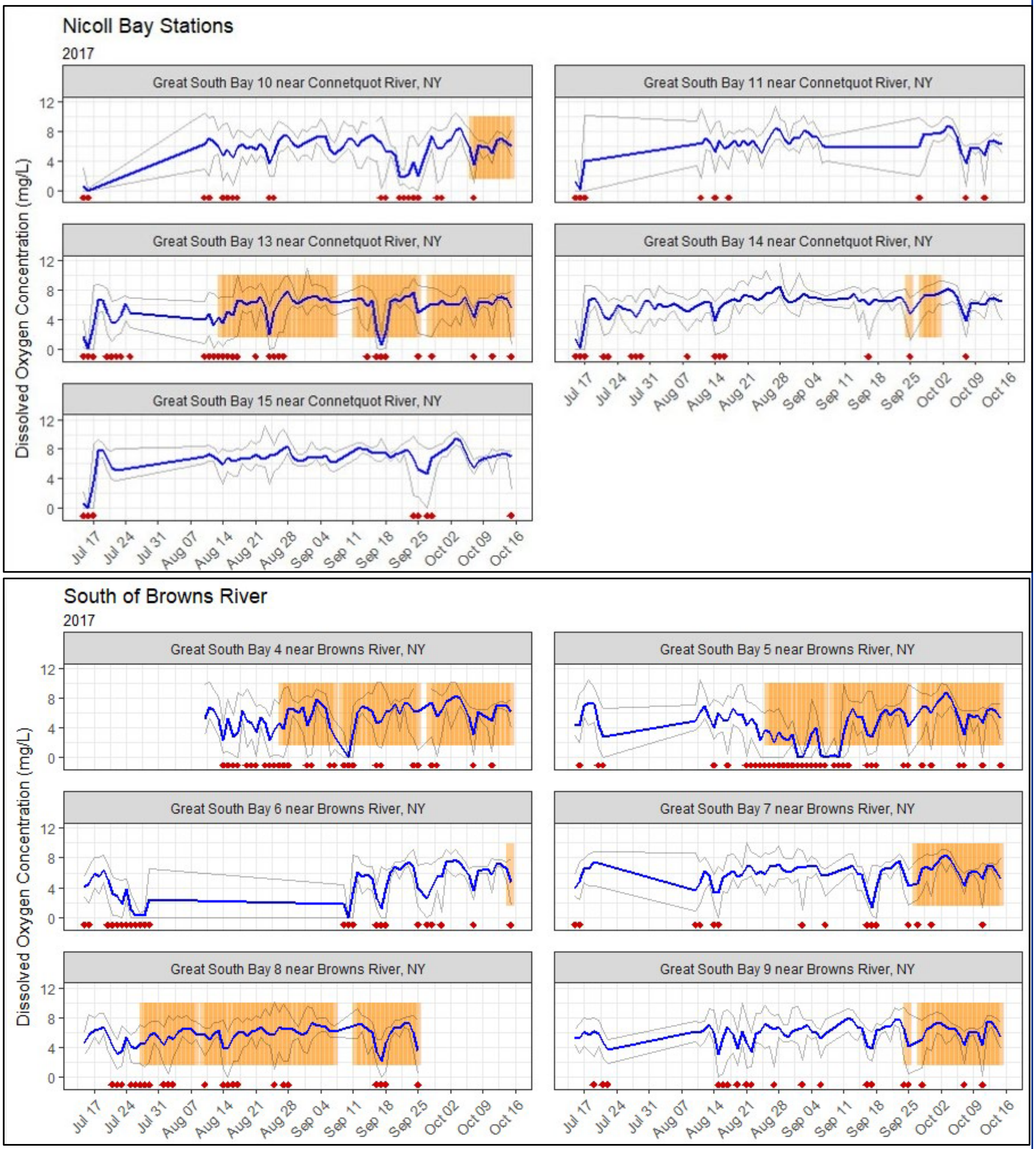
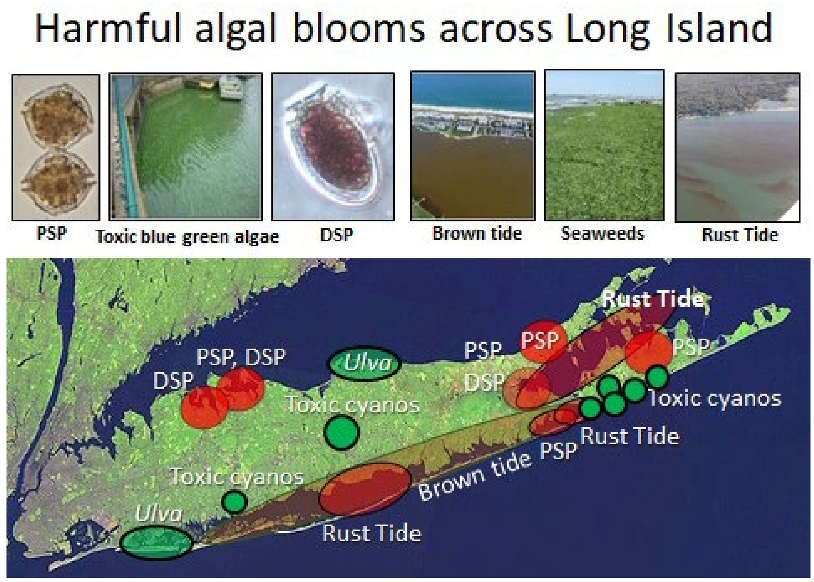


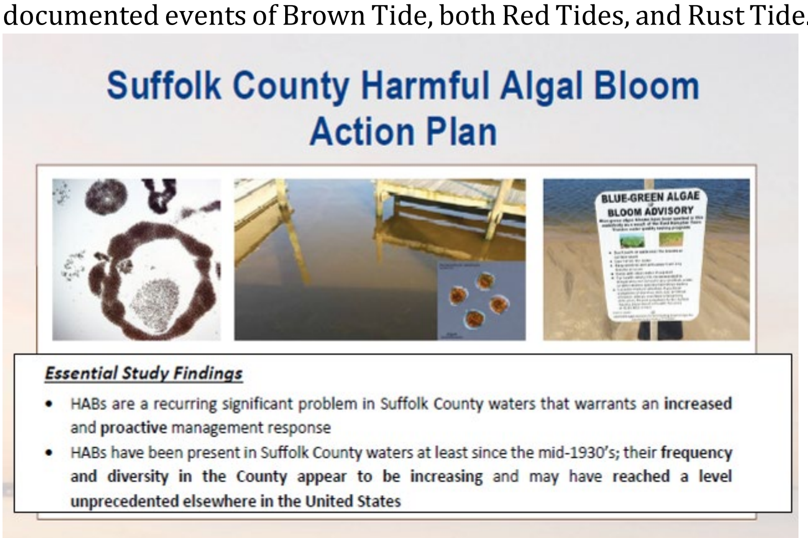
Figure 1-9 Violations of Chronic and Acute Dissolved Oxygen Water Quality Criteria

1.1.3.3.3 Harmful Algal Blooms



Increased nitrogen and phosphorus inputs along with other contributing factors such as increased water temperature have fueled escalation in the intensity and frequency of HABs throughout Suffolk County. According to findings from the Harmful Algal Bloom Action Plan, "***HABs appear to be increasing and may have reached a level unprecedented elsewhere in the United States.***" Regular re-occurrences of several types of HABs have been observed in all three major estuaries of Suffolk County, including brown tide, red tides, rust tide and blue-green algae blooms. Specifically, there have been more than 180 documented HAB events in marine waters and more than 50 HAB events in fresh waters within the last 10 years alone in Suffolk County. HABs can be harmful to human health by poisoning humans and animals that come into contact with them.

Between the years 2007 and 2016, HAB events occurred each year in the SSER including documented events of Brown Tide, both Red Tides, and Rust Tide. The chronic occurrence of brown tide (*Aureococcus anophagefferens*) over the past three decades combined with overfishing has resulted in a dramatic loss of hard clam landings. According to the NY Sea Grant Brown Tide Research Initiative, when brown tide blooms reach between 20,000 and 35,000 cells per milliliter, hard clams have inhibited feeding and slower growth rates. Cell abundances above 150,000 cells per milliliter (considered a bloom condition in this SWP) can be lethal as larvae and juvenile growth stop (Sea Grant, NY, **Brown Tide Research Initiative, Report #9**, March 2006). In the 1970s, it was estimated that the entire volume of the Great South Bay was filtered by hard clams (*Mercenaria mercenaria*) once every three days. An unfortunate result of hard clam population decline is the increase in time it takes for the shellfish to filter the bay from once every three days to about once every 25 days, as per a 1993 study (New York Sea Grant. 2006 "Brown Tide Research Initiative Report #9"). Hard clam harvests in the Great South Bay have fallen by more than 93 percent since 1990 as illustrated



by **Figure 1-10**. In addition, Brown Tide blooms have also been documented to reduce light available to eelgrass, thereby decreasing habitat suitable for eelgrass and impacting other shellfish that rely on eelgrass beds as spawning and nursery grounds [Dennison, W. et. al. (1989) "**Effect of Brown Tide Shading on Eelgrass (*Zostera marina*) Distributions**"].

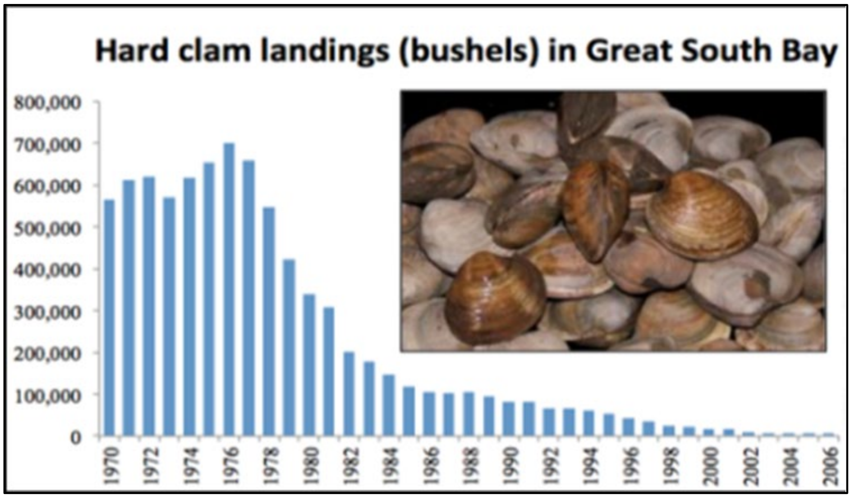


Figure 1-10 Reduction in Hard Clam Landings in Great South Bay

In Long Island Sound harbors HAB events occurred every year between 2007 and 2016, including frequent documented events of both Red Tides. The red tides that occur in Suffolk County's marine waters (*Alexandrium fundyense* and *Dinophysis acuminata*) can contain toxins that cause diarrhetic shellfish poisoning (DSP) and paralytic shellfish poisoning (PSP). The shellfish filter feed the red tide algae and the toxins bioaccumulate in their bodies. Humans and wildlife that consume those shellfish are at risk of poisoning.

In the Peconic Estuary, HAB events occurred in nine of ten years between 2007 and 2016, including frequent documented events of both Red Tides and Rust Tide. Red Tides have resulted in shellfish closures within select creeks and coves in the Peconics. Rust tide (*Cochlodinium polykrikoides*) has been found to be lethal to multiple species and life stages of fish and shellfish. All HABs can also be detrimental to fish and shellfish by interrupting their breathing and feeding mechanisms.

Blue Green Algae (*Cyanobacteria* sp.) has been documented in several fresh water bodies in Suffolk County, and frequently in Agawam Lake, Old Town Pond, Mill Pond, Sagaponack Pond, Georgica Pond, Wainscott Pond, Hook Pond, Mattituck (Marratooka) Pond and Lake Ronkonkoma among others. This freshwater HAB can produce toxins that can cause nausea, vomiting, diarrhea, skin, eye and throat irritation, allergic reactions or breathing difficulties if humans or animals come into contact with the algae. It can become abundant in warm, shallow, poorly flushed, nutrient-rich lakes and streams that receive a lot of sunlight. Blooms can discolor the water or produce floating mats or scums on the water's surface.

1.1.3.3.4 Macroalgae Overgrowth

Just as excess nutrients can create algal blooms in waterways, the excessive growth of macroalgae is also spurred by eutrophication. High densities of macroalgae, also referred to as seaweed, decrease the amount of light in the water column and shade submerged aquatic vegetation (SAV) growing on the sea floor, essentially out-competing important eelgrass beds. The NYSDEC identifies fresh water bodies with aquatic invasive species and algal/plant growth as part of their Priority Water body List (PWL) Individual Assessment Fact Sheets. Water bodies with identified macroalgae problems include the following:

- Belmont Lake
- Upper and Lower Yaphank Lakes
- Upper Connetquot River
- Lake Ronkonkoma
- Upper Nissequogue River, including Philips Mill Pond, Willow Pond, Millers Pond and New Mill Pond
- Peconic River, including Peconic Lake and Swan Pond
- Sans Souci and Lotus Lakes
- Carlls River, including Southards Pond and Elda Lake
- Patchogue River, including Patchogue Lake and Canaan Lake
- West Lake (Tuthills Creek)
- Amityville Creek
- Georgica Pond

Figure 1-11 Macroalgae Bloom in Lily Lake

Excessive amounts of macroalgae have been observed in fresh water bodies, including Lily Lake in Yaphank (**Figure 1-11**) and Canaan Lake in Patchogue. Local governments are investing significant amounts of money to restore the lakes in an attempt to eradicate seaweeds that have clogged these waterways. Both of these lakes contain non-native, invasive plants including fanwort (*Cabomba caroliniana*) and variable leaf watermilfoil (*Myriophyllum heterophyllum*) that are unattractive and inhibit recreational boating and fishing in the lake. The goal of the projects is to restore the lakes to their previous recreational use by removing the macroalgae and nutrient-dense sediment on the bottom on the lake.

In 2016, an aquatic weed harvester (right) was deployed in Georgica Pond in East Hampton to remove the accumulation of macroalgae and aquatic plants to combat the effects of nutrient pollution. In 2016, 55,740 pounds were harvested from June 23rd to September 8th, representing one percent of the annual nitrogen load and two percent of the annual phosphorus load. The purpose of this project was to reduce the amount of nitrogen available in the lake during the summer months to diminish the proliferous blue-green algae levels. The project was deemed successful as blue-green algae levels were an order of magnitude lower than the two prior years (Gobler, 2016, **Evaluation of macroalgae and aquatic plant harvesting as a means for improving water quality in Georgica Pond**).

Figure 1-12 Macroalgae Bloom in Georgica Cove, July 2015. (Friends of Georgica Pond)

1.1.3.4 Nitrogen Trends in Groundwater and Drinking Water

The use of Article 6 of the Suffolk County Sanitary Code to establish minimum lot size for the protection of Suffolk County's drinking water supply has, on the whole, been successful for post-1980 development. However, and not surprising given the observed increased nitrogen trends in surface waters, the concentration of nitrogen in groundwater has been steadily increasing.

Pre-development nitrogen levels in the upper glacial aquifer were less than 1 mg/L, and pre-development nitrate levels in the deeper Magothy and Lloyd aquifers were less than 0.05 mg/L (**1987 Comprehensive Water Resources Management Plan**, SCDHS 1987, [1987Comp Plan]). In undeveloped areas of the County, nitrate concentrations generally remain less than or near 1 mg/L, but in densely developed unsewered areas, data shows that nitrate concentrations in groundwater can exceed the 10 mg/L MCL drinking water standard for nitrate, and in some agricultural areas, nitrate levels in private wells can still exceed 20 mg/L. The 1987 Comp Plan analyzed 25 shallow wells to look at the relationship between land use and groundwater quality. The average total nitrogen concentrations found in these wells by land use type is shown in **Table 1-3**.

Table 1-3 Groundwater Nitrogen Concentrations and Land Use (1987 SCDHS Comprehensive Water Resources Management Plan)

Land Use Type	Observed Average Nitrogen Concentration (ppm)	Number of Samples
Vacant	1.2	1
Low Density Residential	3.9	2
Medium Density Residential	5.9	3
Intermediate/High Residential	7.9	4
Agricultural	7.9	4
Institutional	8.3	2
Recreational & Open Space	4.6	3
Commercial	8.0	3
Industrial	7.1	3
Transportation	2.5	3

To assess changes in nitrate over time, average nitrate concentrations measured in community supply wells that were sampled in both 1987 and in 2017 were compared. A summary of nitrate concentrations of samples taken from the same set of 317 public supply wells sampled in both 1987 and in 2017 is provided by **Figure 1-13**. The data show that nitrate levels have increased in both the Upper Glacial and Magothy aquifers. Specifically, on average, nitrogen concentrations within the Upper Glacial and Magothy aquifers increased 51.4 percent and 94 percent, respectively, between 1987 and 2017. Of 411 private supply well samples in 2014, 2015 and 2016, the majority of which are on the East End, the average pre-treatment nitrate concentration was approximately 3.6 mg/L and the median nitrate concentration pre-treatment was approximately 2.2 mg/L. However, of these same private well samples, 30 percent of the samples had a nitrate concentration greater than 4 mg/L, 19 percent were above 6 mg/L and 7 percent were greater than 10 mg/L nitrate.

Finally, a review of total nitrogen data for private supply well samples analyzed between 1996 and 2016 under the SCDHS Voluntary Private Supply Well Sampling Program indicated that:

- 18 percent of the samples had a total nitrogen concentration greater than 6 mg/L and less than 10 mg/L; and,
- 11 percent of the samples had a total nitrogen concentration above the state's drinking water standard of 10 mg/L.

Conversely, total nitrogen data from public supply wells, which are typically screened deeper within the aquifer than private wells or are sited in less densely developed locations where one would expect excellent water quality, indicate that only a handful of public supply wells exceed the 10 mg/L standard. Untreated water from 22 community supply wells exceeded 10 mg/L in 2018 and simulated concentrations in 97.8 percent of the community supply wells evaluated as part of the SWP were less than 10 mg/L.

Additional groundwater data documenting the unequivocal link between unsewered residential land use density and nitrogen concentrations is documented in the County's Comprehensive Water Resources Management Plan (2015) and Section 3 of this SWP.

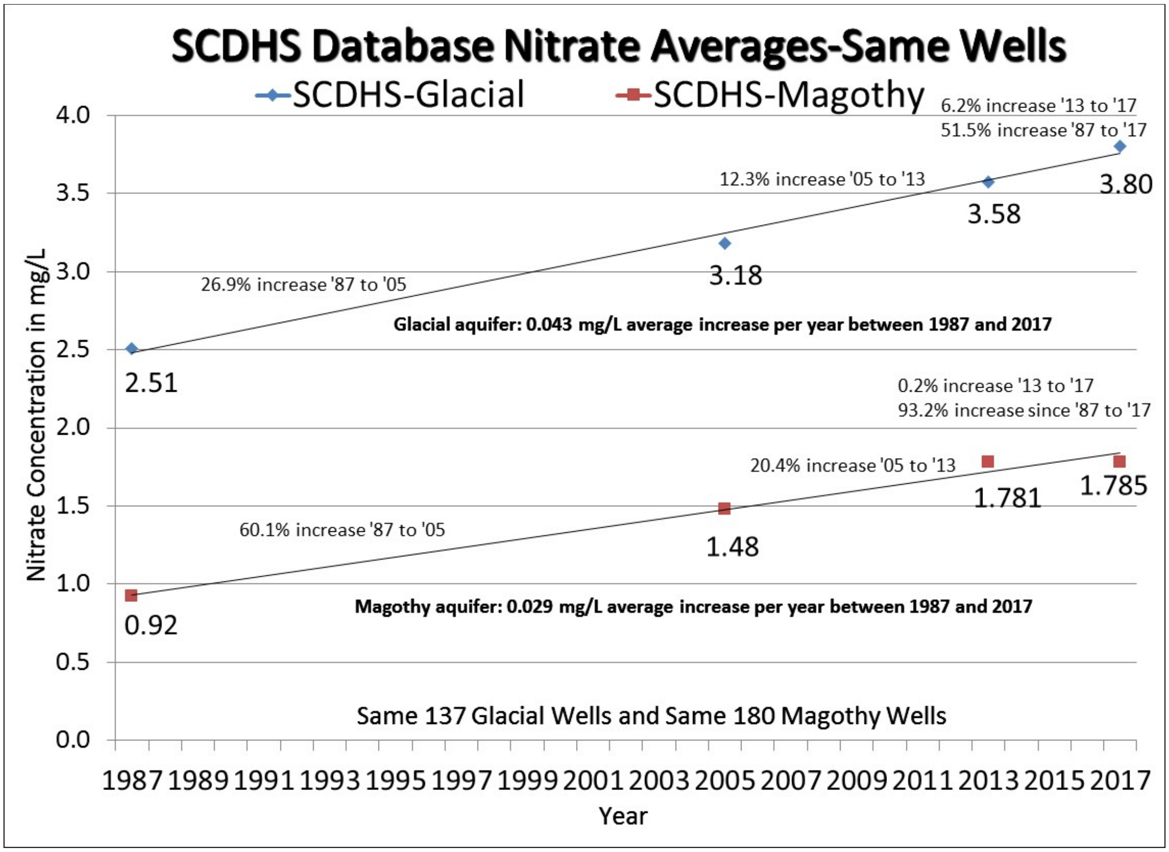


Figure 1-13 Nitrate Concentrations from Community and Non-Community Supply Wells in the Upper Glacial and Magothy Aquifers from 1987 to 2013

1.1.4 Other Wastewater Effluent Constituents

As documented in the Comp Water Plan, more advanced and sensitive analytical techniques have been developed that allow the detection of increasingly lower concentrations of contaminants in the environment. As these methods have evolved, additional contaminants, previously not known to exist in the environment, are being found every day. Other contaminants of concern that can be found in wastewater are often referred to as Contaminants of Emerging Concern (CECs) and include compounds such as pharmaceuticals and personal care products (PPCPs), 1,4-Dixoane, and perfluoro octane sulfonate (PFOS) and perfluorooctanoic acid (PFOA), also known as PFAS (per- and polyfluoroalkyl substances).

1,4-Dioxane ($C4H_8O2$) is an organic solvent with numerous industrial and synthetic uses, including as a degreasing, wetting and dispersing agent. It is highly water soluble and environmentally stable, but it is oxidizable by free radical chemical processes and slowly by Ultraviolet (UV) radiation. When found in water, it is at µg/L levels. It is not efficiently removed by most treatment processes due to its low molecular weight and chemical properties. Pretreatment and discharge controls are the best ways to prevent its presence in wastewater.

Perfluoro octane sulfonate (PFOS) and perfluorooctanoic acid (PFOA), also referred as PFAS, are part of a class of chemicals known as perfluorinated compounds (PFCs). Similar to 1,4 Dioxane, PFCs are highly water soluble and environmentally stable; however, PFC removal has been demonstrated using activated carbon, anion exchange, membrane filtration, and reverse osmosis. Unfortunately, PFC removal rates vary by individual PFC compound and by treatment technology. PFCs have been used in a number of industrial and commercial products such firefighting foam, as well as coatings that repel water, oil, stains and grease. They have been used in textiles, food packaging and non-stick cookware. Thus, people may be exposed to PFAS through air, water, or soil from industrial sources and from consumer products. Though they are currently unregulated by the federal government, many major manufacturers in the United States have agreed to voluntarily reduce the content of PFCs in their products. PFCs have been detected in Suffolk County's groundwater system downgradient of commercial sites where PFCs were historically used.

PPCPs include a broad range of products such as prescription and over the counter drugs, including antibiotics, veterinary and illicit drugs, fragrances, sun-screen products, cosmetics, some detergents, some food and drink additives, trace plasticizers that contaminate the consumer products and all of their respective metabolites and transformation products. Many are used and released to the environment in large enough quantities such that low levels are detected in wastewaters and receiving waters. As most pharmaceuticals are designed to be water soluble, and to be persistent long enough to serve their designated therapeutic purposes, they can be present in dissolved form in receiving ground and surface waters. PPCPs are continuously introduced into the environment by sewage treatment plants and by on-site wastewater disposal systems (e.g., septic tanks and leach fields) in unsewered areas. Based upon estimated release rates to the environment and the field surveys that have been completed, the presence of PPCPs is expected to be at about the nanograms per liter (ng/l) or part per trillion (ppt) level in the environment and it is documented that many of these contaminants (e.g., nonylphenol, which mimics estrogen and is found in detergents, paints and cosmetics) are stable and persistent in the environment. SCDHS Public and Environmental Health Laboratory (PEHL) currently analyzes for thirty PPCPs; contaminants that have been detected in community, non-community, private or monitoring wells are summarized in **Table 1-4**.

Table 1-4 PPCPs Currently Analyzed by the Suffolk County PEHL and Maximum Concentrations Detected

Contaminant	Use	Detected by PEHL
Pharmaceuticals		
Acetaminophen	Pain Reliever	X
4-Androstene-3,17-dione	hormone	
Carbamazepine	anticonvulsant	X @ 17.8 µg/L
Carisoprodol	skeletal muscle relaxant	X @ 13.0 µg/L
Diethylstilbestrol	hormone	X
Dilantin (Phenytoin)	antiepileptic	X
4-Hydroxyphenytoin	metabolite of Dilantin	X
Estrone	hormone	X

Contaminant	Use	Detected by PEHL
17 b Estradiol	hormone	
17 a Ethynylestradiol	hormone	
Gemfibrozil	lipid regulator	X @ 4.6 μg/L
Ibuprofen	anti-inflammatory	X @ 7.6 μg/L
Personal Care Products		
Benzophenone	fragrance	X
Chloroxylenol	antimicrobial	X
Dibutyl phthalate	plasticizer in nail polish	X
1,4-Dichlorobenzene	disinfectant	X
Diethyl phthalate	binds cosmetics & fragrances	X @ 59.8 μg/L
Dimethyl phthalate	used in insecticide repellents	X
Dimethyltoluamide (DEET)	insecticide repellent	X @ 69 μg/L
D-Limonene	deodorant	X
Picaridin	insect repellent	
Triclosan	antimicrobial	X
Other		
Benzyl butyl phthalate	plasticizer	X
bis-(2-ethylhexyl) adipate	plasticizer	X
bis-(2-ethylhexyl) phthalate	plasticizer	X
Bisphenol A	plasticizer	X
Bisphenol B	plasticizer	
Butylated Hydroxyanisole (BHA)	antioxidant; food additive	X @ 2.2 ppb
Butylated Hydroxytoluene (BHT)	antioxidant; food additive	X
Caffeine	stimulant	X

1.1.5 Water Quality and Our Economy

Water quality and associated ecosystem disruptions can have far reaching effects on the economy. Property values and property tax revenues, tourism to beaches, seafood restaurants, marinas, commercial and recreational fin fishing, shellfishing and aquaculture, storm protection as well as overall public use and enjoyment of the environment are dependent on having good water quality. The Comp Water Plan states that in 1993, more than 1,100 establishments were identified as "estuarine dependent" and gross revenues for these establishments exceeded $450 million per year (equal to approximately $680 million in 2014). More than 7,300 people were employed in these businesses, with a combined annual income of more than $127 million (equal to approximately $192 million in 2014). The financial value of goods and services provided to the region's economy by Long Island Sound's natural systems ranges between $17 billion and $36.6 billion annually.

The link between water quality and socioeconomic benefits is documented throughout the literature. To provide a platform on which to assess cause and effect scenarios regarding nutrient policy decisions, impacts to water quality, and related socioeconomic benefits, the USEPA Office of Research and Development has developed Triple Value Simulation (3VS) systems analysis models in conjunction with multiple jurisdictions throughout the United States. The goal of the simulation tool is to inform decisions used to achieve a balanced water resources management system that will support environmental, economic, and social sustainability. By modeling the nutrient cycles and related impacts, the simulation helps to identify solutions that will protect ecosystem integrity while providing the water resources that are essential for continued economic prosperity. An example of the inter-connections between the environment and the economy is included below by **Figure 1-14**.

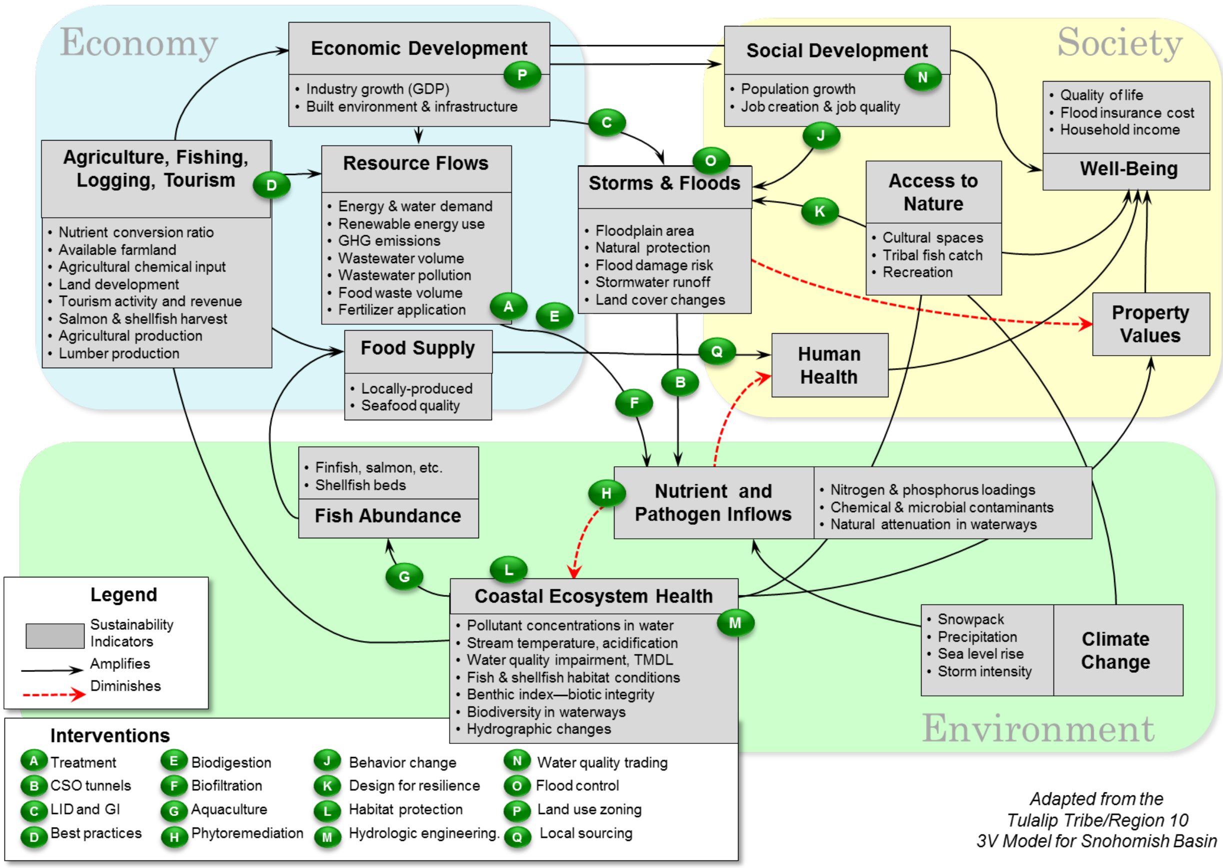


Figure 1-14 Participatory Systems Modeling to Explore Sustainable Solutions: Triple-Value Simulation Modeling Cases Tackle Nutrient and Watershed Management from a Socio-Ecological Systems (SES) Perspective (Poster by US EPA, Buchholtz ten Brink, et. al.)

An Hedonic Analysis of the Effects of Lake Water Clarity on New Hampshire Lakefront Properties

Julie P. Gibbs, John M. Halstead, Kevin J. Boyle, and Ju-Chin Huang

Policy makers often face the problem of evaluating how water quality affects a region's economic well-being. Using water clarity as a measure of the degree of eutrophication levels (as a lake becomes inundated with nutrients, water clarity decreases markedly), analysis is performed on sales data collected over a six-year period. Our results indicate that water clarity has a significant effect on prices paid for residential properties. Effects of a one-meter change in clarity on property value are also estimated for an average lake in four real estate market areas in New Hampshire, with effects differing substantially by area. Our findings provide state and local policy makers a measure of the cost of water quality degradation as measured by changes in water clarity, and demonstrate that protecting water quality may have a positive effect on property tax revenues.

Key Words: eutrophication, hedonics, water clarity, water quality

One of the most well documented and easily understood correlations between water quality and economy is the link between water clarity and real estate values. Water clarity represents the simplest water quality endpoint and the most desirable trait related to the public perception of good water quality. Several existing studies have already established a clear link between water clarity and property values. Specifically, Michael et al (1996), Boyle et al (1999), Boyle and Taylor (1999), Gibbs et al (2002), Krysel et al (2003), Walsh et al. (2011), Zhang V Tech dissertation, concluded that across several states, the majority of studies found a significant relationship between water quality and home prices. To evaluate this relationship between advanced wastewater treatment and potential impact to local real estate valuations in Suffolk, the County has contracted with CoreLogic, a leading provider of property data analytics services.

1.1.6 Wastewater Management in Suffolk County

A detailed description of the history and methods of wastewater management in Suffolk County is provided in Section 8.0 of the Comp Water Plan. The following section presents a summary of the information presented in the Comp Water Plan, and provides a summary of new wastewater management methods, rules, and regulations that have been adopted in Suffolk County subsequent to, and in response to fulfillment of the recommendations in the Comp Water Plan. As documented herein, there has already been enormous progress toward advancing wastewater management in Suffolk County to arrest and reverse the degradation of water quality. Specific milestones include, but are not limited to:

- Article 19 of the Sanitary Code adopted in 2016 allowed for the use of I/A OWTS;
- Septic Demonstration Program tested I/A OWTS technologies in Suffolk County;
- Suffolk County Great South Bay Coastal Resiliency Projects funding for new sewering connections;
- Town/Village mandates for installation of I/A OWTS under certain circumstances, and
- New Construction Standards allowing for the use of alternative leaching.

A summary of the existing wastewater management framework in Suffolk County, including recent achievements towards fulfilment of the Comp Water Plan recommendations is provided below.

1.1.6.1 Introduction to Wastewater Management in Suffolk County

The two primary means of wastewater treatment in Suffolk County have historically included individual onsite disposal systems (OSDS) and the use of sewage collection and treatment plants. Current requirements for conventional OSDS require primary treatment for the removal of BOD and solids through settling within a septic tank, followed by disposal of the septic tank effluent through a leaching pool. STPs include primary and secondary treatment but those discharging to groundwater are also required to include tertiary treatment of nitrogen to an effluent concentration of 10 mg/L or less. While a properly designed OSDS provides partial removal of BOD and solids, it provides minimal nitrogen removal. Of the two primary wastewater treatment methods, approximately 74 percent of all parcels in Suffolk County utilize OSDS (equating to approximately 365,000 systems) and almost 64 percent of the total nitrogen that discharges to groundwater emanates from OSDS. In addition, it is estimated that approximately 252,530 of the 365,000 systems pre-date the requirement for a septic tank. These systems are typically referred to as "cesspools" and many of them are constructed with individual concrete blocks that are at high risk for collapse or failure. Unfortunately, loss of life has already occurred in Suffolk County due to collapsed cesspools.

Nitrogen discharge from onsite wastewater treatment systems is currently regulated by lot size through the implementation of Article 6 of the Suffolk County Sanitary Code. Based on differences in regional hydrogeological and groundwater quality conditions, Article 6 delineated boundaries of eight Groundwater Management Zones (GWMZs) for protection of groundwater quality. The goal of creating the GWMZs was to limit groundwater nitrogen from new development to 4 mg/L in GWMZ III, V, and VI and to 6 mg/L in the remaining zones. The primary focus of keeping groundwater nitrogen concentrations at these levels was for the protection of public health due to reliance on groundwater as a drinking water supply; however, the protection of surface waters was also considered in the establishment of GWMZ VI. While these management efforts have generally been effective in protecting our water supply, it has been widely documented that surface waters have a much lower tolerance to nitrogen concentrations, with existing guidance values recommending concentrations a full order of magnitude lower for the protection of surface water ecology. For example, the USEPA recommends surface water nitrogen concentrations of 0.45 mg/L for the protection of dissolved oxygen, and 0.34 mg/L (USEPA, 2015) for the protection of eelgrass (Long Island Nitrogen Action Plan Scope, 2016). Finally, many areas of Suffolk County were developed before the Article 6 density restrictions were enacted or prior to conventional treatment system requirements, further exacerbating the need for more aggressive means of the management of nitrogen from wastewater sources in Suffolk County.

Additional description of Suffolk County's wastewater management methods are provided in the following sections.

1.1.6.2 Wastewater Management Methods in Suffolk County

Wastewater management in Suffolk County is established through establishment of minimum parcel sizes deemed protective of the environment from contaminants such as nitrogen and wastewater treatment requirements. A detailed summary of these methods is provided in the following subsections.

1.1.6.2.1 Suffolk County Article 6 Density Standards and Groundwater Management Zones

Article 6 of the Suffolk County Sanitary Code outlines sewage disposal requirements for construction to reduce the impacts of nitrogen loading to water resources. Per Article 6 of the Suffolk County Sanitary Code, property owners constructing a new building (including additions to existing buildings or changes of use of existing buildings with an onsite sewage disposal system) are required to obtain a permit from the SCDHS. The permit is usually for a proposed new onsite sewage disposal system conforming to current standards. In some cases where an addition or change of use is proposed, the permit may be to simply verify that the existing system meets current standards and is acceptable for the proposed addition or change of use.

Based on differences in regional hydrogeological and groundwater quality conditions, Article 6 delineated boundaries of eight Groundwater Management Zones (GWMZs) for protection of groundwater quality (See **Figure 1-15**). The primary goal of creating the GWMZs was to protect the County's sole source drinking water aquifer by limiting groundwater nitrogen to 4 mg/L in GWMZ III, V, and VI and to 6 mg/L in the remaining zones.

Figure 1-15 Suffolk County Sanitary Code Article 6 Groundwater Management Zone Map

To achieve these concentration thresholds, residential properties located within GWMZ III, V, and VI are required to have a minimum lot size of 40,000 square feet of land with the use of a conventional onsite sewage disposal system and public water or private wells. Residential properties located in the remaining zones are required to have a minimum 20,000 square feet of land when utilizing conventional onsite sewage disposal systems and public water (40,000 square feet with private wells).

In addition, commercial/industrial properties located in GWMZ III, V, and VI are limited to a total discharge of 300 gallons per day (gpd) per acre when using a conventional onsite sewage disposal system and public water or a private well. The remaining zones are allowed 600 gpd/acre with public water (300 gpd/acre with private well).

Historically, four exemptions were permitted under Article 6, as outlined below, for lots in existence prior to 1981. This permitted higher density development in certain areas when these exemptions where met:

- Lots separately assessed on the Suffolk County Tax Maps as of January 1, 1981 and are buildable under current town or village zoning ordinances;
  - (Applies to four or less lots owned by the same developer)
- Subdivision previously approved by the New York State Health Department and filed in the Office of the Clerk of the County of Suffolk;
- Developments or other construction projects previously approved by the Department; and,
- Development or other construction projects, other than realty subdivisions, approved by a town or village planning or zoning board of appeals prior to January 1, 1981.

In December 2017, the Suffolk County Legislature approved changes to Article 6 that revised the definition of the exemptions and required the installation of I/A OWTS that are capable of reducing effluent nitrogen to 19 mg/L under certain conditions. A summary of the new requirements is provided in Section 8.1.2.

Projects that exceed the density requirements enacted in Article 6 of the Suffolk County Sanitary Code and do not meet one of the exemptions are required to provide advanced treatment capable of reducing effluent nitrogen to 10 mg/L. Compliance with this requirement is accomplished through connection of the site to an existing or proposed community sewage treatment plant.

Many areas of Suffolk County were developed before the Article 6 density restrictions were enacted. As documented in the Comp Water Plan, the Suffolk County Department of Economic Development and Planning estimates that over 60 percent of the residential parcels in Suffolk County are less than or equal to one half acre. There are approximately 372,018 residential parcels less than or equal to ½ acre (See **Table 1-5**). Of the 372,018 residential parcels, 257,626 (52.9 percent of the parcels) are not sewered. Out of the 487,082 residential parcels there are 214,903 residential parcels less than ¼ acre including 129,947 unsewered parcels (26.7 percent, as shown on **Table 1-6**). **Table 1-7** depicts the number of sewered parcels versus unsewered parcels by town, which equates to 75.3 percent unsewered (366,693 residential parcels) and 24.7 percent sewered (120,389 residential parcels).

Table 1-5 Residential Parcels Less Than or Equal to ½ Acre

Residential Parcels Smaller Than or Equal to ½ Acre in Suffolk County Per Town					
Town	# of Parcels Less Than or Equal to ½ Acre	# of Unsewered Parcels Less Than or Equal to 1/2 Acre	# of Sewered Parcels Less Than or Equal to 1/2 Acre	Total Residential Parcels	Percent of Unsewered Parcels Less Than or Equal to ½ Acre
Babylon	58,377	15,291	43,086	59,485	25.71%
Brookhaven	119,535	92,253	27,282	151,672	60.82%
East Hampton	9,452	9,157	295	19,342	47.34%
Huntington	44,952	39,566	5,386	64,747	61.11%
Islip	78,796	47,143	31,653	88,138	53.49%
Riverhead	6,996	5,276	1,720	11,957	44.12%
Shelter Island	491	384	107	2,498	15.37%
Smithtown	28,181	24,985	3,196	37,643	66.37%
Southampton	17,776	17,114	662	37,365	45.80%
Southold	7,462	6,457	1,005	14,235	45.36%
Totals	**372,018**	**257,626**	**114,392**	**487,082**	52.89%

Table 1-6 Residential Parcels Less Than or Equal to ¼ Acre

Residential Parcels Smaller Than or Equal to 1/4 Acre in Suffolk County Per Town					
Town	# of Parcels Less Than or Equal to 1/4 Acre	# of Unsewered Parcels Less Than or Equal to 1/4 Acre	# of Sewered Parcels Less Than or Equal to 1/4 Acre	Total Residential Parcels	Percent of Unsewered Parcels Less Than or Equal to 1/4 Acre
Babylon	50,094	12,381	37,713	59,485	20.81%
Brookhaven	67,423	50,334	17,089	151,672	33.19%
East Hampton	3,479	3,186	293	19,342	16.47%
Huntington	27,373	22,608	4,765	64,747	34.92%
Islip	38,994	19,577	19,417	88,138	22.21%
Riverhead	4,064	2,926	1,138	11,957	24.47%
Shelter Island	128	53	75	2,498	2.12%
Smithtown	13,766	10,823	2,943	37,643	28.75%
Southampton	6,791	6,132	659	37,365	16.41%
Southold	2,791	1,927	864	14,235	13.54%
Totals	**214,903**	**129,947**	**84,956**	**487,082**	**26.68%**

Table 1-7 Sewered vs Unsewered Residential Lots

Sewered vs Unsewered Residential Parcels in Suffolk County Per Town					
Town	Total Unswered Residential Parcels	Total Sewered Residential Parcels	Total Residential Parcels	Percent of Unsewered Residential Parcels	Percent of Sewered Residential Parcels
Babylon	15,694	43,791	59,485	26.38%	73.62%
Brookhaven	122,984	28,688	151,672	81.09%	18.91%
East Hampton	19,046	296	19,342	98.47%	1.53%
Huntington	58,298	6,449	64,747	90.04%	9.96%
Islip	53,968	34,170	88,138	61.23%	38.77%
Riverhead	10,048	1,909	11,957	84.03%	15.97%
Shelter Island	2,348	150	2,498	94.00%	6.00%
Smithtown	34,411	3,232	37,643	91.41%	8.59%
Southampton	36,700	665	37,365	98.22%	1.78%
Southold	13,196	1,039	14,235	92.70%	7.30%
Totals	**366,693**	**120,389**	**487,082**	75.28%	24.72%

1.1.6.3 On-site Sewage Disposal Systems (OSDS)

Seventy-four percent of Suffolk County residences rely on onsite sewage disposal systems as a means of sewage disposal. The effluent from onsite sewage disposal systems is discharged into the ground. The sands, silts, gravels and clays that make up the unsaturated zone and the aquifer itself function as a large sand filter, helping to limit the impact of contaminants contained in effluents to groundwater, but generally provide little removal of nitrogen. The current requirement for a conventional OSDS in Suffolk County includes the use of a precast concrete septic tank for primary treatment and the use of a precast concrete leaching pool for septic tank effluent disposal as shown on **Figure 1-16**. However, leaching pools installed prior to 1972 are typically constructed from concrete blocks and are highly susceptible to collapse. In addition, OSDS constructed prior to April 1, 1972 were not required to contain a septic tank. Therefore, many homes in Suffolk County contain dangerous block cesspools with no primary treatment from a septic tank.

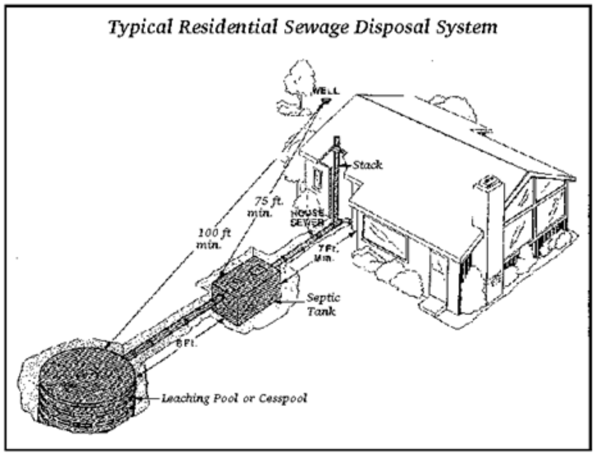


Figure 1-16 Precast Leaching Rings (Left) & Typical System layout (Right)

Historically, property owners with older onsite sewage disposal systems such as cesspools were not required to make an application to the SCDHS to upgrade their system to current standards. When either a cesspool or conventional system failed, the property owner had the right to re-install the system in-kind without obtaining a permit from the SCDHS. This exemption essentially permitted homeowners to continue to operate non-compliant OSDS containing no septic tanks for primary treatment. In December 2017, the Suffolk County Legislature adopted amendments to Article 6 of the Suffolk County Sanitary Code to eliminate this exemption. The updated Code requires the installation of a compliant system including a septic tank any time a new cesspool is proposed to be installed as a replacement for an existing cesspool, beginning July 1, 2019. In addition, the new amendment set forth reporting requirements for liquid waste professionals to track the amount of system pump outs through a new database and portal called the Septic Haulers Information Portal ("SHIP").

Based on 1970 census data, there are 325,777 homes in Suffolk County that predate the Suffolk County Sanitary Code and construction standards requiring installation of a precast septic tank and leaching pool at the time of construction. It is estimated that 252,530 homes out of the 325,777 homes that existed in 1970 are not connected to sewers and do not have a sanitary system that conforms to current standards. **Table 1-8** shows the breakdown of number of houses per town that are likely to require sanitary upgrades assuming 80 percent of homes in Babylon and 33 percent of homes in Islip are on sewers. (**Suffolk County Decentralized Wastewater Needs Survey Final Report**, March 2012).

Table 1-8 Estimated Sanitary Systems Pre-Dating Requirements for Septic Tanks

Estimated Number of Residential Parcels Pre-Dating Requirements for Septic Tanks		
Town	**Homes in 1970 (Census Data)**	**Homes Requiring Upgrade**
Babylon	58,359	11,672
Brookhaven	78,660	78,660
East Hampton	3,137	3,137
Huntington	56,996	56,996
Islip	79,680	53,120
Riverhead	5,402	5,402
Shelter Island	469	469
Smithtown	27,944	27,944
Southampton	10,329	10,329
Southold	4,801	4,801
Total	**325,777**	**252,530**

Most commercial buildings in Suffolk County are served by OSDS. It has been estimated that there are more than 18,700 active commercial properties within Suffolk County using onsite sewage disposal systems. Some of these sites have multiple OSDS serving the building(s) located on the parcel. Similar to residential sewage disposal systems, commercial OSDS that comply with current standards consist of a precast septic tank for primary treatment and precast leaching pool(s). Commercial buildings with any type of food service use also require the addition of a precast grease trap. Similar to residential parcels, many commercial OSDS were constructed prior to the requirement to include a septic tank or precast leaching pool. Finally, the requirements establishing maximum allowable sanitary flow for the protection of groundwater were set forth in 1984. Therefore, there are many sites constructed prior to 1984 that may exceed the current density requirements of Article 6 and may have cesspools as means of sewage disposal.

1.1.6.4 Innovative/Alternative Onsite Wastewater Treatment Systems

The Comp Water Plan established the first integrated framework to address the legacy problem from onsite wastewater disposal systems in a meaningful manner, including a detailed list of program objectives and recommendations. A fundamental basis for all wastewater management recommendations was the acknowledgment that the use of new Innovative/Alternative Onsite Wastewater Treatment Systems (I/A OWTS) would be a critical component of any overall wastewater management strategy in Suffolk County.

I/A OWTS are used to treat wastewater from an individual home or business and include advanced treatment processes to reduce nitrogen in the wastewater. I/A OWTS approved for provisional use in Suffolk County, as defined in Article 19 of the Suffolk County Sanitary Code, have demonstrated the ability to reduce effluent nitrogen to 19 mg/L which represents a significant nitrogen reduction when compared to conventional OSDS (estimated nitrogen reduction of only 6 percent in the septic tank). I/A OWTSs utilize various treatment options, providing aerobic and anaerobic environments to complete nitrification and denitrification of wastewater to reduce nitrogen concentrations. These technologies employ trickling filters, extended aeration, suspended growth, activated sludge, membrane bioreactors, and/or filtration.

To identify areas that might benefit most from I/A OWTS versus sewering and/or other mitigation measures, the Comp Water Plan recommended the development and implementation of a Countywide wastewater management plan. The recommendations in the Comp Water Plan resulted in the inception of an aggressive campaign to launch the use of I/A OWTS in Suffolk County. The campaign to address nitrogen from OSDS also included the I/A OWTS Septic Demonstration Tour which reviewed I/A OWTS technologies in proximate jurisdictions as well as each jurisdiction's approach to permitting, funding, and overall regulation of I/A OWTS. Building on the lessons learned from proximate jurisdictions, a five-track strategy was developed to facilitate the use of I/A OWTS in Suffolk County as shown by **Figure 1-17**.

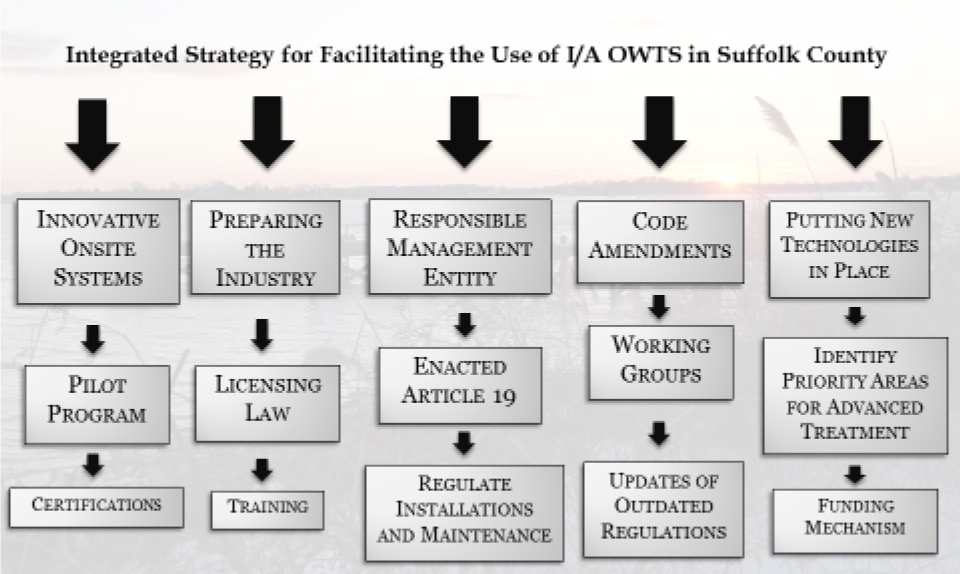


Figure 1-17 Suffolk County I/A OWTS Implementation Strategy

The integrated strategy began with two I/A OWTS demonstration programs to evaluate the performance of I/A OWTS in Suffolk County and to begin the creation and promotion of a local I/A OWTS business market.

To ensure that the I/A OWTS technologies are adequately tested, and are designed, installed, and maintained properly, Suffolk County established regulatory and training requirements for both industry professionals and government oversight staff. First, Suffolk County established a comprehensive training program that provides endorsements to the liquid waste industry for the installation and maintenance of I/A OWTS. Industry professionals who wish to install and maintain I/A OWTS in the county must receive the appropriate endorsements as codified in Article 19 of the Suffolk County Sanitary Code. Although not mandatory, training classes are also provided to design professionals.

In 2016, Suffolk County established the Article 6 Work Group to review, comment, and guide proposed revisions to the Suffolk County Sanitary Code focused on the reduction of nitrogen from onsite wastewater sources in Suffolk County. Under the guidance of the Article 6 Workgroup, re-commended sanitary code changes were grouped into two phases as shown on **Figure 1-18.** Phase I changes included "no regret" policy options that could be implemented immediately. Phase I policy options generally included policy changes that could move forward without the need for a stable and recurring revenue source and without waiting for the identification of wastewater upgrade priority areas. Phase I sanitary code changes are discussed further in Sections 1.1.4.8 and 8.1.2. Phase II policy options generally include sanitary code changes that would require I/A OWTS installation under certain conditions. Potential code amendments for increasing the minimum lot size in Suffolk County were also considered. Because the Phase II policy options resulted in the potential to add significant system upgrade costs, it was concluded that recommendations for Phase II policy options should be tied to the findings of this SWP. The conclusion acknowledged that the SWP would provide recommendations that considered installations within the highest priority areas first, industry and Responsible Management Entity (RME) readiness, and the potential range of stable and recurring revenue needed to offset wastewater upgrade costs to existing property owners.

Additional program milestones in 2016 included the adoption of Article 19 of the Suffolk County Sanitary Code and the start of the development of the SWP. A historic first in Suffolk County, Article 19 enabled the voluntary use of I/A OWTS in Suffolk County and set forth a framework for ensuring the new technologies were properly tested, installed, and maintained.

Building on that momentum, Suffolk County in 2017 announced the first ever Septic Improvement Program which provided grants and low-cost loans to qualified homeowners for the installation of I/A OWTS. Finally, in acknowledgement of Suffolk County's leadership in efforts to combat nitrogen from OSDS, New York State announced the award to the County of over $10 million of $15 million available statewide in grant funding from the New York State Septic Replacement Program.

A description and overview of each of these historic milestones and flagship programs is provided below.

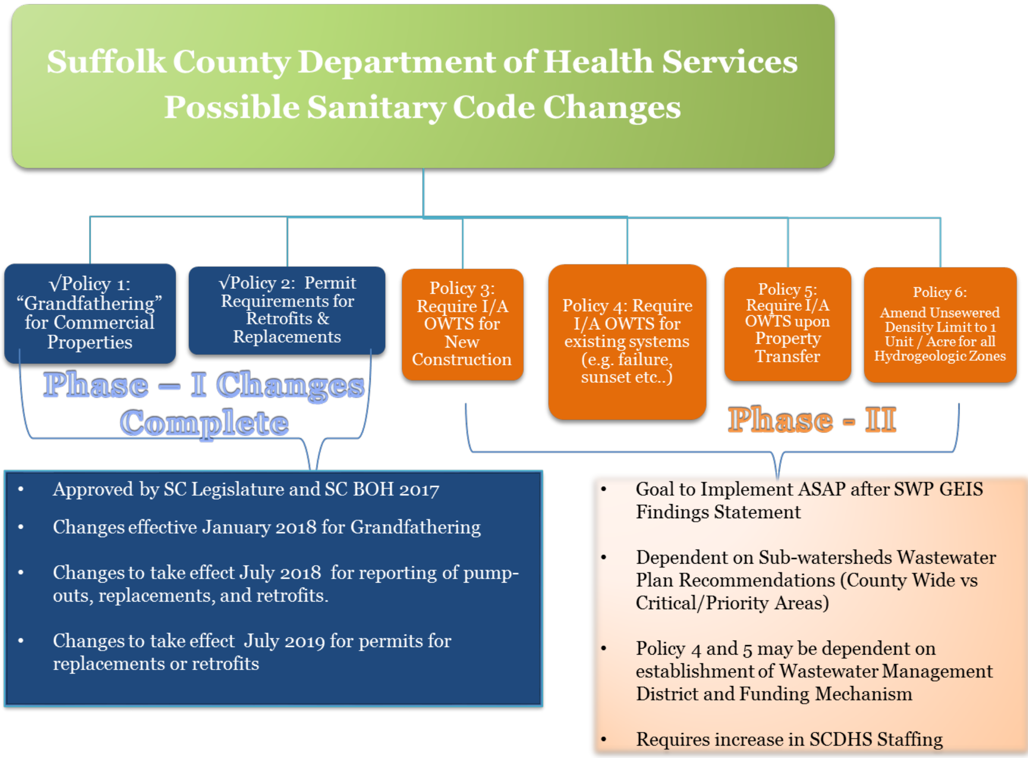


Figure 1-18 Potential Suffolk County Sanitary Code Changes

1.1.6.4.1 I/A OWTS Septic Demonstration Program

In April of 2014, Suffolk County issued the first Request for Expression of Interest (RFEI) for a Demonstration Program of I/A OWTS. This Demonstration Program, designed to evaluate the performance of I/A OWTS in Suffolk County and to begin the creation and promotion of a local I/A OWTS business market, included three primary stages:

1.) The donation of I/A OWTS by participating manufacturers that responded to the RFEI. I/A OWTS technologies participating in the Demonstration Program must have NSF 246 certification or EPA ETV approval for nitrogen reduction;

2.) A homeowner lottery that identified awarded homeowners who would receive a free state-of-the-art I/A OWTS utilizing the donated I/A OWTS; and

3.) Demonstration of the technologies' ability to reduce total nitrogen in the Suffolk County climate through rigorous testing of the systems.

A resounding success, the first RFEI resulted in a total of 19 systems that were donated from four manufacturers representing six different technologies. Following the Countywide lottery for the interested homeowners, the systems were installed between June 2015 and April 2016 and five of the Phase I technologies have received Provisional Approval as of February 2020. A summary of the I/A OWTS technologies installed during Phase I is provided in **Table 1-9** and on **Figure 1-19**.

Table 1-9 Technologies Piloted in Phase I of the Suffolk County I/A Septic System Demonstration Program

Technology	Status
Hydro-Action AN Series	Provisionally Approved September 2016
Norweco Singulair TNT	Provisionally Approved October 2016
Orenco AdvanTex AX-RT	Provisionally Approved March 2017
Norweco HydroKinetic	Provisionally Approved in April 2017
Orenco AdvanTex AX20	Provisionally Approved September 2019
BUSSE MF MBR	Still in Pilot Phase

Based upon the success of Phase I of the Demonstration Program, Suffolk County issued an RFEI for a Phase II Demo Program in which a total of seven manufacturers donated eight technologies which were installed on 21 residential sites. On July 26, 2016, 21 homeowners were selected from a lottery and the Phase II systems were installed from November 2016 through the spring of 2018. **Table 1-10** and **Figure 1-20** summarize the technologies included in the Phase II Demo Program.

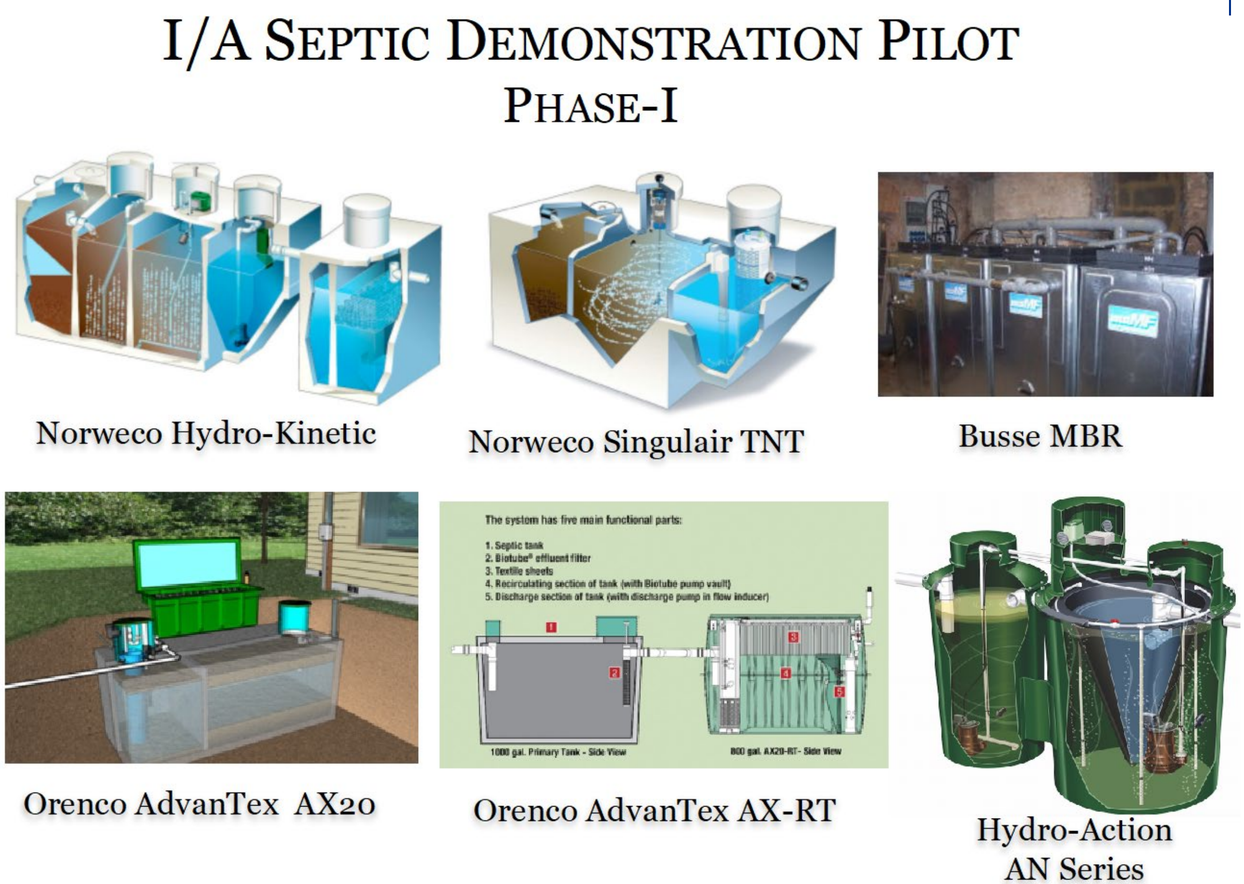


Figure 1-19 Technologies Piloted in Phase I of the Suffolk County I/A Septic System Demonstration Program

Table 1-10 Technologies Piloted in Phase 2 of the Suffolk County I/A Septic System Demonstration Program

Technology	Status
EcoFlo Coco Filter + Denite Polishing Unit	Provisionally Approved September 2019
Amphidrome	Projected Provisional Approval in 2020 (once documents are received)
Pugo Systems	Projected Provisional Approval in 2020 (once documents are received)
FujiClean CEN	Provisionally Approved January 2018
Waterloo BioFilter	Still in Pilot Phase
BioMicrobics BioBARRIER	Projected Provisional Approval in 2020 (once documents are received)
BioMicrobics SeptiTech STAAR	Provisionally Approved in July 2018
Nitrogen Reducing Biofilters	Still in Experimental Phase

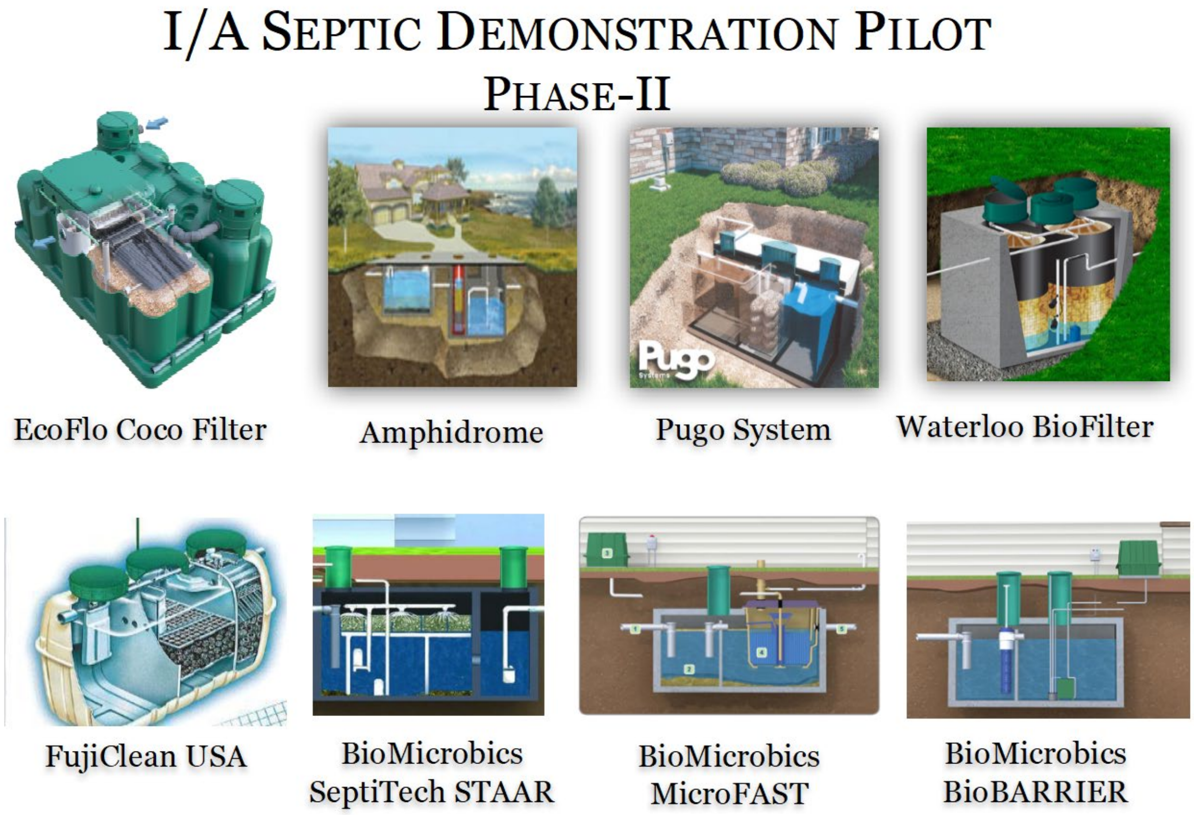
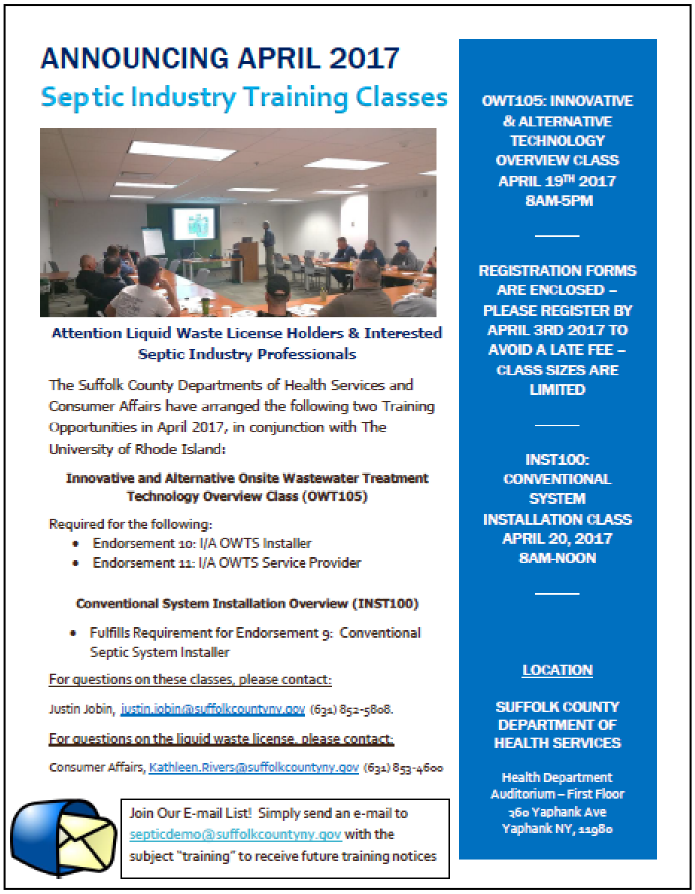


Figure 1-20 Technologies Piloted in Phase 2 of the Suffolk County I/A Septic System Demonstration Program

As discussed previously, the demonstration programs give I/A OWTS manufacturers the opportunity to showcase and demonstrate single family residential onsite wastewater treatment system technologies in Suffolk County—at no cost to the County and participating homeowners — to test the viability of these systems under local conditions and to potentially expedite provisional approval of those technologies. As of February 2020, eight of these technologies had been approved for Provisional Use in Suffolk County and several more technologies are expected to be approved in 2020.

1.1.6.4.2 Suffolk County I/A OWTS Industry Training

Industry training is one of the most important steps when starting a new program incorporating new technologies such as I/A OWTS. I/A OWTS that are installed and maintained without trained operators can lead to malfunction and failure and tarnish an otherwise proven technology. One of the very first actions the County took was to revise the Liquid Waste Licensing Law to create new endorsements on the Liquid Waste License and establish training requirements for each endorsement. A total of ten endorsements are now established under the new training program as follows:



1. Septic Tank Pumping, Cleaning, and Maintenance;
2. Grease Trap Cleaning and Maintenance;
3. Yellow Grease / Fryer Oil Collection;
4. Temporary Restroom Facilities;
5. Waste Line Cleaning and Inspection;
6. Bulk Liquid Waste Transportation;
7. Vactor Services;
8. Conventional Septic System Installation;
9. I/A OWTS Installer;
10. I/A OWTS Maintenance Provider

The Suffolk County Licensing Law also requires installers be certified by the manufacturer of the I/A OWTS technology they are installing. To ensure that installers receive the appropriate training required to properly install and maintain I/A OWTS, Article 19 of the Suffolk County Sanitary Code mandates that installers receive the appropriate endorsement(s) prior to providing I/A OWTS installation and/or maintenance services in Suffolk County. In addition, to ensure installers and maintenance providers are kept current on I/A OWTS installation and maintenance practices, continuing education requirements are now required upon every 2-year liquid waste license renewal. The SCDHS has created the following continuous education classes:

- Two tours of installed I/A OWTS;
- Two overview classes on Sanitary Code changes;
- Two Septic Haulers Information Portal roll-out meetings; and,
- Overview of Construction Standards and Alternative Leaching.

As of December 31, 2018, 21 training classes have been held plus 12 continuing education sessions and tours. A total of 830 participants have taken part in the SCDHS I/A OWTS industry training and continuing education sessions. Finally, a total of 51 liquid waste providers have received the I/A OWTS Installer endorsement and a total of 41 liquid waste providers have received the I/A OWTS Maintenance endorsement.

1.1.6.4.3 Article 19 of the Suffolk County Sanitary Code

Marking a historic first for wastewater management in Suffolk County, the Suffolk County Legislature enacted Article 19 of the Suffolk County Sanitary Code in 2016. For the first time, Article 19 permitted the use of I/A OWTS in Suffolk County. In addition, it set forth the requirements for:

- Testing and approval requirements for new I/A OWTS in Suffolk County;
- Operation and maintenance (O&M) requirements for I/A OWTS;
- Establishment of a Responsible Management Entity (RME) to provide regulatory oversight of system design, installation, and long-term O&M of I/A OWTS; and,
- Annual reporting requirements.

Suffolk County has the most rigorous I/A OWTS testing and approval program in the nation. The testing and approval process established under Article 19 includes a multi-tiered approval process based on the Massachusetts I/A OWTS program and consists of four phases: experimental, piloting, provisional and general use approval. The level of approval determines both the number of installations allowed and the frequency of monitoring for the technology. For example, in the Provisional Use phase, there is no cap on the number of systems that can be installed but the first 20 year-round residential systems have to be monitored and sampled every 60 days for two years. If the two-year average effluent concentration meets Suffolk County's performance standard of 19 mg/L of total nitrogen the technology may be certified for General Use Approval.

Similarly, Article 19 also outlined an approval process for Commercial Systems that also consists of four phases. However, in the Provisional Phase commercial parcels are broken out into the following subcategories:

- Office, retail, industrial, gym and dry goods;
- Restaurants, coffee shops, and other kitchen / fats, oils, and grease (FOG) waste;
- Multi-tenant residential;
- Institutional use; and
- Medical use.

Four systems must be installed and successfully implemented in each subcategory in order for General Use approval to be granted for those specific subcategories.

As of March 2019, the systems approved for use in Suffolk County are listed in **Tables 1-11**, **1-12** and **1-13**.

Table 1-11 List of Experimental Approved Technologies in Suffolk County

Technology Name	# of Systems Approved	Max # of Systems Allowed	Approval Date
Orenco AdvanTex + Nitrex System	0	5	7/20/2017
Waterloo Biofilter + Nitrex System	0	5	7/20/2017
BioMicrobics SeptiTech + Nitrex System	0	5	7/20/2017
Nitrogen Reducing Biofilter - Lined	3	5	7/15/2016
Nitrogen Reducing Biofilter - Unlined	3	5	7/15/2016
Nitrogen Reducing Biofilter – Denite Tank "Box"	1	5	7/15/2016

Table 1-12 List of Pilot Approved Technologies in Suffolk County

Technology Name	# of Systems Approved	Max # of Systems Allowed	Approval Date
ECOPOD-N Series	0	12	7/20/2017
Hoot-ANR	0	12	11/30/2018

Table 1-13 List of Provisionally Approved Technologies in Suffolk County

Technology Name	Approval Date
Hydro-Action AN Series	9/28/2016
Norweco Singulair TNT	10/7/2016
Orenco AX-RT	3/1/2017
Norweco Hydro-Kinetic	4/21/2017
Fuji Clean CEN	1/19/2018
SeptiTech STAAR	7/23/2018
EcoFlo Coco Filter + Denite Polishing Unit	9/26/2019
Orenco AX-20	9/26/2019

As shown above, there are currently six experimental technologies approved to undergo testing in Suffolk County; two approved technologies in the piloting phase; and eight technologies that have achieved Provisionally Approved status. Based on current data trends, Suffolk County anticipates that an additional three technologies could achieve Provisionally Approved status during 2020.

Currently, the SCDHS Division of Environmental Quality serves as the RME. The RME has the authority and responsibility to enforce the requirements of Article 19 and associated Standards. This includes tracking the status of O&M contracts, registrations, and contractor sampling and issuing Notice of Violations and fines if not resolved. The RME also has authority to revoke or suspend a technology's approval in the event of non-performance or non-compliance. Licensed contractors in violation of the Standards can also be fined and referral made to the RME of Labor, Licensing, and Consumer Affairs. A detailed summary of the current RME structure and responsibilities is provided in **Table 1-14**.

Table 1-14
SUFFOLK COUNTY'S RECLAIM OUR WATER INITIATIVE
RESPONSIBLE MANAGEMENT ENTITY OPERATION & ORGANIZATION
AS ESTABLISHED IN ARTICLE 19 OF THE SUFFOLK COUNTY SANITARY CODE

RME COMPONENT	ADMINISTRATION	TECHNOLOGY	TRACKING / DATA MANAGEMENT	PROMOTING I/A OWTS	ENFORCEMENT & COMPLIANCE	PUBLIC OUTREACH	INDUSTRY LICENSING, TRAINING, & OUTREACH	INTEGRATION WITH SUBWATERSHEDS PLAN
INVOLVED DEPARTMENTS	Health Department Administration, Office of Ecology	Office of Ecology, Office of Wastewater Management	Department of IT Office of Ecology, Office of Wastewater Management	Office of Ecology, Office of Wastewater Management, Health Department Contracts Unit, Suffolk County Department of Law	Office of Ecology, Office of Wastewater Management. Department of Labor, Licensing, and Consumer Affairs	Office of Ecology	Office of Ecology, Office of Wastewater Management. Department of Labor, Licensing, and Consumer Affairs	Office of Ecology
DUTIES & RESPONSIBILITIES	SCUPE program administration, supervision, coordination. Oversight of RME operation and organization. Coordinate RFPs, procurement, and contracts for RME initiatives. Manages budgets and finance related to SCUPE, SIP, and RME Expenditures	Field sampling, performance tracking and compliance, evaluation and review of technologies for approval in Suffolk County. Interface with Consumer Affairs on training and continuing education requirements. Oversee and track registration, O&M contracts, and services events for all installed I/A OWTS. Trouble shoot performance and maintenance issues and oversee corrective action plans to improve performance. Prepare data evaluation of demonstration, piloting, provisional and general use systems and request corrective action plans or suspend approval in accordance with Dept. Standards	Coordination with IT on the creation, organization, and implementation of EHIMS integrated data management system. Future operation of RME web-based portal for reporting of performance data, O&M, and homeowner registrations. Tracking and organization of system performance, number of systems, O&M, and property owner registrations.	Septic Improvement Program and State Septic System Replacement Program administration. Goal of issuing 1,000 grants per year. Staff process application intake, grant issuance, and issuance of grant agreements. Coordination with OWM plan approval and system installation. Processing Grant payments to vendors, designers, and property owners. Promote I/A OWTS by streamlining permitting and installations in instances of catastrophic failure.	Plan review, site visits with designers and installers, field inspections, and compliance with Department Standards. System sampling and monitoring. Enforcement of Construction Standards, I/A OWTS Standards, O&M, Performance, and Property Owner Registrations. Ability to issue NOV's, orders on consent, fines, and cross coordination with Department of Labor, Licensing, and Consumer Affairs for potential suspension of LW license.	ReclaimOurWater.info website created to distribute information to residents. The website contains information on the Septic Improvement Program, I/A OWTS Technologies, news and upcoming events, I/A performance data, Annual technology reports, links to the Sanitary Code and Department Standards related to I/A OWTS.	Ecology staff hold industry training and stakeholders meetings on changes in regulations, conventional septic system installations, I/A OWTS tours, overview class and other continuing education opportunities in accordance with the Liquid Waste Licensing Law adopted by the Suffolk County Legislature in December of 2015, which became effective in June 2016. Staff also interface and act as a liaison	Staff will make adjustments to the I/A OWTS and RME Programs based on the recommendations of the Subwatersheds Wastewater Plan. For example, the priority areas currently identified as part of the Septic Improvement Program will be changed to reflect findings of the SWP. In addition, Staff will revise standards to allow for Nitrogen and Phosphorous polishing units as recommended in the SWP, and adjust I/A OWTS performance standards as needed to meet recommended load reduction goals.

1.1.6.4.4 Revision to Leaching Alternatives

Another recent advancement toward the progression of advanced wastewater treatment in Suffolk County included update of the construction standards in 2016 to facilitate the use of alternate leaching technologies. As discussed previously, historic construction standards for OSDS set forth design requirements for the use of leaching pools as means of conveying septic tank effluent back into the groundwater. While leaching pools are an efficient means of recharging effluent wastewater into the aquifer, they provide little, if any, treatment benefit for nitrogen removal and other contaminants such as CECs. Requirements were set forth for alternate leaching requirements under two revisions to the standards:

- September 2016 – Construction standards were amended to reference New York State Appendix 75-A **Wastewater Treatment Standards** and the New York State Department of Health (NYSDOH) "**Residential Onsite Wastewater Treatment System Design Handbook**", Appendix C. This revision defined requirements for use of gravelless chambers and gravelless geotextile sand filters; and,

- December 2017 – Construction standards were amended again to define requirements for the use of Pressurized Shallow Drainfields (PSDs) following an I/A OWTS. **Figure 1-21** provides both a conceptual overview and a photograph of a PSD. This change also incorporated procedures for conducting a percolation test in accordance with State regulations. For purposes of these standards, all I/A OWTS preceding PSDs must fall within one of the following categories:

  - Category 1 Technologies: I/A OWTS that have been classified by the Department as meeting effluent standards less than or equal to 20 mg/L for both BOD and TSS and 5 mg/L for fats, oils and greases (FOG); or,

  - Category 2 Technologies: I/A OWTS that have been classified by the Department as meeting effluent standards less than or equal to 30 mg/L for both BOD and TSS and 5 mg/L FOG.

The December 2017 revision to the standards also facilitated the use of alternate PSD configurations.

The use of alternative leaching technologies has several potential benefits when compared to traditional leaching pools under certain site conditions. Potential benefits of alternate leaching technologies include:

- Up to an additional 30 percent reduction in denitrification using gravity-based alternate leaching methods such as gravelless chambers and gravelless geotextile sand filters in silty and loamy soils;

- Up to an additional 50 percent reduction in denitrification using PSDs;

- Removal of phosphorus ("Nitrogen and Phosphorus Treatment and Leaching from Shallow Narrow Drainfield", Holden et al);

- Degradation of CECs that are capable of breaking down biologically (http://1o44jeda9yq37r1n61vqlgly.wpengine.netdna-cdn.com/wp-content/uploads/2019/04/Heufelder_CEC.pdf); and,
- More cost effective in locations with shallow groundwater where retaining walls may otherwise be required.

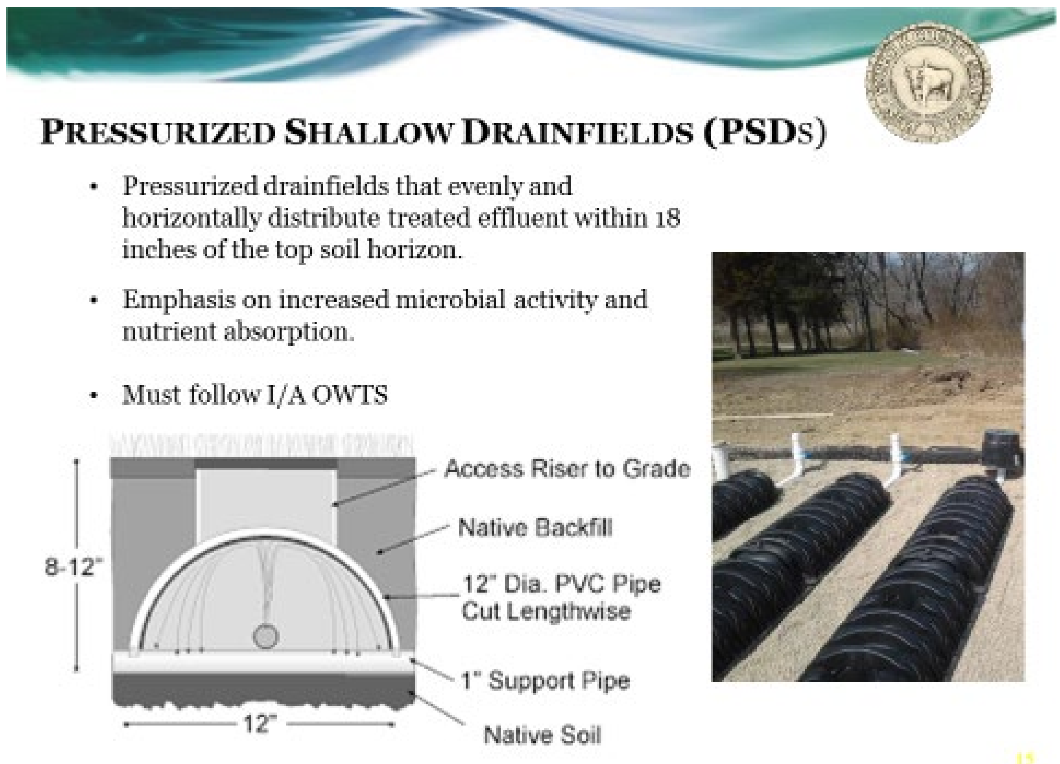


Figure 1-21 Pressurized Shallow Drainfields

The denitrification efficiency of shallow leaching systems will depend, in part, on the amount of nitrification that is achieved in the preceding treatment unit. While shallow leaching systems offer several benefits, the required footprint in locations with percolation rates may exceed the footprint required for conventional vertical leaching pools. In addition, because these technologies are new in Suffolk County, policymakers should consider allowing for an industry acclimation/training period before setting forth requirements for their use, particularly for PSDs, which require careful design and installation for proper operation.

1.1.6.4.5 Suffolk County and New York State Septic Improvement Program

In 2017, County Executive Steve Bellone announced the Suffolk County Septic Improvement Program (SIP), the first grant and loan incentive program for I/A OWTS to be launched in New York State. In addition to promoting the use of I/A OWTS in Suffolk County, the SIP acts as a pilot program for the eventual implementation of a larger Countywide phased septic upgrade program, should a recurring revenue source be established. Under the SIP, homeowners who decide to replace their cesspool or septic system with the new I/A OWTS may be eligible for combined grants of up to $30,000. Grants are disbursed through a combination of two funding sources. The Suffolk

County portion of the funds is derived from the Suffolk County ¼% Drinking Water Protection Program for Environmental Protection (Fund 477). The County provides up to $20,000 in SIP funds per eligible parcel, including a base grant of $10,000 with a $5,000 incentive for Low-to-Moderate income property owners and an additional $5,000 for those homeowners who utilize PSDs following their I/A OWTS.

The State portion of the funds is from the State Septic System Replacement Program (SSRP). In 2018, New York State announced the award of $10.025 million to Suffolk County from the New York State Septic Replacement Fund. The $10.025 million award represents the single largest disbursement – nearly 70 percent - of the $15 million made available statewide. The disbursement demonstrates New York State's commitment to and support of ongoing wastewater upgrade efforts in Suffolk County. The SSRP funds are available to residents in grants of up to $10,000 toward the purchase of an I/A OWTS. In addition to these grants, homeowners can qualify to finance any remaining cost of the systems over 15 years at a low three percent fixed interest rate through loans administered by the Community Development Corporation of Long Island Funding Corp.

Interest in the SIP has been strong since the program was introduced in 2017. A summary of key program statistics, including a breakdown of SIP applications received by month since the inception of the program is provided below on **Figure 1-22**. The red line at the bottom of **Figure 1-22** represents the initial program capacity to process 17 applications per month based upon the County SIP (July 2017 through January 2019). The red line at the top of the figure represents the expanded program capacity, including the SSRP, to process 80 applications per month. Prior to the program launch in July 2017, County staff participated in various town hall outreach presentations where potential applicants were urged to preregister for the septic improvement program. These outreach sessions proved successful, as there were 56 applicants in July of 2017, which was the second busiest month of the program to date. Interest in the program dropped off in February 2018 with the announcement of the New York State SSRP. Many homeowners learned of the infusion of state grant funds for septic system replacement and delayed progress with the County grant program until they confirmed how the two programs would complement each other.

In October of 2018, the County issued a press release stating that homeowners would be able to combine County and State grants for a combined amount of up to $21,000.00 towards the purchase of an I/A OWTS. Interest in the program increased significantly with this announcement. Simultaneously, County staff began working to amend the local law that established the County program to expand both eligibility requirements and amount of funding available. The revised law was adopted by the Suffolk County Legislature in December of 2018 and became effective on

January 22, 2019. At this time, County and State grants can be combined for a total amount of up to $30,000 towards the purchase and installation of an I/A OWTS. In addition, the County's budget included increased staffing for SCDHS to administer the expanded program, which is expected. to increase the amount of grant recipients from 200 per year to 1,000 per year. Over the first six weeks of the expanded program, nearly 100 homeowners applied for grants. Interest continues to grow, and it is expected the program will reach its monthly capacity in April of 2019.

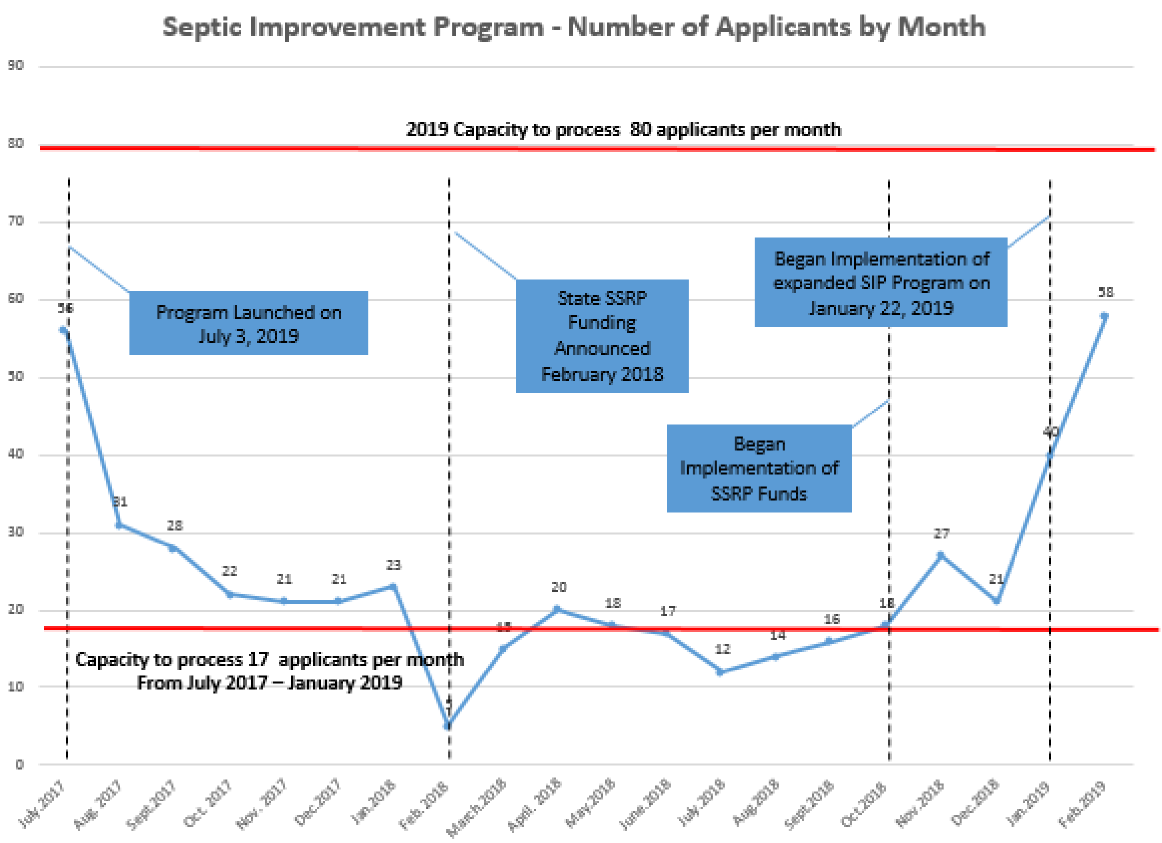


Figure 1-22 Septic Improvement Program Applicants

1.1.6.4.6 Town and Village I/A OWTS Mandates and Rebate Programs

Select individual Towns and Villages have also taken proactive measures to reduce nitrogen from OSDS within their respective jurisdictions by setting forth local laws requiring the installation of I/A OWTS and/or by offering an I/A OWTS rebate program using Community Preservation Funds (CPF). A summary of the individual rebate programs is provided below in **Table 1-15.** A summary of individual Town/Village I/A OWTS mandates is provided in **Table 1-16**.

Table 1-15 Summary of Town I/A OWTS Community Preservation Fund Rebate Program

Town of Southampton, CPF Rebate	Town of East Hampton, CPF Rebate	Town of Shelter Island, CPF Rebate
▪ Rebates up to $20,000 ▪ Residential & Non-residential in high and medium priority areas are eligible ▪ No restrictions on ownership ▪ Seasonal properties, rental properties & second homes ARE eligible ▪ New construction is eligible ▪ Income eligibility requirements in place ▪ No restrictions related to home occupations ▪ No covenants required	▪ Rebates up to $20,000 in the Water Protection District or for homeowners who qualify for affordable housing ▪ Rebates up to $15,000 for all other eligible applicants ▪ Residential and commercial property owners eligible ▪ No restriction on ownership ▪ Second homeowners and rental properties are eligible ▪ New construction not eligible ▪ Income eligibility for residential owners based on NYS STAR Program	▪ Rebates of up to $15,000 to residential property owners ▪ No restrictions on ownership ▪ Seasonal properties, rental properties, & second homes are eligible ▪ No covenants required

As shown in **Table 1-15**, the Towns of Southampton, East Hampton, and Shelter Island have established I/A OWTS rebate programs to offset the cost of installing I/A OWTS within their respective jurisdictions. Rebate funds are generated through the CPF. The CPF was initially established by voter referendum in 1998, when voters in East Hampton, Riverhead, Shelter Island, Southampton and Southold approved a real estate transfer tax of two percent on each transaction occurring in these towns. On November 8, 2016, voters in the five East End Towns extended the CPF to 2050 and also added the opportunity for each Town to invest up to 20 percent of the funds toward water quality improvement projects, which includes funding for the I/A OWTS rebate programs.

When combined with funding from the Suffolk County SIP and NYS SSRP, qualifying property owners living within the three participating I/A OWTS CPF Rebate townships can receive funding of up to $50,000 to offset the cost of I/A OWTS on their property.

As shown in **Table 1-16**, four towns and four villages in Suffolk County have adopted laws mandating the installation of I/A OWTS under certain circumstances. Mandates requiring I/A OWTS for all new construction have already been adopted by the Town of East Hampton, Town of Shelter Island, Village of East Hampton, Village of Sag Harbor, and Village of Quogue. The jurisdictions requiring I/A OWTS at new construction generally also require upgrades to I/A OWTS for any major building expansion. The remaining jurisdictions identified in **Table 1-16** have similar I/A OWTS mandates but have limited their current mandates to projects located within high priority areas (e.g., typically within close proximity to surface waters). While most mandates are focused on I/A OWTS at residential properties, the Town of East Hampton has extended the mandate to commercial projects as well.

Table 1-16 Summary of Existing I/A OWTS Mandates in the Towns and Villages of Suffolk County

Jurisdiction	Description of I/A OWTS Upgrade & Install Mandates	Effective Date
Town of East Hampton	An I/A OWTS shall be required for the following projects: - All new residential and commericial construction; - Any voluntary replacement of an existing system; - Any substantial expansion (50% increase in GFA or value) of existing residential and commercial buildings; or - All nonresidential properties that require site plan review.	1/1/2018
Village of East Hampton	An I/A OWTS shall be required for the following residential projects: - All new construction or reconstruction of new single-family or multiple family residences or buildings capable of being used as a residence, - Any substantial expansion (25% increase in GFA) of existing residential buildings; or - Any construction that increases the number of bedrooms beyond the number authorized in previous SCDHS permits.	2/7/2019
Town of Southampton	The following residential projects located within the High Priority Area require an I/A OWTS: - All new residential construction; - Any substantial sanitary system upgrade required by the SCDHS; - An increase in 25% of the floor area of a residential building; or - When required by the Town Conservation Board or the Environment Division.	10/1/2017
Village of Sag Harbor	An I/A OWTS shall be required for the following projects: - All new residential construction; - Any substantial septic system upgrade or replacement of a residential septic system required by SCDHS; - An increase of 25% or more in the floor area of a residential building; - Any new residential septic system or substantial upgrade required by the Harbor Committee; or - All nonresidential properties that require site plan review.	3/12/2019
Village of North Haven	An I/A OWTS shall be required for the following projects: - All new residential construction; - Any substantial septic system upgrade required by SCDHS; - An increase of 25% or more in the floor area of a building; or - Any improvement to an existing residential building that will result in an increase in gross floor area of the residential building by 1,000 square feet or more; - Any improvement to an existing residential building that includes the elevation of a residential building to comply with FEMA requirements; or - Any improvement to an existing residential building that will result in an increase in the number of bedrooms beyond the number of bedrooms authorized by a permit previously issued by the SCDHS.	6/11/2019
Village of Southampton	An I/A OWTS approved by the SCDHS shall be required for the following residential projects located within the high-priority area and medium-priority area as identified in the Town of Southampton Community Preservation Fund Water Quality Improvement Project Plan: - All new residential construction; - Any substantial septic system upgrade required by the SCDHS or the Village Zoning Board of Appeals pursuant to a wetlands (natural resource) special permit under Article IIIA of the Zoning Code; or - Any increase in the number of bedrooms in an existing residence.	12/1/2017
Village of Quogue	An I/A OWTS shall be required for the following residential projects: - All new residential construction; - Any substantial septic system upgrade in a high-priority area or a medium-priority area; - An addition or renovation to an existing residence that results in an increase of 25% or more in the gross floor area (as defined in § 196-49) of such residence; or - A substantial renovation to an existing residence (whether or not the gross floor area is increased), the cost of which, as determined in connection with the granting of a building permit, exceeds $500,000.	3/18/2018
Town of Shelter Island	An I/A OWTS approved by the SCDHS shall be required for the following projects: - Any new residential construction with greater than 1500 square foot living areas; or - Any residential or commercial septic system upgrade required by the SCDHS.	3/23/2018
Town of Brookhaven	An I/A OWTS shall be required for the following residential projects for properties located in the Nitrogen Protection Zone (500' from a body of water): - New construction of a residential dwelling; or - Major addition that increases the amount of bedrooms or bathrooms.	1/1/2017

1.1.6.5 Sewage Treatment Plants and Sewering

Sewage Treatment Plants (STPs) and sewering are the required means of wastewater management for projects where the existing or proposed land use exceeds the density requirements set forth in Article 6 of the Sanitary Code. STPs must be designed to have a maximum effluent nitrogen concentration of 10 mg/L based on State Pollutant Discharge Elimination System (SPDES) permit limits based on groundwater criteria identified in Chapter 6 of New York Code Rules and Regulations Parts 700-706. As a result of recent actions by SCDHS that facilitated STP upgrades and repairs, the reduction of nitrogen in STPs countywide has far surpassed regulatory requirements in many cases, and the overall compliance rate with NYSDEC effluent requirements is outstanding. Recent observations and trends include:

- Sewage Treatment Plant permit compliance has improved significantly:
  - Overall tertiary STP compliance with the 10 mg/L limit was 35 percent in 1990 percent and is now 93.7 percent (based on plants in steady-state);
- Key Performance Indicators improving (2011-2017):
  - Effluent Total Nitrogen (TN) concentrations for plants in steady-state is down from 9.9 mg/L in 2011 to 6.3 mg/L in 2017 using data from all 175 tertiary plants in steady-state in 2017 (6.6 mg/L if the seven STPs not in steady-state were included in the average); and,
  - Effluent TN average is 5.5 mg/l for the 165 low risk tertiary plants.

"Standards for Approval of Plans and Construction for Sewage Disposal Systems for Other Than Single-Family Residences" Appendices A and B outline the construction requirements for new sewage treatment plants. Appendix A is geared towards plants with flows less than or equal to 15,000 gallons per day while Appendix B is for plants with flows greater than 15,000 gallons per day. The major difference between the two appendixes is the setback requirements. **Table 1-17** outlines the differences in setbacks between Appendix A and B facilities. Enclosed STPs with flows less than or equal to 15,000 gallons per day with the installation of an odor control system (usually carbon drum filters) have the least restrictive setback requirements. In certain cases, enclosed STPs with odor control with flows less than 15,000 gpd may qualify for reduced setbacks to property lines to a minimum of 25 feet when the property line borders a major highway, railroad tracks, recharge basin, or areas designated as permanent open space.

Table 1-17 SCDHS STP Setback Requirements

Required Setback Distance of Sewage Treatment Plants SCDHS Standards for Approval for Sewage Disposal Systems For Other Than Single-Family Residences Appendix A vs Appendix B			
	Distance to Habitable Structure (feet)	**Distance to Non-Habitable Structure (feet)**	**Distance to Property Lines (feet)**
Enclosed STP w/ Odor Control (Less Than or Equal to 15,000 GPD – Appendix A)	75	50	75

Required Setback Distance of Sewage Treatment Plants SCDHS Standards for Approval for Sewage Disposal Systems For Other Than Single-Family Residences Appendix A vs Appendix B			
Enclosed STP w/o Odor Control (Less Than or Equal to 15,000 GPD – Appendix A)	200	100	150
Enclosed STP (Greater Than 15,000 GPD - Appendix B)	200	200	150
STP Open to the Atmosphere (Greater Than 15,000 GPD - Appendix B)	400	400	350
Distance to Leaching Structures (or expansion area)	25	25	25

The types of systems installed meeting Appendix A requirements are normally considered package systems. Two systems, which are currently being installed in Suffolk County are the CromaFlow (formerly known as Cromaglass) treatment system and the biologically engineered single-sludge treatment processes (BESST) (See **Figure 1-23**).

Figure 1-23 CromaFlow (Left) and BESST (Right) Treatment Tanks

Appendix A STPs represent an important tool in the toolbox of wastewater management in Suffolk County because they can accommodate reduced setbacks, are capable of achieving less than 10 mg/L total nitrogen and can be used as a central wastewater treatment method for existing properties where implementation of full-scale sewering (e.g., Appendix B systems) and/or upgrades to individual properties through I/A OWTS are not viable options. For example, the minimum lot size to site an Appendix B system is approximately four acres while the minimum lot size to accommodate an Appendix A system is 0.75 acres. Despite the existing accommodation for reduced setbacks, industry professionals and stakeholders have expressed that the use of Appendix A systems is limited in Suffolk County by:

- The maximum flow limitation of 15,000 gpd. Many projects that could benefit from advanced wastewater treatment hit a dead end because their flows exceed 15,000 gpd and the additional costs associated with going to a full-scale Appendix B system are not economically feasible to the property owner(s);
- Existing setbacks preclude retrofits of existing properties in many cases because there is insufficient land availability to meet the setbacks. This is especially prevalent in downtown commercial areas and on existing (grandfathered) parcels with limited space to install an advanced treatment unit; and,
- The existing administrative/permitting framework for Appendix A systems is cumbersome, particularly for existing parcels with multiple owners who wish to install a new Appendix A treatment plant.

Recommendations to offset the concerns identified above and facilitate more expanded use of Appendix A systems are provided in Sections 2.2.3.2 and 8.1.2 of this SWP.

As of 2017, Suffolk County had 200 operational STPs. Of the 200 STPs, 39 STPs are considered municipal or industrial STPs, and the rest are considered decentralized STPs that are privately owned and operated. Fourteen sewage treatment plants discharge directly to surface waters. The SCDHS' Sewage Treatment Plant Bureau, under dedicated authority by NYSDEC, inspects and oversees all of the privately owned STPs in the County. The plants operate under a SPDES Permit issued by NYSDEC. Municipal plants are enforced by NYSDEC and privately-owned plants are enforced by SCDHS.

The majority of STPs in Suffolk County are considered "tertiary plants" and are capable of reducing Biochemical Oxygen Demand (BOD_5), Total Suspended Solids (TSS), and Total Nitrogen (TN) (See **Table 1-18** at the end of this section). There are 183 tertiary STPs that are designed to remove nitrogen from wastewater with typical effluent total nitrogen of 10 mg/l or less. The 2017 average effluent total nitrogen for the all tertiary plants in steady-state was 6.3 mg/L, less than the permitted 10 mg/L. These numbers indicate that the vast majority of the STPs in the County achieved the efficiency necessary to consistently operate at the required and desired performance level. The remaining 17 STPs are considered "secondary plants" capable of reducing BOD_5 and TSS. These plants pre-date SPDES total nitrogen removal requirements. Most of the secondary treatment plants are in the process of transition to tertiary plants and are projected to upgrade their facilities with nitrogen removal technology by the end of 2019. In 2017, 11 of these secondary treatment plants were under order on consent to replace their facility with either a new plant or to connect to an existing sewer district.

SCDHS requires installation of monitoring wells at each STP that discharges to groundwater in order to detect any impacts to groundwater caused by the discharged effluent. Groundwater monitoring data is reported on a quarterly basis on the required discharge monitoring report (DMR) and if an increase in total nitrogen is observed downgradient from a STP, SCDHS can issue an order on consent to upgrade a facility. SCDHS uses this data to mandate that a secondary treatment plant be updated to tertiary treatment. SCDHS prepares an annual report on the status of STPs in the County. **Table 1-19** includes some of the key performance indicators used to review trends in the annual report.

Table 1-19 Key Performance Indicators from the 2017 STP Report

	2011	2012	2013	2014	2015	2016	2017
Number of High-Risk Facilities	N/A	60	50	50	38	26	28
Total Nitrogen (All Tertiary STPs in Steady State) in mg/l	9.9	8.6	8.7	7.8	7.6	5.95	6.3
Percent of Tertiary STPs meeting NYS Discharge limits for Total Nitrogen (All Tertiary STPs in Steady State)	71.0%	79.6%	82.8%	85.0%	85.8%	95.3%	93.7%

There are approximately 23 centralized STPs located in Suffolk County. Some of the major centralized sewer districts in the County are Bergen Point (Southwest Sewer District #3), Selden (Sewer District #11), Town of Riverhead, and Village of Patchogue, which serve multiple individually owned tax lots and are operated by municipalities. The Bergen Point wastewater treatment plant (WWTP), the largest treatment plant in Suffolk County with an operating capacity of 30 million gallons per day (MGD), is currently under construction to expand the plant to 40.5 MGD. The Bergen Point WWTP, shown on **Figure 1-24**, is the County's only regional facility and is a secondary plant that discharges treated effluent two miles south of Fire Island into the Atlantic Ocean.

Most of the STPs located within Suffolk County are considered to be decentralized STPs. Decentralized STPs are designed to operate on a smaller scale than centralized STPs and do not require multiple remote pump stations to convey sewage to the plant. The historical use of decentralized STPs in the County has been to serve single lots containing condominium complexes, apartment complexes, hotels, and/or industrial/commercial buildings.

The SCDHS has been actively requiring older plants that are underperforming and/or lack nitrogen removal capability, to undergo renovations or replacement. During the past 15 years, 100 new STPs were constructed, of which 20 were constructed to replace existing facilities whose physical conditions and/or treatment capability deteriorated over the years. For example, the Kings Park Sewage Treatment Plant located on the grounds of the former Kings Park Psychiatric Center main structure was built in 1935, rehabilitated in 1960, and upgraded again in 2004 to a sequencing batch reactor.

Figure 1-24 Aerial Photo of Bergen Point STP (Courtesy of Newsday)

1.1.6.6 Sewer Expansion Projects

Sewering is an important part of the overall wastewater management strategy in Suffolk County. Despite the issues related to scandals associated with construction of the Southwest Sewer District in the 1980's, the importance of sewering as a critical tool in the toolbox of nitrogen removal options must be acknowledged. As documented further in Section 2.2.2 of this SWP, while the use of I/A OWTS represents the most cost effective solution in many areas of the County, sewering may have advantages over I/A OWTS in locations with significant water quality impairments due to nitrogen, in areas with challenging site conditions (e.g. small lots, high groundwater, poor soils), in areas within close proximity to existing sewer districts, and in areas with special considerations such as areas that are prone to sea level rise. Using a countywide, parcel-specific scoring analysis modeled from the Chesapeake Bay TMDL Watershed Implementation Plan, it is estimated that as many as 50 percent of the parcels located within the highest priority areas for wastewater upgrades could benefit from sewering as the preferred means for wastewater treatment. This is not to imply that these parcels should connect to sewers as there are multiple other factors that need to be considered when evaluating individual regions for sewer expansion; however, it underscores that sewering is an important element of the overall wastewater management strategy in Suffolk County.

A variety of sewering proposals have been evaluated for feasibility in Suffolk County over the last 20 years. A summary of these proposals, along with their current status, is provided in **Tables 1-20** (County-led projects) and **1-21** (Town/Village-led projects)(please see tables at the end of Section 1). As shown in **Tables 1-20** and **1-21**, over 20 County-led projects have been recently evaluated and over 15 Town/Village-led projects have been evaluated.

The most notable projects currently being advanced by Suffolk County include three Suffolk County Coastal Resiliency Initiative (SCCRI) sewer extension projects that are being funded through the Governor's Office of Storm Recovery's (GOSR) post-Sandy resiliency funding. In 2014, Governor Andrew Cuomo announced that $383 million of funding would be made available to sewer communities along four river corridors in unsewered low-lying areas along Suffolk County's south shore that had been inundated by Superstorm Sandy. This award represented the first major sewering based project within Suffolk County in more than 40 years. The goal of the project is to reduce nitrogen pollution to ground and surface waters to improve coastal resiliency against future storm events.

A8 TOP STORIES

TWO SEWER PLANS OKd

Mastic, Babylon voters say yes; Great River, no

BY DAVID M. SCHWARTZ
david.schwartz@newsday.com

Mastic and Babylon voters on Tuesday approved two sewer projects that will cover 6,500 homes, Suffolk's largest sewer expansion since the 1970s, while Great River voters rejected a measure to expand sewers into their community.

The $360 million worth of approved sewer expansions will be using federal and state grants. Construction is expected to start next year.

"This is a major victory for water quality in Suffolk County," said Peter Scully, a deputy county executive under County Executive Steve Bellone.

The county would look at alternate ways to use the $26.4 million proposed for the Great River project, he said.

Residents will have to pay an estimated annual sewer tax of about $470 and $532 for the Mastic and Babylon projects respectively. It would have been $755 annually for the Great River project.

Mastic voted 414-71 to accept $191.3 million in federal and state grants, according to the Suffolk County Board of Elections. The project would pay to sewer nearly 2,770 residential parcels and businesses along the Forge River, including a commercial corridor along Montauk Highway, and construction of a new sewage treatment plant at Brookhaven Calabro Airport, according to the county.

In West Babylon, North Babylon and Wyandanch around the Carlls River, residents voted 612-85 to connect 2,847 homes at a cost of $140.2 million in grants.

Voters in Great River, along the Connetquot River, voted 230-304 on the proposal that would have connected 474 parcels at a cost of $26.4 million.

Apart from the referendums, grant money will be used to connect 1,500 homes within the existing Southwest Sewer District to the sewer system, and sewers would be extended to 300 homes in Patchogue Village.

About 9,500 voters were eligible to cast ballots, according to the board of elections. Cumulatively, voters approved the projects 1,256 to 460.

Federal and state grants, won post-Sandy to improve the South Shore's storm resiliency by strengthening wetlands that absorb surges, will cover upfront costs. If costs come in higher than expected, though, the projects will go in front of the Suffolk County Legislature.

At a Great River community meeting last week, many homeowners were skeptical of the project's cost in an already high tax area, as well as the technology. Unlike a traditional sewer system that relies on gravity, the proposed systems would use electronic pumps to send waste through pipes to the Bergen Point Sewage Treatment Plant.

"A lot of us are for sewers, but not for this system," said Rich Llewellyn, 59 of Great River.

The cost for Great River residents also was more expensive than the other two, because of the higher home values there, county officials said.

An anonymous mailer was passed out against the sewers. It warned the county fee will increase each year, and that the costs are only projected.

County officials said they scheduled the vote in January, instead of November's election when turnout would have been higher, because the state only agreed in July to convert a $60 million loan into a grant, reducing the amount residents in those districts will have to pay back.

Only those residents who would be getting sewers, and have to pay, were eligible to vote.

At Mastic Fire House, Michael Knight, 47, a machine operator, voted no. He was unhappy with the annual cost, and also worried that sewer installations, involving electric-powered pumps at every house, would damage driveways and yards. "This is a cash-strapped area already," he said.

Ute Ahrens, 58, said she voted in favor of the proposal.

"It's good for the environment," she said. She also liked the idea of coming off septic systems, which she would have to pay to replace if they fail. "If the darn things broke, I don't have to spend tens of thousands of dollars," she said.

JESSICA ROTKIEWICZ

A voter at the Mastic Fire Department on Tuesday casts a ballot on the proposed $191.3 million sewer project along the Forge River.

In January 2019, the Babylon, Mastic, and Great River sewer projects went to ballot for three separate public votes. The Village of Patchogue project did not require a public vote because it involves an expansion of the Village sewer district. The Babylon and Mastic projects were overwhelmingly approved through the ballot while the Great River project was defeated. As a result, the three project areas that are currently being advanced include:

- Carlls River Watershed in North Babylon, West Babylon and Wyandanch, Town of Babylon
- Forge River Watershed in Mastic, Town of Brookhaven
- Patchogue River Watershed in the Village of Patchogue

A project overview and summary of key facts for each of the three SCCRI projects is provided on **Figure 1-25a** through **Figure 1-25c**.

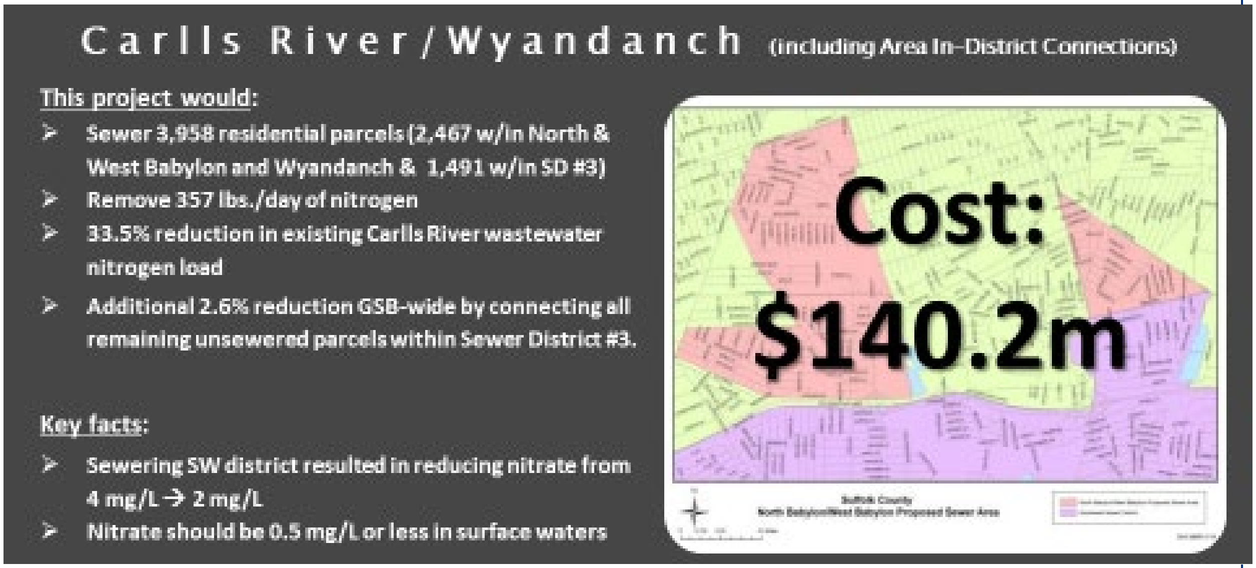


Figure 1-25a Suffolk County Great South Bay Coastal Resiliency Projects

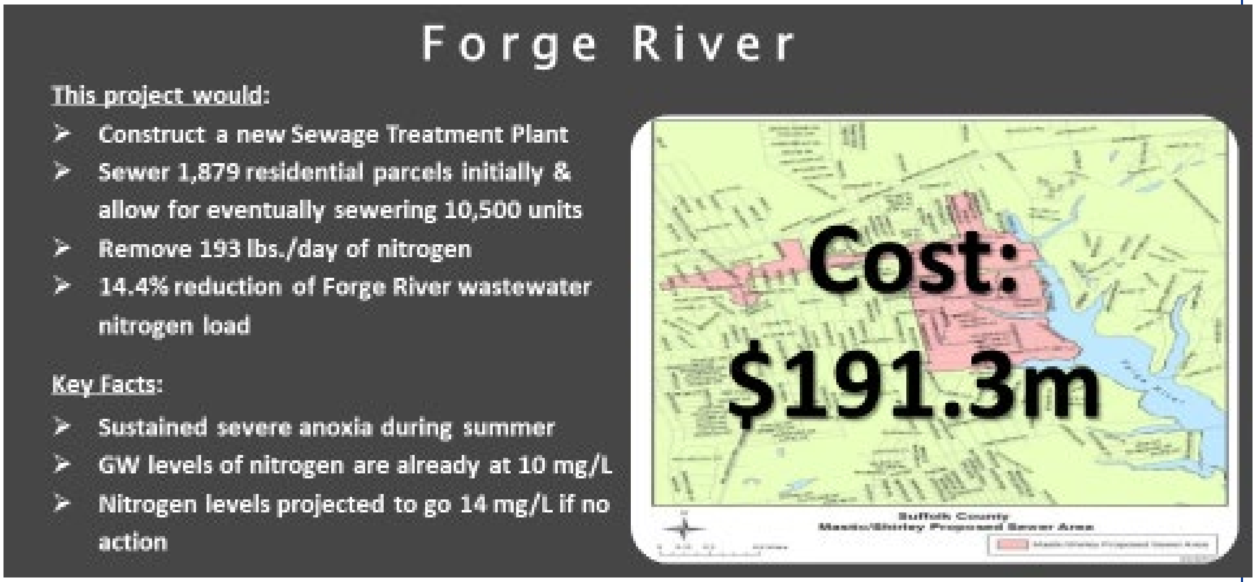


Figure 1-25b Suffolk County Great South Bay Coastal Resiliency Projects

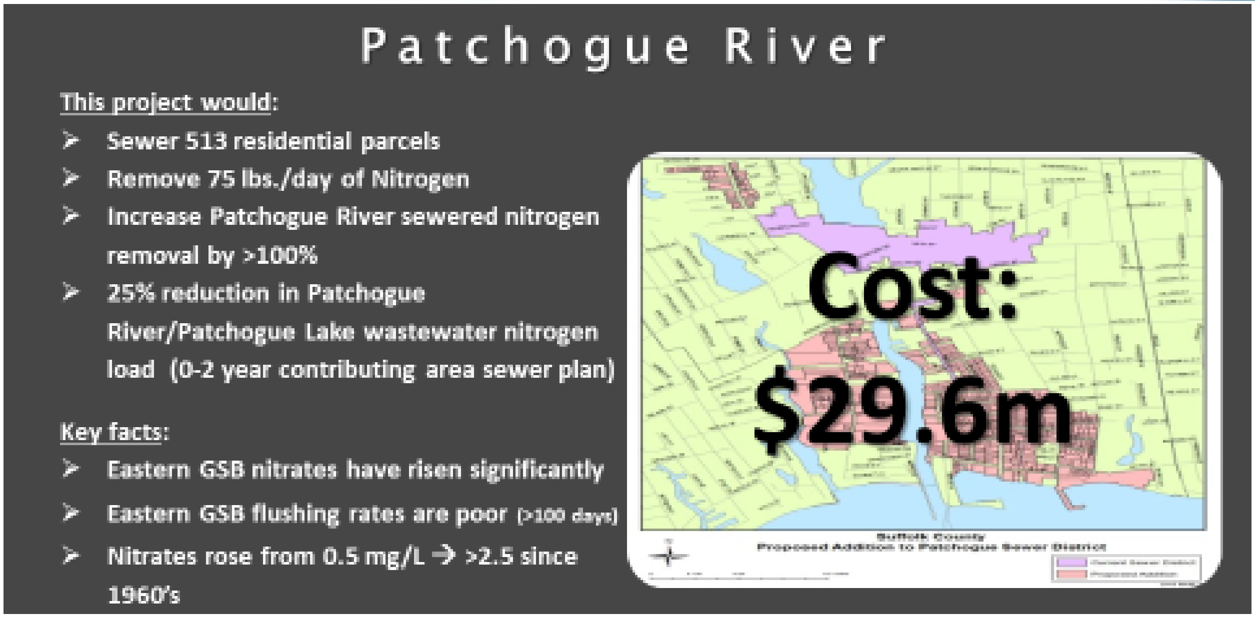


Figure 1-25c Suffolk County Great South Bay Coastal Resiliency Projects

Other notable County-led projects currently under various stages of advancement include the Oakdale Phase 1A extension (**Figure 1-26**), the Ronkonkoma Hub extension (**Figure 1-27**), and the Kings Park Business District (**Figure 1-28**). Each of these projects has construction funding identified and the projects are in various stages of design and/or construction. A short summary of each project is provided by the following text.

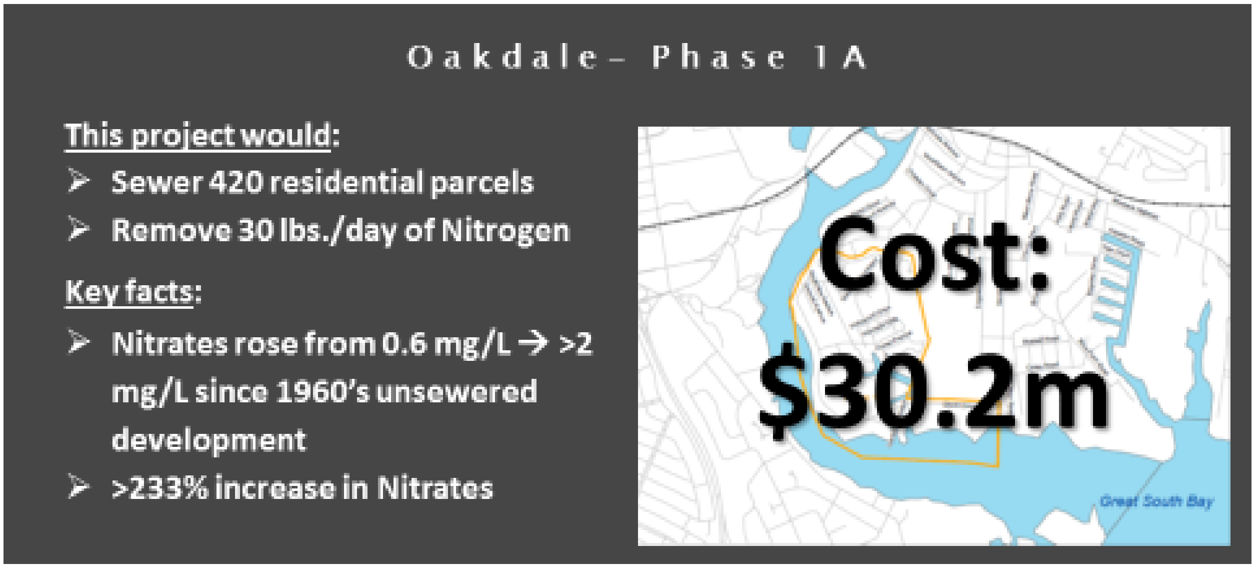


Figure 1-26 Overview of Proposed Oakdale Phase IA Extension

1.1.6.6.1 Ronkonkoma Hub

The Ronkonkoma Hub project includes the construction of a 1.5 million gallon per day pump station and force main to connect the Ronkonkoma Hub Transit Oriented Development (TOD) to the Bergen Point WWTP. The design for the project is complete and the construction contract for the force main has been awarded. Project completion is currently forecasted for the Winter of 2019-2020. In addition to promoting economic development within the Ronkonkoma TOD area, the pump station also includes additional capacity for the connection of existing developed parcels in the region. One project that is currently under evaluation is the MacArthur Industrial District which includes the connection of the existing commercial/industrial district surrounding MacArthur Airport. It should be noted that the proposed district limits shown on **Figure 1-27** below are approximate and subject to change.

Figure 1-27 Ronkonkoma Hub

1.1.4.6.2 Kings Park Business District

The Kings Park Sewer Project involves the connection of approximately 140 businesses in the Kings Park business district, an apartment complex of approximately 100 units served by a failing septic system, and 27 residential parcels to the Suffolk County Sewer District #6 – Kings Park treatment plant. The project design is almost complete and $20M in state grant funding is sufficient to complete the project. It is anticipated that construction will start in 2020 and end in 2023. An overview of the project area is shown in **Figure 1-28.**

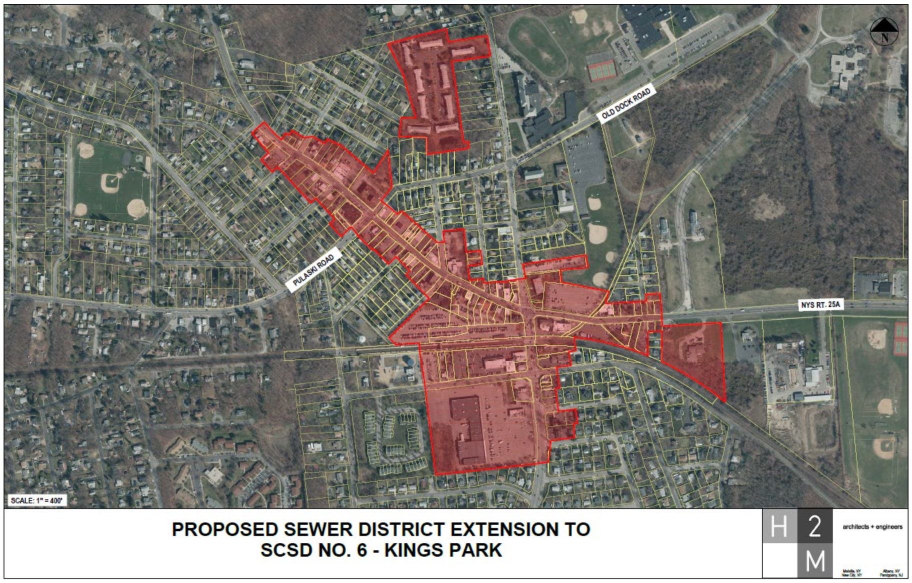


Figure 1-28 Proposed Kings Park Sewer District Extension

1.1.6.6.3 Town/Village Projects

There are several Town/Village led sewer projects that are also in various stages of advancement. **Table 1-20** (please see tables at the end of Section 1) provides a summary of the additional 15 Town and Village led projects that were identified as of March 2019. Projects that are currently noted as having construction funding identified include the Calverton/EPCAL WWTP expansion project and the Village of Westhampton Beach Downtown Commercial Expansion project (see **Figures 1-29** and **1-30**).

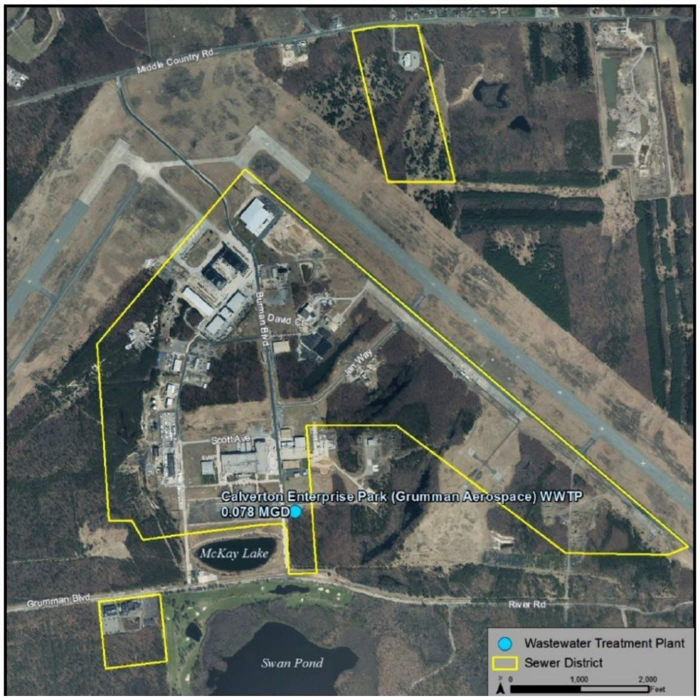
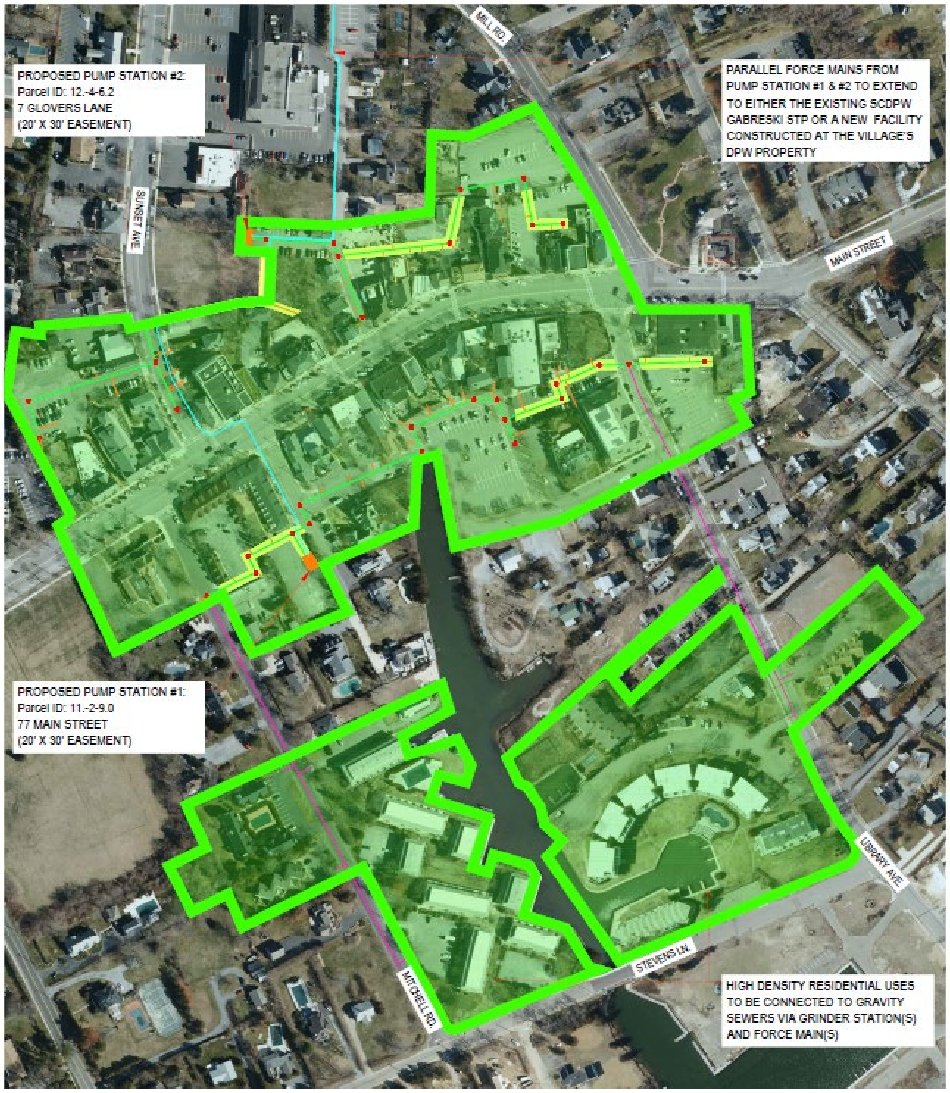


Figure 1-29 Proposed Calverton/EPCAL WWTP expansion project



Preliminary Phase 1 Sewer Service Area Map

SCALE: 1" = 200-0"

N

* AERIAL BACKGORUND IMAGERY WAS OBTAINED FROM THE NEW YORK STATE GIS CLEARINGHOUSE WEBSITE:http://gis.ny.gov/gateway/mg/

LEGEND:

- SCTM PARCEL BOUNDARIES
- PROPOSED SEWER SERVICE AREA
- PROPOSED SEWER SYSTEM EASEMENT LOCATIONS (20' WIDE)
- PROPOSED PUMP STATION SITE
- PROPOSED GRAVITY SEWER MAIN HOLE
- PROPOSED SEWER SERVICE LATERAL
- PROPOSED GRAVITY SEWER MAIN
- PROPOSED FORCE MAIN
- PROPOSED 3" Ø LPS MAIN

Sanitary Flow Projection based on SCWA usage records: (ADF approx. 60,000 gpd)

NYS Land Use	Description	Area		Tax Parcels
		Acerage	% Acreage	Tax Parcel Count
100	Agricultural	0.00 ac.	0.0%	0 parcels
200	Residential	21.95 ac.	70.2%	88 parcels
300	Vacant Land	0.34 ac.	1.1%	1 parcels
400	Commercial	8.70 ac.	27.8%	66 parcels
500	Recreation & Entertainment	0.00 ac.	0.0%	0 parcels
600	Community Services	0.30 ac.	1.0%	1 parcels
700	Industrial	0.00 ac.	0.0%	0 parcels
800	Public Services	0.00 ac.	0.0%	0 parcels
900	Wild, Forested, Conservation Lands & Public Parks	0.00 ac.	0.0%	0 parcels
	TOTAL . . .	31.29 ac.	100%	156 parcels

CLIENT: **Incorporated Village of Westhampton Beach**

PROJECT #: WHBV 16-01

DATE: 7/14/2016

H2M architects + engineers

Melville, NY · Albany, NY · New City, NY · Parsippany, NJ

Figure 1-30 Village of Westhampton Beach Downtown Commercial Expansion Sewer Project

Other projects with a relatively high likelihood of moving forward include the Town of Southampton Riverside redevelopment project, Town of Babylon Wyandanch expansion project, and the Village of Northport STP expansion project.

Additional recommendations for sewering are discussed in Section 8.1.5 of this SWP.

1.1.6.7 Considerations for Commercial Parcels

Many commercial parcels in Suffolk County represent a unique challenge because of the diversity of wastewater flow and quality, potential administrative concerns associated with tenant-owner agreements, potential for substantial costs associated with wastewater upgrades, and potential for significant flow that exceeds allowable density in Suffolk County. For the purposes of discussion within this SWP, commercial parcels with special considerations have been categorized into four subgroups including:

1. Parcels with 1980s passive denitrification systems;
2. Grandfathered parcels constructed prior to the requirements set forth in Article 6 of the Suffolk County Sanitary Code in 1984;
3. Parcels that contain OSDS meeting the definition of a USEPA Large Capacity Cesspool; and,
4. Exempt parcels such as school districts.

Another primary concern for each of the subgroups identified above is that the locations of existing OSDS under each subgroup are unknown. As such, the extent of the potential impacts to individual water bodies cannot be determined relative to the evaluations and recommendations provided within this SWP. To address this concern, the SWP provides a recommended timeline for development of a SWP addendum as described in Section 8.4.11. A description of each of the three subgroups is provided below.

1.1.6.7.1 1980s Passive Denitrification Systems

After the commercial density requirements went into effect in 1984, the SCDHS approved passive denitrification systems as a form of treatment that allowed commercial properties to exceed Article 6 density as long as the total flow generated was less than 15,000 gallons per day (gpd). Passive denitrification systems were installed between 1985 and 1994. There are approximately 450 of these systems installed throughout Suffolk County. Originally, these systems were truly passive treatment systems. Later, in an effort to increase performance, pumps were added to the system to optimize the dosing of the treatment works. The system had five main components. The pretreatment unit consisted of a standard septic tank and grease trap and was followed by a dosing siphon or pump station that distributed flow to the downstream treatment units.

The treatment process included a buried aerobic sand filter where nitrification would take place followed by an upflow denitrification filter that was charged with sulfur and limestone. The limestone acted to buffer the solution and the sulfur acted as the food source for the sulfur-fixing bacteria that performed the denitrification process. The overflow from the denitrification filter was passed on to the final step which was effluent recharge via leaching pools.

Over time, most of these systems failed hydraulically and were bypassed to conventional treatment systems. These systems originally operated under SPDES permits requiring that they met the groundwater nitrogen discharge limit of 10 mg/L. When the systems were discontinued from use, the SPDES permits were modified to eliminate the effluent limitations and place the permittee on notice that additional treatment may be required in the future.

1.1.6.7.2 Grandfathered Commercial Parcels Constructed Prior to 1984

Grandfathered commercial parcels constructed prior to 1984 represent a unique challenge for wastewater management because design flows may potentially significantly exceed the requirements set forth in the design and construction standards for commercial projects. In addition, while some Towns maintain records regarding the location of grandfathered parcels, most grandfathered parcels predate the use of electronic and/ or geospatial related databases or records of their locations do not exist. Because the locations of grandfathered commercial parcels are unknown, the potential magnitude of parcel-specific impacts could not be evaluated as part of this SWP and requires additional study (see Section 8.4).

Historically, grandfathered commercial parcels had a perpetual tacit approval to continue exceeding Article 6 density requirements so long as they met one of the codified exemptions (e.g., developments or other construction projects previously approved by SCDHS and/or development or other construction projects, other than realty subdivisions, approved by a town or village planning or zoning board of appeals prior to January 1, 1981). In 2017, the Suffolk County Legislature took a monumental step toward extinguishing the perpetual as-of-right grandfathering of commercial parcels by approving revisions to Article 6 of the Suffolk County Sanitary Code that set forth new requirements for the practice of grandfathering. Under this amendment to Article 6, certain currently grandfathered sites would no longer have an exemption. However, the proposed amendment to Article 6 would allow maintenance of the grandfathered sanitary flow IF such sites designed and installed an approved I/A OWTS at the time of application to the Office of Wastewater Management. Such applications are required when there is new construction, including additions to or changes of use of existing buildings. The I/A OWTS will provide increased protection of water resources, as compared to an onsite sewage disposal system consisting of a septic tank and leaching structure only.

As discussed further within Section 8.4, the recommendations for commercial parcels within this SWP have been subdivided into commercial parcels with design flows of less than 1,000 gpd and commercial parcels with design flows of greater than 1,000 gpd. This recommendation acknowledges that the methods and cost to upgrade small commercial projects (e.g., less than 1,000 gpd) will typically be similar to the scope of upgrading a single-family residential parcel. However, methods and associated costs for upgrading parcels with large design flows, particularly for those on small lots, may be significantly more challenging and costly than single family residential upgrades. Nonetheless, a review of the Office of Wastewater Management Blacksmith database for commercial final construction approvals between January 1, 2013 and December 31, 2016 indicates that approximately 76 percent of all commercial systems have design flows of less than 1,000 gpd; therefore, the majority of the individual commercial OSDS in Suffolk County are recommended to be subject to all recommendations set forth within this SWP. The remaining, large flow, commercial OSDS will require additional study to identify their respective locations, quantify their design flows and nitrogen loads, and identify recommendations for priority and funding options in the form of a SWP Addendum as proposed in Section 8.4 of this SWP.

1.1.6.7.3 Commercial Parcels with USEPA Large Capacity Cesspools

The USEPA regulates and defines Large Capacity Cesspools as residential multiple-dwelling, community, or regional systems (e.g., townhouse complexes or apartment buildings) that dispose of sanitary waste, or non-residential cesspools that have the capacity to serve 20 or more persons per day (e.g., rest areas or churches) if they receive solely sanitary waste (40 CFR 144.3). Large capacity cesspools do not provide primary treatment through a septic tank. In Suffolk County, this generally includes parcels that meet the USEPA definition described above that were constructed prior to the year 1984.

While large capacity cesspools represent an environmental concern, they also provide a potential opportunity for leveraging federal regulations that require upgrades of Large Capacity Cesspools. Specifically, beginning April 5, 2005, the USEPA requires that all existing Large Capacity Cesspools be replaced with technology that conforms to USEPA regulations. Upgrade options permitted by the USEPA include:

- **Sanitary sewer hookup -** Often, a sewer system hookup may be available even though it was not an option when the home or building was constructed.

- **Holding tanks -** Store the sanitary waste in a holding tank, which is then periodically pumped out for proper disposal of the waste. The amount of wastewater that has to be stored can be reduced by conserving water (e.g., using low-flow shower heads and low-flow toilets). It should be noted that holding tanks or "hold and haul" is currently not an allowable sewage disposal method in Suffolk County.

- **Large-capacity septic systems -** Large-capacity septic systems include a septic tank for primary treatment followed by a leaching pool for disposal of grey water. Note that large-capacity septic systems are regulated as Class V wells and must be approved by the permitting authority prior to construction. In addition, large capacity septic systems are only permitted in Suffolk County if the accompanying land use meets the density flow requirements as set forth in Article 6 of the Sanitary Code.

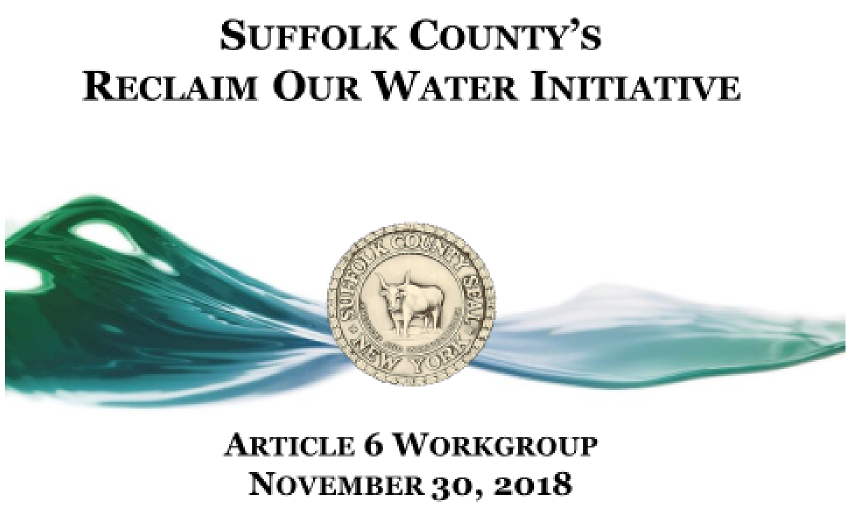
- **Package plants -** Small wastewater treatment systems, known as package plants, are designed to treat limited sewage flow. These plants use prefabricated steel tanks and hold the wastewater for a longer time as part of the treatment process. In Suffolk County, package plants could include Appendix A STPs or approved I/A OWTS.

Similar to concerns regarding the identification of grandfathered commercial parcels, the locations of USEPA Large Capacity Cesspools are generally not known in Suffolk County. Additional study will be needed to identify their respective locations, quantify their design flows and nitrogen loads, and identify recommendations for priority and funding options in the form of a SWP Addendum as proposed in Section 8.4 of this SWP. It should be noted that USEPA has sole jurisdiction over Large Capacity Cesspools, however, Suffolk County has been coordinating with the USEPA on establishing the best means to identify non-compliant systems and how to incorporate their upgrade in the context of the overall wastewater management strategy in Suffolk County.

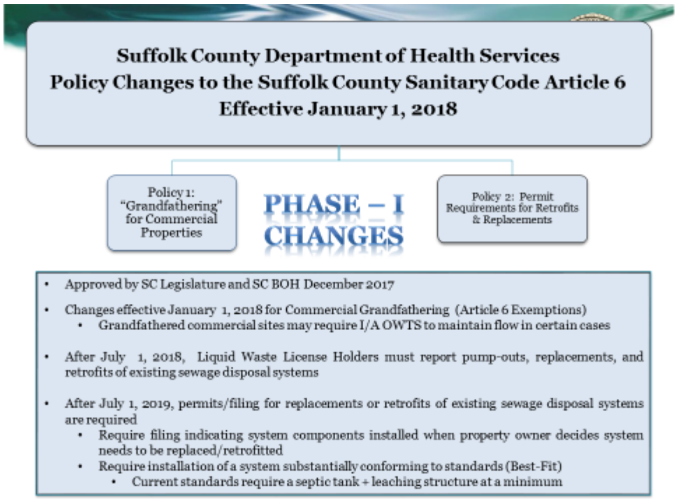
1.1.6.7.4 Exempt Parcels

The SCDHS Office of Wastewater Management reviews and approves sanitary facilities for public schools as an agent for the NYSDEC. New York State has jurisdiction over the type of sanitary system and amount of wastewater flow permitted to be discharged by a public school parcel. As New York State does not set forth density requirements or wastewater treatment requirements for flows of less than 30,000 gallons per day, public schools are currently not subject to the density requirements set forth in Article 6 of the Sanitary Code. In most cases, students who attend public schools likely live and attend school within the same subwatershed, as delineated within this SWP. Therefore, and consistent with the methodology used in regional nitrogen loading models, there would hypothetically be no net increase in estimated nitrogen loading from public schools. However, the evaluations within this SWP indicate that many subwatersheds require significant nitrogen load reductions to restore and protect surface water quality and further recommend wastewater upgrades in support of achieving those reductions. Therefore an evaluation of the impact that individual schools may have on water quality to subwatersheds that are sensitive to nitrogen loading is warranted and recommended for further study as discussed further in Section 8, Implementation Plan.

1.1.6.8 Article 6 Workgroup



As discussed previously, Article 6 of the Suffolk County Sanitary Code was enacted primarily to protect public health by limiting nitrogen loading from sanitary wastewater discharges to maintain groundwater nitrogen concentrations to levels of less than 4 mg/L in Groundwater Management Zones III, V and VI and to less than 6 mg/L everywhere else throughout the County. However, Article 6 did not consider the density or sanitary wastewater treatment levels necessary to protect downgradient groundwater-fed surface waters with the exception of GWMZ VI.

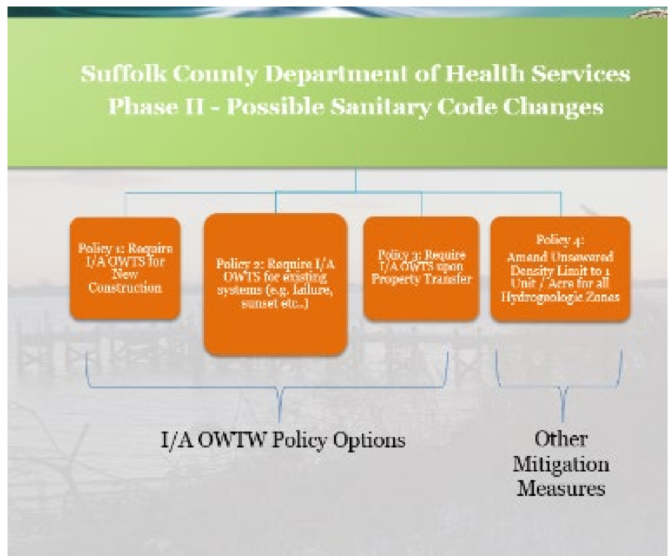


In 2016, Suffolk County established the Article 6 Work Group, a multidisciplinary team of elected officials, regulatory agencies, Town/Village representatives, and other stakeholders to guide changes to the Suffolk County Sanitary Code that will ultimately support protection of County water resources. Through leadership from Suffolk County, the Article 6 Work Group recommended implementing sanitary code amendments in a two-phased approach. Phase I sanitary code changes, adopted in January 2018, included "no regrets" actions that did not need to wait for additional study. Phase I changes included:

1) Addressing 'Grandfathering' for commercial properties;

2) Establishing reporting requirements for sanitary pump-outs; and,

3) Eliminating the practice of replacing cesspools in-kind by requiring installation of a sanitary system that conforms to current standards.



Phase II sanitary code changes included recommendations on how, when, and where to use new I/A OWTS for the protection of the groundwater-fed surface waters and drinking water. Through consultation with the Article 6 Workgroup, it was concluded that this SWP would be the platform through which recommendations for Phase II sanitary code changes would be established. Phase II policy options that were retained for evaluation in the SWP include:

1) I/A OWTS required for new construction;

2) I/A OWTS required at system failure;

3) I/A OWTS required at property transfer; and,

4) Countywide increase in minimum lot size to 1 acre.

As of February 2019, 15 Article 6 Work Group meetings were held. The Article 6 Workgroup process was an invaluable tool for soliciting feedback from a broad spectrum of stakeholders. The process ultimately resulted in Sanitary Code changes that were defensible and supported by these stakeholders which helped streamline the approval process by local policymakers. Based on the overwhelming success of the program, it is recommended that the workgroup continue to be consulted as individual program recommendations within this SWP are rolled out for execution.

1.1.6.9 Evaluation of Existing Capacity of Scavenger Plants

Suffolk County accepts scavenger waste at the Bergen Point WWTP, and scavenger waste is accepted at the Town of Huntington and Town of Riverhead plants to treat waste sludge from STPs and pump-outs from onsite sewage disposal systems. STP sludge holding tanks are pumped on average once a month. Onsite sewage disposal systems are typically pumped only when they start to back up into the building they serve. This means if a system has a septic tank and leaching pool that the septic tank was excessively full, and solids were discharging from the septic tank, clogging leaching systems. Most I/A OWTS systems have septic tanks preceding the treatment system, which should be pumped out routinely to ensure system performance. If clogging or back-up occurs in an I/A OWTS it would mean the I/A OWTS system was probably improperly maintained and therefore wasn't treating wastewater to meet effluent total nitrogen requirements. The implementation of an I/A OWTS program will require that SCDHS create a pump-out schedule to maintain proper treatment. Some jurisdictions require pumping of an I/A OWTS every 3 to 5 years. Massachusetts Department of Energy and Environmental Affairs website provides a reference guide for homeowners which states "have your septic tank pumped out and system inspected every 3 to 5 years by a licensed septic contractor". Currently the existing overall treatment capacity of the three municipal scavenger waste plants is 1.46 MGD (See **Table 1-22**). In addition, there are at least two private scavenger waste facilities in Babylon, the 100,000 gpd Tully/Clearbrook facility in Bay Shore and the 400,000 gpd ClearFlo facility in Lindenhurst.

Table 1-22 Suffolk County Scavenger Plant Capacities

Scavenger Waste Treatment Plant	Capacity (MGD)
SCDPW Bergen Point	0.55
Town of Huntington	0.086
Town of Riverhead	0.1
Tully/Clearbrook	0.1
ClearFlo	0.4

Based upon preliminary evaluation of the recommended wastewater alternative discussed in Section 8.4.3 of this SWP, it estimated that up to approximately 0.08 MGD scavenger waste treatment capacity would be required for pump outs of I/A OWTS. As shown above, the existing municipal scavenger plant capacity is well above the anticipated demand for I/A OWTS maintenance. If future demand increases, the County could consider re-evaluation of Suffolk County Department of Public Works' (SCDPW) 2001 proposed 100,000 to 200,000 gpd scavenger waste treatment facility on County property in Yaphank to provide better access for waste generated in the eastern part of the County.

1.1.7 Surface Water Restoration Success Stories

Successful nutrient management programs that have resulted in measurable water quality improvements have been implemented on both a national and local level. These programs demonstrate, that if action is taken, Suffolk County can Reclaim Our Water to enable lasting fisheries, restored shellfish habitat, resilient wetlands that protect the coast, and a natural environment that is beneficial to humans and wildlife. To demonstrate the potential benefits associated with nutrient reduction and management, the following subsection provides an overview of three of the largest national and regional surface water quality improvement projects with measurable water quality improvements. Specific project case studies presented include:

- Tampa Bay Estuary Program, Florida
- Chesapeake Bay Program, Maryland & Virginia
- Long Island Sound Study
- Boston Harbor

Although not discussed further within this SWP, other successful programs include the Buzzard's Bay National Estuary Program and the Mumford Cove nutrient reduction project. Readers interested in these projects can find additional information on them at the following links:

- Buzzard's Bay:
  An estuary impacted by excess nutrient loading from septic systems resulted in the loss of eelgrass beds, accumulation of benthic algae smothering shellfish beds, and low oxygen concentrations that have resulted in fish kills. Buzzards Bay National Estuary Program was established in 1985 with a mission to protect and restore water quality and living resources in the Bay through the implementation of the Comprehensive Conservation and Management Plan (CCMP). The original 1989 Buzzards Bay CCMP contained 119 recommended actions. By 2009, 68 of these recommendations were complete with significant progress on many of the remaining ones. Some key indicators in Buzzards Bay, like reductions in shellfish bed closures, showed remarkable declines during this time period. The CCMP was updated in 2013 and lays out a variety of approaches for achieving the ultimate goal of a clean and healthy bay and surrounding watershed system of streams, ponds, wetlands, and groundwater.

  Buzzards Bay National Estuary Program. https://buzzardsbay.org/

  Southeast New England Program for Coastal Watershed Restoration.
  http://restore.buzzardsbay.org/index.html

- Mumford Cove:
  Until 1987, more than 3 MGD of secondary effluent was discharged into Mumford Cove. A sewage discharge outfall pipe diversion project resulted in significant nutrient reductions in the water column, 99 percent for both nitrogen and phosphorus, a reduction in the biomass of the macroalgae *Ulva lactuca* and a restoration of eelgrass beds.

  Long Island Sound Resource Center, a CT DEP and UCONN Partnership.
  http://www.lisrc.uconn.edu/eelgrass/index.html

An overview of the four success case studies documented in this SWP is provided below.

1.1.7.1 Tampa Bay, Florida – Restoration of an Estuary

The Tampa Bay nutrient management strategy has become a national and international model for successful watershed management collaborations. Coastal development and urban expansion between 1950 and 1980 negatively impacted the water quality in Tampa Bay (see **Figure 1-31**) due to excess nitrogen load inputs that resulted in high chlorophyll-*a* concentrations, a 50 percent decrease in seagrass coverage, fish kills and dead zones (2). Citizen outcry and community involvement was a major factor in bringing attention to Tampa Bay's declining water quality. Specifically, citizens complained of the phytoplankton and macroalgae that visually plagued the Tampa Bay waterways. Poorly-treated domestic wastewater sources, untreated industrial point sources, stormwater, as well as dredge and fill activities led locals to declare Tampa Bay as "dead". Scientists attributed the poor water quality conditions to coastal urbanization and polluting activities.

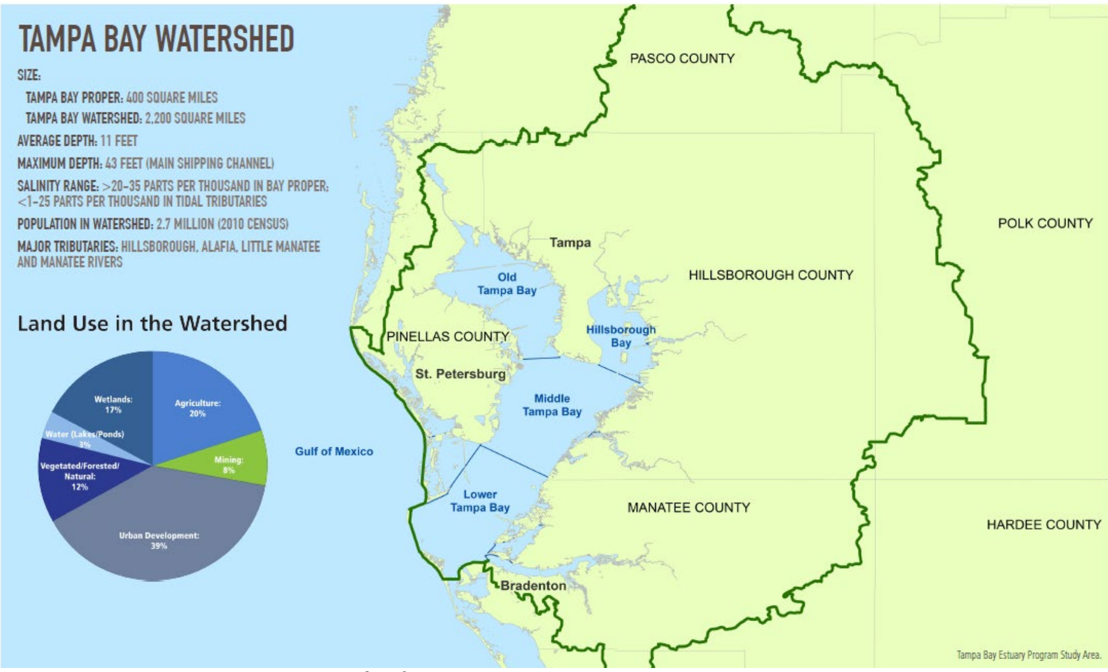


Figure 1-31 Tampa Bay Watershed

According to the Florida Department of Health, there are approximately 250,000 septic systems in the four coastal counties of the Tampa Bay area, many of which were built prior to 1970 and do not meet current standards. In order to amend the nitrogen load from these non-point sources, there have been efforts to convert properties to sanitary sewers when new developments are built, as well as field-testing new nitrogen reducing septic systems for areas where sewers are not feasible (1). Working together over several years, Tampa Bay stakeholders achieved water quality recovery by curbing nitrogen pollution through wastewater and fertilizer management. Wastewater nutrient loading alone was reduced by 90 percent, which jump-started the restoration of the Bay. Other

> "Due to a steady decline in total nitrogen loading from point, nonpoint and atmospheric sources, coincided with a decrease in chlorophyll-a, Tampa Bay has surpassed the seagrass recovery goal of 38,000 acres and now has an equivalent to the amount of seagrass acres present in the 1950s."

actions taken to improve water quality include stormwater regulations, fertilizer restrictions, and upgrades to polluting facilities. Nutrient management actions in the public and private sectors led to a steady decline in total nitrogen loading from point, nonpoint and atmospheric sources coincided with a decrease in chlorophyll-*a* and nitrogen concentrations. By the year 2006, all bay segments achieved Tampa Bay Estuary Program's set water quality targets[(1)]. Nitrogen loads have been significantly reduced and as a result, reduced chlorophyll-*a* concentrations, greater seagrass abundance, and enhanced fishery stocks have been observed in long-term monitoring. These improvements in water quality occurred while the human population in the Tampa Bay metropolitan area increased by more than one million people [(3)]. Tampa Bay is now considered a worldwide model for a recovering estuary.

The major elements and milestones of the restoration program include:

- Florida's 1972 Wilson-Grizzle Act required wastewater plants discharging to Tampa Bay to upgrade to advanced wastewater treatment standards or enact 100 percent reclaimed water. Over the next ten years, all major wastewater treatment plants upgraded to meet this requirement.

- In 1982, a Statewide Stormwater Rule was enacted which required nutrient management from all municipal stormwater systems within the Tampa Bay watershed.

- In the mid-1990s, the Tampa Bay Nitrogen Management Consortium, a public-private partnership, implemented water quality management targets and collectively accepted responsibility for meeting nitrogen load reduction goals. The Tampa Bay Nutrient Management Consortium utilized several approaches to reduce nutrient impacts to the Bay, including wastewater reuse and aquifer recharge, septic conversions and reduction in sewer overflows, stormwater treatment, reduction in fertilizer use, process improvements for industrial manufacturing and power plants, habitat restoration, and homeowner education. Members include the Tampa Bay Estuary Program, government and regulatory agencies, local phosphate mining companies, agricultural parties and electric utilities.

- Tampa Bay Estuary Program was established in 1991 after Congress designated Tampa Bay as an "estuary of national significance." In 1995, the Estuary Program adopted a goal of restoring seagrass to 1950 levels after decades in decline. Initial monitoring of Tampa Bay's ecology began in the 1950s, prior to the initial boom in coastal development, and continuous monitoring through various programs document the decline and recovery of the Tampa Bay estuary. By 2014, Tampa Bay surpassed the seagrass recovery goal of 38,000 acres, as shown in **Figure 1-32**. By 2016, seagrass coverage increased to 41,655 acres. [(1)] Eelgrass coverage is now equivalent to the number of acres present in the 1950s. [(2)]

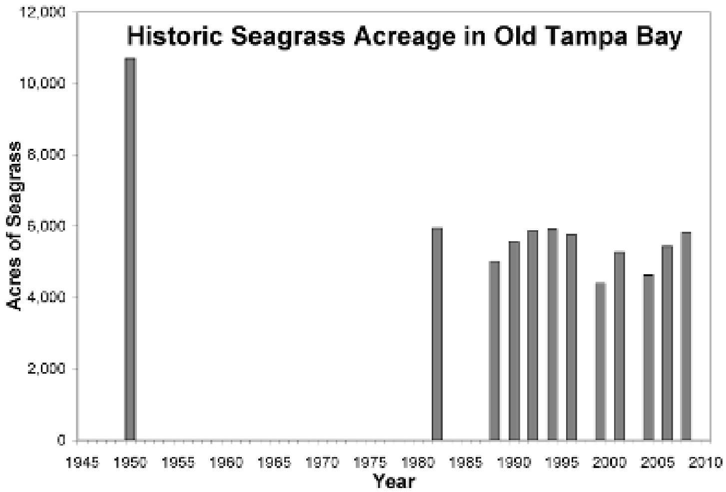


Figure 1-32 Seagrass Acreage with Time in Old Tampa Bay [(1)]

Successful public education efforts, like the 'Be Floridian' campaign by the Tampa Bay Estuary Program, urge residents to decrease their use of residential fertilizer. Print and digital ads, vehicle ads and billboards like **Figure 1-33** remind residents to avoid use of fertilizer in the summer. The 'Be Floridian' website provided resources to homeowners of how to maintain their property in a way that protects Florida's waterways.

An online pledge shown in **Figure 1-34**[(1)] infers that fertilizer use results in the loss of Florida's natural resources that residents and tourists enjoy. Evaluations of the campaign showed an increase in knowledge and compliance with fertilizer ordinances, with less than 5 percent of those polled identifying summer months as the best time to fertilizer lawns. (1)

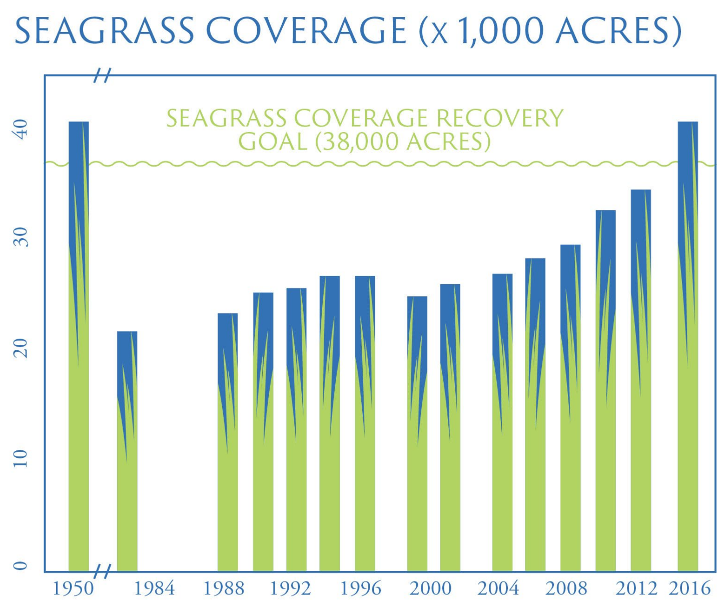


Figure 1-33 Examples of Tampa Bay Estuary's "Be Floridian" Campaign

Figure 1-34 Tampa Bay Estuary Program [1]

(1) Tampa Bay Estuary Program (2017) Charting the Course: The Comprehensive Conservation and Management Plan for Tampa Bay

(2) Sherwood, E.T., Greening, H.S., Janicki, A.J., Karlen, D.J., (2015) Tampa Bay estuary: Monitoring long-term recovery through regional partnerships. *Regional Studies in Marine Science*

(3) Greening, H., Janicki, A., Sherwood, E.T., Pribble, R., Johansson, J.O.R., (2014) Ecosystem responses to long-term nutrient management in an urban estuary: Tampa Bay, Florida, USA. *Estuarine, Coastal and Shelf Science*

(4) Sherwood, E. (2010) Tampa Bay Estuary Seagrass Coverage Trends. https://www.tbeptech.org/data/other-data/73-tampa-bay-estuary-seagrass-coverage-trends

1.1.7.2 Chesapeake Bay Program

The Chesapeake Bay is an estuary of national and international significance for its economic, cultural and ecological importance. The Bay's watershed covers 64,000 square miles within six states and is home to 18 million people. Due to a significant decline in water quality resulting from wastewater discharges as well as urban and agricultural runoff within the watershed, the Chesapeake Bay Program was established in 1987. Several actions were taken to reverse the declining trend in water quality, including the organization of committees, the enactment of laws and implementation of best management practices. Amongst other recommendations and objectives, the primary overall objective of the initial program was to lower the amount of nitrogen and phosphorus entering the Bay by 40 percent by the year 2020. Since much of the Chesapeake Bay watershed was connected to sanitary sewers, a significant focus of the program concentrates on upgrading large scale wastewater treatment plants, see **Figure 1-35**. Other important actions taken include upgrading all individual on-site wastewater disposal systems where sewers were not feasible, agricultural regulations on feed types, animal manure management, forest buffers, erosion control and on-farm conservation practices, reducing the amount and entirely banning phosphorus in lawn fertilizers as well as suburban land planning. Additional elements of the program were enacted in 2000 and in 2010, including the establishment of a TMDL requiring a 25 percent reduction in nitrogen, a 24 percent reduction in phosphorus and 20 percent reduction in sediment in order to fully restore the Bay and its tidal rivers by 2025. In 2015, for the first time, annual progress in wastewater pollution reductions effectively met the TMDL 2025 nutrient pollution limits, due to upgrades at the ten largest wastewater treatment plants, the 472 municipal and industrial plants in the Bay watershed, as well as upgrades to individual on-site wastewater disposal systems.

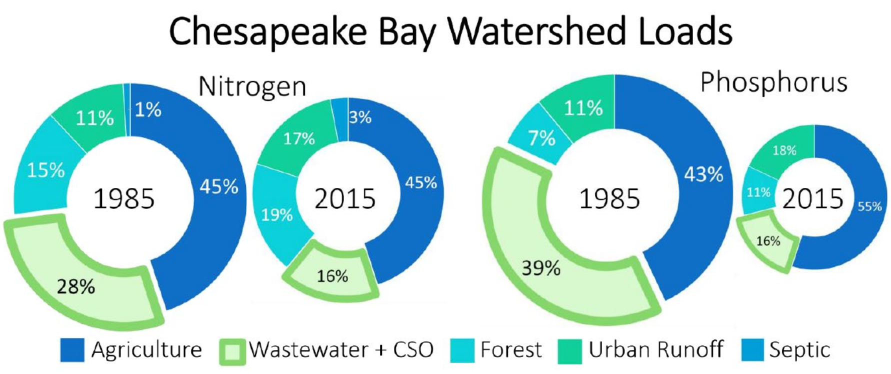


Figure 1-35 Nitrogen Loads to the Chesapeake Bay Watershed

Funding wastewater upgrades was key to the success of the restoration of the Chesapeake Bay. In Virginia, the Virginia Water Quality Improvement Act of 1997 was enacted in response to the need to finance the nutrient reduction strategies being developed for the Chesapeake Bay and its tributaries. The funding assists local governments and individuals prevent, reduce and control nutrient pollution from point source loads to the Chesapeake Bay. In 1999 the Virginia Land Conservation Act established a state tax credit to reward those who donate land or easements for conservation. In Maryland, the Bay Restoration Fund was enacted in 2004 to create a dedicated fund, financed by wastewater treatment plant users, to fund upgrades to Maryland's wastewater treatment plants so that they are capable of achieving effluent quality of 3 mg/L total nitrogen. In addition, the fund paid by septic system users is utilized to fund upgrades to onsite systems.

"Nitrogen concentrations reductions by 23% since 1984 resulted in a restoration of 17,000 hectares of submerged aquatic vegetation, its highest cover in almost half a century."

Thirty years of scientific monitoring coinciding with the introduction of management actions to reduce nutrients within the Chesapeake Bay region have shown promising results. Submerged aquatic vegetation are a critical part of the Chesapeake Bay ecosystem and are good indicators of the overall health of the ecosystem. As shown in **Figure 1-36**, reductions in nitrogen concentration of 23 percent and phosphorus concentrations of 8 percent since 1984 resulted in a restoration of 17,000 hectares of submerged aquatic vegetation, its highest cover in almost half a century and four times the amount of vegetation than previously has been observed in the Chesapeake Bay [(1)],

[2].This represents the biggest resurgence of underwater grasses ever recorded, not only in the Chesapeake Bay, but in the world.

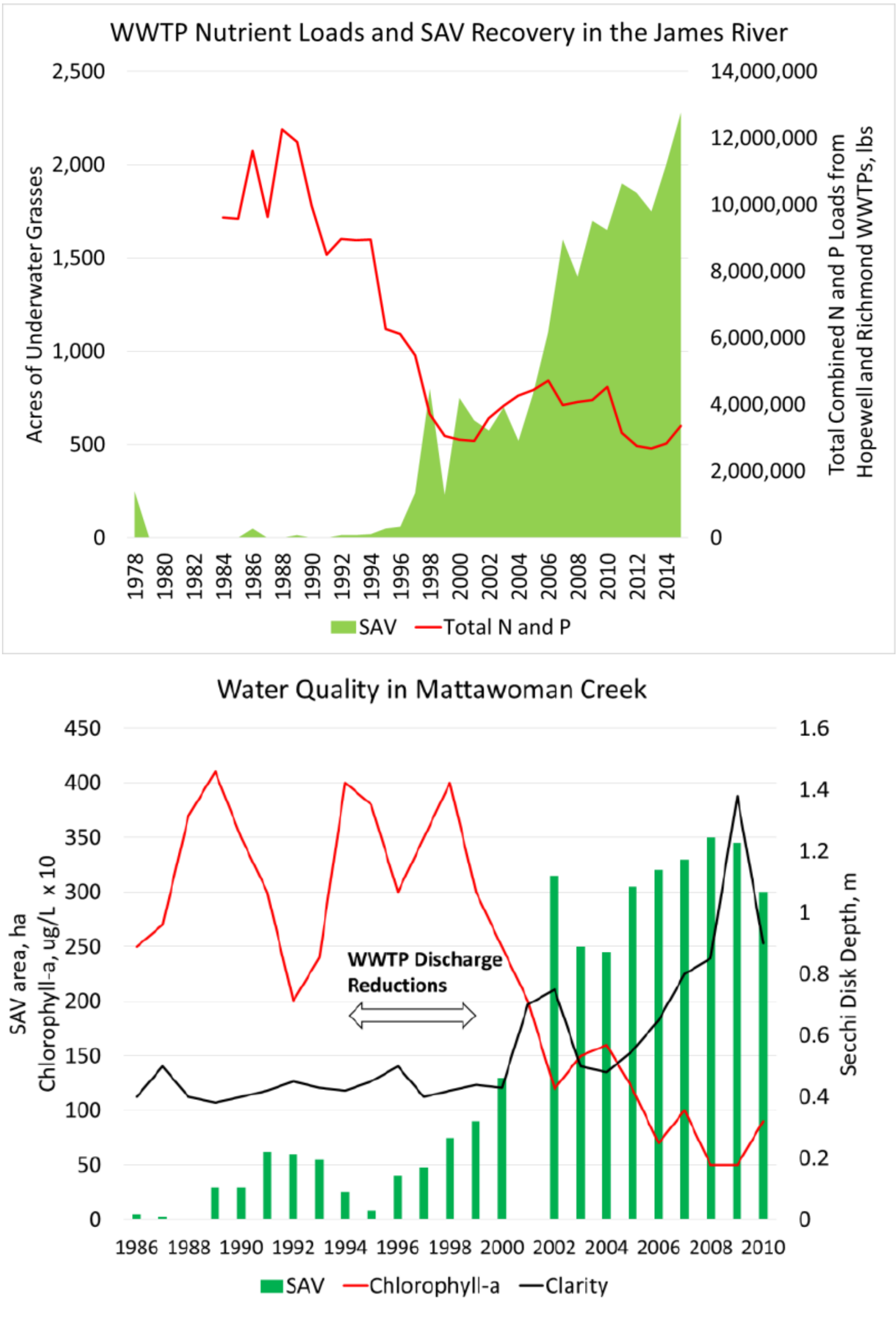


Figure 1-36 Wastewater Treatment Plant Loads, Submerged Aquatic Vegetation Recovery and Water Quality in the James River and Mattawoman Creek (Courtesy of USEPA [3])

Economically important and iconic species like striped bass, blue claw crab and oyster were once abundant fisheries but had seen major declines in population that required declaration of emergency moratoriums. Fortunately, improvements have been observed in all three of these species. The biomass of adult female striped bass is currently above the overfished threshold after a fishing ban in 1985 and harvest limits in multiple states were implemented. The Chesapeake Bay Program reported the adult female blue crab population was above the sustainable goal of 215 million. Lastly, although today's native oyster populations in the Bay are at less than 1 percent of historic levels, hundreds of acres of oyster reefs are successfully being restored in Maryland and Virginia waterways as part of a goal to restore reefs and populations in ten rivers by 2025.

(1)Lefcheck, J. S., et. al. (2018) "Long-term nutrient reductions lead to the unprecedented recovery of a temperate coastal region." *Proceedings of the National Academy of Sciences*. 115 (14) 3658-3662.)

(2) https://www.chesapeakebay.net/news/blog/rebounding_underwater_grasses_signal_recovering_chesapeake_bay

(3) https://www.epa.gov/sites/production/files/2016-06/documents/wastewater_progress_report_06142016.pdf

1.1.7.3 Long Island Sound Study

Since the Long Island Sound watershed consists of land in six different states (see **Figure 1-37**, LISS - http://longislandsoundstudy.net/ ecosystem-target-indicators/ watershed-population/), a joint effort was necessary to plan and implement water quality preservation and restoration efforts. The Long Island Sound Study (LISS) was formed in 1985 as a bi-state partnership focused on monitoring, restoring, and protecting the waters of the Long Island Sound. The partnership consists of federal and state agencies, user groups, concerned organizations, and individuals

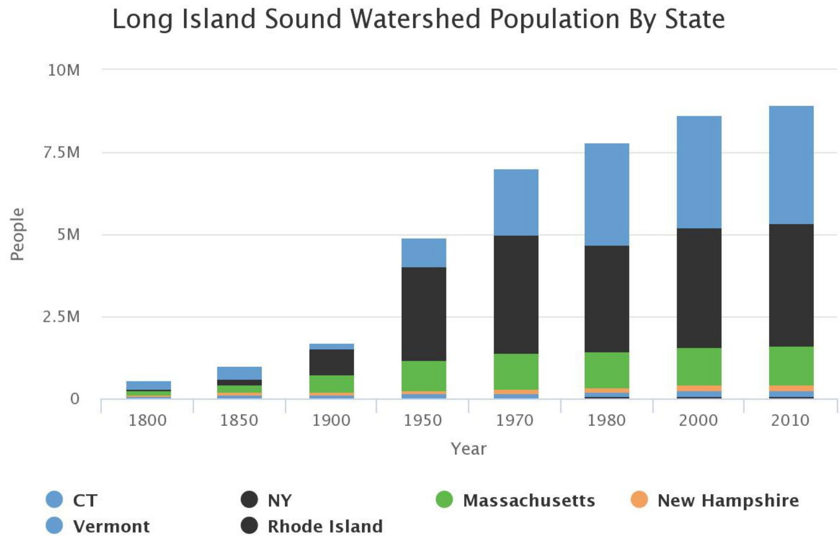


Figure 1-37 Long Island Sound Watershed Population by State

Figure 1-38 LISS - Menhaden kill, along the Mianus River, 1988

dedicated to implementing the Comprehensive Conservation and Management Plan which provides guidance on actions to address hypoxia, reduce toxic substances and pathogens, and restore natural habitats. Water quality monitoring and field surveys implemented through the plan have identified nitrogen pollution as the primary cause of the chronically low dissolved oxygen levels common to the LIS. The poor dissolved oxygen creates dead zones throughout the estuary, which result in fish kills and ecosystems in overall poor health (**Figure 1-38**).

In 2000, the USEPA approved New York and Connecticut's TMDL plan, which called for a 58.5 percent reduction in nitrogen loads entering the Long Island by 2017. The TMDL identifies actions and schedules to reduce nitrogen from the Sewage Treatment Plants discharging to Long Island Sound waters. In addition, recommendations are provided to reduce nitrogen from tributary and atmospheric sources and to implement non-treatment alternatives (like bioextraction, aeration, etc.).

Nutrient concentrations from tributaries draining to Long Island Sound have continually decreased since the implementation of the TMDL actions. By 2011, the communities under the TMDL achieved nearly 83 percent of the target, representing 35,000,000 pounds of nitrogen prevented from entering the Sound by using upgrades to advanced wastewater treatment (1). TMDL goal progress as of 2015 included upgrades to a total of 106 wastewater treatment facilities resulting in a 51.5 percent reduction in nitrogen load, or 40 million fewer pounds of nitrogen, compared to baseline levels. In addition, Federal Clean Air Act controls have reduced atmospheric deposition in the watershed by an average of 25 percent for total nitrogen and 50 percent for nitrate (2). In 2016 and 2017, the states of New York and Connecticut successfully met and exceeded the goal to reduce nitrogen discharges by 58.5 percent, representing 45 million fewer pounds of nitrogen discharged annually to the Sound from human wastewater (**Figure 1-39**). As a result of the reduction of nitrogen loading into the Long Island Sound, there have been improvements to dissolved oxygen and overall water quality, benefitting fisheries, wildlife and eelgrass. A 2018 Newsday article reports that Long Island Sound water quality is graded regularly by Save the Sound and the most recent report showed grades improving throughout the Long Island Sound and stated reducing nitrogen in wastewater really does improve water quality (4).

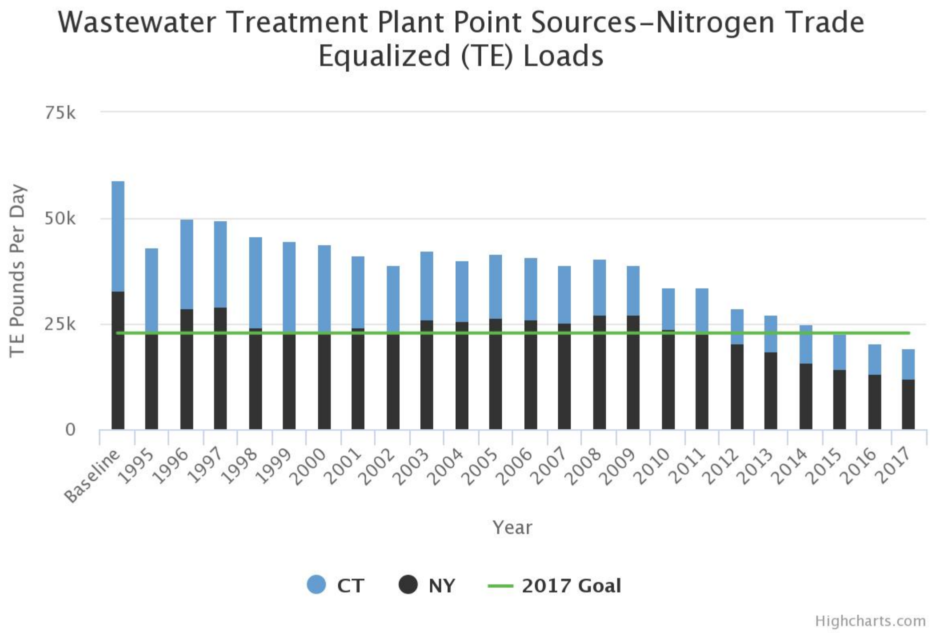


Figure 1-39 Wastewater Treatment Plant Point Sources Loading
http://longislandsoundstudy.net/ecosystem-target-indicators/nitrogen-loading

"By 2016, New York and Connecticut successfully met and exceeded the goal to reduce nitrogen discharges by 58.5%, representing 45 million fewer pounds of nitrogen discharged annually to the Sound from human sewage. As a result, the average duration of hypoxia in Long Island Sound from 1991 to 2013 was 55 days per year, but in 2017 the duration of hypoxia was only 26 days."

Dissolved oxygen in the Long Island Sound commonly fell to levels less than NYSDEC's acute hypoxia standard of 3 mg/L in an area referred to as the "dead zone", which affected the entire western half of its area in some years. This condition of hypoxia can be lethal, harmful and/or limit growth in adult and juvenile fish, invertebrates, and other animals. However, as work to reduce nitrogen loads to the Sound has been implemented, the hypoxia severity has decreased in both area and duration. Annual monitoring of dissolved oxygen has documented a 57 percent reduction in the area of hypoxia compared to pre-2000 TMDL average hypoxic area (2). As shown in **Figure 1-40**, the average peak area of waters with unhealthy levels of dissolved oxygen in the Sound in 2018 was 89 square miles, less than half the pre-2000 average of 205 square miles (3). In addition, the duration of hypoxia has also had a decreasing trend since the implementation of nutrient reduction actions (**Figure 1-41**). The average duration of hypoxia in Long Island Sound from 1991 to 2013 was 55 days per year, but in 2017 the duration of hypoxia was only 26 days.

In addition to improvements in dissolved oxygen, significant positive trends have also been observed in eelgrass beds. As shown in **Figure 1-42**, eelgrass beds have increased in extent by 29 percent between 2002 and 2012 (2). The LISS now has a new goal to restore and maintain an additional 2,000 acres of eelgrass by 2035 from the 2012 baseline of 2,061. This target is planned to be achieved through implementation of additional water quality protections and associated reductions in land-based inputs of nutrients, as well as restoration and replanting efforts (5). The results of a recent eelgrass survey will determine how progress is coming along on the goal since 2012.

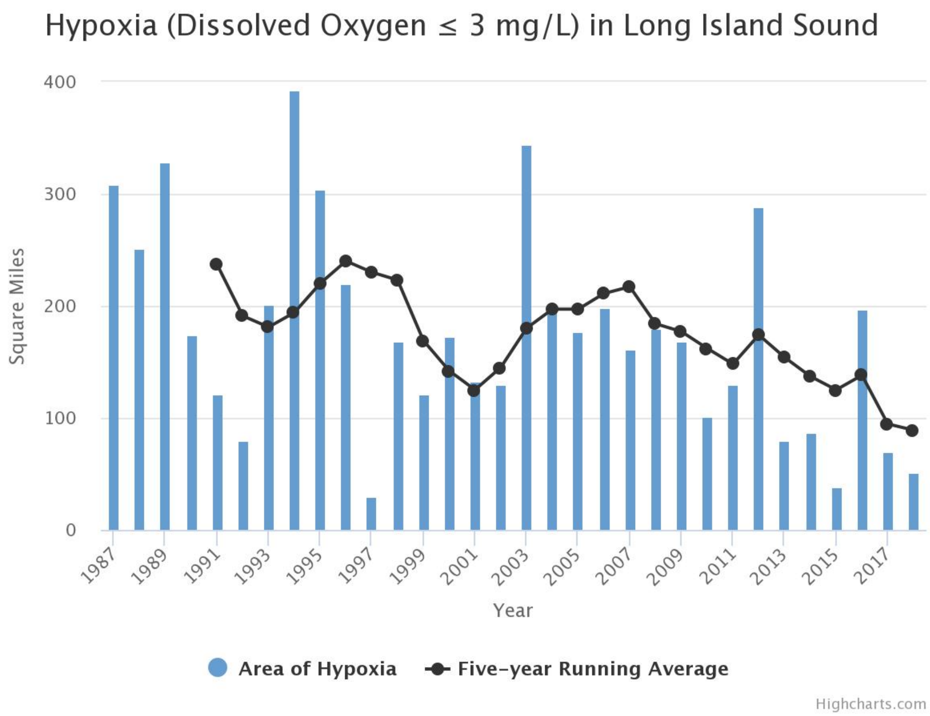


Figure 1-40 Area of Hypoxia in Long Island Sound http://longislandsoundstudy.net/ecosystem-target-indicators/lis-hypoxia/

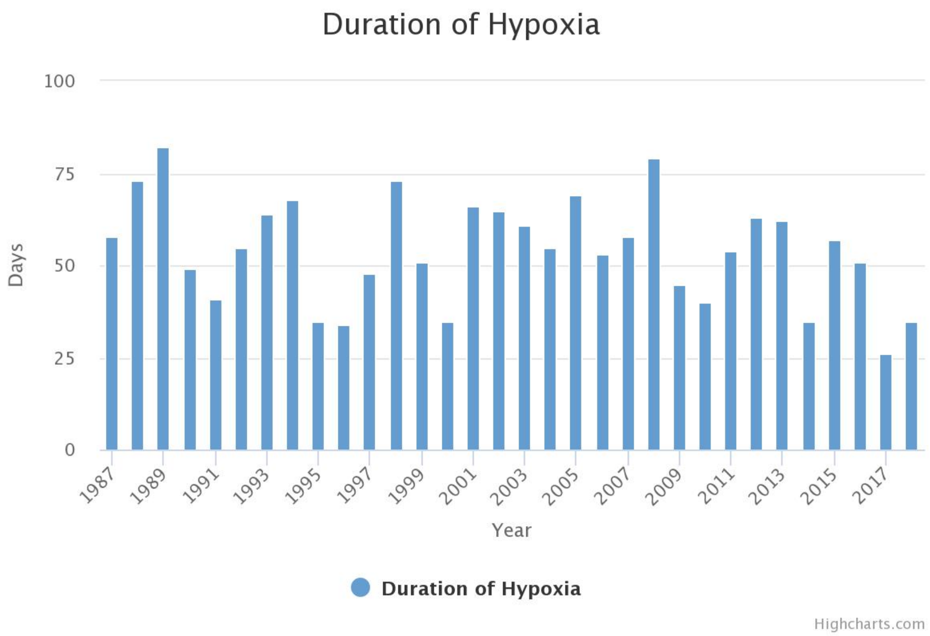


Figure 1-41 Duration of Hypoxia in Long Island Sound http://longislandsoundstudy.net/ecosystem-target-indicators/duration-of-hypoxia/

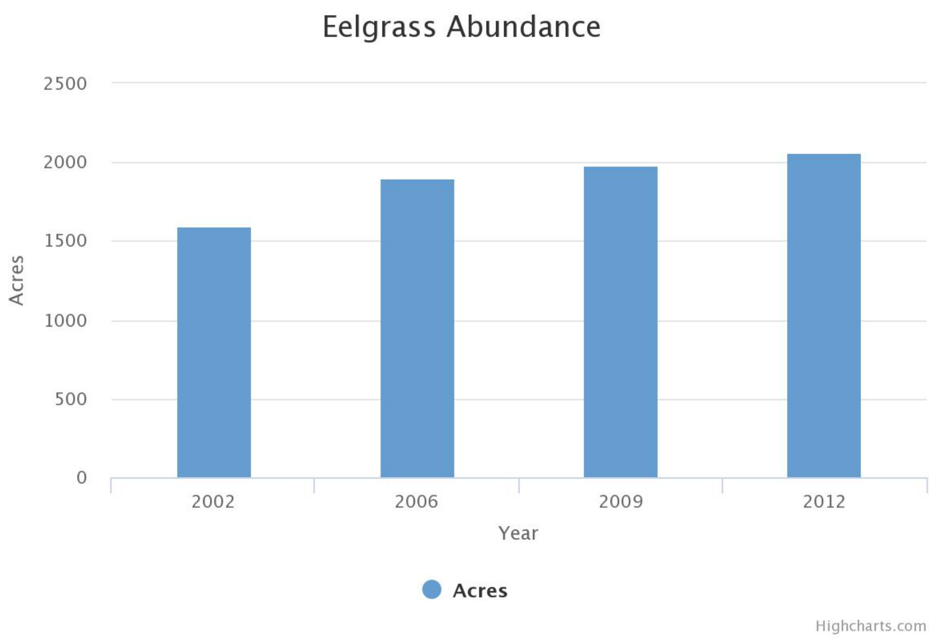


Figure 1-42 Eelgrass Abundance with Time in Long Island Sound
LISS- http://longislandsoundstudy.net/ecosystem-target-indicators/eelgrass-extent/

(1)Long Island Sound Study "2011-2012 Biennial Report – Protection & Progress"

(2) US EPA (2015) "Evolving the Long Island Sound Nitrogen Reduction Strategy."

(3) Long Island Sound Study. Spring 2018 Sound Update Newsletter – LISS's Year in Review: 2017 (Mark Tedesco)

(4) Gralla, Joan. "Report: LI Sound is cleaner and clearer." (2018-9-26). Newsday, p. A21.

1.1.7.4 Boston Harbor

Boston Harbor was once known as the "dirtiest harbor in America" but today is called a "Great American Jewel" due to the much improved water quality as a result of the infrastructure upgrades conducted by the Massachusetts Water Resources Authority (MWRA). After nearly $4 billion invested in wastewater treatment, the harbor clean-up is widely recognized as one of the nation's greatest environmental achievements. Eutrophication, measured by amounts of algae, nutrient concentrations (total nitrogen and total phosphorus) and bottom-water dissolved oxygen, have all changed to reflect better water quality since 1994 (Taylor, 2018). More than 300 technical reports and more than 1,000 scientific papers on the subjects of Boston Harbor and Massachusetts Bay document environmental conditions and changes since the new treatment facilities were brought on-line.

In the late 1980s, the harbor ecosystem was severely degraded, and in many regions, was unsafe for human recreational use (Taylor, 2018). In 1986, a federal court-ordered a 13-year schedule to construct wastewater treatment facilities and upgrades to the combined sewer system. The projects have included, among others, the Boston Harbor Project (BHP), the combined sewer overflow (CSO) Control Plan, the Toxic Reduction and Control (TRAC) pretreatment program, and programs to decrease infiltration into the sewer system (MWRA, 2015). The BHP, which is the construction of the Deer Island Treatment Plant and other major sewer facilities, was implemented from 1991 through 2000, and the CSO Control Plan from 1996 to 2015. In 2000, a 10-mile outfall pipe was completed to divert effluent discharges from the Deer Island Treatment Plant out of the Harbor and into the well-flushed Massachusetts Bay. The TRAC pretreatment and the Infiltration and Inflow programs are ongoing.

Treatment upgrades and diversion of wastewater discharges offshore, lowered nitrogen, phosphorus and organic carbon direct inputs into the Harbor by 80 to 90 percent (Taylor, et. al, 2019). Reduced nitrogen concentrations can be seen in **Figures 1-43** and **1-44**. The reduction of nitrogen inputs resulted in a decrease of phytoplankton biomass (algae), increase in dissolved oxygen levels and expansion of seagrass beds.

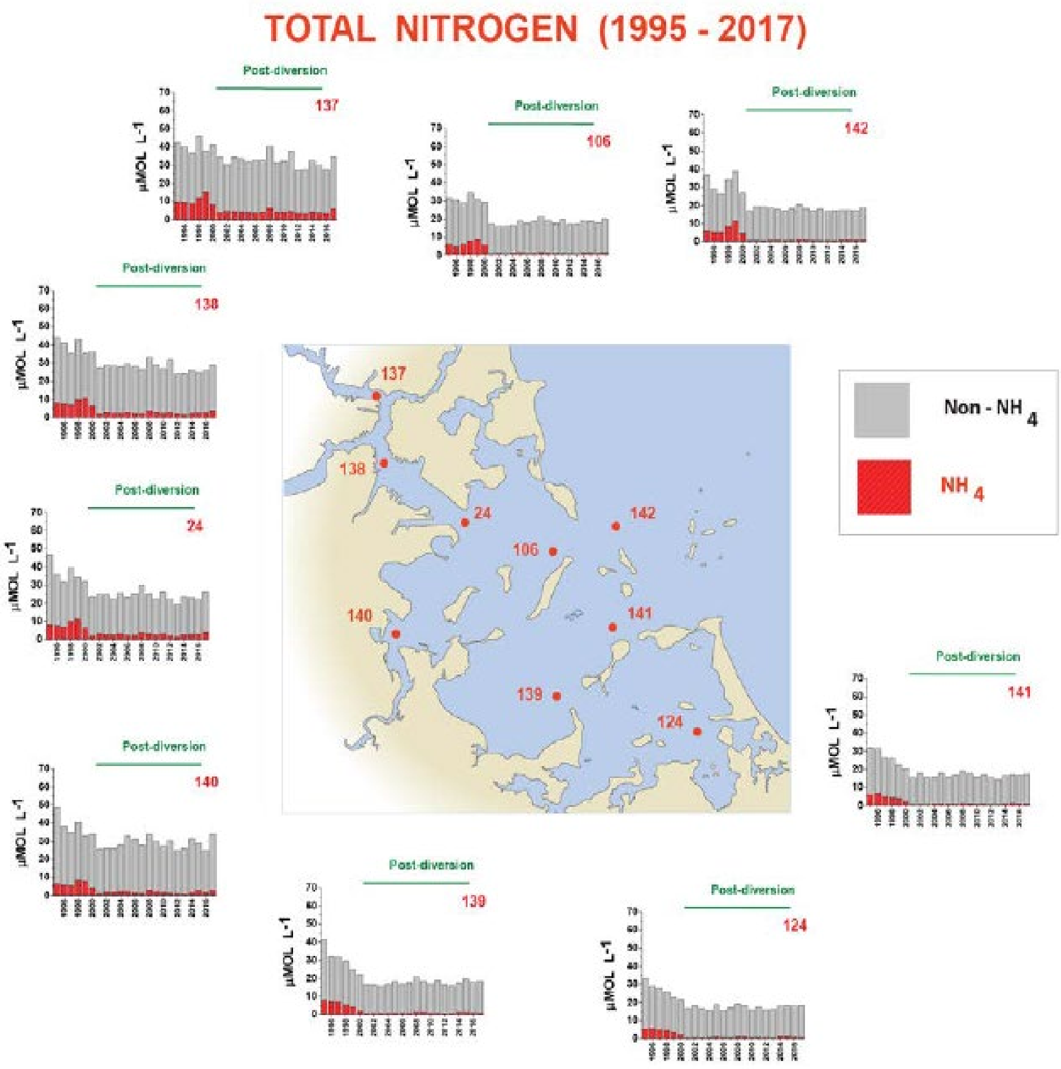


Figure 1-43 Annual total nitrogen concentrations partitioned into the non-ammonium and ammonium fractions at nine sampling locations, 1995-2015 (Taylor, 2018)

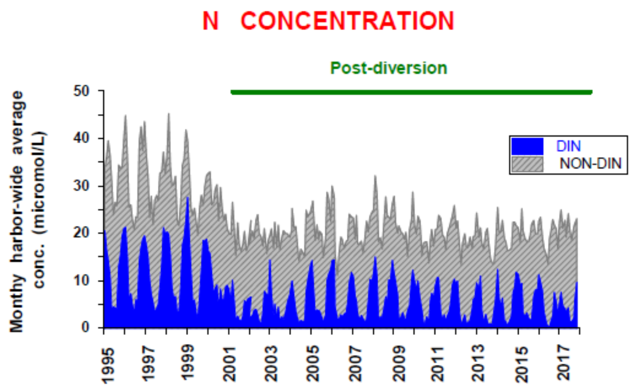


Figure 1-44 Time series plot of monthly harbor-wide average total N concentrations partitioned into the dissolved inorganic N (DIN) and non-DIN fractions, 1995-2017 (Taylor, 2018)

A study conducted by researchers from the Woods Hole Oceanographic Institute and University of Massachusetts Boston sought to develop an economic evaluation of the Boston Harbor Cleanup through a comparison of cleanup costs and relevant ecosystem service values. The results suggest that the ecosystems in the study area provide services to society with a capitalized value ranging from $30 to $100 billion (Jin, et. al, 2018). The $4.7 billion cost of the Boston Harbor Project and Combined Sewer Overflow project is about 5 to 16 percent of the total asset value of ecosystem services. The water quality improvement endeavors completed in Boston Harbor resulted in abundant benefits to the ecosystem, economy and surrounding community. Improvements have been realized harbor-wide and have allowed this "Great American Jewel" to serve as a success story for other harbor-front cities to follow.

1.2 Suffolk County Environmental Setting

Suffolk County's topographic features are generally characterized by sloping hills and vertical bluffs along the glacial moraines of the north shore; and moderately flat lands associated with glacial outwash deposits along the south shore. A series of off-shore barrier beaches that enclose shallow embayments, creating coastal lagoons that are poorly flushed and therefore vulnerable to nutrient related water quality degradation are located along the south shore. Suffolk County receives an average of 48.84 inches of precipitation per year (measured at Brookhaven National Laboratory from 1949 through 2016). Due to the nature of Suffolk County's topography and soils, most precipitation in Suffolk County travels vertically down to recharge the aquifer either naturally or through stormwater recharge basins or pools, or is lost to evapotranspiration. As discussed in Section 8.4.12.5 of the SWP, stormwater is generally not believed to be a major source of nutrient pollution for most water bodies in Suffolk County. However, it is possible that nutrient pollution from stormwater is locally significant in smaller individual subwatersheds along the north shore where significant topographic slopes are present, or in smaller undrained ponds along the south shore.

Suffolk County's sole source aquifer system includes a groundwater reservoir that is divided into three main aquifers (in descending order) – the upper glacial, Magothy, and Lloyd. The surficial upper glacial aquifer can be up to several hundred feet thick, and consists of highly permeable sand and gravel outwash deposits on the south shore and the less permeable, highly variable (e.g., silts, sands, gravels, clays, etc.) glacial moraine till deposits to the north. Groundwater in the upper glacial aquifer provides the majority of the baseflow that reaches Suffolk County's coastal waters and is generally highly aerobic with little organic carbon. Water falling on the hydrogeologic center of the County near the groundwater divide, moves vertically downward in the groundwater system to the deeper aquifers. The velocity of groundwater through the system is on the order of 1 to 2 feet per day in the upper glacial aquifer, and less in the deeper aquifers.

Using 2011 estimates from Suffolk County Planning, major land uses in Suffolk County include: Residential (38.1%); Recreation and Open Space (25.3 percent); and Transportation (12.4 percent), with seven other land uses making up the balance. These include: Commercial (3.0 percent); Industrial (2.4 percent); Institutional (4.9 percent); Agriculture (6.5 percent); Vacant (6.2 percent), Utilities (1.0 percent); and Waste Handling (0.3 percent). The majority of land used for residential purposes is medium density (2-4 dwellings/acre). Farming remains a very important industry in the eastern portion of the county, especially in the Towns of Riverhead, Southold, and Southampton. As a result of the nearly 1,000 miles of shoreline, water related commerce, recreation, and tourism are major activities in Suffolk. The land devoted to recreation and open space includes beaches, marinas, parks, campgrounds, preserves, and over 50 golf courses. Individual land use maps for all subwatersheds evaluated in the SWP are provided in Appendix D.

The Suffolk County Comprehensive Master Plan 2035 (Suffolk County Department of Economic Development and Planning, 2015) indicates a population increase of 6 percent since 2000 to a total of approximately 1.50 million in 2010. Current population trends suggest that by 2035 approximately 1.63 million residents will live in Suffolk County. Population density is concentrated in the five western towns, Huntington, Babylon, Smithtown, Islip, and Brookhaven, which contain 91 percent of the County's population. Demographic trends include an aging population (people age 65 and over increased from 10.7 percent of the population in 1990 to 14.9 percent in 2013) and increasing diversity (the minority population increased from 15 percent in 1990 to 28 percent in 2010).

1.3 Stakeholder Participation

Suffolk County has endeavored to develop the SWP in an open and transparent process, and has incorporated the information, experiences, perspectives and feedback provided by a wide variety of stakeholders engaged throughout the SWP development. Stakeholder participation included:

- Focus Area Work Groups convened by SCDHS to provide technical oversight and guidance on specific technical issues;
- A Wastewater Plan Advisory Committee (WPAC) comprised of representatives with diverse backgrounds and perspectives to provide input, feedback and guidance on SWP development, and
- Stakeholders representing a range of perspectives and interests.

An overview of each group's participation is provided in the following pages.

In addition, SCDHS held bi-weekly project progress calls to update project partners including representatives from the Long Island Regional Planning Council, New York State Department of Environmental Conservation (NYSDEC), New York State Department of State (NYSDOS), State

University of New York School of Marine and Atmospheric Sciences (SUNY SoMAS), Suffolk County Department of Economic Development and Planning (SCDEDP), the Suffolk County Executive's Office, the United States Environmental Protection Agency (USEPA) and the United States Geological Survey (USGS).

Finally, SCDHS presented interim work products and solicited feedback at meetings with individual stakeholders including the Long Island Farm Bureau, NYSDEC, the Peconic Estuary Program (PEP), the Nature Conservancy (TNC), and USEPA.

1.3.1 Focus Area Workgroups

SCDHS convened five Focus Area Work Groups to provide technical expertise, share data and information and guide technical direction. The original Focus Area Work Group subject areas and members are listed on **Table 1-23**. As the project progressed, additional experts and stakeholders contributed to Focus Area Work Group technical meetings and discussions.

Proposed approaches and interim work-products were presented to the Focus Area Work Groups and feedback was obtained at in-person meetings, net-meetings, conference calls and via email.

Table 1-23 Focus Area Work Groups Memberships

Nitrogen Load Model	Groundwater Model	Surface Water Model	Priority Areas/Endpoints
Dr. Chris Gobler, SUNY SoMAS	Chris Schubert, USGS	Dr. Chris Gobler, SUNY SoMAS	Dr. Chris Gobler, SUNY SoMAS
Chris Schubert, USGS	Dr. Chris Gobler, SUNY SoMAS	Dr. Robert Wilson, SUNY SoMAS	Cameron Ross, NYSDEC
Cameron Ross, NYSDEC	Cameron Ross, NYSDEC	Dr. Charles Flagg, SUNY SoMAS	Ken Kosinski, NYSDEC
Ken Kosinski, NYSDEC	Ken Kosinski, NYSDEC	Chris Schubert, USGS	Alison Branco, PEP/TNC
Alison Branco, PEP/TNC	Alison Branco, PEP/TNC	Cameron Ross, NYSDEC	Mike Jensen, SCDHS
Ken Zegel, SCDHS	Ken Zegel, SCDHS	Ken Kosinski, NYSDEC	Ken Zegel, SCDHS
Stephen Lloyd, TNC	Ron Paulsen, SCDHS	Alison Branco, PEP/TNC	Jason Hime, SCDHS
Jamie Vaudrey, UCONN	Steve Colabufo, SCWA	Ken Zegel, SCDHS	Jim Latimer, USEPA
Steve Pacenka, Cornell	Ruth Izraeli, EPA	Jim Ammerman, LIS	Brian Howes, UMASS
Nora Catlin, Cornell	Kristina Heinemann, EPA	Myra Fedyniak/Nancy Rucks, SSER	Tim Kelly, Nassau County
Myra Fedyniak/Nancy Rucks, SSER	Dr. Henry Bokeniewicz, SUNY SoMas	Kristina Heinemann/EPA	Marci Bortman, TNC
Kristina Heinemann/EPA	Jim Ammerman, LIS	Jim Ammerman, LIS	Myra Fedyniak/Nancy Rucks, SSER

Nitrogen Load Model	Groundwater Model	Surface Water Model	Priority Areas/Endpoints
Jim Ammerman, LIS	Tim Kelly, Nassau County	Tim Kelly – Nassau County	Mark Tedesco, LIS
Tim Kelly – Nassau County	Stephen Lloyd, TNC	Stephen Lloyd, TNC	Kristina Heinemann/EPA
Awarded Consultant Experts	Awarded Consultant Experts	Awarded Consultant Experts	Soren Dahl, NYSDEC
			Awarded Consultant Experts

Acronyms:

CCWT – Center for Clean Water Technology

LIFB – Long Island Farm Bureau

LIS – Long Island Sound

NYSDEC – New York State Department of Environmental Conservation

PEP – Peconic Estuary Program

SCDEDP – Suffolk County Department of Economic Development and Planning

SCDHS – Suffolk County Department of Health Services

SSER – South Shore Estuary Reserve

SCWA – Suffolk County Water Authority

SUNY SoMAS – State University of Stony Brook School of Marine and Atmospheric Sciences

TNC – The Nature Conservancy

UCONN – University of Connecticut

UMASS – University of Massachusetts

USEPA – United States Environmental Protection Agency

USGS – United States Geological Survey

Project input provided by the Focus Area Work Groups has been documented in the Task 5, Task 6, Task 7 and Task 11a memoranda and incorporated throughout this SWP. A complete list of Focus Area Work Group meeting participants along with meeting minutes for each Work Group may be found in **Appendix A-1**.

1.3.2 Wastewater Plan Advisory Committee

Because it was important for Suffolk County to develop a SWP based upon the best available information and input from a variety of perspectives, SCDHS convened a Wastewater Plan Advisory Committee (WPAC) comprised of advisors with a wide range of expertise and experiences to help to guide SWP development. Four WPAC meetings were scheduled to present SWP plans and progress and to solicit feedback, input and guidance.

The WPAC included representatives from academia, environmental organizations, local and state government, regulatory agencies and the Suffolk County Water Authority (SCWA); a complete list of WPAC members (in alphabetical order) is provided in **Table 1-24**. In total, more than 140 participants were invited to participate in the WPAC meetings.

Table 1-24 Subwatershed Wastewater Plan Advisory Committee

WPAC Membership
Citizens Campaign for the Environment

WPAC Membership
Cornell Cooperative Extension
Long Island Builders Institute
Long Island Commission on Aquifer Protection (LICAP)
Long Island Farm Bureau
Long Island Nitrogen Action Plan – Executive Council and Project Management Team
Long Island Pine Barrens Society
Long Island Sound Study
New York State Department of Environmental Conservation
New York State Department of Health
New York State Department of State – South Shore Estuary Reserve
New York State Legislators
Peconic Baykeeper
Peconic Estuary Program
Sea Grant
Seatuck Environmental Association
State University of New York – Center for Clean Water Technology
Stony Brook University School of Marine and Atmospheric Sciences
Subwatershed Wastewater Plan Consultant Team
Suffolk County Board of Health
Suffolk County Department of Economic Development and Planning
Suffolk County Department of Health Services
Suffolk County Department of Public Works
Suffolk County Executive Office
Suffolk County Legislators
Suffolk County Water Authority
The Nature Conservancy
Town of Babylon Planning Department
Town of Brookhaven Planning Department
Town of East Hampton Planning Department
Town of Huntington Planning Department
Town of Islip Planning Department
Town of Riverhead Planning Department
Town of Shelter Island Planning Department
Town of Smithtown Planning Department
Town of Southold Planning Department
Town of Southampton Planning Department
United States Environmental Protection Agency
United States Geological Survey

Each of the four meetings were scheduled to solicit WPAC input and guidance on specific aspects of the plan development, as shown by **Table 1-25**.

Table 1-25 WPAC Meeting Overview

WPAC Meeting	Meeting Topics and Requested Input
July 19, 2016	▪ Introduction of SWP Objectives ▪ Request WPAC input and feedback on proposed project scope, list of subwatersheds, and available data
December 22, 2016	▪ Presentation of subwatershed mapping ▪ Presentation of nitrogen load calculation approach ▪ Request for WPAC assistance in filling data gaps and identifying potential pilot areas
June 7, 2018	▪ Presentation of database development ▪ Overview of subwatershed residence time modeling ▪ Overview of subwatershed ranking approach and proposed nitrogen load reduction approach ▪ Request WPAC input and feedback on preliminary priority area mappings
January 24, 2019	▪ Presentation of priority areas and aggregated wastewater management areas ▪ Presentation of nitrogen load reduction goals ▪ Presentation of proposed implementation framework including schedule, costs and implementation triggers

WPAC meeting agendas, PowerPoint presentations and minutes are included in **Appendix A-2** of this SWP along with a complete list of participants in each meeting.

1.3.3 Stakeholder Meetings

In addition to the formal input and guidance provided by the technical experts who participated in the Focus Area Work Groups and the WPAC, SCDHS organized two stakeholder meetings to present the SWP to an even broader spectrum of interested stakeholders. The stakeholder invitation list included more than 300 individuals from academia, environmental organizations, local and state government, regulatory agencies, and the wastewater management industry, and various interest groups. These meetings provided an opportunity both for the County to introduce the SWP to stakeholders and for stakeholders to identify questions and concerns. During the first meeting, held on May 16, 2016, Suffolk County introduced the County's Reclaim Our Waters initiative and NYSDEC provided an overview of the Long Island Nitrogen Action Plan (LINAP). Proposed changes to the County's Sanitary Code and the scope of the SWP were outlined and NYSDEC, the County and their consultant team responded to stakeholder questions.

The PowerPoint presentation and a list of attendees from the first stakeholder meeting may be found in **Appendix B.**

Suffolk County posted the draft SWP on The Subwatersheds Wastewater Plan - A Roadmap to Reclaim Our Water on July 30, 2019. The draft SWP is an appendix to the the draft Subwatersheds Wastewater Plan Generic Environmental Impact Statement (GEIS) that was posted to https://www.suffolkcountyny.gov/Portals/0/formsdocs/planning/CEQ/2019/DGEIS%20for%2

0SWP_August%202019_Public%20Posting.pdf?ver=2019-08-16-131340-510 on August 16, 2019. The SWP was presented to the public at two public hearings. The first public hearing was held on September 5, 2019 at Suffolk County's Legislative Auditorium in Riverhead and the second public hearing was held on September 6, 2019 at the Suffolk County Community College Brentwood campus. Suffolk County accepted verbal comments at both hearings and written comments from the public on both the GEIS and the SWP from August 16-October 16, 2019. A record of both public meetings, comments received and a detailed response to comments may be found at https://www.suffolkcountyny.gov/Departments/Economic-Development-and-Planning/Planning-and-Environment/Regulatory-Review/Council-on-Environmental-Quality#cseis.

1.4 Quality Assurance Project Plans

As the SWP project was initiated, two Quality Assurance Project Plans (QAPPs) were developed to document the SWP project's quality control (QC) and quality assurance (QA) requirements and responsibilities. The primary SWP QAPP was developed by CDM Smith to describe the quality control procedures for development of the majority of the SWP tasks. A second QAPP, developed by the consultant Henningson Durham & Richardson Architecture and Engineering P.C. (HDR) under contract to the New York State Department of State describes the quality control procedures that guided development of the surface water hydrodynamic modeling used to characterize the surface water residence times.

1.4.1 Subwatersheds Wastewater Plan Quality Assurance Project Plan

The primary SWP QAPP, provided in **Appendix C-1**, includes a detailed description of:

- Key project team members, required skills, experience and responsibilities for each of the 12 project tasks within the SWP scope;
- The project schedule;
- Communication procedures;
- Data needs, potential data sources, data quality control;
- Project checking and documentation requirements;
- The existing Suffolk County groundwater model codes, modeling framework and model development and calibration;
- Groundwater model updates, refinements and assumptions that were implemented for the SWP;
- The approach for using the models to delineate subwatersheds and to simulate nitrogen fate and transport through the aquifer system, and
- Nitrogen loading model development and planned application.

The QAPP recognized that a wide variety of existing data was to be assembled and used during development of the SWP. Initially, the SWP was to be based on available data and existing tools to develop a first order assessment of nitrogen loading, water quality response and wastewater treatment priorities. No field data collection tasks were identified in the QAPP and the SWP was to be based on secondary data; e.g., data collected to support other programs and purposes.

The QAPP documented that sufficient secondary data did not exist to comprehensively characterize a number of the subwatersheds, nitrogen loading and attenuation, ecological responses to nitrogen loading and wastewater treatment technologies. As the work proceeded, data gaps and data needs were identified to help prioritize additional data needs that can be addressed more rigorously by LINAP and other water quality management initiatives.

Because secondary data was to be used throughout the project, it was recognized that task-specific data quality objectives would guide whether a specific existing data set should be considered. Most data was to be obtained from agencies with existing quality assurance/quality control programs, and as such would be used without significant additional scrutiny. For example, data obtained from LINAP cooperators or Federal, State or County agencies including USGS, NOAA, NYSDEC, SCDHS or SCWA was not validated or verified independently to document the quality achieved, but documented quality concerns were considered and noted. Similarly, it was presumed that the quality of published data had previously been verified; documented concerns would be considered and noted, but no independent data validation was to be performed. Secondary data sources were identified as each task deliverable was submitted. Data from laboratories that are not ELAP certified or from sources that cannot provide an approved QAPP were to be flagged due to potentially less rigorous QA procedures.

To provide an initial dataset for water bodies with no existing data, SCDHS Department of Environmental Quality (DEQ) collected additional field data from dozens of water bodies as described further in Section 2.1.3.1. This primary field data collected and analyzed by SCDHS to support the subwatershed characterizations was collected in accordance with requirements set forth in the Peconic Estuary Program Surface Water Quality Monitoring QAPP.

The QAPP was amended in June 2017 to identify the use of a new, countywide, 2016 land use coverage dataset developed by the SCDEDP in 2017. The new land coverage was built on a unified set of consistent assumptions and methodology for all ten towns.

1.4.2 Surface Water Hydrodynamic Quality Assurance Project Plan

The surface water modeling effort implemented under contract through New York State Department of State (NYS DOS) on behalf of the NYSDEC was documented in a model-specific QAPP. The surface water hydrodynamic modeling QAPP is provided in **Appendix C-2** and describes the following:

- Key project team members, required skills, experience and responsibilities;
- The development of Environmental Fluid Dynamics Code (EFDC) models;
- Data needs, potential data sources, data quality control;
- Application of the models to calculate surface water flushing times
- Procedures used to confirm that modeling results are valid and defensible.

1.5 Report Organization

The SWP has been prepared in ten major sections as defined herein.

Section 1 of the SWP:

- Documents the purpose and need of this SWP, including:
  - Recommendations from previous studies and programs;
  - An overview of the impact of nitrogen on the groundwater and surface water resources in the County;
  - Identification of other wastewater constituents of concern;
  - Discussion of the economic impacts of water quality and
  - Wastewater management in Suffolk County
- Identifies the many stakeholders and technical experts who participated in SWP development and
- Summarizes the quality planning that established the approach to develop the SWP.

Section 2 describes the technical approach and methodology that was implemented to:

- Identify and delineate the subwatersheds,
- Estimate parcel-specific nitrogen loads,
- Characterize and rank the subwatersheds' priorities for nitrogen load reduction,
- Establish priority areas and nitrogen load reduction goals,
- Evaluate wastewater management alternatives,
- Evaluate pilot areas,
- Evaluate the use of open space preservation to accomplish nitrogen load reduction goals,
- Evaluate the impacts of changing permitted density in Hydrogeologic Zone IV,
- Consider pathogen impacts on wastewater planning and
- Develop recommendations for centralized sewage treatment or areas with special conditions.

In addition, Section 2 also presents a summary of the findings of each of the evaluations described above.

Section 3 documents the methodology, findings, and recommendations for the restoration and protection of groundwater and drinking water resources in Suffolk County, including:

- Simulated nitrogen concentrations in the upper glacial aquifer and
- Simulated nitrogen concentrations in community supply wells resulting from nitrogen loading from existing land uses and potential future build out conditions
- Recommended nitrogen load reduction goals and
- Wastewater management approaches.

Section 4 documents the methodology and recommendations for the integrated, Countywide wastewater management program that incorporates the findings of the previous sections including:

- Integration of the surface water and groundwater priority areas;
- Identification and description of integrated implementation phases;
- Methodology, evaluation, and recommendations of implementation alternatives assuming the countywide use of I/A OWTS (with the exception of presumptive sewered areas as defined below);
- Methodology and findings for sewering and clustering expansion alternatives;
- Methodology and results of the line smoothing exercise used to convert model generated boundaries into administratively implementable boundaries; and.
- Anticipated environmental benefits of SWP implementation.

Sections 5, 6 and 7 provide summaries of the model findings, priority ranks, load reduction goals, and wastewater management strategies for each of the major estuary programs in Suffolk County including:

- Section 5 – Long Island Sound subwatersheds;
- Section 6 – Peconic Estuary Subwatersheds; and,
- Section 7 – South Shore Estuary Subwatersheds.

Section 8 summarizes the County's approach to implement the SWP, based on the principles of adaptive management.

Section 9 summarizes the data gaps and recommendations for further evaluation.

Section 10 lists the primary references used to guide the SWP.

This SWP includes the results from a number of individual tasks that were completed together with Suffolk County, Focus Area Work Groups, the Wastewater Plan Advisory Committee and other stakeholders. **Table 1-26** below identifies individual tasks and the SWP section(s) where they are described. In some cases, additional detail is provided in the individual task memoranda.

Table 1-26 SWP Tasks and Plan Sections

SWP Contract Task	Subwatersheds Wastewater Plan
Task 1 – Wastewater Plan Advisory Committee, Meetings and Preliminary Submittal Services	Appendix A – Wastewater Plan Advisory Committee Meeting Materials Appendix B – Stakeholder Meeting Materials Appendix C – Quality Assurance Project Plan
Task 2 – Subwatersheds Delineation Services	Sections 2.1.2 and 2.1.4 Appendix D – Subwatershed Mappings and Planning Criteria
Task 3 - Data Inventory Services	Section 2.1.3
Task 4 – Nitrogen Load Estimate Services	Section 2.1.5 Appendix D
Task 5 – Surface Water Modeling Services	Section 2.1.6
Task 6 – Tiered Priority Area Services	Section 2.1.7 Appendix D
Task 7 – Nitrogen Load Reduction Goals and Ecological Endpoints for Surface Water Services	Section 2.1.8
Task 8 – Evaluation of Wastewater Alternatives for Surface Water Services	Section 2.1.9 Section 2.2.1 Section 4.1
Task 9 – Nitrogen Load Reduction Goals and Wastewater Alternatives for Public Water Supply Wells and Groundwater Services	Section 3.3 Section 3.4 Section 4.2
Task 10 – Cost and Benefit Analysis Services	Section 2.2.2 Section 2.2.3 Section 2.2.6 Section 3.5 Section 4.5 Appendix E Pilot Area Evaluations
Task 11 – Groundwater Model	Section 2.1.4 Section 3

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Section 1 Tables

Table 1-18 List of Suffolk County STPs

Sewage Treatment Plants		
STP Name	Treatment type	Secondary/ Tertiary
Amber Court of Smithtown	SBR	T
Amneal Pharmaceuticals	MBR	T
Apex Rehab, Birchwood, Nursing Home	SBR	T
Artist Lake	Ex Aeration - Denite Filter	T
Avery Village	SBR	T
Bellhaven Nursing Center	SBR	T
Benchmark Senior Living at Whisper Landing	Baby BESST	T
Birchwood @ Spring Lake	Ex Aeration - Denite Filter	T
Birchwood Glen	Ex Aeration - Denite Filter	T
Birchwood on the Green	Ex Aeration - Denite Filter	T
Blue Ridge	SBR	T
Bretton Woods	SBR	T
Bristal @ Lake Grove	Cromaglass	T
Bristal East Northport	Cromaglass	T
Broadway Knolls	SBR	T
Broadway West	Cromaglass	T
Brookhaven Memorial Hospital	SBR	T
Brookhaven National Lab	Modular Aeration	T
Brookhaven Town Hall	Ex Aeration - Denite filter	S
Brookhaven Town SD#2	BESST	T
Brookwood on the Lake	RBC/DENITE FILTER	T
Cabrini Gardens	Cromaglass	T
Calverton Enterprise Park	Ex Aeration	S
Calverton Hills	Ex Aeration	S
Cedar Lodge	Ex Aeration	S
Cenacle Manor	SBR	T
Chelmsford Weald Condominiums	Cromaglass	T
Concern at Middle Island	SBR	T
Concern of Ronkonkoma	Cromaglass	T
Country Point Woods at Smithtown	BESST	T
Country Pointe at Smithtown	SBR ABJ	T
Country View Estates	SBR	T
Country View Estates of Smithtown	Cromaglass	T
Courtyards at Southampton	Cromaglass	T
Crescent Duck Processing Company	Anaerobic Digester SBR	T
Dowling College	RBC/DENITE FILTER	T
DSW Plaza (Loehmann's Plaza)	RBC/DENITE FILTER	T
Eagle Walk	Cromaglass	T
Eastport Meadows	Cromaglass	T
Emanon Group	Cromaglass	T
Emerald Green Apts.	SBR	T
Encore Atlantic Shores (Bristal Estates)	SBR	T
Exit 63 Development	SBR	T
Fairfield @ Ronkonkoma	Cromaglass	T
Fairfield @ Selden	SBR	T
Fairfield Mastic, LLC	Cromaglass	T
Fairfield Southampton	Cromaglass	T
Fairfield Village Garden Apts. (Groton)	MBR	T
Fairfield Villas at Medford	Cromaglass	T
Fairhaven Apartments @ Nesconset	Ex Aeration	S

Table 1-18 List of Suffolk County STPs

Sewage Treatment Plants (cont.)		
STP Name	Treatment type	Secondary/ Tertiary
Fairway Manor	Ex Aeration - Denite Filter	T
Fox Meadow	Ex Aeration - Denite Filter	T
Greenport Village	Aerotor-Clarifier	T
Greenview Commons	SBR	T
Greenview Court PRC	Cromaglass	T
Greenwood @ Oakdale	Ex Aeration - Denite Filter	T
Greenwood Village	Ex Aeration - Denite Filter	T
Gurwin Jewish Assisted Living	SBR	T
Gurwin Jewish Geriatric Center	SBR	T
Hampton Rehab Center (Payton Lane)	SBR	T
Hawthorne Court	MBR	T
Heatherwood @ Holbrook (Hillcrest)	BESST	T
Heatherwood @ Lakeland (Colony Park)	Ex Aeration - Denite Filter	T
Heatherwood House Ronkonkoma	Ex Aeration	T
Heritage Gardens At Brentwood	BESST	T
Hidden Ponds @ Smithtown	Ex Aeration - Denite Filter	T
Hilton Gardens	SBR	T
Holiday Inn	Ex Aeration - Denite Filter	T
Holiday Inn Express	Cromaglass	T
Holt Hotel	SBR	T
Homestead Village	Aeration - Suspended Growth Denite	T
Huntington Town	SBR/RBC	T
Indian Crest Apartments	Cromaglass	T
IRS Service Center	SBR	T
Island View	SBR	T
Islandia Center	Ex Aeration-Denite Filter	T
L A Fitness	BESST	T
La Quinta Inn	Cromaglass	T
Lake Grove Apartments	SBR	T
Lake Pointe	Ex Aeration-Denite Filter	T
Lakes @ Setauket	RBC/DENITE FILTER	T
Lakeview Woods @ Bayport	Cromaglass	T
Larkfield Gardens	SBR	T
Lexington Village	Ex Aeration	S
Mac Arthur Plaza	Ex Aeration - Denite Filter	S
Marriott Courtyard (Browning Hotel)	SBR	T
Marriott Hotel	Cromaglass	T
Medford Hamlet Assisted Living	SBR	T
Medford Multicare Center for Living	SBR	T
Medford Ponds	BESST	T
Melville Mall	RBC/ Denite	T
Memorial Sloan Kettering	Cromaglass	T
Middle Island Co-Op Apts (Hidden Meadows)	Ex Aeration	S
Mill Pond Estates	BESST	T
Mirror Pond	SBR	T
Montauk Manor	OXIDATION DITCH	T
Nesconset Nursing Center	Ex Aeration - Denite Filter	T
Newsday	Aerorotor - Denite Filter	T
North Isle Village	BESST	T
Northport Veterans Hospital	Aeration-Suspended Growth Denite	T
Northport Village	Aeration-Suspended Growth Denite-Denite Filters	T

Table 1-18 List of Suffolk County STPs

Sewage Treatment Plants (cont.)		
STP Name	Treatment type	Secondary/ Tertiary
Oak Hollow Nursing Center	Ex Aeration - Denite Filter	T
Oak Ridge Hollow	Cromaglass	T
Oakcreek Commons	Cromaglass	T
Oakwood Care Center (Affinity)	SBR	T
Ocean Beach	Primary-Chemical-Carbon Filter	S
Patchogue Senior Apartments	SBR	T
Patchogue Village	Aeroter-suspended growth denite	T
Paumanack Village	Ex Aeration-Denite Filter	T
Petite Fleur	Ex Aeration-Denite Filter	T
Pine Hills	Ex Aeration-Denite Filter	T
Pinewood Gardens	Cromaglass	T
Plum Island	EQ-Activated	S
Ponds @ Southampton	BESST	T
Preserve @ Connetquot	Cromaglass	T
Quail Run	SBR	T
Radisson Hotel	Ext Aeration - Denite Filter	T
Residence Inn by Marriott	Cromaglass	T
Riverhead Town	SBR	T
Rocky Point Apartments	EX Aeration	S
Ross Health Care Center	BESST	T
Rough Riders Landing	OXIDATION DITCH	T
S.C.S.D. #13 Windwatch Hotel	Ex Aeration - Denite Filter	T
S.C.S.D. #20 W Leisure Village	SBR	T
S.C.S.D. # 20E Ridgehaven	Ex Aeration - Denite Filter	T
S.C.S.D. # 28 Fairfield @ St. James	Ex Aeration - Denite filter	T
S.C.S.D. #1 Port Jefferson	SBR	T
S.C.S.D. #10 Stony Brook Pump Station	Pump Station	T
S.C.S.D. #11 Selden	SBR	T
S.C.S.D. #12 Holbrook/Birchwood	Aeration - Suspended Growth Denite	T
S.C.S.D. #14 Parkland	Aeration - Suspended Growth Denite	T
S.C.S.D. #15 Nob Hill	Aeration - Suspended Growth Denite	T
S.C.S.D. #16 Yaphank County Center	RBC - Denite Filter	T
S.C.S.D. #18S Hauppauge Industrial Park	SBR	T
S.C.S.D. #21 SUNY	Oxidation Ditch	T
S.C.S.D. #22 Hauppauge County Center	Aeration - Suspended Growth Denite	T
S.C.S.D. #23 Coventry Manor	RBC - Denite Filter	T
S.C.S.D. #24 Gabreski Airport	SBR	T
S.C.S.D. #26 Greens @ Half Hollow	SBR	T
S.C.S.D. #3 Bergen Point	Ex Aeration	S
S.C.S.D. #4 Smithtown Galleria (Avalon)	SBR	T
S.C.S.D. #5 Strathmore Huntington	SBR	T
S.C.S.D. #6 Kings Park	SBR	T
S.C.S.D. #7 Twelve Pines	Aeration - Suspended Growth Denite	T
S.C.S.D. #7 Woodside	Ex Aeration - Denite Filter	T
S.C.S.D. #9 College Park	Aeration - Suspended Growth Denite	T
S.C.S.D.# 2 Tallmadge Woods	SBR	T
Saddle Brook Apartments	Cromaglass	T
Sag Harbor	SBR	T
Sagamore Hills	SBR	T
Sayville Commons	SBR	T
Setauket Meadows	SBR	T

Table 1-18 List of Suffolk County STPs

Sewage Treatment Plants (cont.)		
STP Name	Treatment type	Secondary/ Tertiary
Shelter Island Heights	SBR	S
Silver Ponds	Bio Disc - Denite Filter	T
Smith Haven Mall	SBR	T
Somerset Woods	Ex Aeration	S
Southampton Commons	SBR	T
Southampton Hospital	RBC - DeniteFilter	T
Southern Meadows	SBR	T
Springhorn @ Blue Point	Cromaglass	T
Spruce Ponds Garden Apts	SBR	T
St. Annes Gardens	Cromaglass	T
St. James Nursing Home	Ex Aeration - Denite Filter	T
Stone Ridge at Dix Hills	Cromaglass	T
Stonehurst III	SBR	T
Stonington @ Port Jeff	SBR	T
Stony Hollow	SBR	T
Stratford Greens	MBR	T
Strathmore on the Green (Bal Moral)	Ex Aeration - Denite Filter	T
Suffolk CCC - East Campus	SBR	T
Suffolk County Community College - Selden	Extended Aeration - RBC - Denite Filter	T
Sunrise @ Dix Hills	Cromaglass	T
Sunrise @ East Setauket	Cromaglass	T
Sunrise @ Holbrook	Cromaglass	T
Sunrise Assisted Living @ Smithtown	Cromaglass	T
Sunrise Garden Apartments	BESST	T
Sunrise Village	SBR	T
Tall Oaks	BESST	T
The Inn @ Eastwind	Cromaglass	T
The Orchard at Bulls Head Inn	Cromaglass	T
Timber Ridge @ Westhampton Beach	Cromaglass	T
Towne House Village South	Ex Aeration	S
Valley Forge	SBR	T
Victorian Gardens	SBR	T
Victorian Homes @ Medford	SBR	T
Village in the Woods	Ex Aeration - Denite Filter	T
Villages at Lake Grove	SBR	T
Vineyards @ Moriches	Cromaglass	T
Walden Ponds	SBR	T
Waterways @ Bay Pointe	Ex Aeration - Denite Filter	T
Waverly Park	SBR	T
Westhampton Nursing Home	Ex Aeration - Denite Filter	T
Westhampton Pines	SBR	T
Westhampton Senior Living	BESST	T
Whispering Pines	Ex Aeration - Denite Filter	T
Wildwood Estates	BESST	T
Willow Ponds	SBR	T
Windbrooke Homes	SBR	T
Woodbridge @ Hampton Bays	Cromaglass	T
Woodcrest Estates	SBR	T
Woodhaven Manor	Ex Aeration	S
Woodhull Garden Apts	BESST	T
Yardarm Condos	RBC - Denite Filter	T

Table 1-20 Suffolk County Sewer Projects

Sewer Project	Project Description	Status	Funding	Estimated Population Equivalent	Priority Rank & Contributing Area
Carlls River (funded portions) West Babylon, Wyandanch, North Babylon (areas 108-11, 108-8, 110-2)	Connection of 4,297 residential parcels to Bergen Point WWTP under Suffolk County Coastal Resiliency Initiative (SCCRI)	Design underway, environmental review underway.	FEMA/GOSR to fund construction after design is complete.	12,800	Surface Water 1 Groundwater 3
Forge River Watershed Sewer District Phases I & II (Mastic/Shirley)	Construction of 1 MGD WWTP and connection of 2,893 parcels as part of SCCRI	Design underway, environmental reviews underway.	FEMA/GOSR to fund construction after design is complete.	9,000	Surface Water 1 Groundwater 3 0-2 Year
Patchogue / Patchogue River	Connection of 648 parcels to existing Village WWTP as part of SCCRI	Design contract awarded, environmental review completed. Final design work underway, contract letting expected by early 2019.	FEMA/GOSR to fund $18 million construction costs after design is completed.	3,000	Surface Water 1 Groundwater 3 0-2 Year
Oakdale Phase 1a / Connetquot River	Connection of 420 residential parcels to Suffolk County Sewer District No. 3, Southwest.	Pre-design phase. Phase 1a boundaries mapped and undergoing study.	State funds of $26.4 million have been allocated.	1,250	Surface Water 1 Groundwater 3 0-2 Year
Kings Park Business District	Connection of 140 commercial parcels in business district, Kingswood Apartment complex (144 units) and six residential parcels to SD#6 at estimated cost of $18 million	Project design is 95% complete. State enabling legislation required for use of town-owned parcel as site for pump station.	New York State FY 2017-18 Budget includes $20 million to advance project.	1,400	Surface Water 2 Groundwater 3
Ronkonkoma Hub	Construction of 1.5 million GPD pump station and force main to to Bergen Point WWTP to connect the Ronkonkoma Hub Transit-Oriented Development project. Project would also provide capacity for MacArthur Industrial Sewer District project (see below).	Design completed, construction contract for force main awarded. Town of Brookhaven's selected Master Developer to construct pump station.	$31 million in sewer bonds and $4M Empire State Development Corporation (ESDC) Grant appropriated.	5,000	Surface Water N/A Groundwater 3
Smithtown Business District	Siting, design and construction of new WWTP to serve 350 parcels in Smithtown business district at estimated cost of $55 million.	Design of collection system essentially complete, but need to identify potentially viable locations for WWTP.	New York State FY 2017-18 Budget includes $20 million to advance project.	2,500	Surface Water 2 Groundwater 3 0-2 Year
Huntington Station	Connection of 290 parcels in proposed Huntington Station TOD to Bergen Point WWTP/SD#3 via Walt Whitman pump station (SD 17) at an estimated cost of $20 million.	The RFP for Planning and Design Services was issued in July 2017. Consultant selected and award process underway.	Planning and Design RFP - $1.25 million appropriated through "Start-Up NY" funds. No funding identified for construction.	1,500	Surface Water 1 Groundwater 3
Carlls River - unsewered areas in West Islip, North Babylon, West Babylon, Deer Park, Wyandanch	Connect 15,706 parcels not being funded through SCCRI to Bergen Point/SD#3 at estimated cost of $800 million.	Feasibility Study completed in 2012.	No funding identified for construction of these remaining projects.	47,100	Surface Water 1 Groundwater 2

Table 1-20 Suffolk County Sewer Projects

Sewer Project	Project Description	Status	Funding	Estimated Population Equivalent	Priority Rank & Contributing Area
Forge River Watershed Sewer District Phases III & IV (Mastic/Mastic Beach)	Connection of 7,607 parcels not being funded under SCCRI to Forge River WWTP at estimated cost of $500 million.	Feasibility Study completed.	No funding identified for design or construction.	22,800	Surface Water 1 Groundwater 3 0-2 Year
Holbrook	Connection of 71 existing commercial parcels and 76 residential units to Bergen Point/SD#3 via Ronkonkoma Hub at estimated cost of $9 million	Feasibility Study completed in 2016.	No funding identified for design or construction.	700	Surface Water N/A Groundwater 3
Port Jefferson Station	Connection of 126 commercial and residential parcels in Port Jefferson Station and Terryville to SD#2, Tallmadge Woods.	Feasibility Study completed. RFP for project design issued 10/17, proposals due 1/12/18. Although $5M in sewer bonds is included the 2018 Capital budget, it cannot be used because a sewer district has not been created.	$500k in sewer bonds appropriated for design in 2017. If additional design funds are needed, a portion of the $5m in 2018 sewer bonds could be appropriated.	1,500	Surface Water 3 Groundwater 3
Sayville Extension (Oakdale, W. Sayville, Sayville, Bayport)	Connection of 8,947 parcels in south Islip communities to Bergen Point/SD #3 estimated cost of $700 million.	Town Feasibility Study completed in 2012. Design contract awarded for Force Main only (estimated project cost $45 million), not for complete collection system.	Design cost of $3 million is funded. No funding identified for construction.	28,100	Surface Water 1 Groundwater 3 0-2 Year
SC SD # 7 Woodside/ Bellport Village/N. Bellport	Upgrades to STP to expand capacity by 160,000 GPD to connect 128 commercial and residential properties in N. Bellport and Bellport (est. cost between $25M and $30M)	SC to begin improvements to expand existing STP capacity and proposed connection to SD #7 using $1.75 million appropriated in Capital Budget.	Capital Budget includes $1.75 million in construction sewer bonds appropriated for upgrades at the STP/No funding identified for connection of new parcels	1,600	Surface Water 1 Groundwater 3
Central Islip	Connection of business district to Bergen Point/SD #3 (# of parcels to be determined)	RFP for Feasibility Study issued in September 2017. Contractor selection process underway.	$200k appropriated for FS. No source of design or construction funds identified.	TBD	Surface Water N/A Groundwater 3
Brentwood	Connection of business district to Bergen Point/SD #3 (# of parcels TBD)	RFP for Feasibility Study to be issued in Spring 2018.	$200k appropriated for FS. No source of design of construction funds identified.	TBD	Surface Water N/A Groundwater 3
MacArthur Industrial Sewer District	Create new district to connect MacArthur Airport and industrial commercial area to Bergen Point WWTP/SD #3 via Ronkonkoma Hub Pump Station at an estimated cost of $125 million	An RFP was issued for Planning and Design Services for Pump station and force main only, not collection system (estimated project cost for force main and pump station is $10 million).	No funding identified for construction.	TBD	Surface Water 1 Groundwater 3
Yaphank	FS to evaluate potential development of County owned land surrounding existing STP.	FS funding never approved	No further funding.	Unknown	Surface Water 1 Groundwater 3

Table 1-20 Suffolk County Sewer Projects

Sewer Project	Project Description	Status	Funding	Estimated Population Equivalent	Priority Rank & Contributing Area
Rte. 25/Middle Island/Selden	FS to evaluate sewering options along Rte. 25A between NYS Rte. 347 and County Rte. 21	FS funding never approved	No further funding.	Unknown	Surface Water N/A Groundwater 3
Rocky Point	277 mixed use parcels. Cost est. of $17M to $35M	FS completed. Sewers not recommended.	No further funding.	1,500	Surface Water 3 Groundwater 3
Center Moriches	Connection of 102 commercial and 45 residential parcels to a new STP. Cost est. $30 Million.	FS completed in 2013. No land for STP.	No further funding.	2,000	Surface Water 1 Groundwater 3

Legend
FS, Design & Construction Funded
FS & Design Funded
FS Funded & Complete
FS Funded/Proposed
Undetermined / Under Consideration
Unfeasible

Priority Rank dependent on 25% or more of project area falling within the contributing area

Table 1-21 Town / Village Sewer Projects

Sewer Project	Project Description	Status	Funding	Estimated Population Equivalent	Priority Rank & Contributing Area
Calverton/EPCAL - Town of Riverhead	Proposed plant improvements to increase water quality treatment to treat 100,000 gpd for future EPCAL flow and relocation of discharge outfall with 1.4 mile force main to new recharge beds north of the groundwater divide. Total project costs including FS is $10.2 million.	FS report to upgrade/expand existing WWTP completed in 2014. Project design to be completed by the end of January 2018. Project went to bid and construction slated to begin in summer/fall 2019. Additional expansions with modules to 200,000 gpd and 300,000 gpd are planned for ultimate maximum buildout of property in the future, not included in this project.	$476,000 Water Quality Improvement Project (WQIP) grant for relocation of EPCAL sewer outfall from the Peconic Estuary - contract not quite executed. $5M NYSDEC grant for upgrade of Calverton WWTP and relocation of outfall - contract not quite executed. $125,000 appropriated SC WQPRP grant for elimination of EPCAL point source discharge to the Peconic Estuary. Total of $7.5 million in grants received.	TBD	Surface Water N/A Groundwater 3
Westhampton Downtown - Village of Westhampton Beach (Phase 1 of 4)	Connection of 66 commercial lots on Main Street and condos on Moneybogue Bay to existing SD #24 Gabreski WWTP. Phase 1 is 60,000 gpd.	Initial map and plan completed. Village Board passed a resolution to create a sewer district. Engineering design work is finalize for the collection and conveyance system and also future upgrades to Gabreski STP. Bid for construction in 2020. May conduct season construction. Construction and start-up for Phase 1 expected 2020-2022. Engineering, construction, soft costs budgets at $16,750,000 total for the conveyance and collection system as well as upgrades to the STP.	Construction funding to be in place by 2020. Village to fund engineering design for Gabreski WWTP improvements. Southampton Town CPF funding engineering design and EPG funding toward the map and plan. $5M NYSDEC WQIP grant to help fund construction.	500 (156 parcels)	Surface Water 1 Groundwater 3 0-2 Year
Riverside - Town of Southampton	New sewer district required to manage wastewater generated by Riverside redevelopment project.	Draft map and plan completed. Engineering design work completed. Meeting with Suffolk IDA to finalize the sewer district. SEQRA review (supplemental GEIS) to be completed July 2019. Town Board anticipates to create the sewer district by August 2021. Construction and start-up for Phase 1 expected to be completed 2021.	Funding in place: project listed on 2019 NYS EFC Annual Intended Use Plan for $57 million in low interest loans set aside for the construction of the plant and associated infrastructure.	1,500	Surface Water 1 Groundwater 3 0-2 Year
Wyandanch - Town of Babylon	Connection of commercial lots on Acorn Street (32 parcels) and Wyandanch Avenue (57 parcels) to existing Bergen Point WWTP/SD#3.	Acorn Street and Wyandanch Avenue projects are at the RFP stage for design work and cost estimates. Project is expected to be project completed in 2021. Town IDA project. There is overlap with the County's Carlls River projects.	Funding may be coordinated with the IDA, Environmental Facilities Corporation (EFC) loan, and SC Sewer Infrastructure grant. No cost estimates prepared yet.	TBD	Surface Water 1 Groundwater 3

Table 1-21 Town / Village Sewer Projects

Sewer Project	Project Description	Status	Funding	Estimated Population Equivalent	Priority Rank & Contributing Area
Northport Expansion - Village of Northport	Expansion of sewer district into two near-shore areas, Steers Pit and Bluff Point Road. Approx. 40,000 gpd.	Feasibility Study completed. Conceptual construction cost for collection system is $9M to $11M. Preparing maps/surveys/plans.	Awarded $5M Water Quality Improvement Project (WQIP) NYS grant. Additional funding from SC Sewer Infrastructure requested.	450 (149 residential + 2 commercial)	Surface Water 2 Groundwater 3 0-2 Year
Patchogue Expansion - Village of Patchogue	Proposed expansion of existing WWTP capacity from 800K to 1.2M gpd to accommodate new commercial growth.	Facility Plan' feasibility study completed; under Village review. Total project cost, including construction and engineering cost is $10.4M	$100,000 for 'facility plan' funded. Village to apply for NYS water qual. funding for STP improvements project construction. Received $30,000 grant from NYSDEC.	TBD	Surface Water 1 Groundwater 3 0-2 Year
Hampton Bays Downtown - Town of Southampton	Proposed new sewer district for existing commercial development is being planned.	Feasibility Study not completed.	No funding identified for construction.	TBD	Surface Water N/A Groundwater 3
Southampton Downtown - Village of Southampton	Proposed new sewer district for downtown area.	FS/design complete but construction bids came in too high; considering alternative project.	Funding requirements uncertain.	1,500	Surface Water 1 Groundwater 1 0-2 Year
Montauk Downtown - Town of East Hampton	Proposed sewer district for commercial lots around Fort Pond and include Montauk Manor and Rough Riders.	Feasibility Study underway with Lombardo Associates.	FS funded. Initial project costs at $32M. Town applied for $5M in NYS water quality funding for design/construction. $10M in Town CPF funding is uncertain.	TBD	Surface Water 4 Groundwater 1 0-2 Year
East Hampton Downtown - Village of East Hampton	Village has discussed creating a sewer district in the commercial area.	No plans or studies in place.	No funding identified for construction.	TBD	Surface Water 1 Groundwater 1
Springs School District - Town of East Hampton	Town of East Hampton has discussed constructing advanced treatment at the Springs School.	Town is considering package STP or I/A OWTS. No plans or studies in place.	No funding identified for construction.	TBD	Surface Water 3 Groundwater 1 0-2 Year
Port Jefferson – Village of Port Jefferson	FS for expansion/additional connection of parcels within the Village boundary to the existing Village WWTP completed under SC CP 8185	Since the Village is not completely within the district it is possible that use of available capacity that has been discussed for the Village would be for an outside connection. Village indicated no plans to move forward.	No further funding.	2,300	Surface Water 3 Groundwater 3

Table 1-21 Town / Village Sewer Projects

Sewer Project	Project Description	Status	Funding	Estimated Population Equivalent	Priority Rank & Contributing Area
Sag Harbor - Village of Sag Harbor	FS for expansion/additional connections to existing Village WWTP completed under SC CP 8185	Possible expansion of the sewer service area under potential built-out scenario (85,000 gpd) - has to be owned/decided on by the Village and requires funding. Village indicated no plans to move forward.	No further funding identified.	800	Surface Water 2 Groundwater 3
Riverhead - Town of Riverhead	FS for expansion/additional connections to existing Riverhead Sewer District WWTP completed under SC CP 8185	No additional capacity for outside connections and no plans for expansion. Owned by Town of Riverhead. Town indicated no plans to move forward.	No further funding identified.	Unknown	Surface Water 1 Groundwater 2
Fire Island Expansion - Village of Ocean Beach	Rebuild STP/collection system to expand sewer service district.	Village indicated no plans to move forward.	No further funding identified.	8,000	Surface Water 1 Groundwater 3

Legend
FS, Design & Construction Funded
FS & Design Funded
FS Funded & Complete
FS Funded/Proposed
No Plans to Move Forward with Project

Priority Rank dependent on 25% or more of project area falling within the contributing area

Section 2
Project Approach

The recommendations of the SWP were built upon a foundation of state-of-the-art models, data analyses, statistical evaluations, cost analyses, and other technical evaluations. An overview of the various technical approaches used in the SWP and guided by the Wastewater Plan Advisory Committee (WPAC), Focus Area Work Groups and other stakeholders is presented below. A summary of the technical findings associated with each evaluation is also provided, where applicable. While this section focuses on identification and mitigation of nitrogen impacts on surface waters, the evaluation of nitrogen impacts and priority areas for groundwater restoration and protection is described in Section 3 of this SWP.

2.1 Surface Water Priority Ranking and Load Reduction Goals

2.1.1 Overall Approach

Surface water priority ranking for nitrogen load reduction and nitrogen load reduction goals were developed for all 191(1) water bodies evaluated in the SWP using the following general sequence of steps:

- Work with project partners and stakeholders to develop a list of individual surface water bodies to be studied within this SWP;
- Collect available data and develop a database of water quality data to characterize existing water quality within each water body studied in the SWP;
- Use groundwater models to delineate the areas contributing groundwater baseflow to the surface water bodies (e.g., subwatersheds);
- Calculate parcel-specific nitrogen loads from sanitary wastewater, fertilizer, atmospheric deposition and pets for all properties in Suffolk County;
- Use groundwater flow and contaminant transport models to simulate nitrogen concentrations within the aquifer system and the migration of the parcel-specific nitrogen loads through the aquifer;
- Calculate the nitrogen load from groundwater baseflow to each of the surface water bodies;
- Use surface water models to calculate the residence time within each of the surface water bodies;

(1) Working together with the Wastewater Plan Advisory Committee and other stakeholders, SCDHS identified 191 priority surface waters in the County. Groundwater modeling was used to delineate the area contributing groundwater baseflow to each of these surface waters; together the groundwater contributing area and the surface water body itself are referred to as subwatersheds in this task memorandum. 190 of the total 191 subwatersheds evaluated were ranked for nitrogen load reduction priority. One subwatershed, Block Island Sound, was not ranked because it could not be sufficiently characterized to provide a rank. Nitrogen load reductions in upstream subwatersheds will result in nitrogen load reduction to Block Island Sound.

- Define the ecological endpoints that drive priority ranking and establishment of nitrogen load reduction goals;
- Characterize each subwatershed and its associated surface water body based on nitrogen load, residence time and surface water quality data;
- Use a decision support tool along with the subwatershed characterizations to rank each subwatershed's priority for nitrogen load reduction based upon ecological sensitivity to predicted nitrogen loads;
- Consider alternative approaches to define the relationship between nitrogen loads and desired water quality; and
- Identify the nitrogen load reductions that would be required to result in the desired water quality under the defined ecological endpoints.

Each of these steps is described in the remainder of this Section 2.1 of the SWP.

2.1.2 Subwatershed Identification

The 191 individual Suffolk County water bodies evaluated within this SWP were identified in an iterative fashion based on stakeholder outreach and input. Suffolk County's goal was to identify discrete surface waters and their subwatersheds for evaluation of nitrogen loading and resulting water quality to establish priority areas for wastewater upgrades and to establish first order nitrogen reduction requirements. Groundwater modeling was used to delineate the area contributing groundwater baseflow to each of these surface waters; together the groundwater contributing area and the surface water body itself are referred to as subwatersheds. These outputs ultimately guided the establishment of a phased Countywide wastewater upgrade program to address nitrogen from wastewater sources. The NYSDEC Water body Inventory/Priority Water bodies List (PWL) was used as the starting point for the identification of individual surface water bodies. The NYSDEC PWL is "a statewide inventory of the waters of New York State that NYSDEC uses to track support (or impairment) of water uses, overall assessment water quality, causes and sources of water quality impact/impairment, and the status of restoration, protection and other water quality activities and efforts." As such, the PWL provides a logical organizational framework for Suffolk County's SWP, consistent with other state regulatory efforts. Through discussion with the NYSDEC and various workgroup members, it was determined that while the NYSDEC PWL represented a solid foundational starting place, various modifications were required to the individual NYSDEC PWL water bodies in order to align them more appropriately for the purposes of the SWP technical evaluations and wastewater management recommendations. A summary of these modifications may be found in the summary notes from the July 19, 2016 WPAC and the Modeling workgroup kick-off meetings (**Appendices A-1** and **A-2**). The primary modifications were based on the following:

- Aggregating hydraulically connected individual PWL identified stream systems and lakes into a single study area. For example, the Patchogue River system aggregated Patchogue River Upper and Tributaries, Canaan Lake, Patchogue Lake and tidal tributaries to Patchogue Bay.

- Modifying PWL administrative boundaries to facilitate a more accurate evaluation of a system's hydrodynamic residence time calculations;
- Modifying PWL administrative boundaries to facilitate wastewater management evaluations. For example, the Great South Bay, Middle-East boundary was modified to correspond to the boundary of the Southwest Sewer District; and,
- Disaggregating individual PWL water bodies where the PWL had several adjacent, but separate, water bodies grouped together as a single PWL.

During 2016, additional subwatersheds were added to the list, based on WPAC input, further review of water quality data and/or the occurrence of new harmful algal bloom (HAB) events. The final list of the 191 subwatersheds that were simulated and evaluated as part of the SWP is shown on **Table 2-1** (please see tables at the end of this section). The 191 subwatersheds are listed in alphabetical order, along with the towns in which they are located, and where applicable, the estuary to which they discharge. In addition, the table identifies an existing or modified PWL number for each subwatershed. Original PWL numbers have been modified in many cases, depending on whether the subwatershed was disaggregated from a larger water body or aggregated with an adjacent subwatershed. The rationale for aggregating or disaggregating specific subwatersheds is also noted in **Table 2-1.** The subwatershed numbers referred to in this SWP are identified as SWP PWL numbers.

The 191 subwatersheds include 27 subwatersheds contributing to Long Island Sound (LIS), 75 contributing to the Peconic Estuary, 74 contributing to the South Shore Estuary Reserve (SSER), and 14 other fresh or Coastal Ponds. Five of the 14 fresh water ponds were located within the Peconic Estuary or SSER watershed.

2.1.3 Project Water Quality Database Development

2.1.3.1 Water Quality Data

A first ever in Suffolk County, all readily available water quality data from a wide variety of sources was identified, acquired, and compiled into a single, seamless, Countywide water quality Excel-based database. The final database includes over 332,000 individual data points. The initial database was established using data obtained from the SCDHS' on-line portal:

https://gisportal.suffolkcountyny.gov/gis/home/group.html?id=cbd4d20b287d4ef79af28a9b56cea71a#overview

and data obtained from the United States Geologic Survey (USGS), Stony Brook School of Marine and Atmospheric Sciences (SoMAS), and the three estuary programs (Long Island Sound, Peconic Estuary and South Shore Estuary). The initial data inventory confirmed that many subwatersheds were characterized with extensive data sets, while no data was available to characterize others. SCDHS sought additional data through several outreach attempts from Towns, Villages and the NYSDEC, and identified additional in-house data sets to supplement the initial dataset. After determining that no data was available for over 70 subwatersheds, SCDHS collected and analyzed water quality samples from these water bodies to provide an initial assessment of existing conditions as described below in Section 2.1.3.4.

The searchable database was organized by subwatershed based on the subwatershed names and modified PWL numbers identified above in Section 2.1.2 and **Table 2-1**. Parameters that were included in the database organized for this project are:

- Water Clarity indicated as Secchi Depth
- Nitrogen species – Ammonia, Nitrite, Nitrate, Organic-N, and Urea
- Phosphorus species – Total/Dissolved Phosphorus, Phosphate, and Ortho-Phosphate
- Chlorophyll-*a*
- Dissolved oxygen
- Fecal coliform (pathogen indicator)
- Temperature
- Salinity
- Conductivity
- pH
- Carbon Dioxide
- Organic Carbon
- Total Suspended Solids

SCDHS Office of Ecology (OE) and Office of Water Resources (OWR) have monitored surface water quality throughout Suffolk County for decades and provided the majority of the water quality data used to characterize the subwatersheds as shown on **Figure 2-1** and **Table 2-2**. It should be noted that SCDHS screened the sampling stations included in the SWP database to eliminate those that were not representative of water quality conditions. For example, a surface water quality monitoring station that is explicitly monitored to track contaminants from an upgradient landfill would not be included because of its potential bias for various analytes that are not representative of typical land use in Suffolk County. In addition, in some cases, water quality sampling locations have not been randomly selected but may have been established to monitor known water quality impairments. In these cases, concentrations of specific parameters may be biased high, and provide a conservative representation of water quality.

Table 2-2 Data Sources Contributing to the Water Quality Database

Data Source	Number of Samples
Suffolk County Department of Health Services	276,549
Stony Brook University School of Marine and Atmospheric Sciences	31,095
United States Geological Survey	21,272
New York State Department of Environmental Conservation	2,529

Data Source	Number of Samples
Connecticut Department of Environmental Protection	473
Environmental Monitoring and Assessment Program	53
Other	57

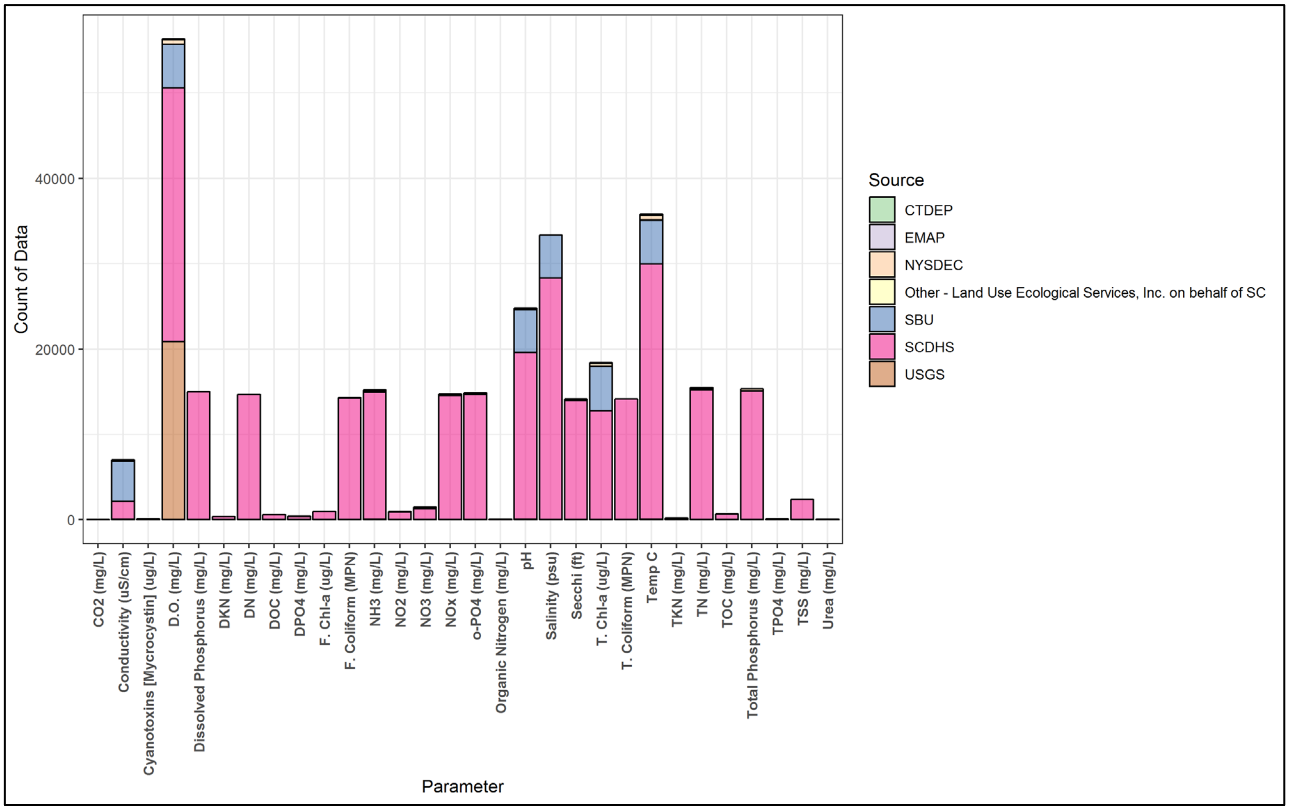


Figure 2-1 Surface Water Quality Samples by Data Source

2.1.3.2 Data Quality

After data was collected and inventoried, the data characterizing each subwatershed was assessed for adequacy based on:

- Reliability (source of the data),
- Quantity (count of data points), and
- Relevance (date data was collected).

Each entity that contributed data to the database has different quality assurance procedures. The vast majority of the data used for the watershed characterization was collected by SCDHS professionals in accordance with their own quality assurance procedures and/or study-specific Quality Assurance Project Plan (QAPP) and analyzed by SCDHS' own New York State Environmental Laboratory Approval Program (ELAP)-certified laboratory. The SWP QAPP recognized that exclusion of water quality data that is not generated by a laboratory with ELAP certification would significantly limit the team's ability to provide initial recommendations for a number of water bodies in Suffolk County. Because water quality data obtained from laboratories with ELAP certification is not available to characterize many of the subwatersheds, and because data measured directly in the field will be valuable to support first order water body characterization purposes, both will be used for this project as described in the QAPP. Data from laboratories that are not ELAP certified and from sources that cannot provide an approved QAPP was flagged due to potential less rigorous QA procedures.

Data measured directly in the field also provides valuable information to support first order water body characterization purposes; this data was also flagged and used for this project. For example, the characterization of diurnal and/or seasonal dissolved oxygen variation within a water body provides insight into data variability, the condition of a water body and the temporal response to loads and hydrologic events that quarterly or annual sampling and analysis by an ELAP certified laboratory cannot provide. This data was also incorporated into the subwatershed characterizations.

One of the intents of the subwatershed characterization process was to link nitrogen loads estimated at current conditions to current water quality. Therefore, the data was filtered so that only data collected during the most recent ten-year period was used for the water quality characterization used for subwatershed ranking, e.g., data collected prior to 2007 was not used, except as described below.

A subwatershed was identified as well-characterized if the results of ten samples within the past ten years were available. Availability of ten data points allowed determination of the 90th percentile and 10th percentile of water quality data characterizing each water body as described in Section 2.1.7. Data collected prior to 2007 was used as secondary data for those subwatersheds where no other data was available to characterize water quality, or if less than ten data points were available to characterize a water quality parameter. Before including samples collected prior to 2007, the data were screened further for relevance by confirming that major changes in land-use and/or wastewater management method (e.g., sewering) in the subwatershed had not occurred subsequent to the sample collection dates.

Figure 2-2 shows the total number of samples available to characterize each water quality data parameter and the number of samples available after screening was completed.

In addition, surrogate parameters were used in some cases when no data were available to characterize a selected indicator. For example, the sum of ammonia, nitrite and nitrate was used in place of, or to supplement, total nitrogen data for those subwatersheds with insufficient data. Even with the additional data collected by SCDHS Office of Ecology, data to characterize one or more parameters was not available for some of the subwatersheds. In those cases, the average concentration for all other subwatersheds was used as a place holder for ranking purposes, as described below in Section 2.1.7. The intent of using the Countywide average concentration was to make that particular parameter "neutral" for the purpose of priority ranking (e.g., no net benefit or disadvantage when compared to the Countywide average for the particular parameter).

The subwatersheds with limited datasets, and those subwatersheds where one or more parameters was characterized by an average value are illustrated on **Figure 2-3** and summarized on **Tables 2-3** and **2-4** (please see tables at the end of this section). The smaller estuaries, upper reaches of the fresh water streams, the ponds and the coastal ponds comprised the majority of the water bodies that were not well characterized.

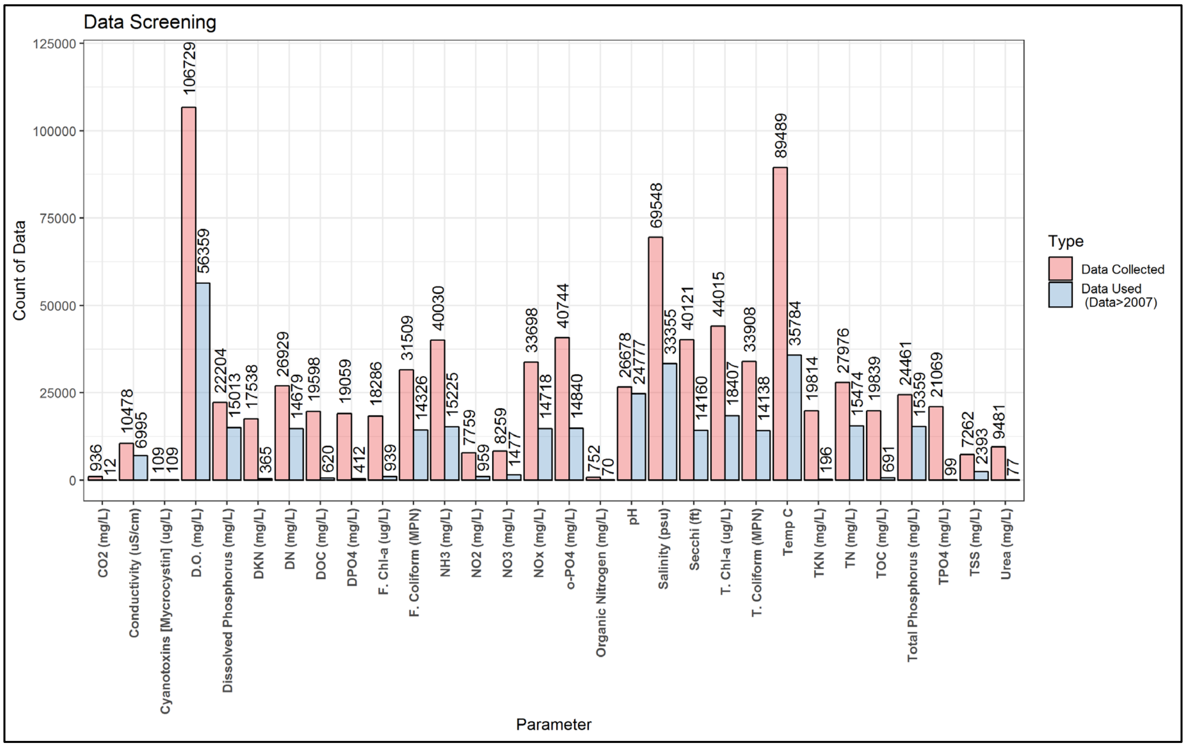


Figure 2-2 Total Number of Samples Collected and Samples Collected Since 2007

Overall, 35 percent of marine water bodies were poorly characterized, 84 percent of mixed water bodies were poorly characterized and nearly all, e.g., 88 percent of fresh water bodies, were poorly characterized. Recommendations for additional data collection, particularly to characterize the impacts of nitrogen loading on the poorly characterized fresh waters, may be found in Section 9.5.

2.1.3.3 Ecological Response Data - Harmful Algal Bloom (HAB) Database

Measures of the ecological response to water quality were also characterized for each subwatershed, including the presence or absence of harmful algal blooms (HABs). Another first of its kind in Suffolk County, a HAB database was developed in consultation with the SBU SoMAS. The HAB database incorporated all known HAB data including quantitative data characterizing HAB cell counts, toxins and other HAB-related analytes. HABs were subdivided into two categories, HABs causing primarily health impacts and HABs causing primarily environmental impacts, as well as plant and macroalgae overgrowth. HABs with human health impacts were comprised of:

- Blue green algae (cyanobacteria)
- Red Tide (Alexandrium fundyense, causes Paralytic Shellfish Poisoning, PSP)
- Red Tide (Dinophysis acuminate, causes Diarrhetic Shellfish Poisoning, DSP)

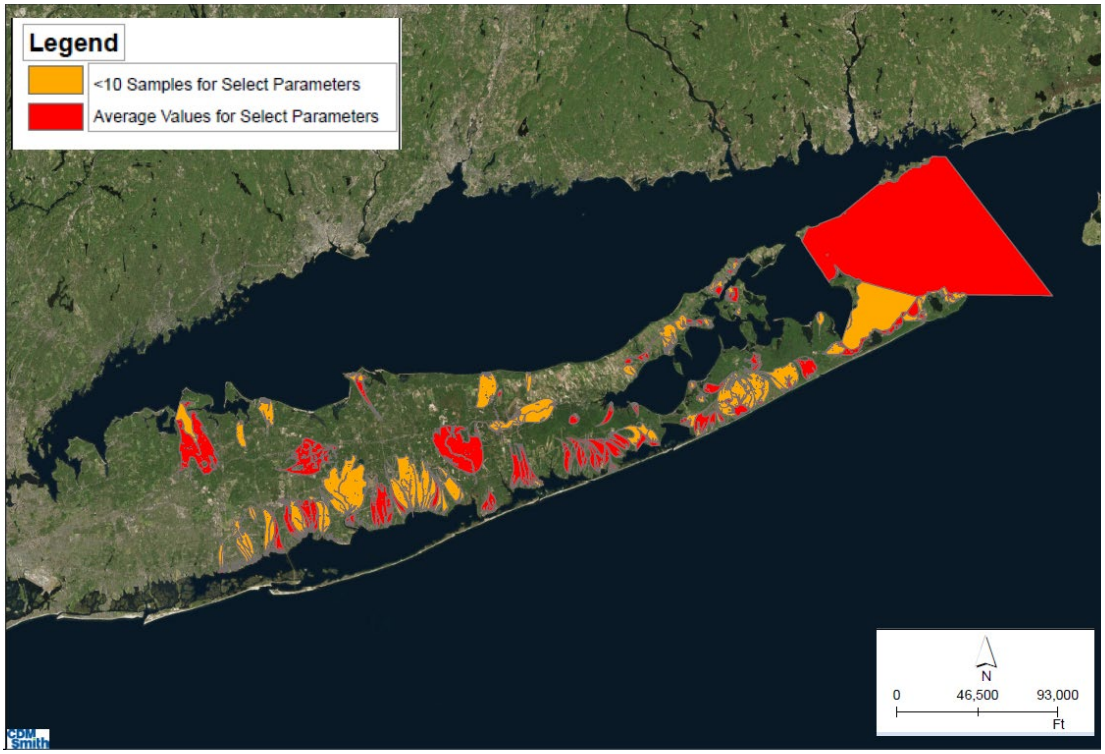


Figure 2-3 Subwatersheds with Less than 10 Data Points to Characterize One or More Parameters and Subwatersheds with One or More Parameters Characterized by an Average Value

HABs with environmental impacts were comprised of:

- Brown tide (Auerococcus anophagefferens)
- Rust tide (Cochlodinium polykrikoides)
- Other (unspecified species).

The number of samples analyzed for each type of HAB is summarized in **Figure 2-4**.

Macroalgae overgrowth was also characterized for the fresh subwatersheds based on readily available data provided in the NYSDEC PWL Fact Sheets. It should be noted that macroalgae overgrowth is generally not well characterized or documented in Suffolk County, particularly in marine waters.

The project-specific excel-database was linked to the subwatershed-specific mappings described in Section 2.1.4 below, and to mappings depicting the locations of the surface water sampling stations used to characterize the receiving water. **Figure 2-5** provides an example mapping showing the Napeague Harbor and tidal tributaries subwatershed and sampling stations.

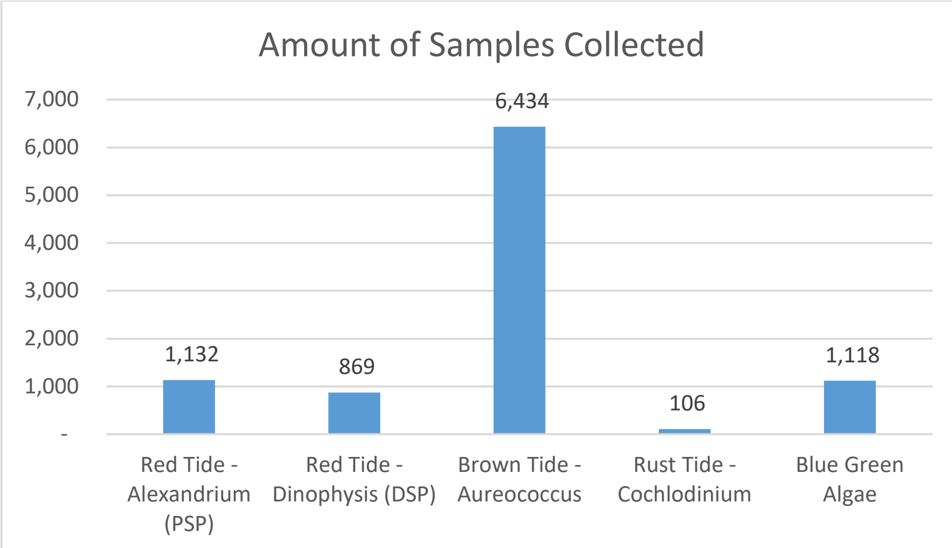


Figure 2-4 Number of Samples Analyzed for HABs

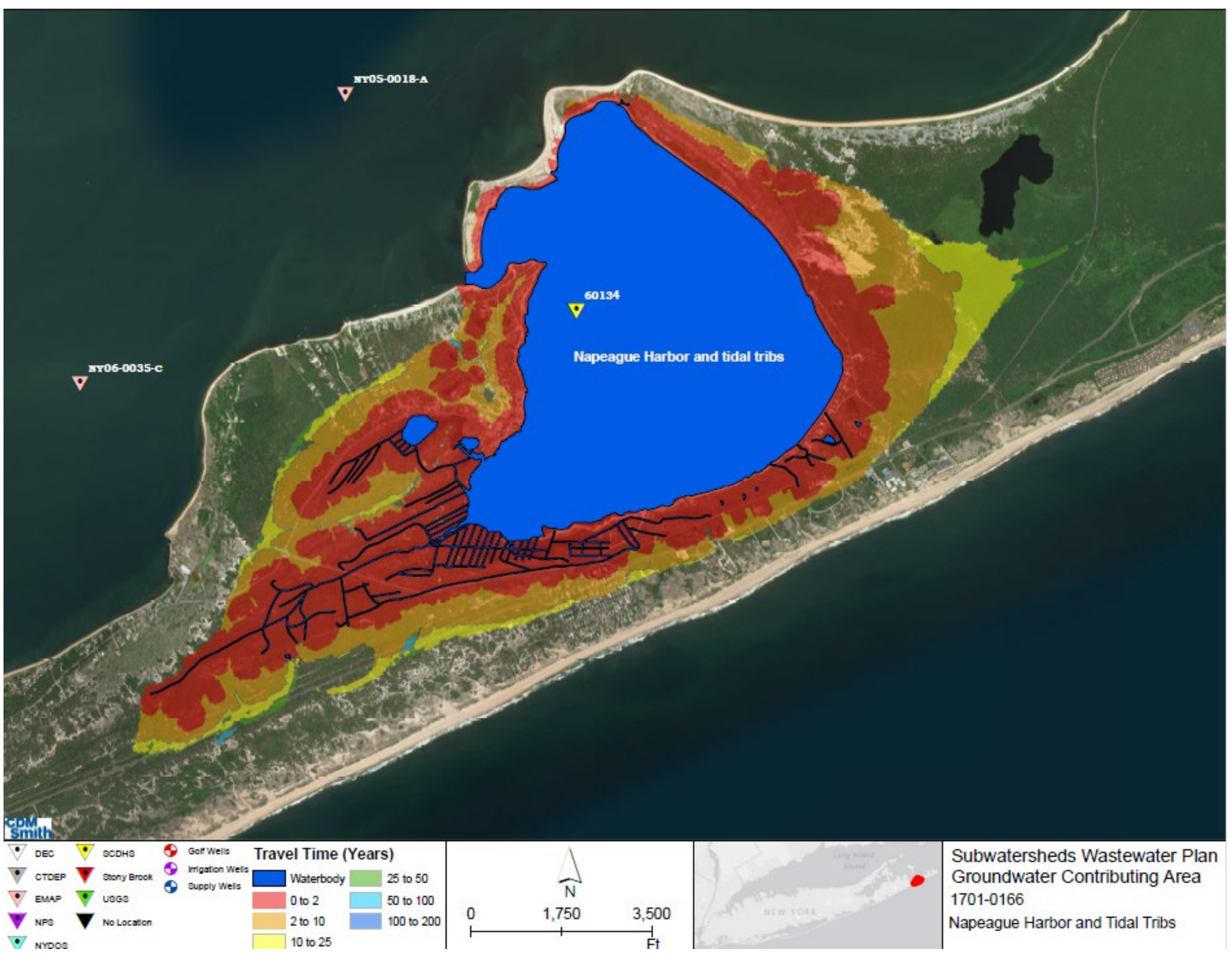


Figure 2-5 Napeague Harbor and Tidal Tributaries – Sampling Station Example

2.1.3.4 Supplemental Sampling

Despite the enormous quantity of existing surface water quality data in Suffolk County, more than 70 individual SWP water bodies were identified as having little or no water quality data. In addition, 10 water bodies were identified as having no existing bathymetry data for use in the Environmental Fluid Dynamics Code (EFDC) hydrodynamic model. A list of the surface waters with little or no water quality data and/or insufficient bathymetry data is provided in **Table 2-3** (please see tables at the end of this section)**.**

In response to the data gaps, SCDHS Division of Environmental Quality staff collected a synoptic round of surface water quality samples and bathymetry data to characterize each of the water bodies listed in **Table 2-3**. Surface water samples were collected in accordance with the EPA-approved QAPP and procedures outlined in the Suffolk County Bureau of Marine Resources Standard Operating Procedures manual. All samples were submitted for laboratory analysis to the NYS ELAP certified Suffolk County Public & Environmental Health Laboratory (PEHL). Marine water quality samples were sampled during the last two hours of the outgoing tide from the top of the water column. Fresh water samples were also collected from the top of the water column. All samples were analyzed for total nitrogen, dissolved nitrogen, ammonia, nitrate, nitrite, total phosphorus, dissolved phosphorus, ortho-phosphate, chlorophyll-a, and total & fecal coliform. In addition, field parameters were recorded for bathymetry, secchi depth (where applicable), temperature, dissolved oxygen, salinity (marine only), conductivity (fresh only), turbidity (fresh only), oxidation-reduction potential (fresh only), and pH. While all 70 sampling locations were sampled at least once, a subset of 23 sampling locations was sampled twice. Supplemental water quality data was used for initial water quality characterization in the priority ranking of individual subwatersheds; however, consistent with the methodology described in Section 2.1.3.2 of the SWP, these water bodies were flagged as being poorly characterized to acknowledge that a single (or two) sample is insufficient to accurately characterize a water body's water quality and that additional data collection is recommended.

SCDHS collected additional bathymetry data in the winter of 2017 to characterize the following water bodies: Acabonack Harbor, Carmans River, Conscience Bay, Crab Meadow Creek, Flax Pond, Little Neck Run, Mecox Bay, Stillman Creek, Yaphank Creek, Nissequogue River, and Sunken Meadow Creek. Utilizing a canoe or motorized boat, depth and coordinate readings were recorded approximately every 150 feet, with the aid of a fiberglass measuring rod or depth sounder, and a cell phone with a mapping application. The additional bathymetry data was incorporated by HDR into the surface water hydrodynamic model discussed further in Section 2.1.6.

2.1.4 Subwatershed Delineation

Under predevelopment conditions, Suffolk County surface waters received over 90 percent of their baseflow from groundwater (Comp Plan, Rozel). Therefore, groundwater is of critical importance to maintaining both the flow and quality of the County's surface water resources. Understanding where surface water baseflow originates as recharge is key to surface water resource management. The four existing regional Suffolk County groundwater flow models (representing the Main Body, South Fork, North Fork and Shelter Island) were used to delineate the land surface area where recharging precipitation travels from the water table to discharge as baseflow or underflow to the surface water bodies within each subwatershed.

2.1.4.1 Existing Groundwater Model Overview

The existing, calibrated models have been utilized for nearly two decades to evaluate various water resources management strategies, contaminant transport and salt-water intrusion investigations throughout Suffolk County. The Suffolk County Main Body Flow Model was originally developed and calibrated as a cooperative effort with SCDHS, Suffolk County Department of Public Works (SCDPW) and Suffolk County Water Authority (SCWA) in 1996 and 1997, with guidance and input provided by NYSDEC and the Suffolk County Planning Department. Working together with SCDHS and SCWA, dual-density groundwater models were developed and calibrated in 2001-2002 for the North and South Forks and Shelter Island. The three dual-density models were developed using DYNSWIM, a dual-density three- dimensional finite element code that allows for the simulation of multiple salt-water interfaces. The dual-density models were later converted to freshwater models for use in the New York State Department of Health (NYSDOH) Source Water Assessment Program (SWAP) and the Suffolk County Comprehensive Water Resources Management Plan (2015). A detailed description of the development and calibration of each of these models can be found in CDM Smith (2003) and is not repeated here. The original Suffolk County model was calibrated to hundreds of water levels and to stream baseflows measured during two independent time periods representing different conditions of precipitation, recharge and development. The model was validated to a third set of water level measurements and stream baseflows. The model's ability to represent the aquifer's response to changing conditions of recharge and water supply pumping was further confirmed by a semi-transient simulation of the period from 1981 through 1994. The models' continued ability to represent observed conditions in response to changing water supply pumping and precipitation and recharge conditions has been evaluated through the years on a project-specific basis. The existing groundwater modeling framework (e.g., model stratigraphy, hydrogeologic properties) was not changed for this model application.

2.1.4.2 Updates and Refinements to Main Body, North Fork, South Fork and Shelter Island Models

The model computer codes were re-dimensioned for use in the SWP to allow for simulation of much more highly discretized flow and transport models that were required to provide the resolution needed to simulate detailed baseflow contributing areas (subwatersheds) to surface waters. The updates and modifications made to all four existing models are as follows:

- Additional discretization (e.g., thousands of additional model nodes) was added to allow more accurate representation of the coastline and surface water features;
- All models were converted to the horizontal datum of NAD 1983 State Plane New York Long Island (feet).
- Light Detection and Ranging (LiDAR) data representing the ground surface elevation was assigned to the top level of the groundwater flow model to allow for more accurate representation of groundwater discharges to surface waters and wetlands within the model domain;

- Boundary conditions were updated to represent contemporary conditions of precipitation, recharge, water supply pumping and sea level elevation. Estimated irrigation pumping from agricultural and golf course wells was also incorporated, and

- At least one model level was added to improve vertical model discretization within the upper glacial aquifer. Another model level was added to represent lakes simulated for SWP.

A detailed summary of the model refinements may be found in the Task 11a memorandum developed as part of the SWP project. A brief description of the primary refinements is provided below.

2.1.4.2.1 Additional Discretization

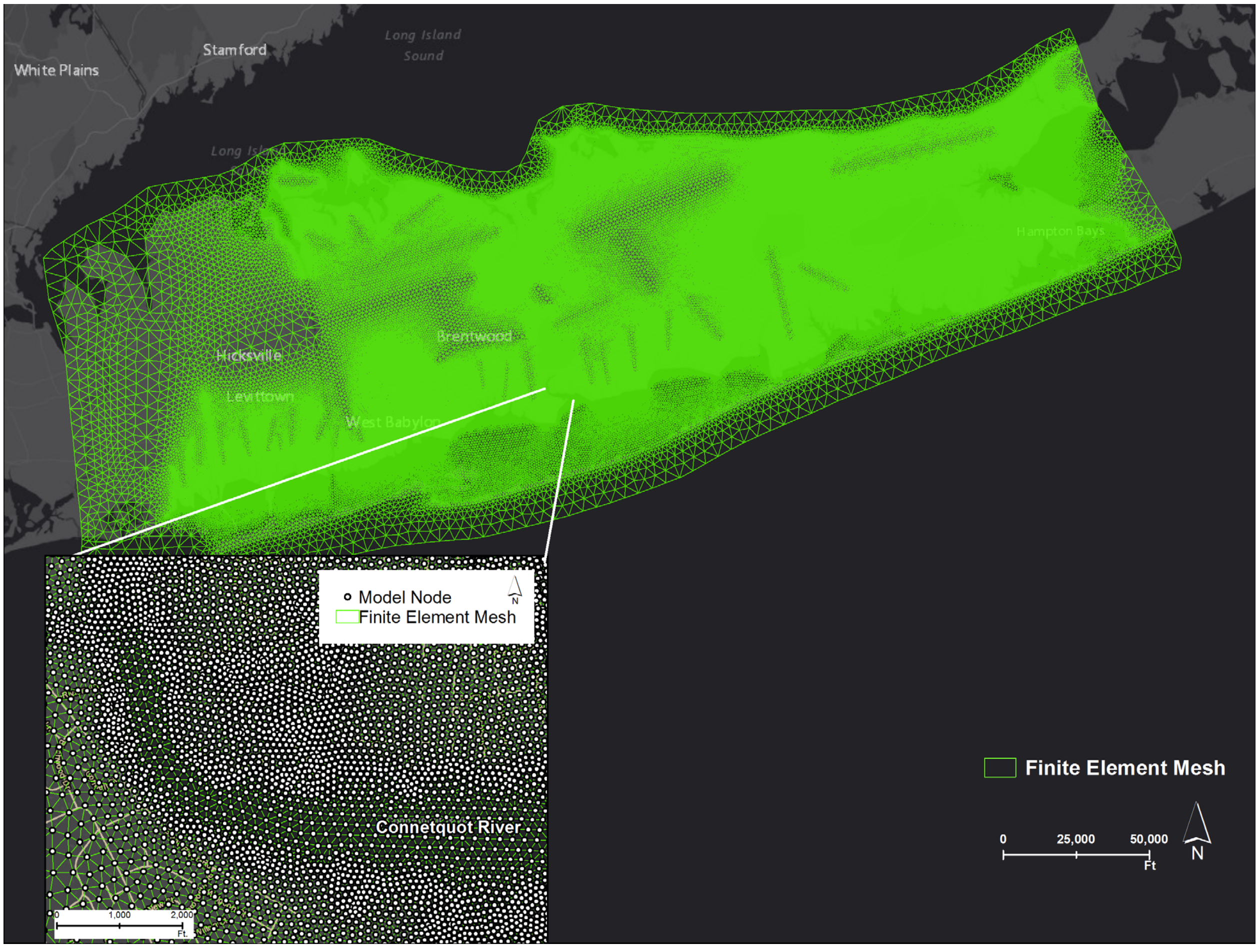
The models' computational framework is based on writing and solving the equations of groundwater flow at model nodes, the vertices of each finite element within the finite element grid, or model domain. For the SWP, additional detail was added to each model, particularly in coastal areas, to generate a more accurate representation of stream corridors, embayments and harbors and the freshwater ponds identified in Section 2.1.2. The additional detail also allowed for a better representation of water supply wells, as compared to the regional models as well as more discrete representation of the parcel-specific nitrogen loads described in Section 2.1.5. In general, node spacing in coastal areas was reduced to approximately 100 feet. The main body groundwater model was expanded to 511,247 nodes comprising 1,022,272 elements. The finite element grid for the Main Body SWP model is shown on **Figure 2-6**.

Similarly, the North Fork, Shelter Island and South Fork models were also refined with significant additional model discretization. The North Fork SWP model includes 169,969 model nodes comprising 339,698 elements. The Shelter Island SWP model includes 50,881 model nodes comprising 101,161 elements. The South Fork SWP model includes 153,691 model nodes comprising 307,131 elements. The finite element grids for the North Fork, Shelter Island and South Fork SWP models are shown on **Figures 2-7, 2-8** and **2-9**, respectively.

2.1.4.2.2 Incorporation of Light Detection and Ranging (LiDAR) Data

The groundwater models identify the presence of groundwater-fed surface water features (e.g., streams, ponds and wetlands) at model nodes where the groundwater table is simulated to intersect the ground surface.

A number of sensitivity analyses were conducted when the groundwater models were calibrated. Because the model-simulated groundwater-surface water interaction is sensitive to assigned stream bed elevations and to ground surface elevations in areas with high water tables, the ground surface elevation incorporated in the models was updated by incorporating more detailed elevation data. Ground surface elevations in the Suffolk County groundwater models were originally defined based upon the USGS five-foot contour mapping interval mappings available at the time that the models were developed. All four groundwater models were updated by incorporating more detailed ground surface elevation data using LiDAR data provided by Suffolk



County. LiDAR data contain very detailed topographic data capable of reproducing 2-foot contours.

Figure 2-6 Main Body Groundwater Flow Model for SWP Finite Element Grid

2.1.4.2.3 Boundary Condition Update

Model boundary conditions were updated to incorporate a recent period representing long-term average annual conditions of precipitation and water supply pumping. The long-term average annual precipitation from January 1949 through October 2016 at the Brookhaven National Laboratory (BNL) gage of 48.84 inches was utilized in the Main Body model, average annual precipitation from the Riverhead gage was used to characterized recharge for the North Fork model, average annual precipitation from the Bridgehampton gage was used to characterize recharge for the South Fork model, and the Shelter Island model used the average of the BNL, Bridgehampton and Riverhead gages.

As described in the Suffolk County Groundwater Model Report (CDM 2003), recharge to the aquifer system is comprised of recharge from precipitation and recharge from on-site wastewater treatment systems. Through the years, the models were modified to incorporate updated delineations of areas where sanitary wastewater is conveyed to major sewage treatment plants and wastewater discharges to groundwater. The flows for County and municipal wastewater plants that discharge to groundwater were incorporated into the flow model where they represented significant returns.

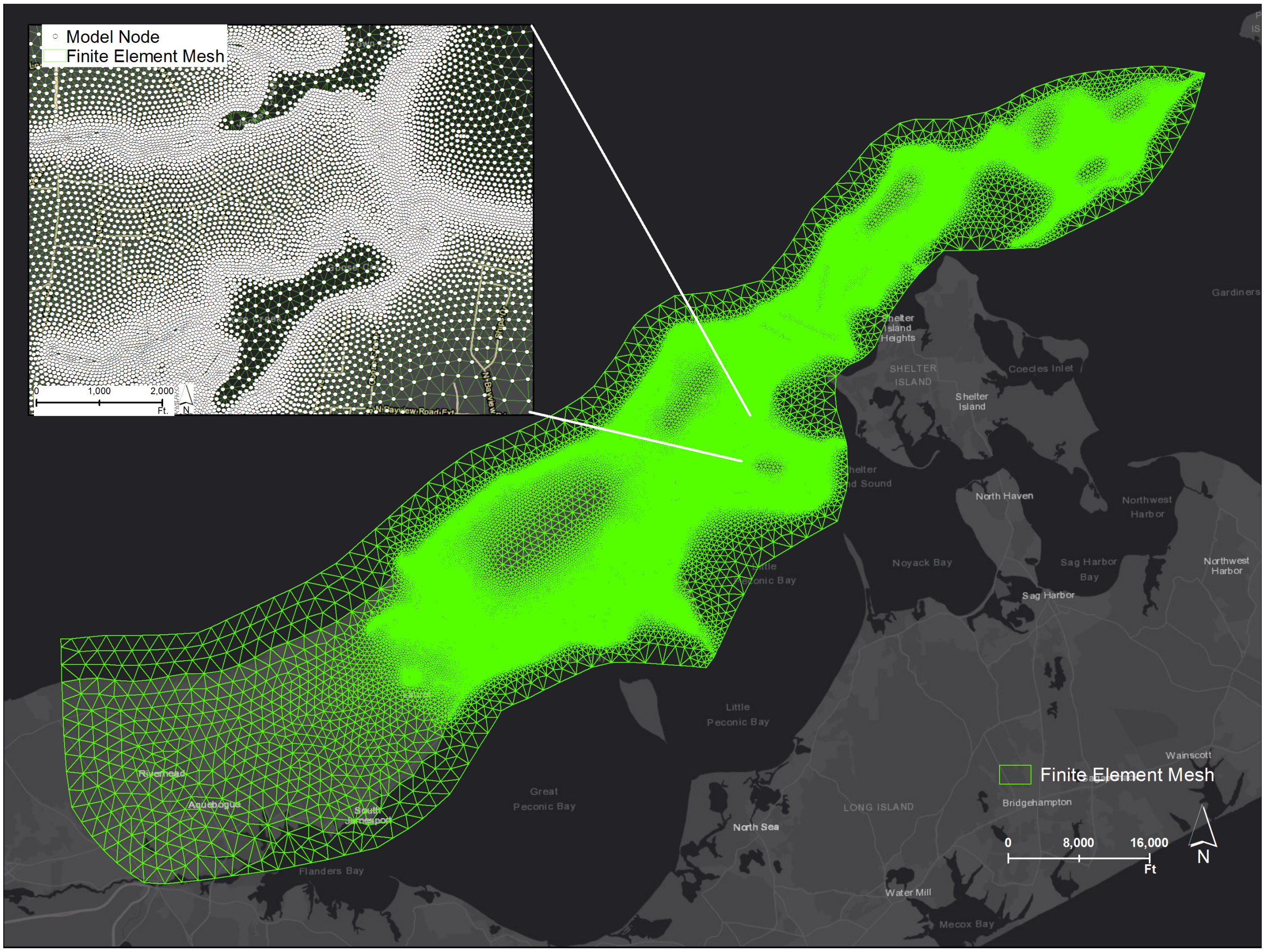


Figure 2-7 North Fork Groundwater Flow Model for SWP: Finite Element Grid

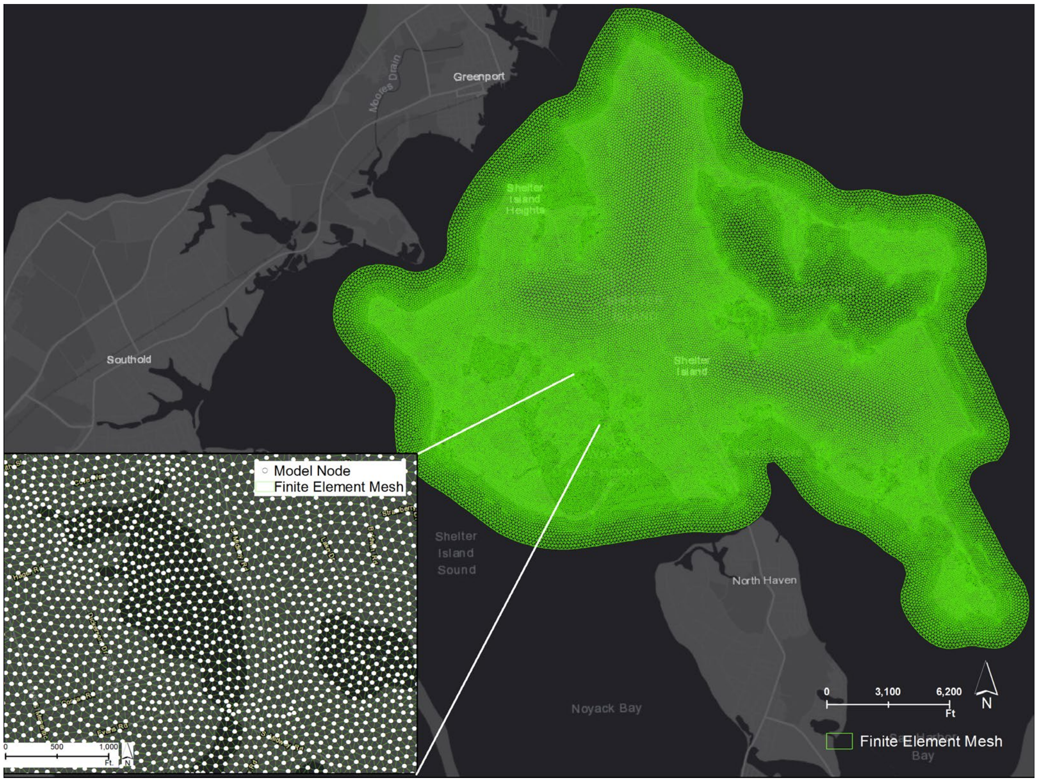


Figure 2-8 Shelter Island Groundwater Flow Model for SWP: Finite Element Grid

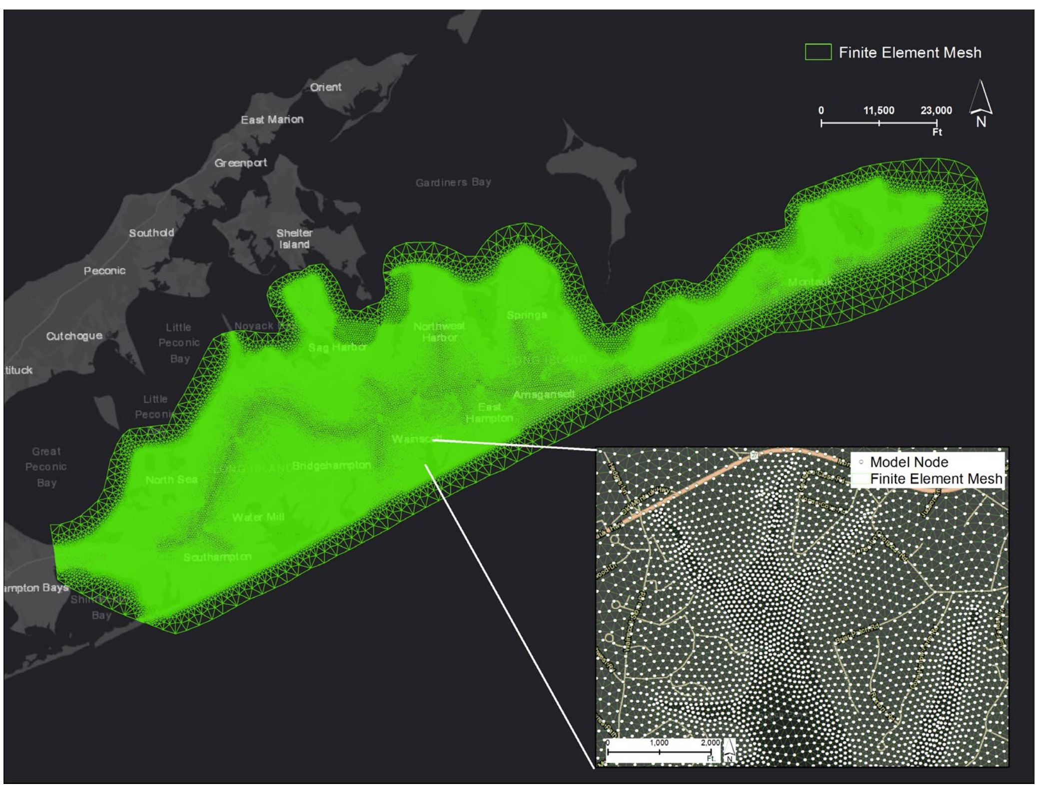


Figure 2-9 South Fork Groundwater Flow Model for SWP: Finite Element Grid

The average annual community supply well pumping rates from 2012 to 2013, which represent recent water supply pumping rates consistent with a period when precipitation was close to the long-term annual average were used for the SWP modeling. Recharge from on-site wastewater disposal systems (septic systems) was applied as 85 percent of the average non-growing season pumpage from November to March. Recharge from on-site wastewater disposal systems was applied to developed land uses within the County but not to open spaces or to areas served by County or municipal sewer systems.

Pumping from agricultural land use and golf courses was also incorporated into all four groundwater models. Because data documenting irrigation well locations, depths and pumpage is not readily available, irrigation wells were located at the centroids of golf courses and agricultural parcels and wells were screened approximately 80 to 100 feet into the water table for the model applications. Agricultural pumping locations were based on locations of irrigated parcels as published by the USGS Data Series 932: Geospatial Compilation and Digital Map of Center-Pivot Irrigated Areas in the Mid-Atlantic Region, United States (Finkelstein and Nardi, 2015). Pumping rates were assumed to be equivalent to an estimated irrigation depth of 8.26 inches per year based on the USGS Circular 1405 (Maupin et al, 2014). Because different crop types have different irrigation requirements, and crops are often rotated, 8.26 inches per year was applied to all irrigated parcels. Golf course irrigation was assigned based on an annual irrigation rate of 14.04 inches per year, based on published data from the USGS Circular 1405 (Maupin et al, 2014) and the National Water Information System golf course irrigation data for Suffolk County.

In addition, the mean sea level elevation used to define coastal and off-shore water levels was adjusted to reflect the increase in sea level rise over the past two decades. As the model is based in NVGD29, mean sea level elevation was adjusted to 0.83 feet, representing local sea level rise, using the Montauk NOAA Station. This sea level correction was applied throughout all models.

Changes to the boundary conditions described in the Suffolk County Groundwater Model Report are summarized in **Table 2-5**.

Table 2-5 Suffolk County Groundwater Model Boundary Condition Updates

Boundary Condition	Model Domain	Data Source	Notes
Recharge based upon long-term average precipitation	Main Body	BNL gage	Long term average conditions. Recharge estimated as documented in the Suffolk County Groundwater Model Report. 50 percent of annual average precipitation applied directly to simulated Lakes.
	North Fork	Riverhead gage	Long term average conditions. Recharge estimated as documented in the Suffolk County Groundwater Model Report.
	South Fork	Bridgehampton gage	Long term average conditions. Recharge estimated as documented

Boundary Condition	Model Domain	Data Source	Notes
			in the Suffolk County Groundwater Model Report.
	Shelter Island	Average of BNL, Bridgehampton and Riverhead gages	Long term average conditions. Recharge estimated as documented in the Suffolk County Groundwater Model Report.
2012-2013 Average Annual Water Supply Pumping (Community): Suffolk	All	SCWA, SCDHS, NYSDEC, NCDPW	Consistent with Comp Plan periods and period consistent with long-term average precipitation.
2012 Average Annual Water Supply Pumping (Community): Nassau			2012 pumping data were available from existing databases.
Agricultural Irrigation Pumpage	All (excluding Nassau County)	NYSDEC, SCDHS, USGS	Agricultural irrigation pumpage was estimated based on USGS documentation and estimates derived from agricultural land use, crop cover, and crop-specific irrigation requirements. As irrigation pumpage is not typically metered and varies significantly from year to year based upon weather and crop type, there is considerable uncertainty in the assigned pumpage locations and rates.
Golf Course Irrigation Pumpage	All (excluding Nassau County)	USGS	Golf course irrigation pumpage was estimated based USGS documentation and estimates derived-specific irrigation requirements. As irrigation pumpage is not typically metered and varies significantly from year to year based upon weather, there is some uncertainty in the assigned locations and pumpage rates.
Sewage Treatment Plant Service Areas	All	SCDPW, SCDHS, SCDEDP	Areas where sanitary waste is directed to sewage treatment plants; within the SWSD, wastewater from parcels that are not yet connected to the sanitary sewer system assumed to be

Boundary Condition	Model Domain	Data Source	Notes
			recharged via on-site systems.
Sewage Treatment Plant Discharge Rates (County and Municipal)	All	SCDHS/NYSDEC	County and municipal flows and 2015 nitrogen concentrations were incorporated where they represent a significant flux to the aquifer.
Sea Level Elevation	All	NOAA	Montauk Station (sea level rise trend)

2.1.4.2.4 Model Specific Updates

All four groundwater models had at least two model levels added to refine vertical discretization within the upper glacial aquifer and to incorporate lakes. Lakes were incorporated into the model by adding a surface layer of zero thickness in all areas with the exception of the lakes. Bathymetry data from the New York State Lake Contour Map Series (NYSDEC) were used to define lake bottom elevations in the groundwater models. Water in the lakes was represented as having a very high hydraulic conductivity relative to the surrounding formation, to allow for groundwater to pass through the lake freely. For lakes where bathymetry data were not available from NYSDEC, bathymetry was based on anecdotal data from the internet (fishing websites, etc.).

2.1.4.3 Model Application

The models were used to generate steady-state flow fields representing recent "average annual" conditions of water supply pumping, recharge and wastewater management. Suffolk County's aquifer system is constantly responding to changes in factors such as precipitation, recharge and water supply pumping, and is not in a steady-state condition, hence, the simulated flow field does not represent an observed flow field but an estimate of groundwater conditions that would result if the average conditions that were simulated remained constant for centuries.

The average annual flow fields established by the steady-state simulations were used to delineate the land surface (water table) area contributing groundwater recharge as baseflow or underflow to the County's surface waters, as well as an estimate of the time it would take recharging precipitation to travel from the water table to discharge at the downgradient surface water under the average conditions.

Figures 2-10, 2-11, 2-12 and **2-13** show the land surface area contributing groundwater baseflow to surface waters on the main body of Suffolk County, on the North Fork, Shelter Island and South Fork respectively. The figures show the areas where recharging precipitation travels from the water table to surface water discharge within two years in red, between two and ten years in orange, between ten and twenty-five years in yellow, between 25 and 50 years in green, between 50 and 100 years in light blue, and finally between 100 and 200 years in dark blue. Similarly, the areas where recharging precipitation is ultimately withdrawn by a community supply well or an irrigation well are also depicted, using the same color keys.

The figures highlight the areas where nitrogen introduced at the water table is carried down through the aquifer and discharges to surface waters via groundwater baseflow. Comparison of

Figure 2-10 with **Figures 2-11**, **2-12** and **2-13** also illustrates the differences between the deeper aquifer system on the Main Body of the island where it may take decades or even centuries for the recharging precipitation to discharge to coastal waters and the shallower aquifers on the Forks and Shelter Island. For example, **Figure 2-13** shows that nearly all of the precipitation that recharges Shelter Island will discharge to a coastal water body within 50 years, with most of the groundwater baseflow discharging in less than 25 years. This indicates that a reduction in the nitrogen introduced in this area will result in reduced nitrogen loading to Shelter Island surface waters relatively quickly, compared to areas in western Suffolk County where it may take decades to realize the benefit.

The groundwater models were used to delineate water body-specific groundwater contributing areas for each of the 191 water bodies identified. These 191 subwatersheds or groundwater contributing areas provided the framework for evaluation of nitrogen loads to each water body along with evaluation and development of nitrogen load reduction plans. Two example subwatershed delineations are shown here as **Figure 2-14** (Forge River and tidal tributaries) and **Figure 2-15** (Hallock/Long Beach Bay and tidal tributaries). **Figure 2-14** shows the extensive area contributing groundwater baseflow to the Forge River and its tributaries, extending over a mile north of the river headwaters where recharging precipitation can take over a century to discharge as baseflow. **Figure 2-15**, depicting a smaller water body on the North Fork, shows that most of the baseflow to Hallock/Long Beach Bay recharged the nearby shallow water table aquifer less than ten years ago.

The subwatershed delineations for each of the 191 subwatersheds were coupled with GIS coverages of 2016 Suffolk County land use data, as provided by Suffolk County Department of Economic Development and Planning (SC DEDP). These land use mappings, along with planning criteria such as areas where the average depth to groundwater is less than ten feet and Sea, Lake and Overland Storm Surges from Hurricanes (SLOSH) delineations provided further information that could potentially be used to guide wastewater planning. The land use mappings also provided the basis for the nitrogen load assignment and modeling described in Section 2.1.5 below.

Figures 2-16 and **2-17** illustrate the land use mappings for the Forge River and Hallock/Long Beach Bay within the 25 year contributing areas, respectively. Land use mappings for all 191 subwatersheds may be found in **Appendix D**.

2.1.4.3.1 Groundwater Baseflow Compilation

The groundwater baseflow contributions to each water body, based on the land surface area contributing recharge to the water body within each travel time interval simulated, were also compiled. These travel time baseflow percentages support the SWP by identifying the areas that contribute the most groundwater baseflow and associated nitrogen load to each of the surface water bodies studied in the plan. The percentages are based on the total baseflow discharged to the surface water body over the 200-year simulation period. For some of the coastal water bodies (e.g., Long Island Sound) the complete contributing area is not delineated by a 200-year simulation. In these cases, additional centuries would need to be simulated to capture the complete contributing area. However, the 200-year simulations do capture the majority of the contributing area, and as noted provide a reasonable framework for nitrogen management planning. In addition,

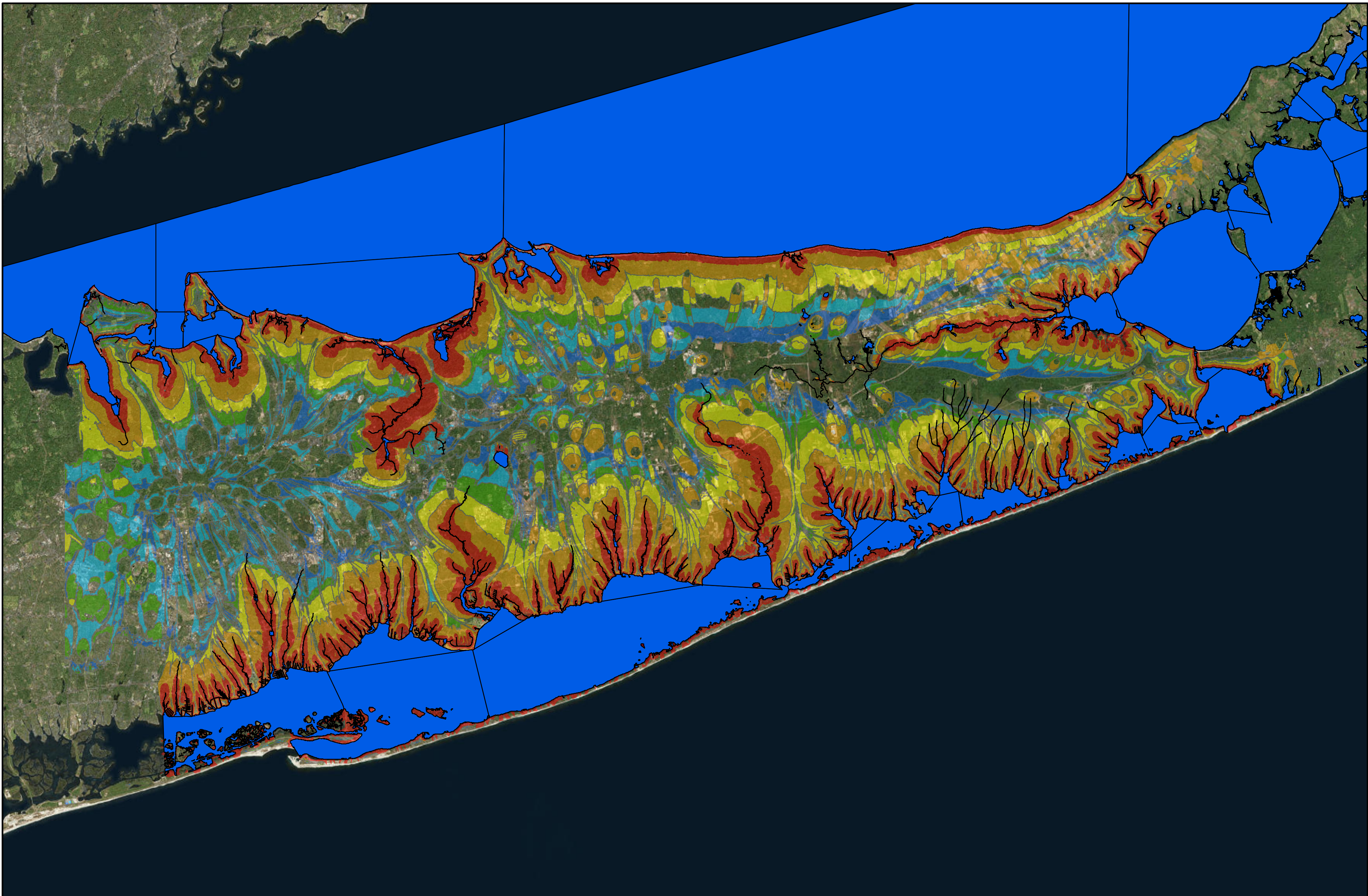
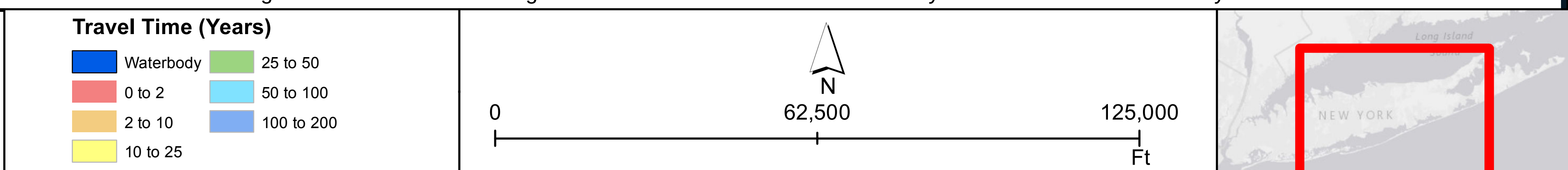


Figure 2-10 Area Contributing Groundwater Baseflow to Suffolk County Surface Waters – Main Body



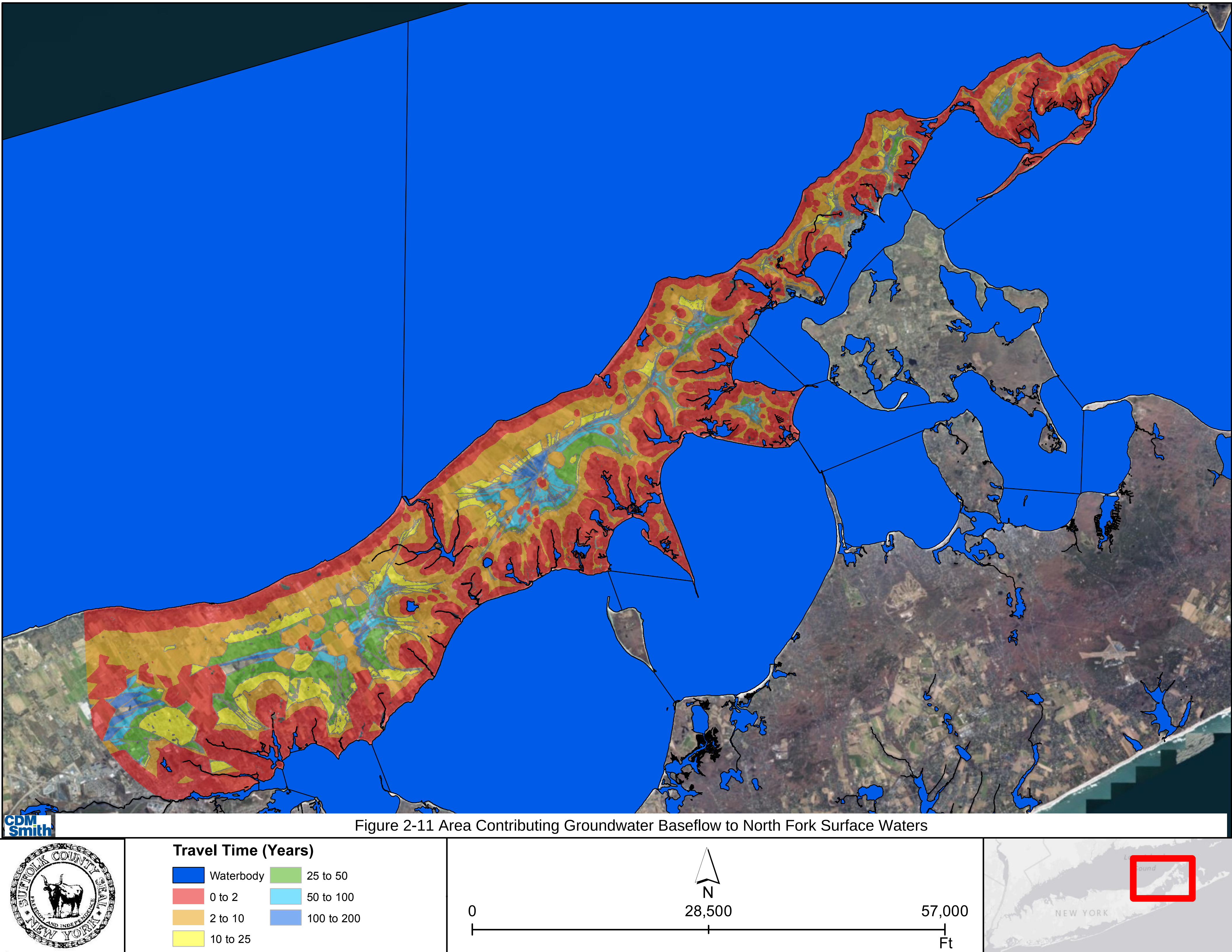


Figure 2-11 Area Contributing Groundwater Baseflow to North Fork Surface Waters

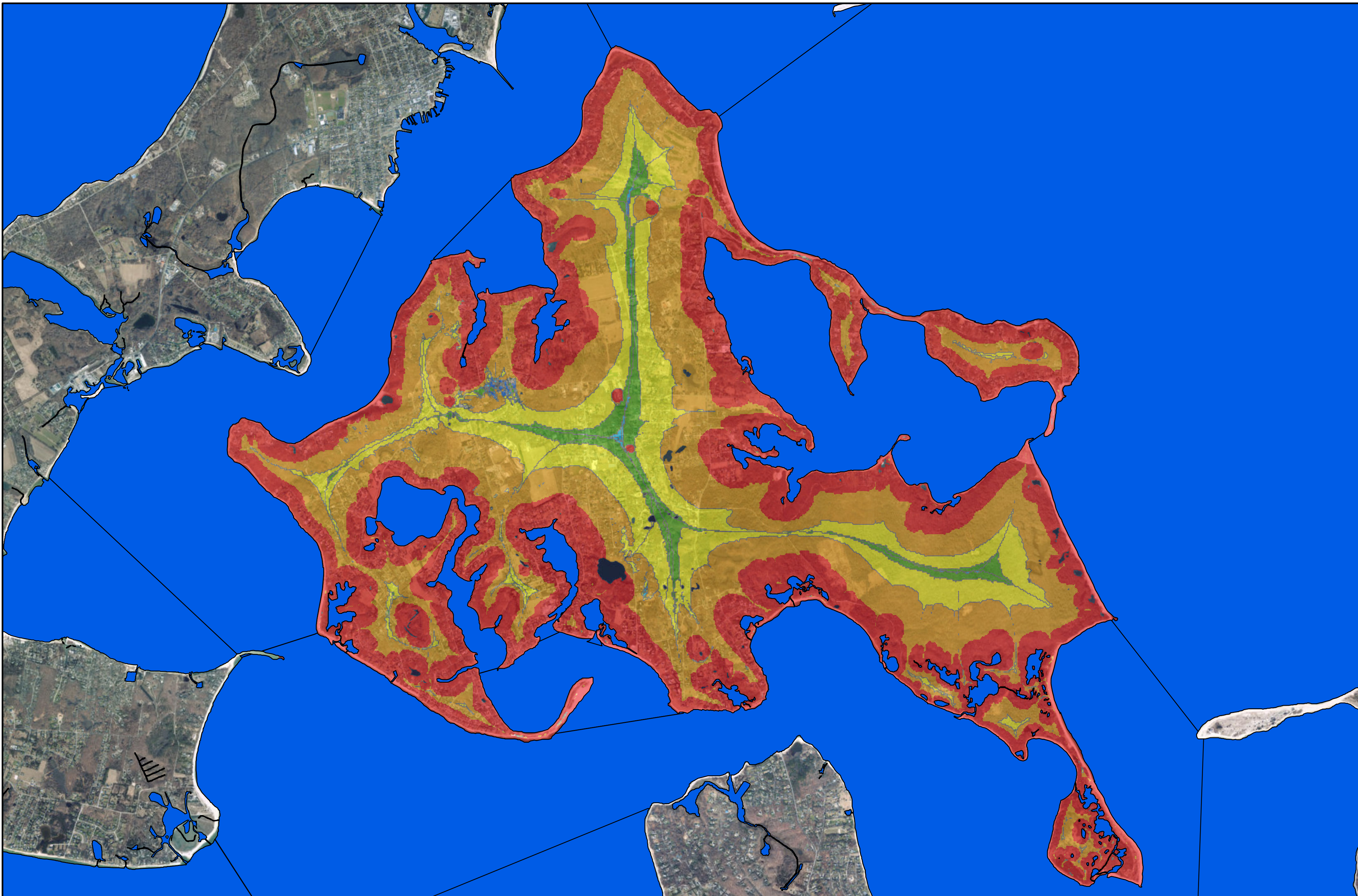


Figure 2-12 Area Contributing Groundwater Baseflow to Shelter Island Surface Waters

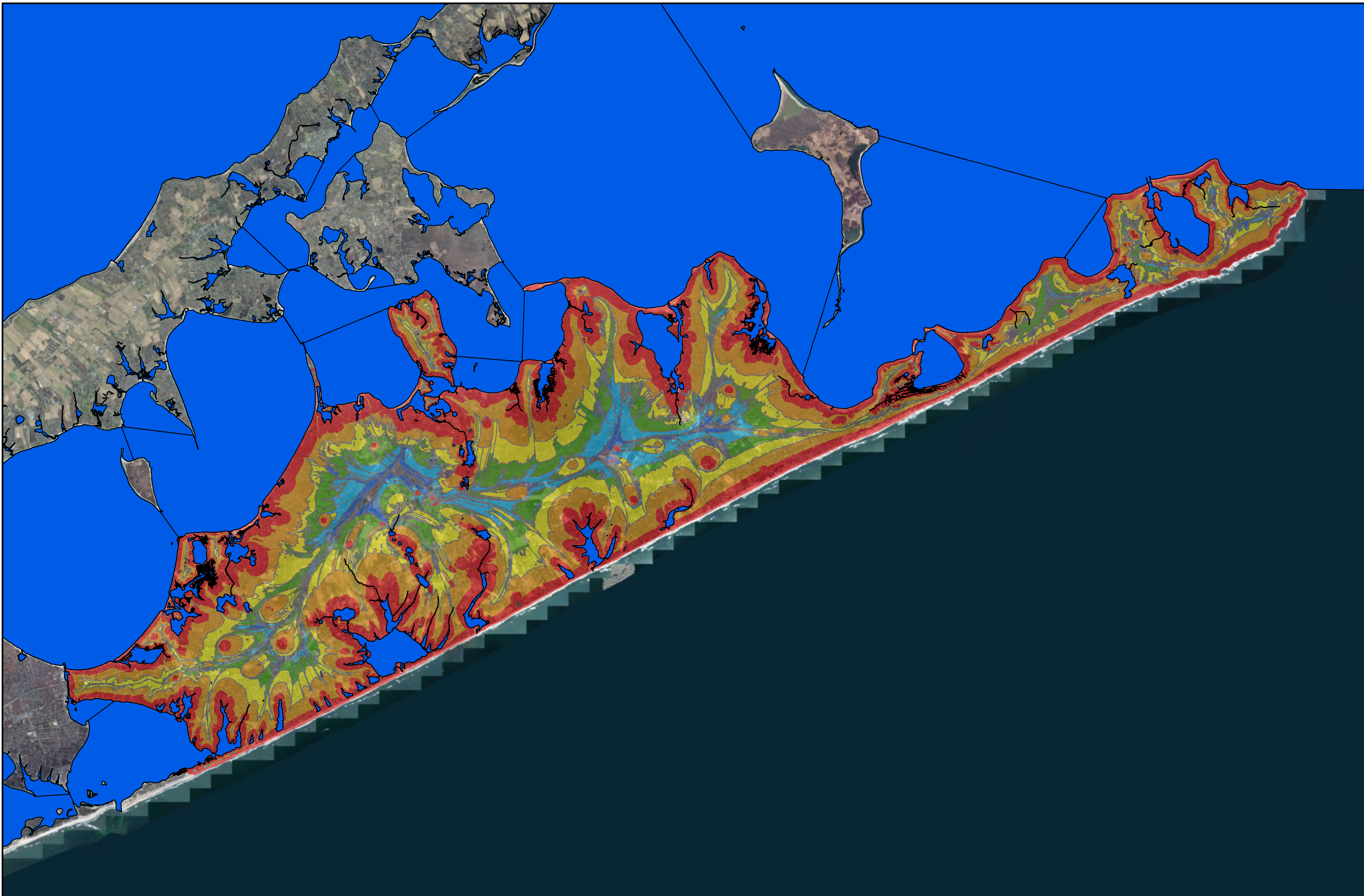
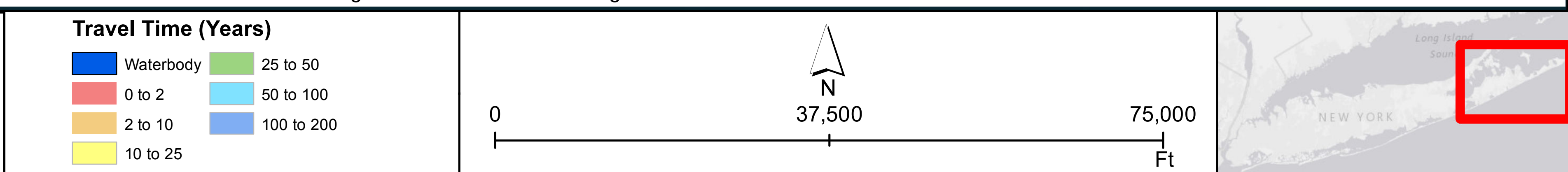


Figure 2-13 Area Contributing Groundwater Baseflow to South Fork Surface Waters



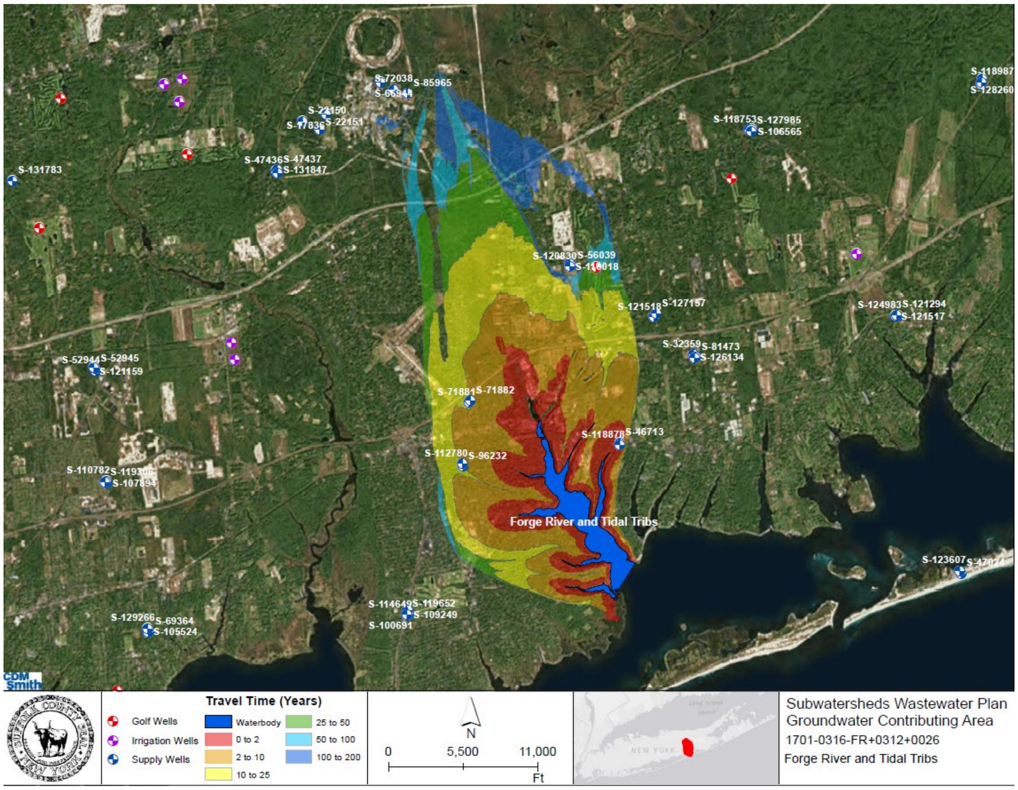


Figure 2-14 Example Subwatershed Contributing Area Forge River and Tidal Tributaries

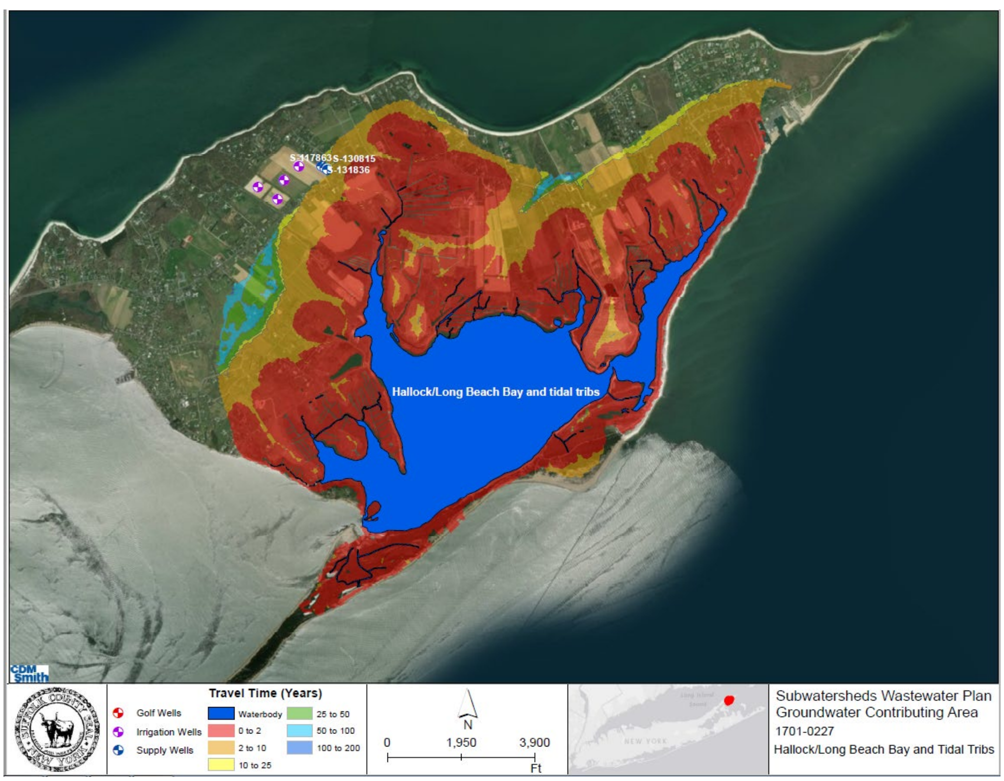


Figure 2-15 Example Subwatershed Contributing Area Hallock/Long Beach Bay and Tidal Tributaries

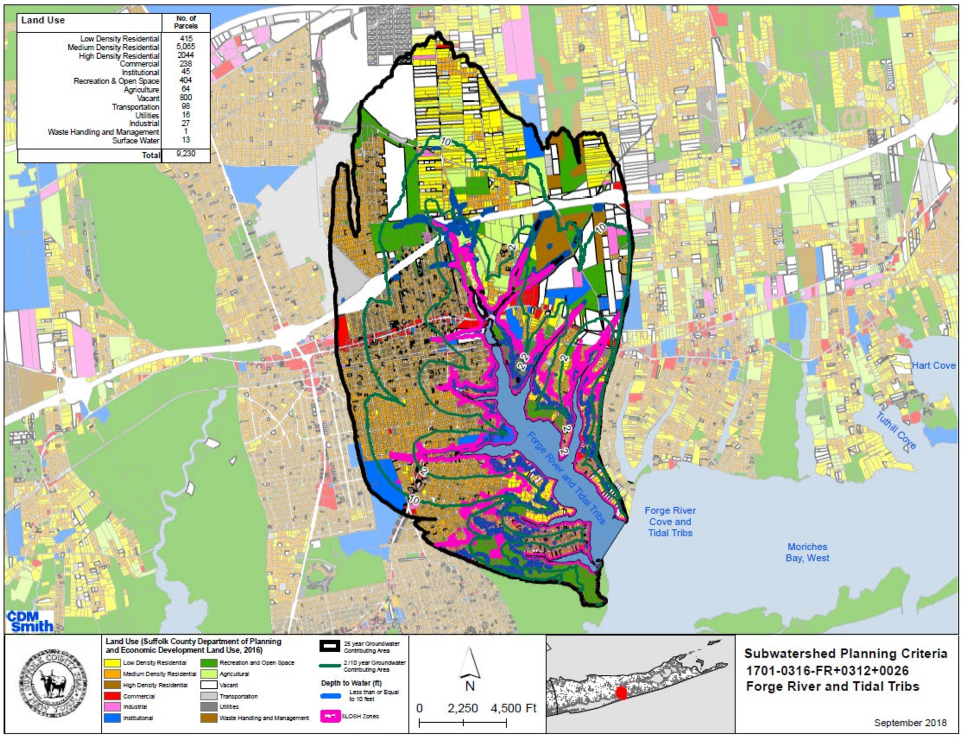


Figure 2-16 Land Uses and Planning Criteria within the Forge River 25-Year Contributing Area

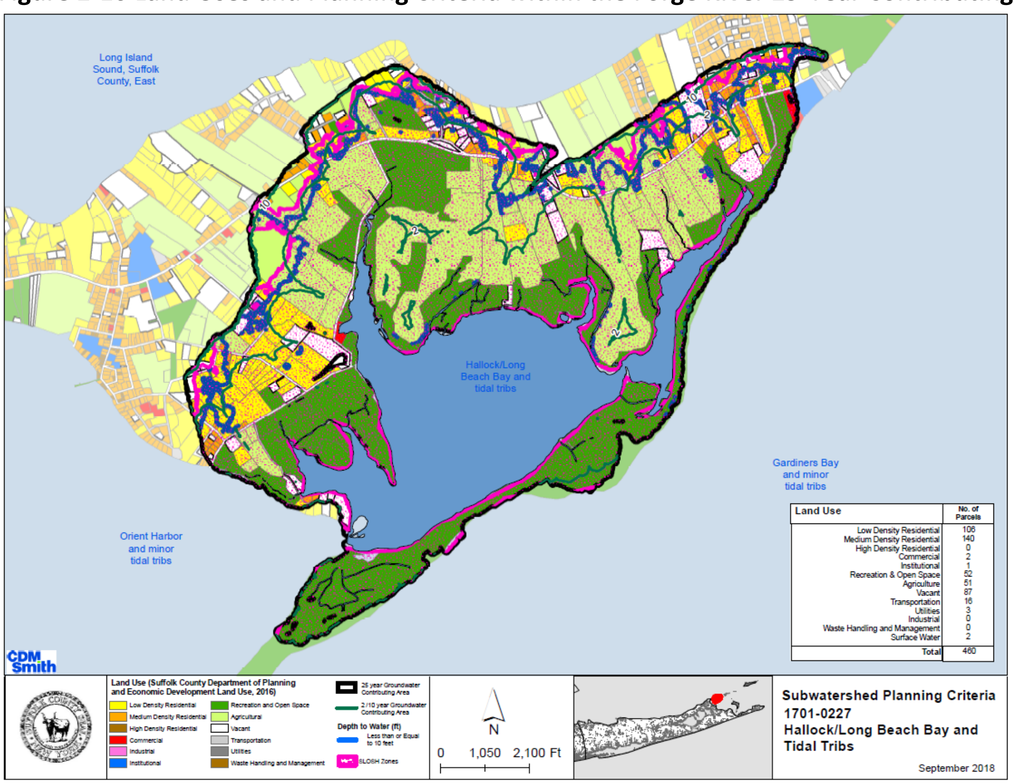


Figure 2-17 Land Uses and Planning Criteria within the Hallock/Long Beach Bay 25-Year Contributing Area

when combined with the contributing areas to public supply wells, there is very little remaining land surface area that is not accounted for in either the predicted surface water contributing areas or public supply well contributing areas, particularly in the developed areas of Suffolk County.

Over ninety percent of the groundwater baseflow to water bodies located in the East End towns (such as Shelter Island) is less than 25 years old; that is, it has taken less than 25 years for most of the recharging precipitation to travel from the water table to discharge to water bodies such as Coecles Harbor, Dering Harbor and Shelter Island Sound. Groundwater baseflow from the North Fork and South Fork to subwatersheds of the Peconic Estuary in general is comprised of groundwater that is only decades old, with over ninety percent contributed from the zero to 25-year contributing areas. In general, the water table on the East End is much shallower than areas to the west and the fresh groundwater system is relatively limited due to the salt-water interface.

Over ninety percent of the groundwater baseflow contributing to subwatersheds that are tributary to the Great South Bay, on average, is less than fifty years old. In areas along the County's north shore within the Long Island Sound watershed where the aquifer system is deeper, over eighty-three percent of the groundwater baseflow is less than fifty years old. It takes longer for recharging precipitation to travel down through the aquifer system to discharge in areas of the main body of the island where the aquifer system is deeper than on the forks, and it will take longer before the benefits of management actions can be observed than on the East End.

A summary of the groundwater baseflow contributions to each subwatershed based on the direct groundwater recharge area from each travel time interval is provided by **Figure 2-18** and **Table 2-6** (please see tables at the end of this section). On an average annual basis, over 75 percent of groundwater baseflow has travelled from the water table to surface water discharge in less than 25 years, and over 85 percent of groundwater baseflow to surface waters has travelled from the water table to surface water discharge in less than 50 years.

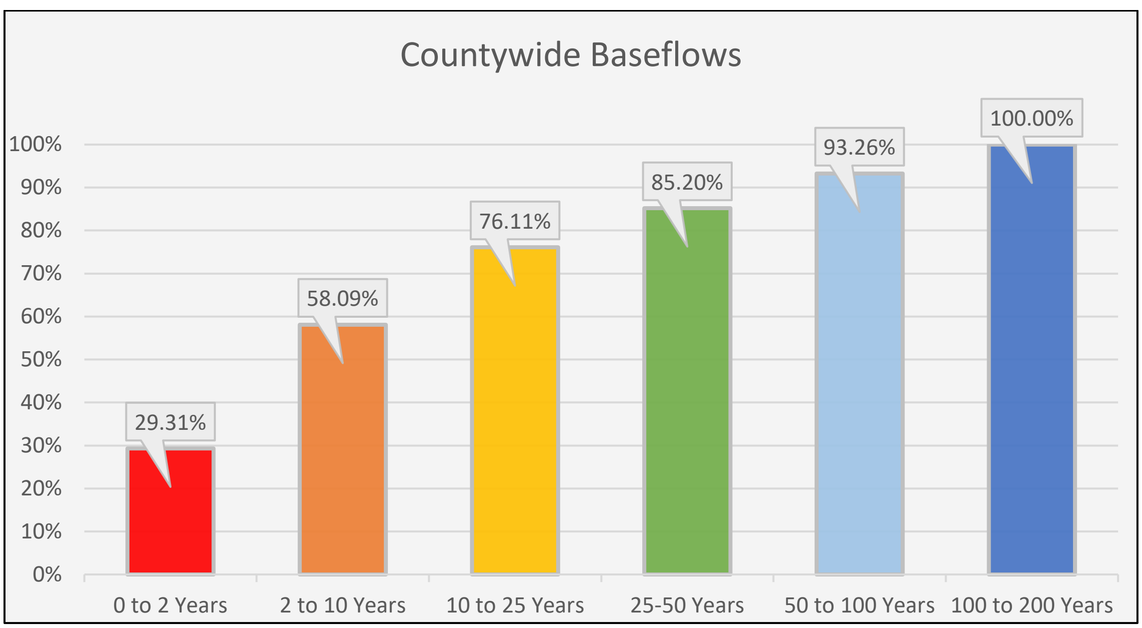


Figure 2-18 Groundwater Baseflow Travel Times

2.1.4.4 Seasonal Sensitivity Evaluation for the Peconic Estuary & Lake Ronkonkoma

Initial steady-state model simulations for the SWP showed contributing areas to the Peconic River subwatersheds that were smaller than expected or were absent in areas, particularly within the Upper Peconic subwatershed. Similarly, for Lake Ronkonkoma, the simulated contributing area did not include some wetland areas upgradient of the lake within Lake Ronkonkoma County Park. As the water table varies seasonally with changes in recharge and pumping, so does the length of flowing stream and groundwater discharge to streams. Therefore, a sensitivity simulation was conducted to evaluate the subwatersheds of Lake Ronkonkoma and the Peconic River (both included in the "main body" groundwater flow model) under transient conditions, incorporating seasonal recharge and pumping.

The model was updated in two ways for the sensitivity evaluation. The SWP "main body" model was run for a period of 200 years using time steps of 90 days to represent seasonal variations in recharge from precipitation and variations in water supply pumping. The model calculates the average pumping and recharge over each 90-day period and these quarterly average recharge and pumping rates based on 2012-2013 conditions were cycled through a period of 200 years. Assigned recharge rates were highest during the non-growing season months when losses to evapotranspiration were low. During the non-growing winter season months, public water supply pumping was lowest. During the growing season, recharge rates from precipitation were reduced, while water supply pumping rates increased.

A second change based on SCDHS field work completed during the winter of 2018 was also incorporated into the transient simulations along the Peconic River. As described above, SWP groundwater models utilize elevations depicted by LiDAR data to define the top of the model. Areas where the groundwater table is simulated to rise to the ground surface defined by the elevation of the top of the model identify the locations where groundwater discharge to a surface water is simulated to occur. During the winter of 2018, Suffolk County conducted a field survey of stream depth and flow at various locations in the upstream portions of the Peconic River. Stream depths ranged from less than a foot to more than four feet. Average depths from these observations were incorporated into the model, and the depths were interpolated and/or extrapolated to characterize the remainder of the River as shown by **Figure 2-19.** Lake Ronkonkoma bathymetry had already been incorporated into the Main Body model for the steady-state simulations based upon available information.

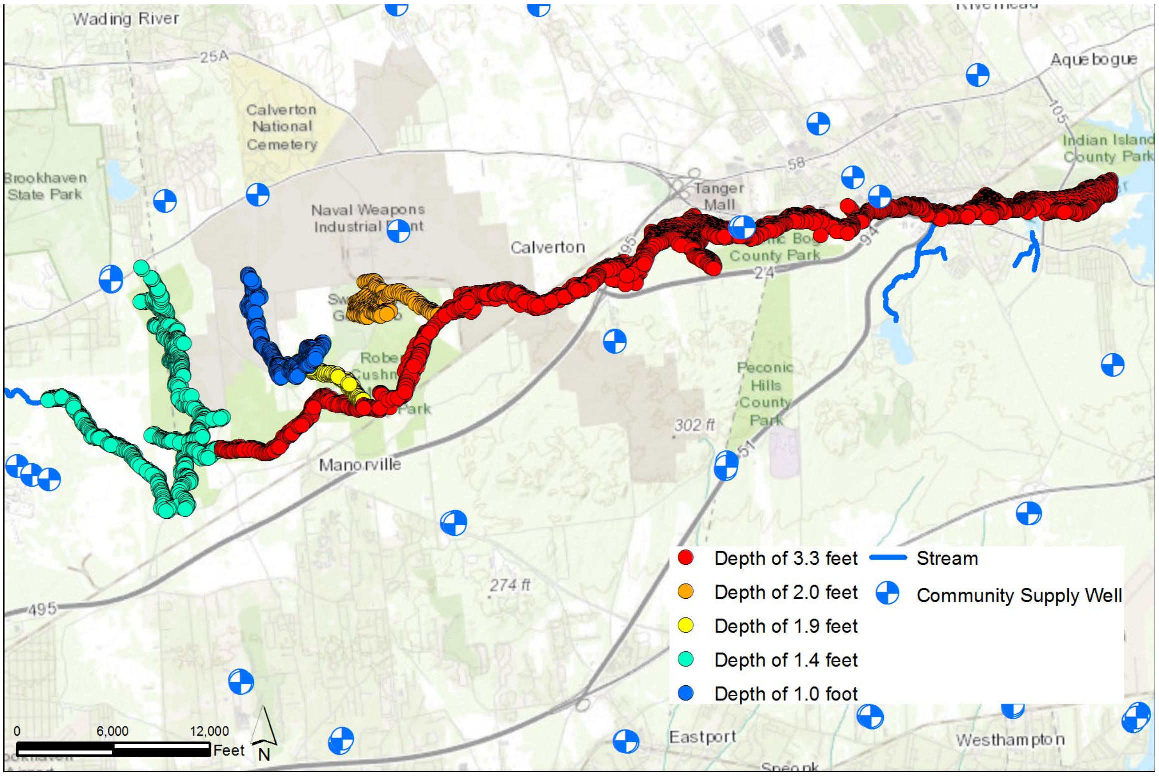


Figure 2-19 Assigned Peconic River Depths Based on 2018 SCDHS Field Surveys

The simulated flow field was used by the accompanying solute transport model to simulate the 200-year transient contributing area to the Peconic River and Lake Ronkonkoma. At the beginning of the subwatershed simulation, particles were spread at 50-foot intervals over an area much larger than the subwatersheds and then were tracked through the aquifer system. The resulting simulated contributing areas (e.g., subwatersheds) for the Peconic River and Lake Ronkonkoma are shown on **Figures 2-20** and **2-21**, respectively.

Incorporation of the seasonal sensitivity in recharge and water supply pumping, along with the updated depth information provided by SCDHS results in a larger simulated subwatershed for the Peconic River, particularly for the Upper Peconic River subwatershed. Prior simulations under average annual steady-state conditions indicated that although the simulated water table approached the ground surface, little if any flow discharged to the Upper Peconic River. However, seasonal sensitivity results including the increased recharge during the winter months provide a much better match to SCDHS' winter observations, with subwatershed delineations extending much further upstream than the original average annual simulations suggested. The transient simulation depiction of the larger subwatershed was used as the basis for the nitrogen loading calculations described below in Section 2.1.5 and other SWP evaluations.

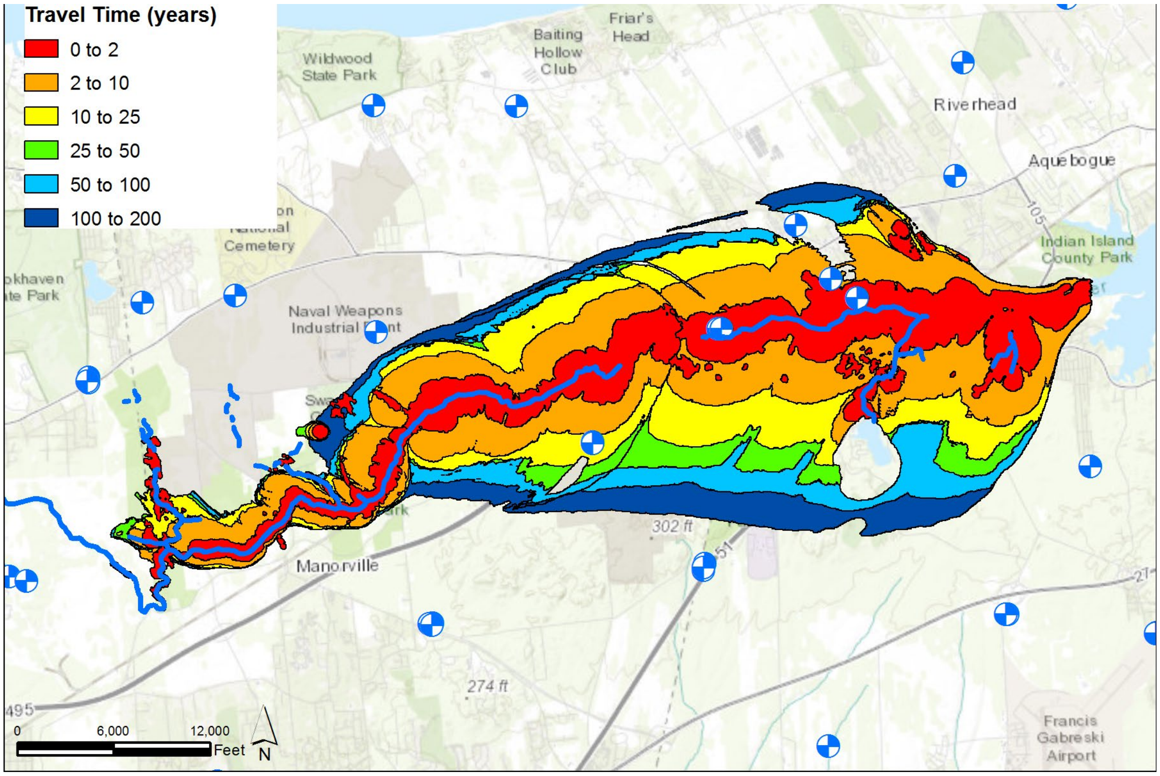


Figure 2-20 Seasonal Groundwater Contributing Area to the Peconic River Subwatersheds

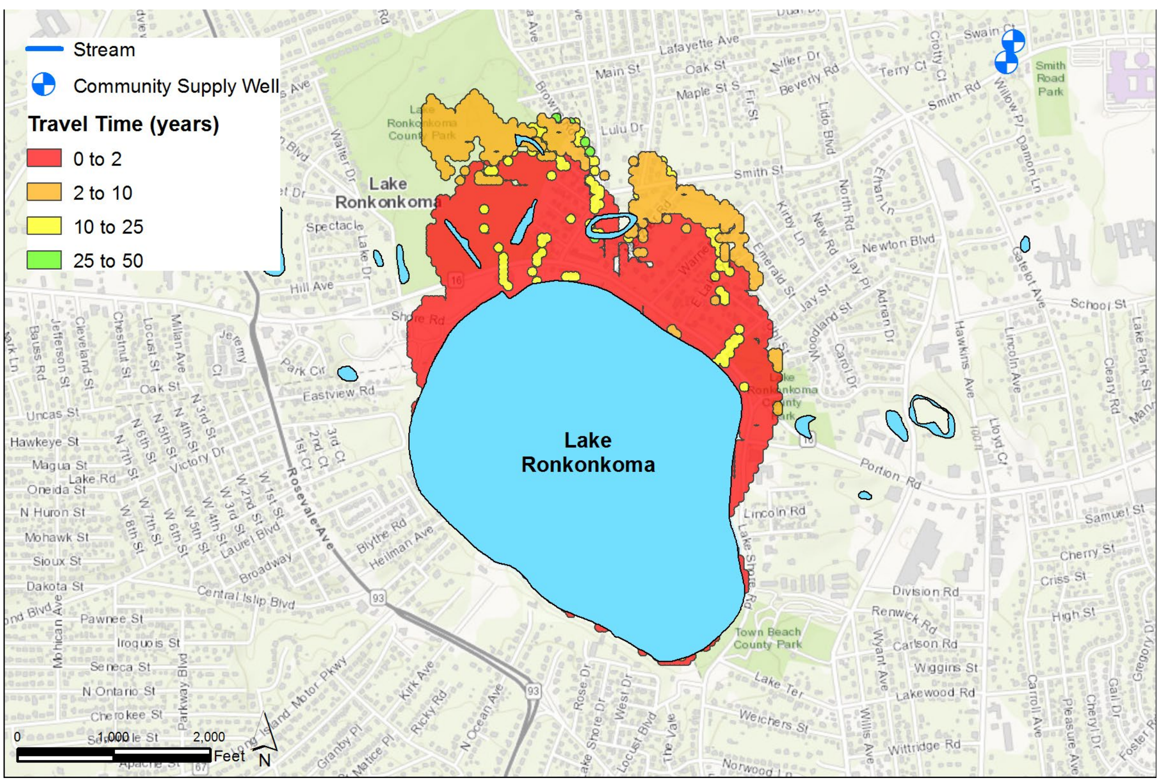


Figure 2-21 Seasonal Groundwater Contributing Area to Lake Ronkonkoma

The subwatershed defined by the transient simulation for Lake Ronkonkoma is similar to the original subwatershed and is somewhat smaller than the steady-state simulation. The intent of this simulation was to capture the wetlands within Lake Ronkonkoma County Park, but the transient simulation only extends slightly further west than the original simulation. Furthermore, the upgradient extent of the subwatershed does not extend as far north as the steady-state simulation. This could be due to large changes in seasonal pumping that result in deeper flow paths to downgradient supply wells, therefore limiting discharge to Lake Ronkonkoma, as recharge to the area directly west of the Lake is captured by two downgradient community supply wells. The original, steady-state subwatershed was utilized as the basis for the nitrogen load calculations.

The results show the subwatershed delineation sensitivity to the assumed conditions of recharge and water supply pumping selected to define the flowfield.

2.1.5 Nitrogen Load Estimation

Parcel-specific nitrogen loading was incorporated into the three-dimensional solute transport models to simulate groundwater nitrogen concentrations and nitrogen migration throughout the aquifer system and to:

- Estimate nitrogen loading to each of the 191 subwatersheds;
- Estimate the nitrogen concentrations in the shallow upper glacial aquifer, and
- Estimate the nitrogen concentrations in community supply wells.

The development of the parcel-specific nitrogen loads under both existing (2016) conditions and projected future build-out conditions is described in the following pages.

2.1.5.1 Baseline/Current Conditions

To calculate parcel-specific nitrogen loads for existing conditions, parcel-specific land uses were defined by the up-to-date information designated by the 2016 land use coverages provided by Suffolk County Department of Economic Development and Planning. Potential nitrogen sources, nitrogen loading rates and nitrogen attenuation factors were developed in cooperation with the Nitrogen Loading Model Focus Area Work Group convened by SCDHS.

Nitrogen from the following sources was incorporated into the nitrogen loading model:

- Sanitary wastewater
- Fertilization
- Pet Waste
- Atmospheric Deposition

Nitrogen loading rates from sanitary wastewater, fertilizer and pet waste were based on each parcel's land use. Nitrogen loads from atmospheric deposition was applied uniformly across all land use types in the County. Incorporation of nitrogen loads conveyed to surface waters via direct stormwater runoff was considered, but not included for this first order assessment. HDR (**Flushing**

Time Calculations for Suffolk County Water Bodies, 2019) found that surface runoff amounted to approximately five percent of the groundwater baseflow to the surface waters. The components of nitrogen in stormwater runoff; e.g. nitrogen from fertilizer, atmospheric deposition and pet waste were primarily captured in the groundwater baseflow assessment. In addition, storm sewer collection catchment area delineations were not readily available for incorporation into the evaluation.

Nitrogen contributions from wildlife and avian populations were considered but could not be incorporated into the current nitrogen loading model as described further below.

The assumptions used to characterize each component of the parcel-specific nitrogen loads are summarized in the following pages.

2.1.5.1.1 Nitrogen from Sanitary Wastewater

Nitrogen loads from sanitary wastewater were based on land uses and loading estimates used in previous studies conducted in Suffolk County and elsewhere in the country.

Nitrogen from sanitary wastewater generated by approximately 1.5 million Suffolk County residents includes the nitrogen introduced to groundwater via on-site wastewater systems in unsewered residential areas and direct discharges from sewage treatment plants (STPs) that discharge to groundwater or surface water in sewered areas. Nitrogen loads from sanitary wastewater contributions in unsewered commercial areas, downtown areas where residential units exist above commercial establishments, Suffolk County and New York State parks, and mobile home parks were also estimated.

Nitrogen from On-Site Wastewater Systems in Unsewered Residential Areas - As approximately 74 percent of Suffolk County is unsewered, nitrogen introduced to the aquifer system by on-site sanitary systems represents the most significant component of nitrogen load throughout much of the County. Per capita nitrogen load was assigned as an average of 10 pounds-nitrogen/person/year. This value is consistent with values used in the literature and other regional studies.

Based on consensus of the Nitrogen Load Model Focus Area Work Group, this wastewater load was reduced by two attenuation factors, assuming:

- Six percent removal of nitrogen in the septic tank (consistent with Valiela (1997), Lloyd (2016), Vaudrey (2016) and Stinnette (2014)).
- Ten percent removal of nitrogen as the wastewater is recharged to the unsaturated zone (e.g., loss through biologically active areas of aged leaching pools and/or through the vadose zone).

In addition, 15 percent additional nitrogen removal was assumed in the aquifer for unsewered residential parcels located above morainal deposits (supported by Young et al., 2013), which, in general, have a higher organic carbon fraction that can support denitrification when compared to the sands of the glacial outwash deposits (coastal plain). No denitrification through the coastal plain sediments was included; however, additional nitrogen attenuation was included through the hyporheic zone as discussed further below.

The datasets used to develop the nitrogen load from sanitary wastewater in residential unsewered areas are summarized in **Table 2-7.**

Table 2-7 Data Used to Estimate Nitrogen Load from Sanitary Wastewater in Unsewered Residential Areas

Data/Assumptions Required	Data/Estimate Used	Data Source
Parcel-specific Land Use	2016 Land Use coverages for Babylon, Brookhaven, East Hampton, Huntington, Islip, Riverhead, Shelter Island, Smithtown, Southampton, Southold	Suffolk County Department of Economic Development and Planning
Household Size*	2010 Population Data and Number of Households	Suffolk County Planning Department, 2010 U.S. Census
Unsewered Parcel Locations	Sewer District Coverages and unconnected parcels in SWSD coverages	Suffolk County Department of Economic Development and Planning, SCDHS and Suffolk County Department of Public Works coverages
Nitrogen Loading Rate	10 pounds/capita/year	New Jersey Nitrate Dilution Model (Hoffman and Canace, 2009), Vaudrey (2016), Valiela (1997)
Nitrogen Attenuation	6% attenuation in septic tank, 10% attenuation in the unsaturated zone	Valiela (1997), Lloyd (2016), Vaudrey (2016) and Stinnette (2014), Desimone and Howes (1998), Chesapeake Bay Partnership (2014) recommendations of Nitrogen Load Modeling Focus Area Work Group

* Adjusted for seasonal population for East Hampton, Riverhead, Shelter Island, Southampton and Southold

Nitrogen from On-Site Wastewater Systems in Unsewered Non-Residential Areas - Nitrogen from sanitary wastewater is also introduced to the aquifer in non-residential areas, including parcels with commercial, industrial and institutional uses. No nitrogen from sanitary wastewater was assumed to be generated at parcels identified as recreational and open space (including golf courses and with the exception of County and State parks as identified further below), agricultural, transportation, utilities, vacant or surface water.

Nitrogen loads from sanitary wastewater discharges generated by parcels with commercial, industrial or institutional land uses vary significantly. For example, both wastewater flow and the associated nitrogen load generated by a restaurant or bar would be significantly higher than the wastewater flow and nitrogen load generated by a jewelry store. Because sanitary wastewater generated by commercial facilities varies so widely, and because the occupants of leased commercial properties can change from year to year, a typical effluent nitrogen concentration was utilized to characterize all commercial properties. Furthermore, County land use coverages do not specify business type, so an average countywide loading rate was generated using the design flowrates for commercial sanitary systems provided in the **Standards for Design and Construction of Other than Single Family Residences** (SCDHS, 2017) and using data obtained from the SCDHS Office of Wastewater database.

For purposes of this study, parcel-specific nitrogen loads for unsewered commercial properties were estimated based upon flow generation rates compiled in SCDHS' Standards for Approval of Plans and Construction for Sewage Disposal Systems for Other than Single-Family Residences. Specifically, the average design flow rate for commercial projects that received final approval in the SCDHS OWM database between the years 2011 and 2016 was calculated, and the average flow rate was multiplied by a factor of safety of 1.5. The factor of safety was included to provide an initial allocation for grandfathered parcels which can have actual flows significantly greater than permitted by Article 6 of the Sanitary Code. The average design flow rate was than multiplied by parcel-specific building footprint areas and a representative effluent nitrogen concentration of 60 mg/L. Building footprints for all land uses were obtained from Suffolk County Real Property and each parcel-specific building footprint for non-residential land uses was multiplied by a land use specific wastewater flow rate (based on Suffolk County Sewerage Standards) and the 60 mg/L effluent nitrogen concentration to estimate the parcel-specific nitrogen load from sanitary wastewater. The nitrogen load was assigned at the parcel centroid. Unit sanitary wastewater flow generation rates and representative nitrogen concentrations for each non-residential land-use type are summarized in **Table 2-8.** The flow rate for commercial is conservative and was based on a blended average of various commercial uses.

Table 2-8 Unit Sanitary Wastewater Flow Rate and Nitrogen Concentrations for Non-Residential Areas

Land Use Type	Flow Rate (gpd/ft2)	Nitrogen Concentration (mg/L)
Commercial	0.07	60
Industrial	0.04	60
Institutional	0.06	60
Waste Handling and Management	0.04	60

Calculated nitrogen loads were attenuated by the same attenuation factors used for the residential wastewater loads as described above.

Additional Nitrogen Load in Downtown Areas - Because second-floor residential apartments are located above commercial parcels in some Suffolk County downtown areas, the nitrogen loads from sanitary wastewater in these areas were increased to include both the commercial and residential components. Downtown areas and the associated estimated percentage of two-story buildings with residential apartments, estimated using Google street view are summarized on **Table 2-9.**

Table 2-9 Downtowns with Residential Units above Commercial Establishments

Town	Percent Commercial Buildings with Second Story Residences
Amagansett	50%
Bellport	60%
Bridgehampton	70%
Center Moriches	40%
East Hampton	50%
Hampton Bays	70%
Huntington Station	80%
Mattituck	40%
Montauk	50%
Sayville	50%
Smithtown	50%
Village of Southampton	70%
Village of Westhampton Beach	70%

Residential loads from the second-floor apartments were calculated as single-family homes, using the same methodology as described for residential areas above. Commercial and residential sanitary load components were then added together and applied to each parcel. The total calculated nitrogen loads were attenuated by the same attenuation factors used for the residential wastewater loads.

Nitrogen from Sanitary Wastewater in Unsewered Parks - To avoid underestimating the nitrogen load from sanitary wastewater generated at popular Suffolk County and New York State parks with restrooms, but no wastewater treatment facilities, sanitary loads were estimated for thirty-one parks, based upon data and guidance provided by SCDHS.

SCDHS provided data on the average number of visitors to each park per year. For County Parks, the number of annual visitors was based on parking fees, number of camping reservations, and number of nights stayed. The average number of visitors to State parks per year was also provided.

The nitrogen load for each park was estimated based upon the calculated number of visitors per day and an average nitrogen load of 0.0274 pounds per person per day. Septic system and leaching ring removal factors are also applied. The resulting nitrogen loads were assigned to building locations, assuming that restrooms are located in the major building structure of the park.

Nitrogen from Sanitary Wastewater Generated at Mobile Home Parks - Nitrogen load from sanitary wastewater generated at mobile home parks was included based on a list of 40 mobile home parks received from SCDHS. The total daily nitrogen load for each mobile home park was calculated based on the number of units for each mobile home park and the population housing density from U.S. Census data.

Nitrogen Loads from Sanitary Wastewater in Sewered Areas - There are approximately 200 sewage treatment plants providing sanitary wastewater treatment in Suffolk County. Nitrogen introduced to the aquifer from treated sanitary effluent recharged to groundwater was included in the nitrogen load estimates based upon 2013 wastewater flow rates provided in the 2013 SCDHS STP Annual Report and average annual effluent nitrogen concentrations provided by SCDHS and NYSDEC for 2016. Nitrogen loads were applied at the centroids of each parcel where the sewage treatment plants were located, and no sanitary loads were applied to the residential parcels located in each sewage treatment plant's sewer service area. The 2,271 parcels that are located in the Southwest Sewer District that have not connected to the sewer collection system were identified by Suffolk County Department of Economic Development and Planning and sanitary wastewater loads generated at these parcels were included in the groundwater model estimate. Nitrogen loads from sewage treatment plants discharging to surface waters are not included in the groundwater model but were included in the subwatershed-specific nitrogen load totals.

2.1.5.1.2 Nitrogen from Fertilizer

Nitrogen load from fertilizer was applied to each of the following land use types:

- Residential;
- Golf courses;
- Parks and recreation and
- Agriculture

The nitrogen load from fertilizer was based on previous studies and assumptions vetted through the County's Nitrogen Load Model Focus Area Work Group. Much of the nitrogen that is applied as fertilizer does not travel down to the water table and into the aquifer but remains within the root zone and is utilized by the plants. To account for this, a leaching factor is applied to the nitrogen load from fertilizer; the leaching factor is dependent on the type of ground cover. The fertilizer leaching rates incorporated into this evaluation are summarized on **Table 2-10**. The leaching rate for golf courses was based on the Massachusetts Estuary Project and is similar to rates calculated using data provided by The Bridge Golf Course in Southampton. The leaching rate was increased slightly for residential parcels as the turf is not as robust and typically does not have the benefit of management by turf professionals who are typically hired to manage golf course turf.

Table 2-10 Leaching Rates Applied to Nitrogen Loading from Fertilizer

Ground Cover	Leaching Rate (%)
Turf (Residential, Parks and Rec).	30
Golf Courses	20
Agricultural Fields	40

Fertilizer on Residential Parcels - For residential fertilizer load, it was conservatively assumed that fertilizer is applied to all residential parcels. In reality, fertilizer application rates vary significantly on any given residential parcel and while many residents do not apply fertilizer at all, some apply much more than the average.

The assumed nitrogen fertilizer application rate for residential parcels was 2.04 lbs. per 1,000 square feet per year based on average values used by Vaudrey (2016). Fertilizer is assumed to be applied to a percentage of each residential parcel. Using the building footprint layer provided by Suffolk County Department of Economic Development and Planning, the building areas were removed from the residential parcels. Fertilizer was then assumed to be applied uniformly to a percentage of the remaining area to account for unfertilized areas such as patios, landscaping, driveways, wooded buffers, etc.). The percentage of residential parcel (minus buildings) to which fertilizer was applied in the model is as follows:

- Low density residential – 25%
- Medium density residential – 60%
- High density residential – 20%

Nitrogen from fertilizer is then attenuated by the 30 percent leaching rate, and an additional 15 percent attenuation was applied in areas where till materials were present.

Fertilizer on Golf Courses - Nitrogen from fertilizer was applied to golf courses at a rate of 3.89 lbs.-N per 1,000 square feet per year based on Vaudrey (2016). Fertilizer was applied to a portion of the total golf course parcel, estimated to be greens and fairways. The percentages of the golf courses representing greens and fairways were estimated using aerial surveys. A leaching rate of 20 percent was applied, and an additional attenuation of 15 percent was applied in areas underlain by till.

Fertilizer on Parks and Recreational Areas - Nitrogen from fertilizer was also applied to parks and recreational fields, assuming that 50 percent of all parks are fertilized. If a park was dominated by vegetation or forest based on the United States Department of Agriculture (USDA) 2016 CropScape data, fertilizer was not applied.

A loading rate of 0.92 lbs.-N per 1,000 square feet per year was applied to all parks. This represents 50 percent of the load used by Vaudrey (2016) for fertilizer nitrogen load at parks and athletic fields. It is assumed that 75 percent of the parcel area is fertilized and a leaching rate of 30 percent was applied.

Fertilizer on Agricultural Parcels - Fertilization application rates in agricultural areas vary widely. Fertilization varies by crop type; crop type can also change from year to year and crop type data can be inconsistent. The assumed fertilizer loads for the SWP were based on best available data, including fertilization rates based on data provided by Cornell Cooperative Extension (**Table 2-11**), and land use data obtained from the Nature Conservancy and the Peconic Estuary Program (PEP) that was used to assign crop types to agricultural parcels. Agricultural parcels from the 2016 County land use database were selected, crop type was assigned initially from the PEP data and subsequently confirmed or assigned using the USDA CropScape 2016 database. Vineyards were subsequently verified and/or incorporated using a vineyards database developed by CDM Smith using aerial photography and roadside surveys.

Table 2-11 Agricultural Nitrogen Use (from CCE, dated October 3, 2016).

Crops	Acreage	Nitrogen Use (lb. N/acre/year) (1)	Comments
Mixed Vegetables	7,500	80-160	Split applications, 95%, 85%, sweet corn growers CRNF
Potatoes	2,200	150-200	Split applications 80%; CRNF about 500 acres
Nurseries (field and container)	5,000	50-200(2)	Multiple applications; estimated 75% using some CRNF
Vineyards (vinifera grapes)	2,200	0-40 (10-20 most common)	Foliar and/or ground applications
Sod	2,800	200-300 (3)	Five to seven applications; estimated 80% using CRNF
Small fruit-berries	200	30-120	Split applications
Greenhouse	700	60-350 (2)	Multiple applications
Small Grains	1,000	0-60	Split applications
Field Corn	1,200	120-150	Split applications 100%
Pasture/hay	2,800	0-40	

(1) N rates – references Cornell Guidelines for small fruit, field crops and vegetables
(2) Area does not include aisles and/or roadways
(3) Amount over an 18-month cropping period

Based on the information included in the table, nitrogen loading rates were specified for broad ranges of crops as summarized by **Table 2-12**. The "other crops" category represents crops that are not listed in the table above and uses a weighted average of nitrogen use for other crops as specified by CCE. Greenhouses were not included in any calculations because fertilizer is applied indoors.

Table 2-12 Nitrogen Applications to Agricultural Land Use from Fertilizer

Crop Type	Nitrogen (lbs.-N/1,000sf/yr.)
Pasture / hay	0.46
Orchards	1.61
Vineyards	0.34
Sod	5.74
Other Crops	2.91

Nitrogen loads from fertilized agricultural parcels were calculated based on application to 90 percent of each agricultural parcel and a 40 percent leaching rate. The 40 percent leaching rate was agreed upon by the Nitrogen Load Model Focus Area Workgroup and considered published leaching rates from studies which appeared to have soil conditions consistent with Suffolk County. Studies considered in the determination of average 40 percent leaching rate are provided below in **Table 2-13.**

Table 2-13 Summary of Studies used for Establishment of Agricultural Leaching Rates

Study	Leaching Rates
Hochmuth, et. al. 2003 - Potatoes in Florida	47% - 70%
Prasad & Hochmuth, 2016 - Potatoes & Corn in Florida	32% - 35%
Hermanson, et. al. 2000 - Agriculture Literature Search	30% - 70%

It should be noted that based upon the available literature, the agricultural leaching rates utilized in the SWP were reduced significantly from the 60 percent leaching rate used in the original NLM work completed by Valiela (Valiela et. al, 1997) and subsequently used in most regional nitrogen loading studies. However, these assumptions were further supported by comparison of model predicted concentrations in the upper glacial aquifer to actual monitoring well data collected by the SCDHS which showed an overall excellent correlation. Nonetheless, actual parcel specific leaching rates likely vary significantly based upon crop type, irrigation practices, actual application rates, and other parcel specific factors and consideration should be given to completion of a long-term leaching rate study using actual parcel specific application rates and observed water quality.

2.1.5.1.3 Nitrogen from Animal Waste

Based upon input from stakeholders, the potential to quantitatively assess the nitrogen load from pets, birds and wildlife was also considered. Further investigation confirmed that nitrogen load from pets was the only additional source that could be quantified based upon existing information. Additional data collection is necessary to quantify nitrogen loading from birds and wildlife.

The potential to estimate the nitrogen loads contributed by pets and wildlife (specifically, geese) was carefully considered based on:

- The estimated net nitrogen load generated by each population;
- The percentage of nitrogen generated that could migrate to groundwater and
- The ability to quantify each population on a parcel-specific basis.

While some literature reported that nitrogen from wildlife (e.g., deer, geese and other waterfowl) was largely recycled (e.g., the population ingested plants containing nitrogen and excreted nitrogen in the same vicinity), it was agreed that pet waste should be considered as a potential external load to the groundwater system. An estimate of the nitrogen excreted by dogs and by cats was available from **Nitrogen on Long Island Sources and Fates**, Porter, 1978. The nitrogen load produced by each dog was estimated as 4.29 lb.-N/dog/year and the load produced by each cat as 3.22 lb. N/cat/year. For modeling purposes, it was estimated that fifty percent of the nitrogen load was lost to volatilization and does not reach the water table, and the remaining fifty percent was applied. The nitrogen loads from pet waste were assigned to residential parcels only and were applied at the centroid of each residential parcel.

According to the **U.S. Pet Ownership & Demographics Sourcebook** (American Veterinary Medical Association, 2012), there were an average of 1.4 dogs per household and an average number of 1.9 cats per household in New York in 2011. Because many cats spend their lives indoors, the nitrogen load from their waste is not released to the environment and was not included in this nitrogen loading assessment. One New York City veterinary practice that tracked the fraction of cats that resided completely indoors versus the population of outdoor cats (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2603649/) concluded that 61 percent of the domestic cat population is confined indoors, and 39 percent may spend some time outdoors. Attempts to obtain Town-specific breakdowns of the assumed Suffolk County dog, cat and outdoor cat populations were not successful. None of the veterinary practices consulted were able to provide additional insight into the pet population or fraction of outdoor cats.

Based on the New York City estimate, only the nitrogen load for the 39 percent of the pet cats that spend some of their time outside (e.g. 0.74 cats/household) was included in the nitrogen load from pet waste estimates. The pet waste loading assumptions are summarized in **Table 2-14.**

Table 2-14 Assigned Nitrogen Load from Pet Waste

Pet Type	Number of Pets per Household	Annual Nitrogen Load per Pet (lbs./yr.)	Percent Lost to Volatilization
Dogs	1.4	4.29	50
Cats	1.9	3.22	50
Outdoor Cats	0.74	3.22	50
Indoor Cats	1.16	0	N/A

2.1.5.1.4 Nitrogen from Atmospheric Deposition

Atmospheric nitrogen deposition also contributes both to the nitrogen load to the aquifer system and directly to each surface water body's nitrogen load. Nitrogen load from atmospheric deposition is comprised of both wet (via rainfall) and dry deposition. Nitrogen load from wet deposition was calculated based on data collected at the rainfall/deposition monitoring station at Cedar Beach in Southold, which is part of the National Atmospheric Deposition Program's (NADP) National Trends Network (NTN). The station provides average nitrogen concentration in rainfall on an annual basis (wet deposition). The data from 2010 to 2014 were used to calculate the wet atmospheric nitrogen deposition.

Total nitrogen deposition was calculated by scaling the wet deposition data using a regional station that is part of the USEPA Clean Air Status and Trends Network (CASTNET; **Figure 2-22**). Wet deposition that was calculated using data collected at the Southold station was scaled up to total deposition using data collected over the same time period (2010-2014) from the CASTNET station.

Atmospheric deposition is applied to all parcels within the County using 100 percent of the parcel area. As mentioned above in Section 2.1.5.1.2, nitrogen can attenuate as it infiltrates through the ground surface. Leaching factors were also applied to the atmospheric nitrogen load. The leaching rates (TNC,2016) and calculated nitrogen load from atmospheric deposition are shown in **Table 2-15**. Total nitrogen deposition was calculated by scaling the wet deposition data using a regional station that is part of the USEPA Clean Air Status and Trends Network (CASTNET; **Figure 2-22**).

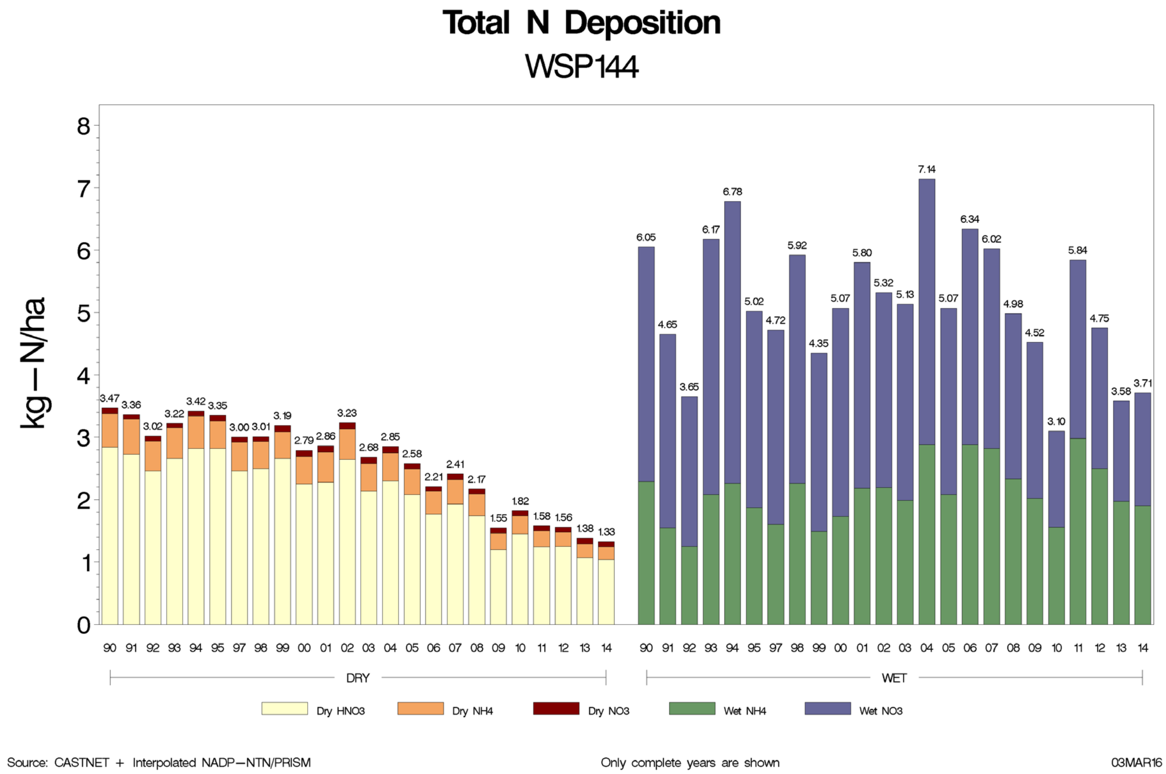


Figure 2-22 Nitrogen from Atmospheric Deposition

Table 2-15 Assigned Nitrogen Load from Atmospheric Deposition

Ground Cover	Leaching Rate (%)	Nitrogen Load (lbs.-N/1,000 sf/yr.)
Natural Vegetation	25	0.103
Turf	30	
Agriculture	40	

2.1.5.1.5 Denitrification Effect of Coastal Wetlands and the Hyporheic Zone

The hyporheic zone is a zone of saturated sediment within the bed of a surface water body where discharging groundwater mixes with surface water. Denitrification through the hyporheic zone has been documented in the literature (Wexler et al, 2011; Peyrard et al, 2011; Pinay et al, 2009; Puckett, 2008). As nitrogen discharges through this zone, biological respiration and vegetation uptake may utilize some of the nitrate and promote denitrification. Denitrification through the hyporheic zone is highly variable and site specific. While data was not available to quantify the potential for denitrification throughout the County, denitrification through wetlands discharge areas was included in the nitrogen load estimates based on values documented in the literature. Hamersley (Hamersley, 2001) completed a study in New England documenting that salt marshes can remove about 15 percent of the total nitrogen discharging from groundwater flow to estuary shorelines. Based on similar conditions, nitrogen loss through the hyporheic zone and wetlands was considered as subwatershed-specific nitrogen loads were compiled.

Nitrogen and Pathogen Loads from Birds and Wildlife

Nitrogen *- Nitrogen loads from animals and the avian population were identified by stakeholders as potentially significant loads for consideration. Avian and wildlife generated nitrogen loads were not incorporated into the SWP evaluation for two reasons. First, the available literature indicated that in general, nitrogen excreted by wildlife such as deer, geese and other water fowl was largely recycled; e.g., the populations ingested plants containing nitrogen and excreted nitrogen in the same vicinity. For example, Clarke and Meredith (2014) reported that goose/waterfowl droppings did not significantly increase nutrient concentrations in the water column. Swanson, et al (2010) referenced Valiela's (1997) conclusion that the net nitrogen contribution to a waterway from resident birds such as swans is zero because they remove as much nitrogen as they excrete. Swanson, et al concluded that even if the swans did not consume nitrogen but only excreted it, it would be a very small component of the total nitrogen load to that water body, amounting to 0.03 percent of the total nitrogen load to the Forge River, based on an estimate of 150 resident swans. Other studies referenced in the literature (Unckless and Makarewicz 2007, Pettigrew et al 1998, Scherer et al 1995, Brandvold et al 1976) also concluded that the addition of goose/waterfowl droppings did not significantly increase water column nutrient concentrations based on experimental systems.*

In addition to available literature indications that geese do not introduce a net nitrogen load, a second challenge was identifying the data required to estimate location-specific populations. Location-specific population estimates were not available from the resources that were checked including:

- *The Audubon Society;*
- *Cornell Lab of Ornithology;*
- *Ducks Unlimited;*
- *Goosewatch;*
- *Long Island Goose Control;*
- *New York State Department of Environmental Conservation (on-line, 2016), and*
- *The Nature Conservancy.*

Based on the limited information available to quantify net nitrogen loads generated by geese and other wildlife and the inability to reliably quantify subwatershed-specific populations upon which to base an estimate, they could not be incorporated into this evaluation.

Additional study and data collection are required to develop this parameter for incorporation in future evaluations.

Pathogens *- Unlike nitrogen loads, pathogen loads from birds in particular are significant sources to surface waters. Pathogens, including the results from bacterial source tracking studies documenting avian and wildlife impacts on surface waters are described in Section 2.2.6. Recommendations for additional pathogen evaluations in collaboration with NYSDEC who is currently completing a bacteria source tracking study in support of a revised pathogen TMDL for Suffolk County waters are included in Sections 2.2.6 and 8.4.7.*

Table 2-16 Nitrogen Removal from Wetlands

Wetland Type	Percentage of Nitrogen Removal
Littoral Zone.	10
Fresh Marsh	15
Intertidal Marsh	15
Coastal Shoals, Bars and Mudflats	15
High Marsh	15

2.1.5.1.6 Summary and Results

Parcel-specific nitrogen loads were compiled for each parcel in the County, comprised of one (atmospheric deposition) to all four of the potential nitrogen load components. Parcel-specific nitrogen loads were applied to the centroid of most parcels. For parcels larger than two acres, however, sanitary waste and pet waste loads (if applicable) were applied at the centroids, while fertilizer and atmospheric deposition of nitrogen were distributed across the area of the parcel using model nodes for source locations.

The nitrogen loads identified for each parcel were introduced as hundreds of thousands of point sources to the three-dimensional solute transport models to simulate nitrate migration through the aquifer system for a period of 200 years, assuming average annual precipitation, recharge and water supply pumping remained constant over this period.

The solute model transport was used to generate three types of results used in the development of the SWP:

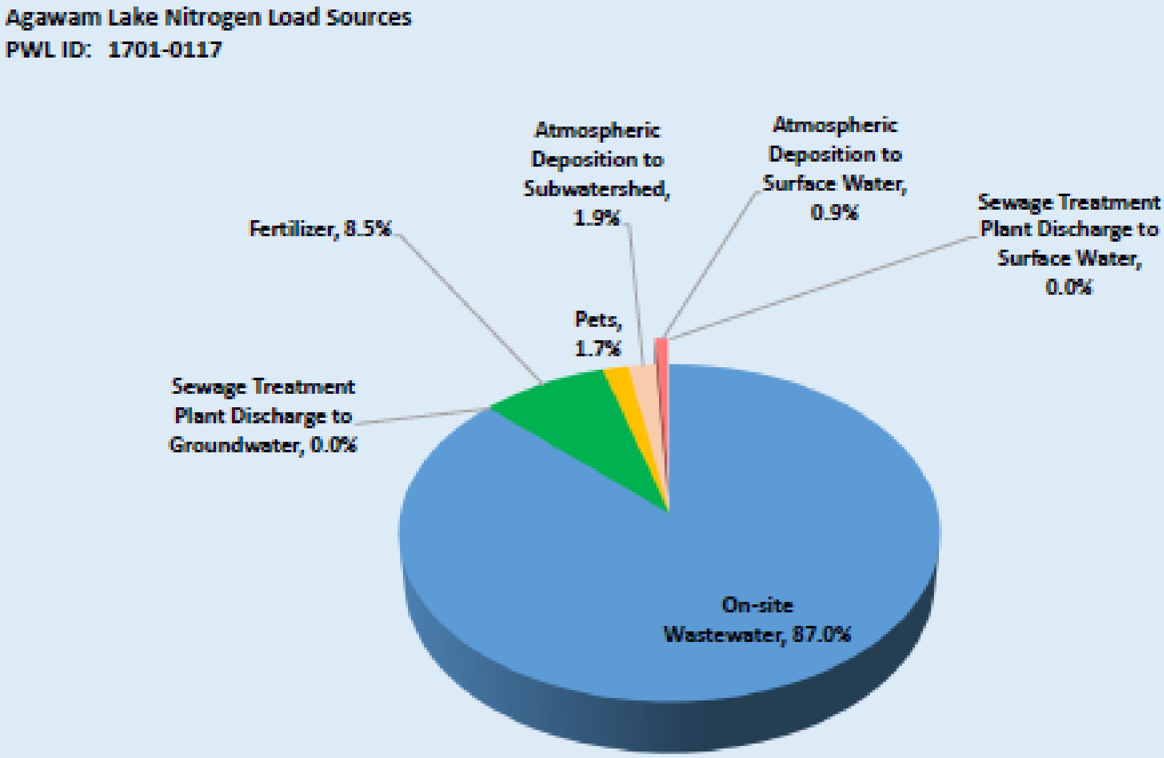
- Nitrogen load from groundwater discharged to each of the 191 surface water bodies;
- Nitrogen concentrations in the shallow upper glacial aquifer (described in Section 3), and
- Nitrogen concentrations in community supply wells (also described in Section 3).

These model-simulated nitrogen levels represent the nitrogen concentrations and loads that would be anticipated to occur after 200 years of existing land use, precipitation and recharge, water supply pumping locations and rates and wastewater management.

2.1.5.2 Subwatershed Nitrogen Loads Based on Baseline/Current Conditions

2.1.5.2.1 Nitrogen Loads to Individual Subwatersheds

Subwatershed-specific nitrogen loads were compiled in a series of charts and tables depicting the simulated pounds of nitrogen introduced to each subwatershed on an annual basis. Each component of the nitrogen load contributing to each subwatershed was identified in the Task 4A deliverable, as illustrated by **Figure 2-23**, which summarizes the nitrogen loading to Lake Agawam. The graphic shows that 87 percent of the nitrogen load to the lake originated from on-site wastewater disposal; fertilizer is the second highest nitrogen load contributing 8.5 percent, followed by atmospheric deposition to the subwatershed at 1.9 percent, nitrogen from pets at 1.7 percent and atmospheric deposition directly to the Lake at 0.9 percent.



Nitrogen Load Sources (without Hyporheic Zone Attenuation)*

Nitrogen Source	Nitrogen Load (lbs/day)	% Contribution
Groundwater Sources		
On-site Wastewater	76.5	87.0%
Sewage Treatment Plant Discharge to Groundwater	0.0	0.0%
Fertilizer	7.5	8.5%
Pets	1.5	1.7%
Atmospheric Deposition to Subwatershed	1.6	1.9%
Surface Water Sources		
Atmospheric Deposition to Surface Water	0.8	0.9%
Sewage Treatment Plant Discharge to Surface Water	0.0	0.0%
Total N Load (without Hyporheic Zone Attenuation)	87.9	100%

*Attenuation reduces the nitrogen load from groundwater baseflow as it travels through the hyporheic zone to surface water discharge. The hyporheic zone reduces the total nitrogen load to 83.4 lbs/day

Figure 2-23 Example Summary of Nitrogen Loads to Agawam Lake

The nitrogen loads contributing to each subwatershed are summarized on **Table 2-17** (please see tables at the end of this section). The nitrogen load contributed by each potential component of the total load varies considerably among the subwatersheds, with the contribution from on-site sanitary loads varying from zero (Big Reed Pond) to 87 percent (Agawam Lake). **Figure 2-24** shows the percentage of each component of the nitrogen loads from groundwater sources within the 200-year contributing area to the 191 subwatersheds. The nitrogen contribution from on-site wastewater discharge to groundwater amounts to 63.6 percent of the nitrogen load from groundwater and is the most significant nitrogen source to the subwatersheds, followed by fertilizer at 26.9 percent, atmospheric deposition to the subwatershed at surface water at 4.4 percent and pets at 3.9 percent.

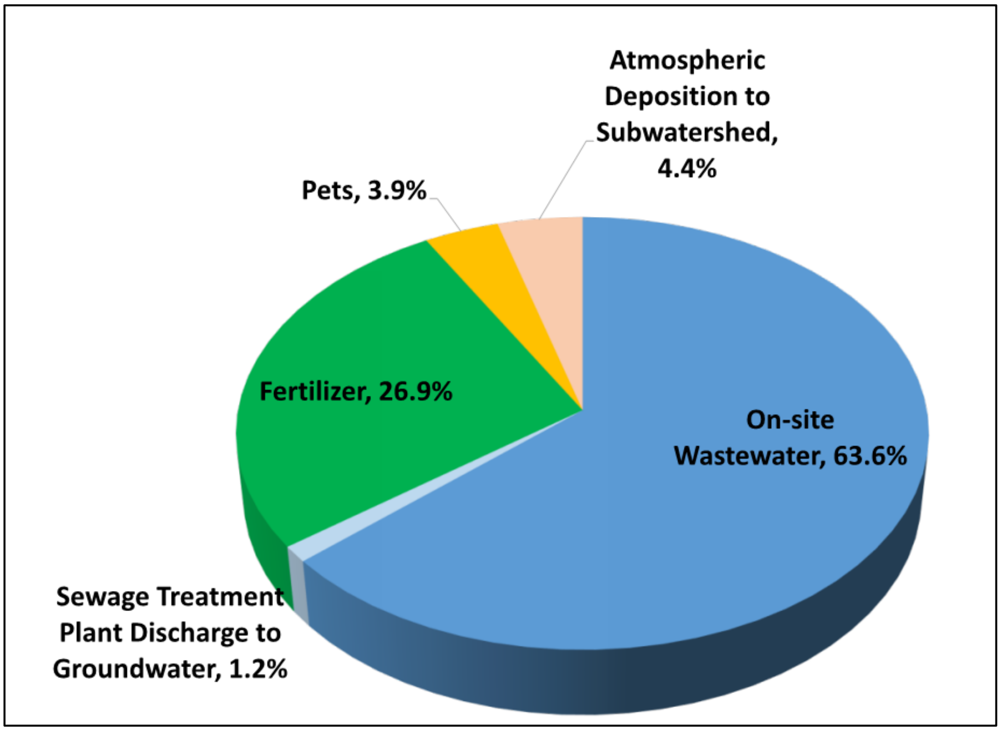


Figure 2-24 Nitrogen Loads from Groundwater to All 191 Subwatersheds

Figure 2-25 shows the percentage of each component of the nitrogen loads from the 200-year contributing area to the 191 subwatersheds. At 47.7 percent, the nitrogen contribution from on-site wastewater discharge to groundwater was the most significant source to the subwatersheds, followed by direct atmospheric deposition to surface water at 23.7 percent and fertilizer at 20.2 percent. Nitrogen from atmospheric deposition to the subwatersheds, pets, and sewage treatment plant discharges directly to the surface waters or to the contributing areas all contributed a very small percentage of the total nitrogen load on a Countywide basis.

Subwatershed-specific nitrogen loads may be found in **Appendix D** of this SWP.

2.1.5.2.2 Nitrogen Loads to Aggregated Subwatersheds

The total nitrogen loads that contribute to water bodies that are connected to upgradient draining streams, lakes, tributaries, and sub-embayments include nitrogen from the direct subwatershed groundwater contributing area, nitrogen to the surface water body itself (e.g., deposition and STP effluent, where applicable), and the nitrogen from upstream connected water bodies as groundwater baseflow and direct discharge to the surface water. The total nitrogen loads for these water bodies were compiled by aggregating the loads from each upstream water body as shown by **Figures 2-26** and **2-27** which show the individual subwatershed for Patchogue Bay and the aggregated subwatershed including upstream subwatersheds Abets Creek, Corey Lake and Creek and tributaries, Dunton Lake, Upper and Tributaries and Hedges Creek, Howell's Creek, Mud Creek, Robinson Pond and tidal tributaries, the Patchogue River, Stillman Creek, Swan River, Swan Lake and tidal tributaries and Tuthills Creek.

Patchogue Bay, in fact receives the total nitrogen load contributed to all of the upstream subwatersheds, hence the nitrogen loads to all of the upstream subwatersheds were aggregated. Aggregated loads were used as the basis for the subwatershed rankings and identification of nitrogen load reduction targets described in Section 2.1.9.

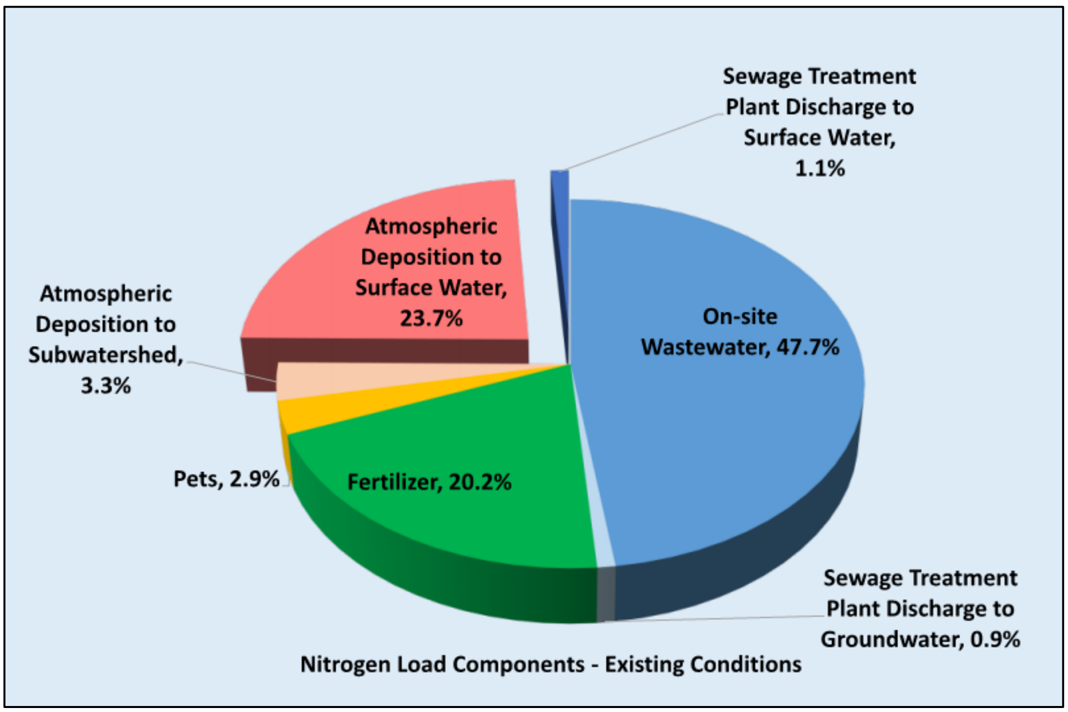
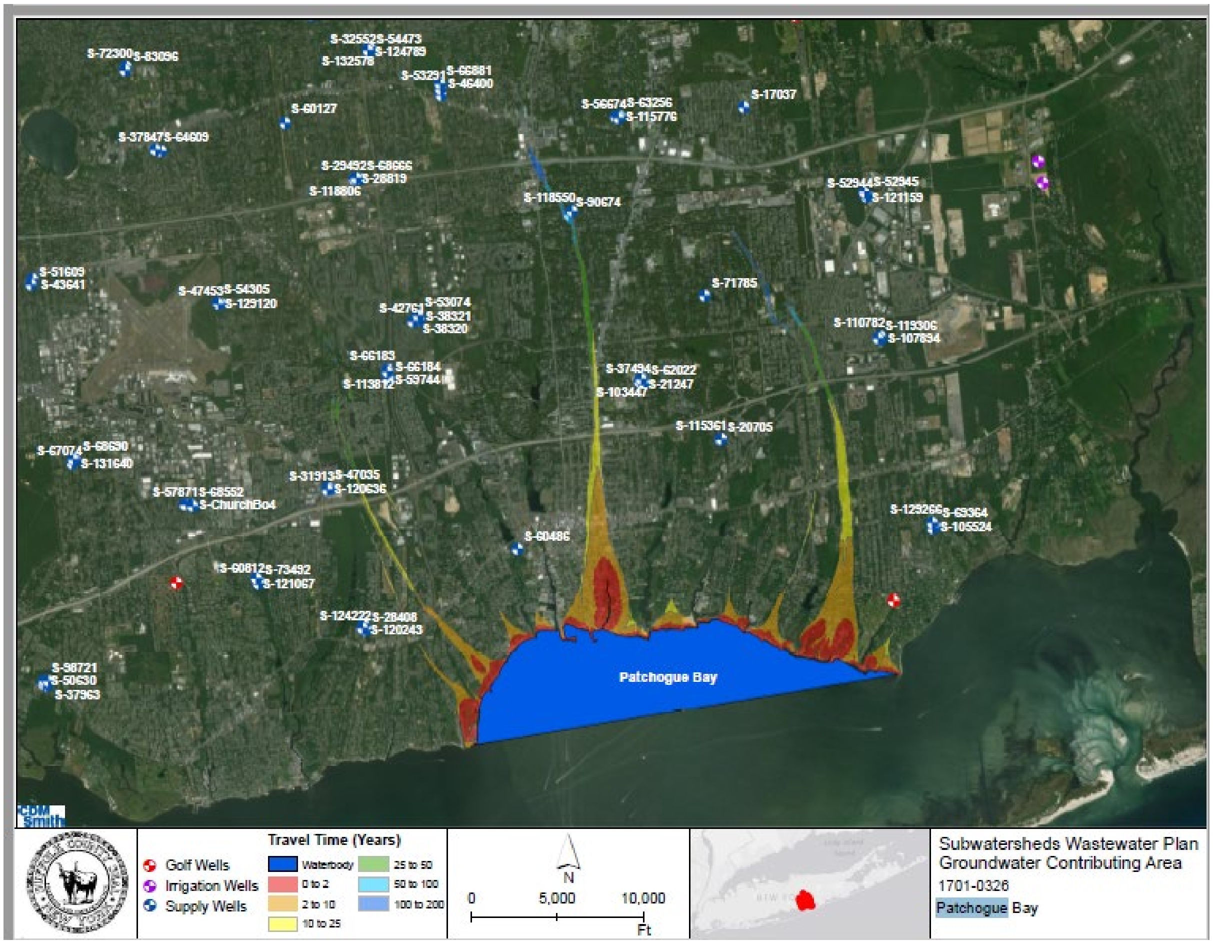


Figure 2-25 Nitrogen Load Components to the 191 Subwatersheds

In all, a total of 55 water bodies were identified for nitrogen aggregation as shown in **Table 2-18**. For all evaluations in this SWP (e.g., priority area establishment, load reduction goals, etc.), the aggregated nitrogen loads were used for each of the 55 water bodies identified.

Nitrogen loads for aggregated subwatersheds along with select freshwater or coastal ponds were also normalized per unit acre of applicable land use to satisfy the requirements of NYSDEC's Nine Elements Watershed Plans. **Table D-1** in Appendix D provides a list of the Nine Elements subwatersheds and the individual water bodies that constitute each Nine Element subwatershed. **Table D-2** presents a summary of the Nine Elements Plan nitrogen loads. In addition, **Table D-3** presents a summary of the individual STPs and their respective nitrogen loads for each of the Nine Elements Watershed Plans water bodies.



Nitrogen Source	Nitrogen Load (lbs/day)	% Contribution
Groundwater Sources		
On-site Wastewater	186.8	60.6%
Sewage Treatment Plant Discharge to Groundwater	49.9	16.2%
Fertilizer	32.0	10.4%
Pets	8.8	2.9%
Atmospheric Deposition to Subwatershed	4.7	1.5%
Surface Water Sources		
Atmospheric Deposition to Surface Water	25.9	8.4%
Sewage Treatment Plant Discharge to Surface Water	0.0	0.0%
Total N Load (without Hyporheic Zone Attenuation)	**308.1**	**100%**

Figure 2-26 Individual Patchogue Bay Subwatershed

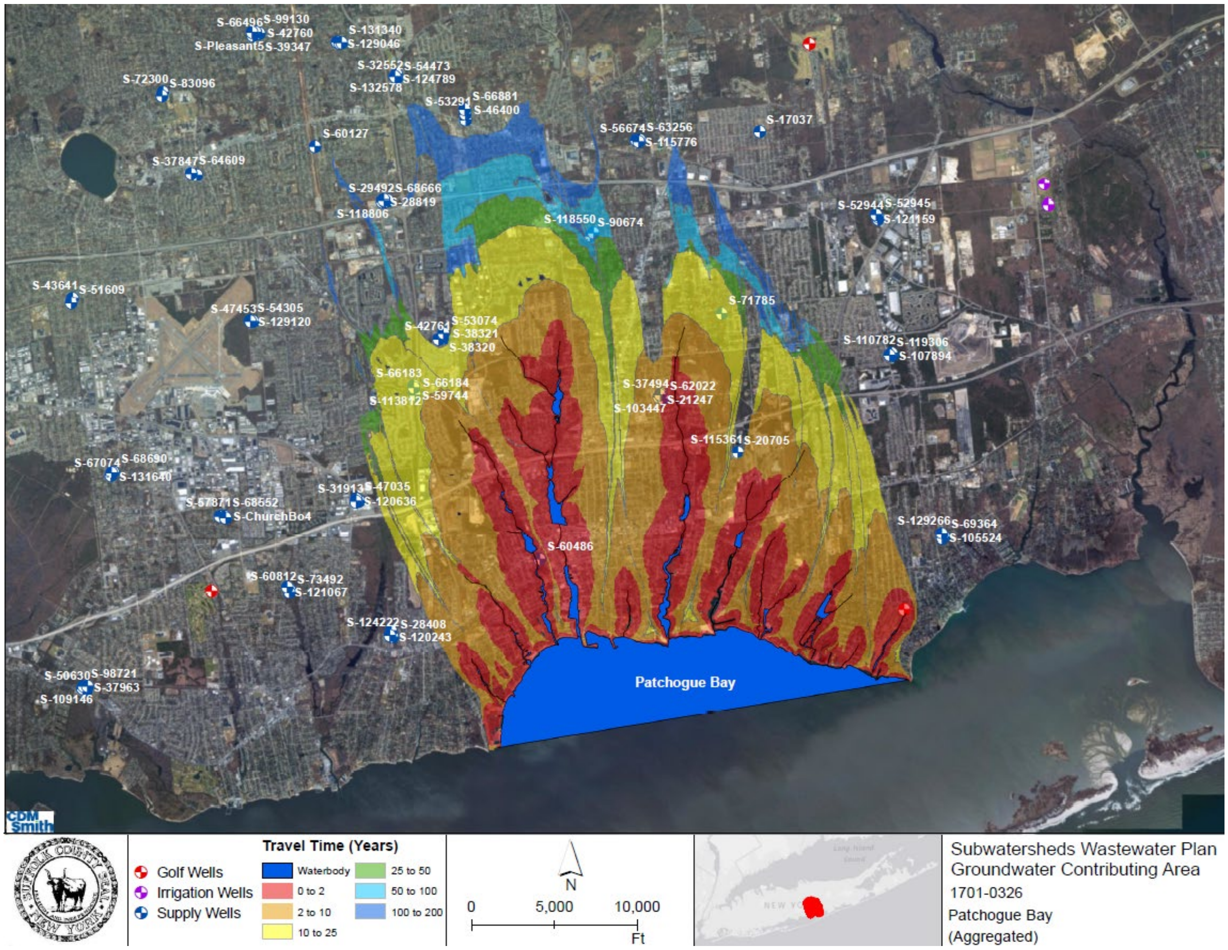


Figure 2-27 Aggregated Patchogue Bay Subwatershed

Table 2-18 Subwatersheds with Aggregated Nitrogen Loads

Subwatershed	Subwatershed	Subwatershed	Subwatershed
Bellport Bay	Great Cove	Napeague Bay	Quantuck Bay
Brown Creek	Great Peconic Bay and minor coves	Narrow Bay	Quogue Canal
Carlls River	Great South Bay, East	Nicoll Bay	Sag Harbor
Carmans River, Lower and Tribs	Great South Bay, Middle	Nissequogue River Lower/Sunken Meadow Creek	Sag Harbor Cove and Tribs
Centerport Harbor	Great South Bay, West	North Sea Harbor and Tribs	Shelter Island Sound North and Tribs
Connetquot River, Lower and Tribs	Huntington Bay	Northport Bay	Shelter Island Sound South and Tribs
Connetquot River, Upper and Tribs	James Creek	Northwest Harbor	Shinnecock Bay, Central
Cutchogue Harbor	Little Peconic Bay	Noyac Bay	Shinnecock Bay, East
Deep Hole Creek	Long Island Sound, Central	Orient Harbor and minor tidal tribs	Shinnecock Bay, West

Subwatershed	Subwatershed	Subwatershed	Subwatershed
Flanders Bay, East/Center and Tribs	Long Island Sound, East	Patchogue Bay	Smithtown Bay
Flanders Bay, West/Sawmill Creek	Long Island Sound, West	Peconic River Middle and Tribs	Southold Bay
Forge River Cove and Tidal Tribs	Mecox Bay and Tribs	Peconic River Lower, and Tidal Tribs	Wading River
Fort Pond Bay	Moriches Bay East	Pipes Cove	West Neck Harbor
Gardiners Bay and minor tidal tribs	Moriches Bay West	Port Jefferson Harbor, North	

2.1.5.3 Potential Future Buildout Conditions

In addition to evaluating the nitrogen loading to each subwatershed based on existing conditions, the potential future nitrogen loading that would result if a new residence was built on each undeveloped (or underdeveloped) residential parcel in the County was also calculated. Suffolk County Department of Economic Development and Planning developed the conditions used for potential future build-out which were based on the more stringent of Suffolk County Sanitary Code Article 6 or local zoning for all:

- Vacant parcels without development restrictions,
- Agricultural parcels without development restrictions, and
- Subdividable low density residential parcels.

The number of additional households that could be constructed in accordance with existing development opportunities was estimated for each town as summarized by **Table 2-19**. This does not indicate that these changes will occur within any specific timeframe, or even that they will ever occur at all, but it does provide a reasonable upper limit on anticipated future nitrogen loading from on-site sanitary wastewater disposal in specific areas of the County.

Table 2-19 Additional Residences Resulting from Potential Future Build-out

Town	Additional Homes	From Subdivisions
Babylon	996	22
Brookhaven	12,137	758
East Hampton	3,074	234
Huntington	2,361	407
Islip	6,156	249
Riverhead	4,221	131
Shelter Island	763	155
Smithtown	1,452	278
Southampton	6,872	650
Southold	4,714	397
Totals	**42,746**	**3,281**

The groundwater flow fields used for the existing conditions simulations were used for the future build-out simulations; e.g., boundary conditions such as recharge from precipitation and water supply pumping remained constant. In addition, parameters used to establish the nitrogen loading from on-site sanitary wastewater, pets and fertilizer remained unchanged from the existing conditions evaluation.

In addition to the changes in land use that were incorporated in the build-out evaluation, two other changes were made to better reflect future anticipated conditions:

- Flows and nitrogen loads from sanitary wastewater treatment plants were adjusted to match permit conditions. In some cases, the future flows were increased, based on anticipated future development; the increased flow and existing nitrogen concentrations combined to increase the total assigned nitrogen loads. In other cases, nitrogen concentrations were anticipated to be reduced to comply with permit limits, resulting in a net reduction in nitrogen load.
- Nitrogen loading from atmospheric deposition was reduced by ten percent, based upon unpublished model estimates provided by the USEPA.

Nitrogen loads from future potential build-out conditions were simulated using the solute transport model; the results are discussed in Section 3. Nitrogen loads in approximately 29 subwatersheds would decline based on the conditions simulated; while nitrogen loads in the remaining subwatersheds are projected to increase. Nitrogen loads to each subwatershed under build-out conditions are listed on **Table 2-20** while **Table 2-21** presents a comparison of predicted baseline nitrogen loads versus predicted buildout nitrogen loads (please see tables at the end of this section). Countywide, the percentages of each nitrogen load component are anticipated to change if the additional development takes place, as shown by **Figure 2-28.** Overall nitrogen loading to Suffolk County subwatersheds is projected to increase by only 2.9 percent should all of the projected potential build-out be completed. The percentage of the total nitrogen load from onsite wastewater sources increased by four percent when comparing build-out loading simulations to current conditions. **Figure 2-29** summarizes the nitrogen load components from groundwater sources within the 200-year contributing area showing that the projected contribution from sanitary wastewater is anticipated to increase to 65.3 percent on a Countywide basis, an increase of 1.7 percent. Despite the overall modest increase in predicted buildout nitrogen load on a Countywide basis, potential increases in build-out loads for some subwatersheds warrant mitigation. For example:

- Ninety-seven subwatersheds are predicted to have a 0 to 10 percent increase in nitrogen load at buildout when compared to baseline conditions. Mitigation of nitrogen through wastewater management alone (e.g., requiring a nitrogen removing sanitary system) is sufficient to address nitrogen loads for these water bodies.
- Nitrogen loads to forty-six subwatersheds are predicted to increase by between 10 and 20 percent at buildout when compared to baseline conditions. Mitigation of nitrogen through wastewater management alone (e.g., requiring a nitrogen removing sanitary system) is likely sufficient to address nitrogen loads for many of these water bodies; however, policymakers

should consider coupling wastewater management mitigation with other mitigating measures such as purchasing open space, revising local zoning, increasing minimum Article 6 lot size, and/or TDR programs; and,

- Thirteen subwatersheds are predicted to have a greater than 20 percent increase in nitrogen load at buildout when compared to baseline conditions. Mitigation of nitrogen through wastewater management alone (e.g., requiring a nitrogen removing sanitary system) may be insufficient for some of these water bodies. As such, policymakers should consider coupling wastewater management mitigation with other mitigating measures such as purchasing open space, revising local zoning, increasing minimum Article 6 lot size, and/or TDR programs.

Additional information on the build-out evaluations is provided in Section 4.8.

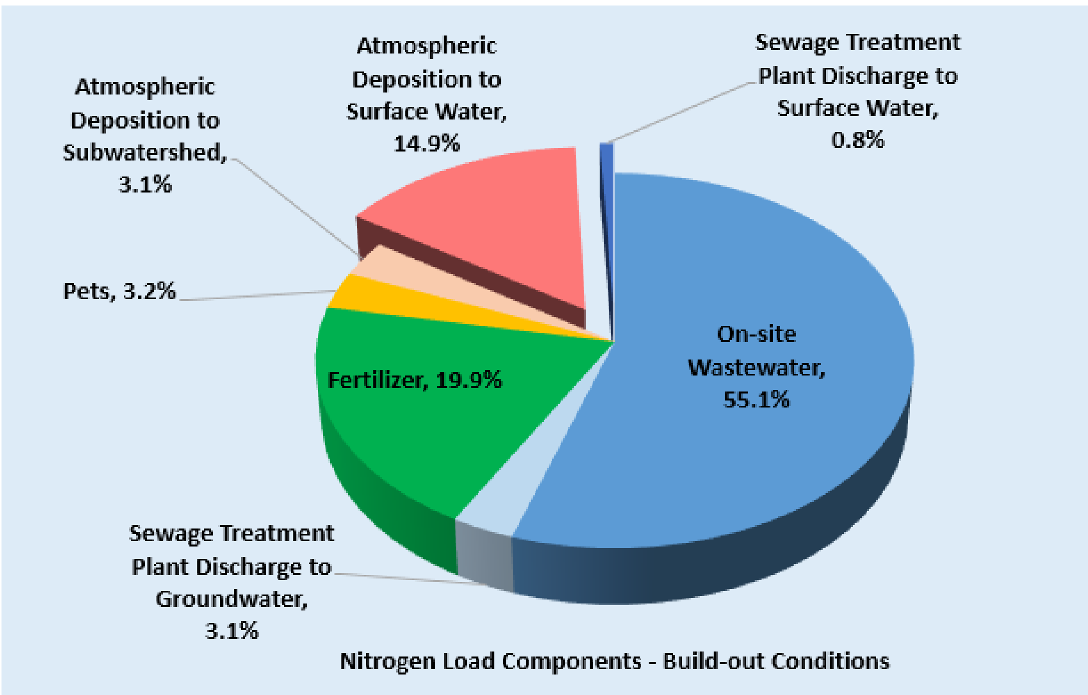


Figure 2-28 Summary of Projected Future Nitrogen Load Components

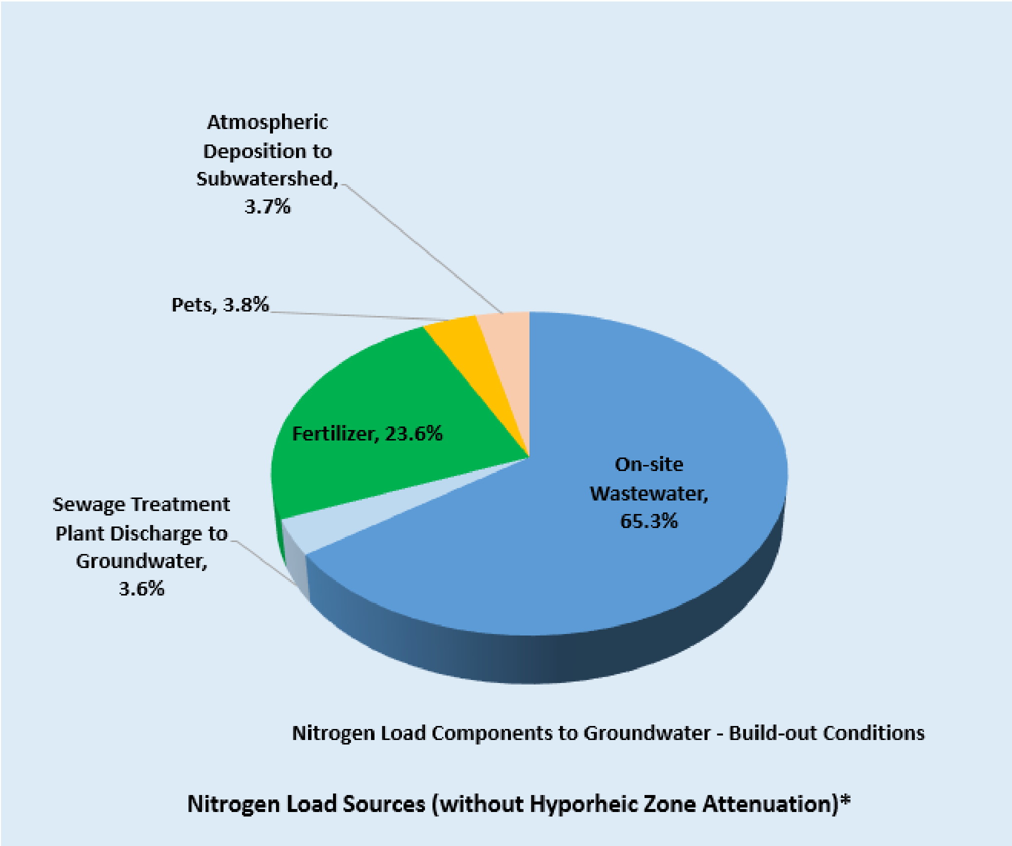


Figure 2-29 Summary of Projected Future Nitrogen Loads from Groundwater

2.1.6 Surface Water Modeling and Residence Time Calculation

Under separate contract, Henningson, Durham & Richardson Architecture and Engineering P.C. (HDR) calculated hydraulic flushing times for each of the surface water bodies. HDR used Environmental Fluid Dynamics Code (EFDC) hydrodynamic modeling to calculate flushing times for 146 marine PWLs, the SoMAS Great South Bay FVCOM model was used to calculate the flushing times for seven marine PWLs, and HDR calculated flushing times for 11 water bodies using the tidal prism method. Flushing times for freshwater priority receiving water bodies were calculated as hydraulic residence times (i.e., water body volume divided by freshwater flow through the water body). Each of these approaches is described below, based on the information documented in HDR's report entitled **Flushing Time Calculations for Suffolk County Water Bodies** (2019).

2.1.6.1 EFDC Hydrodynamic Models

EFDC hydrodynamic models were developed for 14 marine water body areas that encompassed 146 marine PWLs. **Table 2-21** lists and **Figure 2-30** depicts the 14 EFDC modeling areas and model calculation grids used for the study. **Figure 2-31** shows the example EFDC model grid No. 13, Port Jefferson and Mt. Sinai Harbors.

Table 2-21 EFDC Model Areas

EFDC Model Number	Model Name
1	Western Great South Bay
2	Great South Bay (Bay Shore)
3	Great South Bay (Nicoll Bay)
4	Great South Bay (Patchogue Bay)
5	Great South Bay (Bellport Bay)
6	Moriches Bay/Quantuck Bay
7	Shinnecock Bay
8	Mecox Bay
9	Peconic Bay & Three Mile Harbor
10	Acabonack Harbor, Napeague Harbor, Lake Montauk
11	Huntington Bay
12	Smithtown Bay
13	Port Jefferson & Mount Sinai Harbors
14	Mattituck Inlet

The following data were used to develop the EFDC hydrodynamic model inputs:

- Coastline and bathymetric data - Bathymetric data defining EFDC model segment depths was obtained from NOAA and where bathymetric data was not available, water depths were estimated based on nearby and/or similar water bodies that have water depth data. In some cases, additional water depth data was obtained by SCDHS for the project.
- Annual average groundwater inflow – Average annual groundwater baseflows from the groundwater models described in Sections 2.1.4 were assigned either as a tributary inflow (if groundwater model output was outside of the EFDC model grids) or as a direct source to EFDC model grids (if groundwater model was within the EFDC model domain). The groundwater inflows were treated as freshwater (i.e., zero salinity) with an assigned temperature of 11°C (52°F).
- Annual average surface water runoff - The annual average surface water runoff was calculated using average monthly rainfall minus groundwater recharge and evapotranspiration for each priority subwatershed. For the marine PWLs, surface runoff was estimated at approximately two percent of the groundwater inflow.

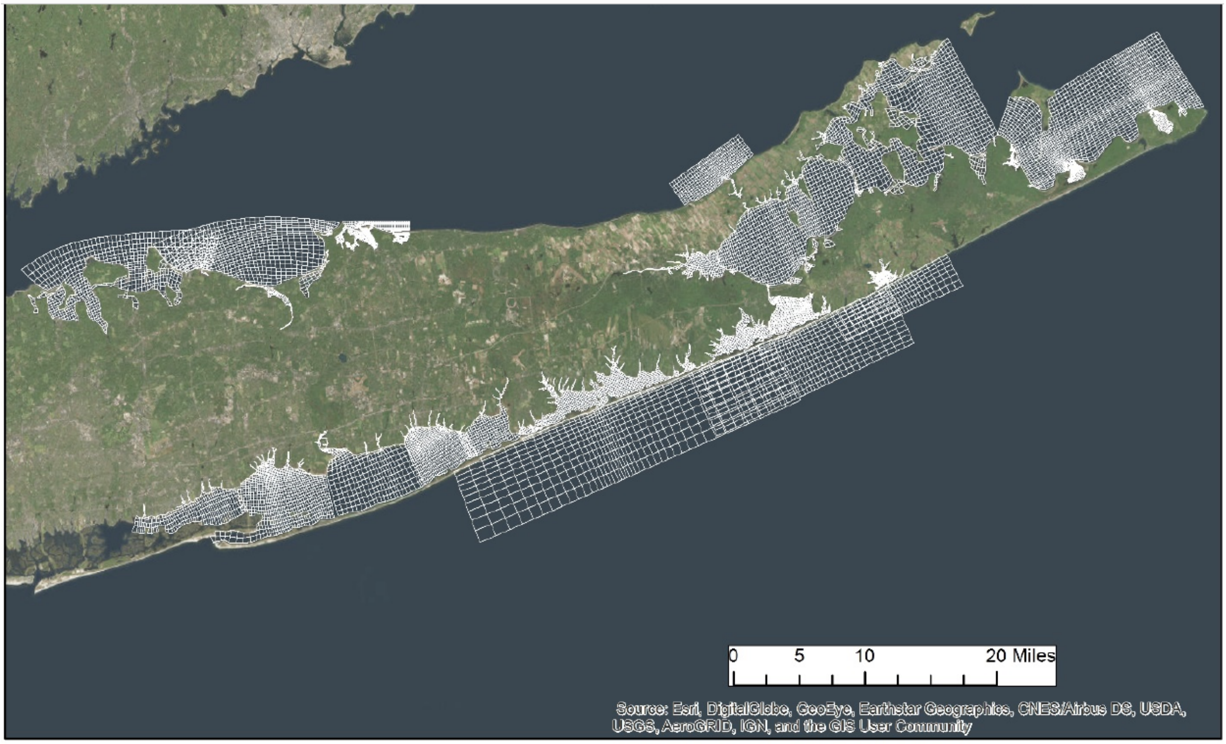


Figure 2-30 Surface Waters Modeled Using EFDC (source: HDR)

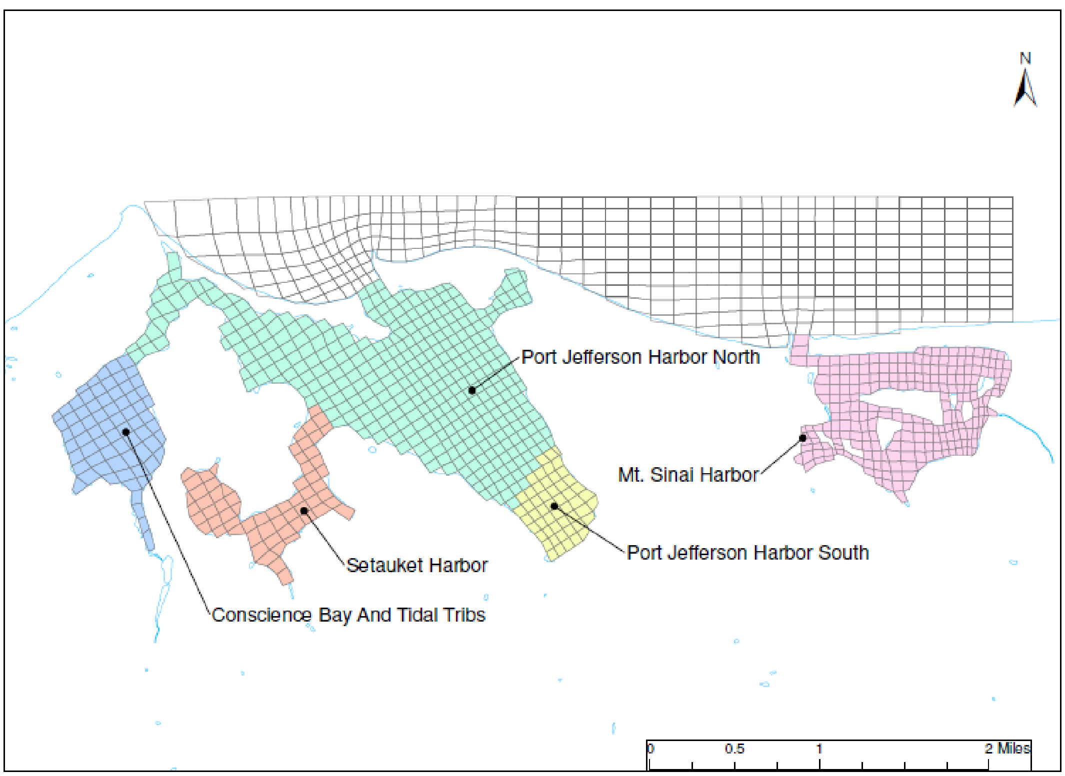


Figure 2-31 EFDC Grid No. 13 – Port Jefferson and Mt. Sinai Harbors

- Downstream or tidal boundary condition water elevation, salinity and temperature - Downstream or tidal boundary condition water elevations, salinity and temperature were assigned as follows:
  - For the south shore EFDC models within Great South Bay and Moriches Bay, existing hydrodynamic model output for tidal water elevation, salinity and temperature from the SoMAS Great South Bay FVCOM model was assigned at the boundary condition locations in the new EFDC models. SoMAS Great South Bay model output for July 2014 was readily available and used.
  - For the north shore models, existing model output for tidal water elevation, salinity and temperature from the HDR Regional ECOM hydrodynamic model for July 2014 was used at the boundary condition locations in the new EFDC models.
  - For the other modeled areas (e.g., Peconic Bay, east end of Long Island), available NOAA tidal elevation data/predictions, salinity and temperature data from reliable data sources (e.g., NOAA, SCDHS) or HDR Regional ECOM hydrodynamic model output for July 2014 was used.
- Meteorological conditions (e.g., wind speed and direction) – Meteorological conditions were obtained from the nearest NOAA National Climatic Data Center (NCDC) and National Buoy Data Center (NBDC) data sources.
- Point sources – Sewage treatment plant discharges to the modeled surface waters that were incorporated into the model are listed in **Table 2-22**.

Table 2-22 Point Source Discharges

Wastewater Treatment Plant	Average Flow (MGD)	EFDC Model
Ocean Beach WWTP	0.17	2 – Great South Bay - Bay Shore
Patchogue WWTP	0.23	4 -Great South Bay – Patchogue
Riverhead WWTP	0.80	9 -Peconic Bay and Three Mile Harbor
Shelter Island Heights WWTP	0.02	9 -Peconic Bay and Three Mile Harbor
Sag Harbor WWTP	0.07	9 -Peconic Bay and Three Mile Harbor
Huntington Sewer District WWTP	2.12	11 – Huntington Bay
Northport WWTP	0.26	11 -Huntington Bay
Kings Park SCSD # 6	0.32	12 – Smithtown Bay
Port Jefferson – SCSD #1	0.70	13 – Port Jefferson & Mt. Sinai Harbors
SUNY SCSD #21	1.66	13 – Port Jefferson & Mt. Sinai Harbors

The 14 EFDC hydrodynamic models were calibrated with available NOAA water elevation data and model results from other regional studies in Great South Bay by Stony Brook University and in the

Long Island coastal system (including the East River, Hudson River and NY/NJ Bight) by HDR. Salinity data from the SCDHS routine monitoring program at various stations in the 14 modeling areas were also used for model-data comparisons.

Preliminary EFDC hydrodynamic model calibration was completed using water level observations or SoMAS Great South Bay model output for the Great South Bay and Moriches Bay model areas. (Details on the model calibration may be found in **Flushing Time Calculations for Suffolk County Water Bodies**, HDR, 2019). The wetting and drying of tidal flats is not included in the EFDC models developed for the SWP. In water bodies where there are extensive tidal flats (e.g., Stony Brook Harbor), the exclusion of wetting/drying in the EFDC models may result in longer (e.g., conservative) calculated flushing times due to the increased water body volumes, then if the wetting/drying feature was included in the models. Overall the EFDC models reproduce observed and modeled water elevations well and the preliminary EFDC model calibrations are considered acceptable. In some areas the EFDC models over- or under-predict water elevation ranges, which may result in either greater or smaller flushing times. These areas included water bodies in Moriches Bay, Shinnecock Bay and Napeague Bay where modeled water elevation comparisons to NOAA tide predictions or measured elevation data could be improved to refine model flushing time calculations. As the SCDHS SWP transitions into longer term LINAP efforts, additional hydrodynamic model calibration may be needed in some areas where refined flushing times are needed or where the EFDC hydrodynamic models may be linked to water quality (eutrophication) models.

After completing the preliminary model calibration for all 14 EFDC modeling areas, the models were used to calculate flushing times for the marine (tidal) PWLs.

The method for calculating flushing times with the EFDC hydrodynamic model involved the following steps.

- For each PWL, all model segments were assigned an initial tracer concentration of 100 mg/L. This tracer concentration was treated as a conservative substance (i.e., no loss or decay).
- The EFDC model was then run for a period of time to track how the initial concentration of mass dissipated over time due to tidal mixing and freshwater (groundwater and surface) dilution. Initial testing evaluated starting the model at low slack, max flood, high slack and max ebb tidal conditions as the starting time can affect the results. In order to be conservative, the model was started at low slack before flood, as this provided the longest flushing time out of the four tidal conditions.
- The calculated concentration mass versus time was used to determine the time it takes to reach 37% (e-folding time) and 10% of the initial mass reduction. As part of the SWP discussions, it was decided to use the flushing time based on 10% of the initial mass to account for areas that may be affected by short-circuiting or eddies. It was also determined that the flushing time based on 10% of the initial mass would better represent water quality effects in the marine PWLs.

Figure 2-32 provides example model output for the Flanders Bay East/Center and Tribs; the blue line showing the modeled mass intersects the green ten percent mass line at approximately 23 days.

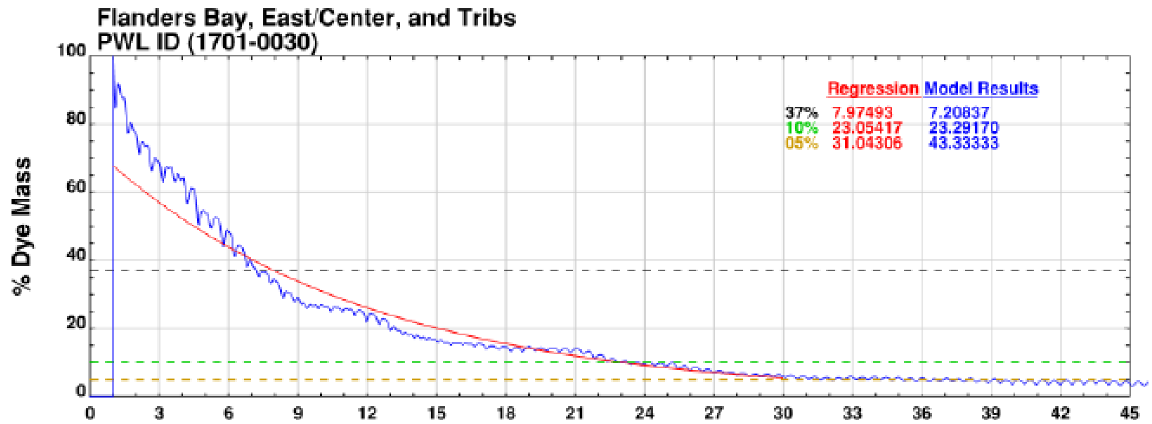


Figure 2-32 Example Modeled Mass and Flushing Time

2.1.6.2 FVCOM-Calculated Flushing Times

Due to the large open waters of the Great South Bay, the five EFDC Great South Bay models used to estimate flushing times for the smaller tidal tributaries and embayments were not capable of calculating flushing times for the open water PWLs. SoMAS provided FVCOM-calculated flushing times for:

- Great South Bay West,
- Great South Bay Middle,
- Great South Bay East,
- Great Cove,
- Nicoll Bay,
- Patchogue Bay and
- Bellport Bay.

The flushing times based on the e-folding time were used to estimate the 10 percent flushing time as 2.316 the e-folding flushing time based on an exponential relationship between mass and time.

2.1.6.3 Tidal Prism Flushing Times

Flushing times for eleven water bodies were calculated using the tidal prism method.

For the three Long Island Sound (LIS) PWLs (West, Central, East), there was no ideal method to determine flushing times without use of a larger (regional) hydrodynamic model that includes the tidal connections on the west end of LIS (East River) and east end of LIS (Block Island Sound/Atlantic Ocean). In some PWLs where EFDC model segmentation was not available or the PWL was not modeled, a tidal prism method was used to calculate flushing times. The marine PWLs where the tidal prism method was used included:

- Gardiners Bay,
- Georgica Pond,
- Goldsmith Inlet,
- Halsey Neck Pond,
- Hog Creek,
- Long Island Sound Central,
- Long Island Sound East,
- Long Island Sound West,
- Sagaponack/Poxabogue Ponds,
- Spring Pond and
- Wading River.

The method for calculating flushing times using the tidal prism method[1] used the equation below and involved the following steps.

$$T_f = V / [(1-b) \times V_{TP} + Q_{FW}]$$

$$V_{TP} = A \times \Delta H / T$$

where: T_f – tidal prism flushing time (T), 37%;

V – volume of water body (L^3);

V_{TP} – tidal prism volumetric flow (L^3/T);

Q_{FW} – freshwater flow (L^3/T);

b – return flow factor;

A – area of water body (L^2);

ΔH – tidal range (L); and

T – tidal period (T), 12.42 hours.

- The return flow factor (b) represents the amount of water body volume leaving on ebb tide that returns on the subsequent flood tide. This factor was estimated by adjusting the b factor to reproduce the EFDC model calculated flushing times (37%) in a number of similar areas as needed. The estimated return factors using the EFDC model calculated flushing times ranged from 0.4 to 0.9. The return factors used were based on those calculated or adjusted lower (0.1 to 0.2) to reflect connection with larger, well flushed water bodies (e.g., Long Island Sound).
- Tidal ranges for specific areas were obtained from nearby NOAA gages and the tidal period reflects one full tidal cycle (about ½ day).
- The 10% flushing time was estimated as 2.316 times the tidal prism method flushing time (37%) based on an exponential relationship between mass and time.

2.1.6.4 Fresh Water Body Flushing Times

Flushing times for the fresh water bodies were calculated as water body volume divided by flow. This assumed that the streams, lakes and ponds were completely mixed hydraulically. Water body geometry was estimated based on available information from NYSDEC, USGS or SCDHS, or based on delineation of the water body surface area and an assumed water body depth. It is acknowledged that some of the lakes and ponds may be stratified such that a shorter residence time may be representative.

2.1.6.5 Sensitivity Evaluations

Flushing time sensitivities to model inputs were considered. The flushing times were directly related to water body depth; e.g., a 25 percent reduction in water body depth would result in a 25 percent reduction in residence time.

It was anticipated that flushing times in most of the marine surface water bodies were dominated by tidal flushing rather than groundwater inflow or wind driven flushing. To evaluate this assumption, sensitivities were completed to assess the impact of freshwater impacts for spring high-flow period and a summer low-flow period as follows:

- Groundwater baseflows/surface runoff were increased by 25% using spring/April wind conditions,
- Groundwater baseflows/surface runoff were increased by 25% using summer/July wind conditions, and
- Groundwater baseflows/surface runoff were reduced by 25% using summer/July wind conditions.

The results of the sensitivity evaluation are summarized by **Table 2-23.** The higher groundwater baseflow and surface runoff resulted in shorter flushing times, while the lower groundwater baseflow and surface runoff scenarios resulted in longer flushing times. The changes in weather conditions included changes in wind direction; these changes affected water bodies differently, depending on their locations/orientation.

The maximum observed change in residence time for all sensitivity evaluations was an approximately 10 percent difference when compared to the baseline condition assumptions used in the SWP. Based upon these findings and coupled with the sensitivity findings of both Priority Rank and load reduction goals, it is not anticipated that seasonal variation will have any meaningful impact on the findings within this SWP. However, as documented in many publications and by NYSDEC, it is the general consensus of scientists that the effects of climate change will include an increase in mean sea level (https://www.dec.ny.gov/energy/45202.html, https://www.dec.ny.gov/docs/administration_pdf/slrtffinalrep.pdf) and will result in more intense storm events and increased precipitation (https://www.dec.ny.gov/energy/94702.html) . Consistent with the adaptive management strategy of the SWP, sea level rise and mean annual precipitation events should be closely monitored and documented in future SWP status reports. If the anticipated changes come to fruition, then consideration should be made to rerun select SWP models and technical evaluations to quantify their potential implications to the findings of this SWP.

Table 2-23 Flushing Time Sensitivity Results

PWL Name	Base Flows and Summer Wind	25% Increased Flows and Spring Wind	25% Increased Flows and Summer Wind	25% Reduced Flows and Summer Wind
Cold Spring Pond	9.3	9.4	9.2	9.3
Flanders Bay East/Center	13.4	13.9	12.9	14.4
Great Peconic Bay	167	149	164	171
Peconic River Lower	10.3	9.2	9.3	11.3
Wooley Pond	1.8	1.3	1.5	1.8

2.1.6.6 Flushing Time Adjustments

A comparison of initial calculated flushing times to observed water quality data and readily available flushing time estimates from existing studies prompted review of the model assumptions and adjustment of the results based on consideration of additional data and information. The major adjustments are summarized below.

2.1.6.6.1 Narrow Bay and Quantuck Bay

EFDC-calculated flushing times for Narrow Bay and Quantuck Bay indicated two well flushed water bodies at 10% flushing times of 3.2 days and 4 days, respectively. However, this was not consistent with the poor observed water quality.

Further consideration of the water bodies suggested that the flushing times were affected by the larger connected bays; Great South Bay and Moriches Bay for Narrow Bay and Moriches Bay and Shinnecock Bay for Quantuck Bay. HDR determined that Narrow Bay is located very close to the western boundary of the EFDC Moriches Bay model, and therefore mass that was simulated to leave the model to the west was not returning on the following tidal cycle. Based on published results of SoMAS Great South Bay modeling (Hinrichs, Flagg and Wilson, 2018), an adjusted Narrow Bay flushing time of 13.5 days was recommended.

The EFDC-calculated flushing time for Quantuck Bay was 4 days. The nearby Quantuck Canal/Moneybogue Bay and Quogue Canal water bodies also had low flushing times of 38 days and < 0.1 days that were not consistent with the observed poor water quality. The Quantuck Bay system is comprised of three PWLs; Aspatuck Creek, Quantuck Bay and Quantuck Creek. Further evaluation suggested that the five water bodies, located between Moriches Bay and Shinnecock Bay, appeared to interact significantly. Consequently, it was recommended that they be treated as a single water body characterized by the combined flushing time. Based on SoMAS' **Eastern Bays Project Report** (Stony Brook University, 2016), a combined flushing time of 60.9 days was recommended.

2.1.6.6.2 Great South Bay – Pre-Breach Flushing Times

Superstorm Sandy opened a breach on Fire Island near Bellport Bay in 2012 which has been documented to increase ocean flows and reduce flushing times (Hinrichs, C.). Because it is anticipated that the breach will eventually close, SCDHS wished to consider the closed breach flushing times in the SWP. Using the published pre-breach and post-breach net flows and flushing times for the summer conditions, the 10% flushing times were adjusted for the larger water bodies in the eastern part of Great South Bay as shown on **Table 2-24**. Because it was not anticipated that the breach impacted mixing between the tidal creeks and the larger water bodies, these flushing times were not modified.

Table 2-24 Adjusted Pre-Breach Flushing Times for SWP

PWL Name	SWP PWL ID	Post-Breach 10% Flushing Time (Days)	Pre-Breach 10% Flushing Time (Days)
Western Great South Bay	1701-0173+0373	27.7	27.7
Great Cove	1701-0376-0338	13.9	22.2
Great South Bay Middle	1701-0040-rev	46.1	115.3
Great South Bay East	1701-0039-rev+0333	121.2	351.5
Nicoll Bay	1701-0375-0333	7.0	20.2
Patchogue Bay	1701-0326	9.3	26.8
Bellport Bay	1701-0320-0325	9.3	36.1

It should be noted that the pre-breach flushing times presented above were modified slightly based upon a minor revision to the methodology used to calculate the pre-breach residence times. The minor modification was completed after completion of the SWP evaluations presented herein (e.g., after completion of the priority ranking and load reduction goal establishment) and has no bearing on the outcome of the plan recommendations. The revised flushing times are documented in the hydrodynamic model task report.

2.1.6.7 Flushing Time Results

The final marine and fresh flushing times that were used in the subwatershed ranking process are listed in **Tables 2-25** and **2-26** respectively (please see tables at the end of this section). Marine flushing times ranged from 1 day (Pipes Cove, Crab Meadow Creek) to 351.5 days (for Great South Bay East). Calculated fresh water body flushing times ranged from 0.2 days (Green Creek, Upper and Tribs) to years for several of the lakes and ponds. In some cases, these long flushing times were modified for subwatershed ranking purposes as described in Section 2.1.7.

The calculated flushing times are sensitive to the groundwater baseflow contributions and to water body volume. The water body volume estimates are sensitive to the assigned water body depths. The calculated flushing times do not include wetting/drying of tidal flats; incorporation of these tidal flats and connected wetlands could impact the calculated residence times.

2.1.7 Subwatershed Characterization and Ranking

In collaboration with SCDHS and the Ranking/Priority Area Focus Area Work Group that SCDHS established for the SWP, an approach was developed and implemented to characterize the subwatersheds and rank the priority of each subwatershed. Establishing priority ranks for individual water bodies accomplishes the following:

- Ranks and groups water bodies scientifically with respect to current ecological condition and vulnerability to nitrogen loads from wastewater (nitrogen load vs flushing time and existing water quality) to assist in funding resource allocation;
- Supports the analysis of cost-benefit;
- Supports the identification of areas that may benefit from alternate wastewater management strategies such as sewering and clustering; and,
- Ultimately, helps guide the recommendations of a Countywide phased wastewater upgrade program with the understanding that program resources are limited and need to be allocated in the most efficient means possible.

The rankings built upon the characterizations of the subwatersheds' groundwater contributing areas, the nitrogen loads (described in Section 2.1.5), the surface waters' residence times and the surface water body water quality data described in Section 2.1.3.

The project database was updated for the priority ranking task to include the results from Task 4a (annual nitrogen load to the subwatershed) and Task 5 (10 percent residence or flushing time of the surface water body). The nitrogen loads were normalized by dividing the total aggregated load (e.g., the load to each subwatershed and each upstream subwatershed) by the total aggregated subwatershed volume (e.g., the volume of the receiving surface water and all of the upstream surface waters).

2.1.7.1 EVAMIX

The subwatersheds were ranked with respect to priority for nitrogen load reduction based upon a variety of criteria. In order to consider a range of subwatershed characteristics simultaneously in an organized and objective process, EVAMIX, a mathematically sophisticated decision support tool, was used to help guide the process of comparing each subwatershed to the others in the County to establish priorities for nitrogen reduction. EVAMIX was originally developed in the 1980s at Delft in the Netherlands by Dr. Henk Voogd and Dr. Mark Maimone. EVAMIX is a matrix based, multi-criteria evaluation program that allows use of both quantitative (cardinal) and qualitative (ordinal) criteria. The algorithm behind EVAMIX maintains the essential characteristics of quantitative and qualitative criteria yet is designed to eventually combine the results into a single appraisal score for each alternative. This unique feature of the program provides the ability to make use of all available data, whether it is quantitative or qualitative. EVAMIX has been successfully applied both in the United States and internationally. EVAMIX has been successfully used to support a variety of projects in New York State, and the results have been upheld in the courts, because the evaluation was completed in a rigorous, open and technically sound process.

The comprehensive set of criteria selected to characterize each subwatershed for priority ranking is described below in Section 2.1.7.3. Use of the decision support tool requires that each criterion be clear and unambiguously defined. Criteria can be either quantitative (e.g. nitrogen load per unit volume, residence time, dissolved oxygen concentration) or qualitative (e.g., presence or absence of macroalgae overgrowth). Whether a criterion is defined as quantitative or qualitative depends on the ability to assign a numerical value and the reliability of the quantitative data available within the timeframe of the evaluation. Criteria that cannot be reliably and quickly quantified were described qualitatively. Each criterion is identified as N (numerical, or quantitative) or Q (qualitative). Preliminary ranking approaches incorporated both quantitative and qualitative criteria, however, as input from the community of experts (including the Endpoints/Load Reduction Focus Area Work Group) was incorporated into the evaluation, the criteria that were qualitatively characterized were removed from the evaluation, except for the macroalgae overgrowth criterion used to characterize fresh water systems.

Figure 2-33 shows conceptually how EVAMIX handles both quantitative (also called cardinal) and qualitative (also called ordinal) data. In the first step, the evaluation matrix is split into two sub-matrices, one with only quantitative criteria, and one with only qualitative criteria. Next, the priority of each criterion is assigned to one of two vectors. Using the scores and weights, dominance scores representing the degree to which one alternative is better than another are calculated for each pair of alternatives for each criterion. These scores are calculated separately for the qualitative and quantitative data respectively. For the quantitative criteria, the difference in the values assigned to each alternative is preserved in the equations to reflect that one alternative may be significantly better than another. For the qualitative criteria, only the fact that one alternative is better than another is identified but the degree of difference is not included in the equations. In this way, EVAMIX treats qualitative criteria correctly by only recognizing the order of preference, not the degree of preference.

After the dominance scores are calculated (one for each possible alternative pair for each of the criteria), they must be standardized in such a way that the relative value of the scores for both quantitative and qualitative criteria can be recombined without distorting the calculations. There are several mathematical techniques to accomplish this. After the scores are standardized, they are recombined, using the weighting matrix to assign relative importance to the overall dominance score. Finally, a single score, representing the overall worth of an alternative relative to the other alternatives considered is developed. This score establishes the final ranking of alternatives from best to worst, or most important to least important.

EVAMIX also allows for direct stakeholder involvement; stakeholders can assign different weights (indicating importance) to each of the criteria, and the sensitivity of the results to varying viewpoints can be considered. The weights used in the ranking process were discussed and reviewed with stakeholders during Focus Area Work Group meetings; the original criteria weights selected were modified throughout the ranking process.

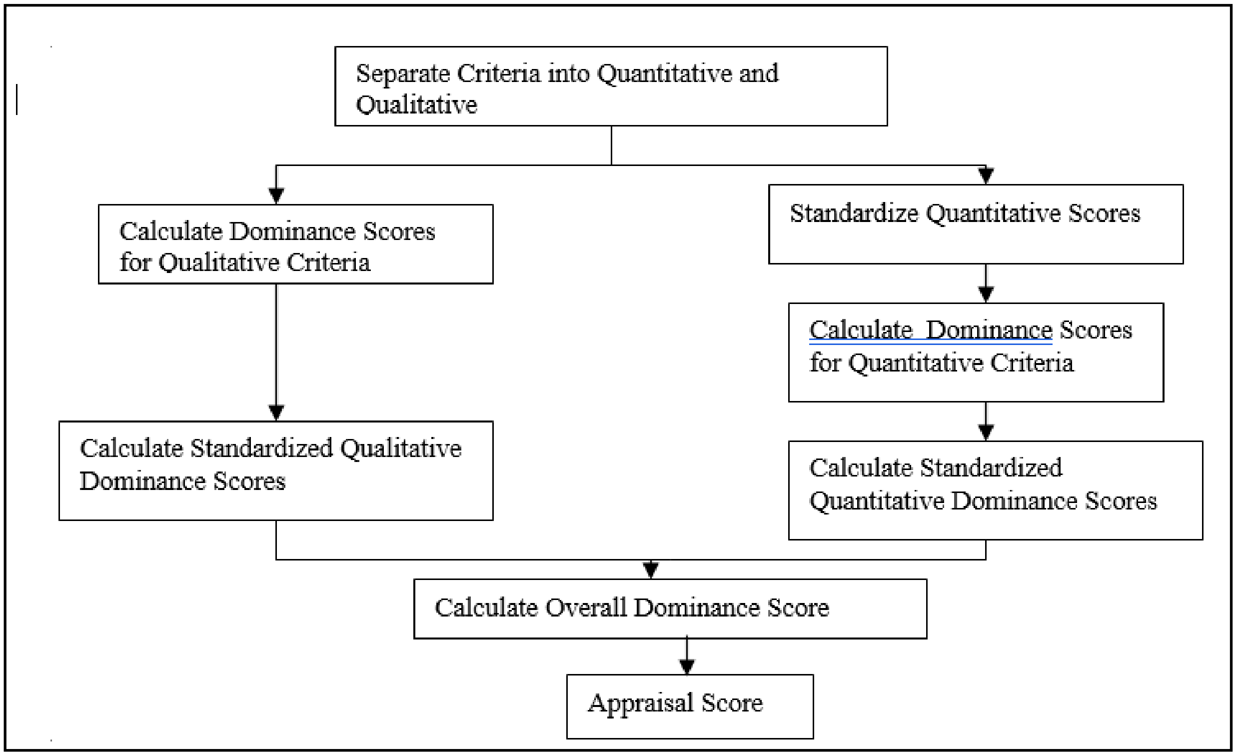


Figure 2-33 EVAMIX Flow Chart

2.1.7.2 Water Body Groupings

Recognizing that fresh surface waters and marine surface waters may respond differently to nitrogen loads, the subwatersheds were divided into two main categories for ranking, fresh and marine. A number of the water bodies included both fresh and marine reaches; these were identified as "mixed" water bodies that were considered in both categories. There were also three subcategories within the fresh surface water group, including undrained ponds and lakes (e.g., not directly connected to a downstream stream), drained surface waters (e.g., the upper reaches of a stream corridor such as Carmans River Upper) and Coastal Ponds (e.g., Georgica Pond) which have unique characteristics.

The subwatersheds included in the marine/mixed and fresh/mixed subwatershed lists for ranking are found in **Table 2-27** (please see tables at the end of this section). The subwatersheds shaded blue were identified as "mixed" subwatersheds, that is, the water bodies included both fresh and marine reaches. The mixed subwatersheds were included in both the marine and fresh lists for ranking.

2.1.7.3 Subwatershed Ranking Matrix

2.1.7.3.1 Subwatershed Ranking Evaluation Criteria

A variety of potential criteria were considered to characterize the subwatersheds for priority ranking. Based on available data and input from the Focus Area Work Group, the criteria listed on **Table 2-28** were considered. The decision-support tool requires that the criteria used to characterize each subwatershed are defined consistently and that a higher value is always better.

Therefore, for those criteria where a lower value is better (e.g., unit nitrogen load * residence time, as a lower unit nitrogen load * residence time is better for water quality than a higher load), the values are assigned as negative numbers in the decision support tool matrix. The evaluation criteria considered to rank the marine and fresh subwatersheds using available data are summarized in **Table 2-28**, along with the approach used to characterize each of the selected criteria. Each of the selected criteria is also briefly described in the following pages.

Table 2-28 Evaluation Criteria

Marine	Fresh	Criteria Characterization Approach
Estimated Unit Nitrogen Load * Residence Time	Estimated Unit Nitrogen Load * Residence Time	25/50 Year Onsite WW N-Load - (Aggregated lbs.-N/aggregated-m3/year)[1] (load selection based on sensitivity variation)
Residence Time	Residence Time	10% flushing time
Total Nitrogen Concentration	Total Nitrogen Concentration	90^{th} Percentile of subwatershed specific TN (mg/L)
Total Phosphorus Concentration	Total Phosphorus Concentration	90^{th} Percentile of subwatershed specific TP (mg/L)
Dissolved Oxygen	Dissolved Oxygen	10^{th} Percentile of subwatershed specific D.O. (mg/L)
HAB – Human Health	HAB – Human Health	Count of years in which Human Health HAB occurred from 2007-2017
HAB - Environmental	HAB - Environmental	Count of years in which Environmental HAB occurred from 2007-2017
Total Chlorophyll-A	Total Chlorophyll-*a*	90^{th} Percentile of subwatershed specific T-Chl-*a* (µg/L)
Clarity	Clarity	Average of subwatershed specific Secchi Depth (ft)
	Plant and/or Macroalgae Overgrowth	The presence of aquatic invasive species and algal/plant growth was identified from the NYSDEC PWL assessment fact sheets
Eelgrass (coastal resiliency)		Insufficient historical coverage information to establish subwatershed-specific eelgrass losses; however, water clarity and chlorophyll 'a" criterion are used as surrogates since these parameters directly impact the conditions for eelgrass growth
Pathogens	Pathogens	To be evaluated under separate GIS-based analysis. Recommendations for pathogen-related wastewater upgrades will be provided separately.
Submerged Aquatic Vegetation		Insufficient historical coverage information to establish subwatershed-specific SAV losses. In addition, the presence of SAV is influenced by other factors including water depth, substrate, turbidity, and presence of sulfates or pesticides.

Predicted Unit Nitrogen Load – Annual average nitrogen loads to each subwatershed were estimated as described in Section 2.1.5 and summarized in **Table 2-17** (please see tables at the end of this section). To reflect the fact that larger surface water bodies may more readily assimilate nitrogen loads than smaller surface waters, the nitrogen loads were normalized by dividing the total subwatershed nitrogen load by the volume of the receiving surface water body. Both nitrogen loads and surface water volumes were aggregated from upstream to downstream reaches to reflect the fact that a downstream surface water body receives the nitrogen loads entering all upstream surface waters as well as nitrogen loads that enter the water body directly.

To properly correlate current observed water quality with the calculated nitrogen loads (e.g., cause and effect) the nitrogen loads from the 25-year contributing areas were used to characterize subwatersheds on the North and South Forks, on Shelter Island and in eastern Brookhaven. Groundwater travel times from the water table to surface water discharge are relatively short in the eastern part of the County with approximately 85 percent of the total groundwater baseflow to the Peconic Estuary surface waters traveling from the water table to surface water discharge within 25 years and population growth has occurred in recent decades. Nitrogen loads from the 50-year contributing areas were used to characterize the subwatersheds in the western part of the County where most significant development occurred from the 1950s through the 1970s. In addition, the groundwater travel times contributing to surface water bodies tend to be longer with almost 85 percent of the total groundwater baseflow traveling from the water table to discharge to the Long Island Sound water bodies within 50 years. Because the primary focus of priority area establishment is to identify areas for on-site wastewater system upgrades, nitrogen loads from on-site sanitary systems provided the basis for the unit nitrogen load * residence times used in the final subwatershed ranking characterizations.

Nitrogen loads were quantified as pounds per year per cubic meter of receiving water. Surface water volumes were provided by HDR (**Flushing Time Calculations for Suffolk County Water Bodies,** 2019). Nitrogen loads were assigned as negative values.

Residence or Flushing Time – Flushing times were defined by HDR as described in the Task 5 documentation. Nitrogen loads to subwatersheds that are well flushed, such that nitrogen discharging to the water body is rapidly removed before it contributes to low dissolved oxygen or algal blooms, may have less of an impact than nitrogen loading to poorly flushed surface waters that may take many days for the nitrogen load to exit the system.

Flushing times were characterized as the number of days required for 90 percent of the mass of a substance such as nitrogen to be flushed from the system. Flushing times for mixed water bodies were comprised of flushing times for the fresh water portion of the water body and the flushing time for the marine portion of the water body. The fresh water flushing time was used in the fresh/mixed ranking matrix and the tidal flushing time was used for the marine/mixed ranking matrix.

Water body residence times were capped at 244 days based upon the longest algal blooming season identified in the County’s database. Capping the residence times acknowledged that there is a theoretical maximum residence time beyond which no further water quality degradation would occur due to further increases in residence time. Because faster flushing times or shorter residence times are correlated with better water quality, residence times are assigned as negative values in the ranking matrix.

Total Nitrogen Concentration – While predicted unit nitrogen loads and residence times are calculated values based on available data and work-group approved input parameters, the resulting nitrogen concentrations in the water column are direct measurements indicating the presence of nitrogen.

Total Nitrogen was used to characterize in-water nitrogen levels because it captures all available forms of nitrogen. Nitrogen concentrations are reported as milligrams per liter (mg/L). Although nitrogen is an essential nutrient for plants and aquatic organisms, excess nitrogen can result in excess productivity and low dissolved oxygen.

Nitrogen levels in some of the Suffolk County subwatersheds have been monitored for decades; other subwatersheds are characterized by a single grab sample. To best represent nitrogen concentrations resulting from current or recent land uses and resulting nitrogen loads, data collected during the last ten years was used to characterize total nitrogen. For all subwatersheds characterized by ten or more samples, the 90th percentile of all grab samples collected was used to characterize the total nitrogen concentration. The 90th percentile was used in lieu of the maximum measured concentration to avoid biasing the evaluation with anomalously high values that are not representative of typically observed conditions.

Although nitrogen is an essential nutrient for plants and aquatic organisms, excess nitrogen can result in excess algal productivity and low dissolved nitrogen, therefore total nitrogen concentrations were assigned as negative values in the ranking matrix.

Total Phosphorus Concentration – While it is anticipated that nitrogen is the primary nutrient responsible for excess algal productivity in the marine subwatersheds, recent literature (Gobler, et al, Shatwell and Kohler) indicates that in some cases, excess phosphorus may also fuel algal blooms and impact water quality . Phosphorus is also typically the limiting nutrient in fresh water bodies. Total phosphorus, reported as milligrams per liter (mg/L), was selected as the indicator of phosphorus levels used for the subwatershed characterizations to best capture all forms of the nutrient. Similar to nitrogen, more data is available to characterize phosphorus levels in some Suffolk County subwatersheds than in others that may be characterized by a single grab sample. To best represent phosphorus concentrations resulting from current or recent land uses, data collected during the last ten years was used to characterize total phosphorus. For all subwatersheds characterized by ten or more samples, the 90th percentile of all grab samples collected was used to characterize the total phosphorus concentration, and because excess phosphorus has been linked to algal blooms, the concentrations were assigned as negative values.

Dissolved Oxygen Concentration – Low dissolved oxygen levels are one of the most significant water quality concerns in Suffolk County surface waters. Aquatic life requires sufficient dissolved oxygen to survive and to thrive and low dissolved oxygen values can result in water quality impairments that stress or even kill aquatic life. Dissolved oxygen concentrations may vary seasonally, spatially and with depth, and even diurnally within any surface water. For example, the saturation value, or amount of oxygen that water can hold increases with decreasing temperature, so that dissolved oxygen concentrations are typically much higher during cold weather than warm. Surface waters with strong currents that are reaerated and well mixed also may have higher dissolved oxygen levels than slower moving or stratified water bodies. Phytoplankton blooms can also significantly impact dissolved oxygen. During daylight hours oxygen produced by photosynthesis may cause supersaturated oxygen concentrations. These high oxygen concentrations can plummet during the overnight hours as the algal respiration utilizes all available oxygen in the water column. Because of these factors it is a challenge to characterize this highly variable water quality parameter by a single value.

To best represent dissolved oxygen concentrations resulting from current or recent land uses, only data collected during the last ten years was used. For all subwatersheds characterized by ten or more samples, the tenth percentile of the dataset was used to characterize dissolved oxygen for ranking. The tenth percentile value was used to characterize the lower end of the range of dissolved oxygen values to eliminate any anomalously low values that may have resulted from atypical conditions or instrument readings. Dissolved oxygen concentrations are reported in mg/L as positive values in the ranking matrix.

Harmful Algal Blooms (Health and Environmental Impacts) - Harmful algal blooms with primarily health impacts are blooms of algal species that produce toxins that can cause illness to humans and animals. HABs with primarily health impacts can also have significant environmental impacts. For purposes of this project, harmful algal blooms with primarily health impacts were characterized as:

- Populations of blue green algae(cyanobacteria) exceeding 25 µg/L;
- Red Tide;
  - Populations of Alexandrium fundyense exceeding 1,000 cells/L or
  - Populations of Dinophysis acuminata, exceeding 10,000 cells/L.

The number of years with one or more HAB events with potential human health impacts during the past ten years was counted, and the criteria was scored from zero (no blooms) to ten (at least one bloom occurring during all ten years). HABs were scored as negative values in the matrix.

Harmful Algal Bloom – (Environmental Impacts) – Harmful algal blooms with environmental impacts are algal populations that are sufficiently high enough to:

- Deplete oxygen in the water column;
- Reduce light penetration in surface waters (affecting the health of other species, including submerged aquatic vegetation); and/or
- Negatively impact filter feeders.

For purposes of this project, harmful algal blooms with environmental impacts were characterized as:

- Brown tide; e.g. populations of Auerococcus anophagefferens exceeding 150,000 cells/mL (Sea Grant New York, Brown Tide Research Initiative, Report No. 9, March 2006);
- Rust tide, e.g., populations of Cochlodinium polykrikoides exceeding 300 cells/mL (personal communication Dr. Chris Gobler, January 25, 2018), and/or
- Other, e.g., high concentrations of unspecified species identified by SCDHS. It should be noted that careful data review was completed to ensure that HABs identified as “other” were not double-counted with one of the known species categories defined above.

SCDHS reviewed the previous ten years of data and identified the number of years that a HAB with environmental impacts occurred. HABs with environmental impacts were scored from zero (no blooms) to a maximum of ten (at least one bloom occurring all ten years). HABs were scored as negative values in the ranking matrix.

***Chlorophyll-a* –** Chlorophyll-*a* was selected as a measure of algal biomass and indicator of primary productivity (synthesis of organic compounds, primarily through photosynthesis, forming the base of the food chain). The 90th percentile of measured chlorophyll-*a* concentration was used to characterize each subwatershed in lieu of the maximum reported concentration to avoid biasing the evaluation with anomalously high values that are not representative. Concentrations are reported in μg/L and because lower levels of chlorophyll-*a* are better than higher values, negative values were assigned.

***Secchi Depth* –** Water clarity has also been identified as a key criterion. Light penetration is important for aesthetic value, for primary productivity and for thriving submerged aquatic vegetation (SAV). While there are a number of factors that affect water clarity, nitrogen can play a large role when excess nitrogen spurs the growth of phytoplankton that significantly reduce light penetration. While there are several approaches that can be used to characterize water clarity, secchi depth was the selected indicator, based primarily on data availability. Secchi depth is measured by lowering an 8-inch diameter disk with alternating black and white quadrants into the water body until it can no longer be seen; this depth is the secchi depth. The average measured secchi depth is reported in feet. Greater secchi depths indicate increased water clarity and were represented as positive values in the ranking matrix. In a limited number of instances, the recorded secchi depth was limited to the depth at the sampling location.

***Plant/Macroalgae Overgrowth* –** The presence or absence of aquatic invasive species and algal/plant growth was obtained from NYSDEC's Priority Water Bodies List Assessment Fact Sheets. This was incorporated as a qualitative evaluation criterion for fresh water bodies where data was readily available. To be consistent with the convention that higher is better, a "1" in the ranking matrix indicates that macroalgae overgrowth was not reported, and a "0" indicated that overgrowth had occurred.

Other Factors – As summarized in **Table 2-28**, a variety of other criteria were initially considered for incorporation into the subwatershed evaluation but were ultimately not included in the nitrogen load reduction priority ranking. These criteria included:

- Presence/Absence of Submerged Aquatic Vegetation (SAV) were not included as a criterion due to insufficient spatial coverage of data for both pre-anthropogenic quantification of SAV/wetlands acres in each surface water and current estimates. In addition, there are a number of other factors including water body depth, substrate, turbidity, potential presence of sulfate or pesticides that affect the presence or absence of SAV.

- Pathogens were not included in this evaluation as many water bodies where pathogen indicators are detected are impacted by storm water rather than wastewater. Pathogens are discussed further in Section 2.2.5.

- Fish kills were not included as a criterion due to the importance of other factors including water body configuration, however, addressing dissolved oxygen and HABs is expected to address nutrient-related fish kills.
- Shellfish were not included as a criterion due to insufficient subwatershed-specific information for both pre-anthropogenic and current quantification of shellfish populations.
- Subwatershed characteristics including land use, depth to groundwater and SLOSH zone were not included as criterion for the nitrogen load reduction priority ranking but will be considered further during identification of appropriate wastewater management alternatives.

2.1.7.3.2 Subwatershed Ranking Criteria Weights

To utilize the EVAMIX program, the relative importance, or weight of each criteria, is also assigned. The total of all assigned criteria weights must add up to 100 percent. After each subwatershed was characterized using the qualitative and quantitative information developed to describe each criterion and initial criteria weights were assigned, EVAMIX was used to calculate a score for each subwatershed. This score represents the overall ranking of the subwatershed relative to the other subwatersheds in Suffolk County (based on the criteria selected, and the weights attached to each criterion.) The appraisal scores were used to rank each subwatershed from best water quality and lowest sensitivity to nitrogen loading to poorest water quality and highest sensitivity to nitrogen loading. The rankings provide an organized and consistent use of both the objective data and the subjective priorities of the decision-makers. Because they result from impartial data and information, they provide an objective characterization of the subwatersheds.

EVAMIX was run dozens of times, using different weights for each criterion, to reflect different perspectives on criteria importance, to discern the impact of each criterion on the rankings, and to assess the sensitivity of the rankings to changes in the assigned criteria weights. Initial sensitivity evaluations were based on nitrogen load and residence time alone, changing the weights to assess the sensitivity of the results to each of the criteria. During this sensitivity evaluation, the weights for nitrogen load and residence times for marine and mixed water bodies were adjusted and the results considered based on water bodies with good water quality and known water quality impairments. The final weight ratio of nitrogen load to residence time of 15 percent:25 percent was selected because it provided the best correlation to observed water quality. Ultimately the criteria weights for the final ranking evaluations were selected by SCDHS based upon input from the project team, the Focus Area Work Group and their understanding that the resulting rankings reflected the understanding of subwatershed water quality.

The subwatersheds were divided into two groups for separate ranking using EVAMIX. One matrix was used to evaluate the marine/mixed subwatersheds and one to evaluate the fresh/mixed subwatersheds. The mixed subwatersheds were ranked using both the marine criteria and criteria weights and the fresh criteria and criteria weights. Watersheds were ranked, and then grouped into quartiles, as follows:

- Priority Rank 1- generally moderate to severe water quality impacts, highest nitrogen loads and/or poorly flushed;

- Priority Rank 2 – generally minor to moderate water quality impacts, may have moderate to high nitrogen loads and/or be poorly flushed;
- Priority Rank 3 – generally minor water quality impacts, small to moderate nitrogen loads and/or be poorly flushed, and
- Priority Rank 4 – generally no known or minor water quality impacts, low nitrogen loads and/or well flushed.

As described in Section 2.1.7.2, the subwatersheds were divided into two groups for separate ranking using EVAMIX. One matrix was used to evaluate the marine/mixed subwatersheds and one to evaluate the fresh/mixed subwatersheds. The mixed subwatersheds were ranked using both the marine criteria and criteria weights and the fresh criteria and criteria weights. The combined ranking of all subwatersheds utilized the ranking resulting in the greatest required nitrogen load reduction for the mixed subwatersheds that were ranked in both the marine and the fresh matrices. Watersheds were ranked, and then grouped into four quartiles. The ranking for the mixed subwatersheds was based on the lower of the marine/mixed and fresh/mixed ranking matrices.

Rankings were compared by continuous review of changes in overall subwatershed priority rank. The final subwatershed characterizations that were used to describe each subwatershed are included here. **Tables 2-29** and **2-30** at the end of this section for provide the data used to characterize the marine/mixed and fresh/mixed subwatersheds respectively.

The final criteria weights used in the marine and fresh ranking matrices are summarized on **Table 2-31**. The final weights were based on SCDHS and Focus Area Work Group concurrence that the resulting priority ranks best reflected observed water quality. In addition, it was agreed that the selected weighting factors represented the most appropriate relative importance of each criterion's weight for the purposes of characterizing a water body's overall water quality and sensitivity to nitrogen loading. The final weights were also reviewed with and agreed upon by the WPAC.

Table 2-31 Criteria Weights Selected for Subwatershed Ranking

Criteria	Marine/Mixed Subwatershed Criteria Weights	Fresh/Mixed Subwatershed Criteria Weights
Unit nitrogen load * residence time (pounds/m^3/year)	15	35
Residence Time (10% flushing time)	25	5
Total Nitrogen Concentration (90th percentile)	10	10
Total Phosphorus Concentration (90th percentile)	2	10
Dissolved Oxygen Concentration (10th percentile)	15	5
HABs – Human Health Impacts (Number of blooms from 2007/2008 to 2017)	13	15
HABs – Environmental Impacts (Number of blooms from 2007/2008 to 2017)	10	5
Total Chlorophyll-A (90th percentile)	5	5

Criteria	Marine/Mixed Subwatershed Criteria Weights	Fresh/Mixed Subwatershed Criteria Weights
Clarity (average Secchi depth)	5	5
Macroalgae Overgrowth	N/A	5

Note: The ranking evaluation included both calculated nitrogen load and measured total nitrogen, for a combined weight of 25 percent.

The final weighting factors used for the marine subwatersheds criteria identified the factors that contribute to ecological stress (e.g., residence time, predicted unit nitrogen loads and total nitrogen concentration) as the critical factors in ranking water body priority for nitrogen load reductions. Dissolved oxygen and HABs were the two factors resulting from the excess nutrients and poor flushing that were identified as the most important due to their direct and indirect impacts to human health, the environment and other water quality parameters (e.g., the presence of HABs also impacts chlorophyll-*a* concentrations, and ultimately impacts SAV and coastal resiliency). As water clarity and chlorophyll-*a* are already partially addressed through the HAB ranking criteria, they were given slightly lower relative importance.

The weighting factors' rationale for the fresh subwatersheds' criteria were similar to marine waters with the following changes:

- An increase in the relative importance of predicted nitrogen loads and a decrease in the overall importance of residence times. Most freshwater systems can be categorized as either drained or undrained systems. For drained systems, water is constantly flowing in a downstream direction which typically eliminates concerns regarding poor flushing for most systems. The estimated residence times for many undrained systems may be artificially high because stratification is not accounted for in the calculation method (e.g., insufficient information exists to accommodate refinement of the approach at this time) and the relative importance of residence time was reduced in the priority ranking evaluation and more focus was shifted toward nutrient loading parameters;
- Increased the weight for measured phosphorus levels, which are believed to have a greater impact on algal productivity in fresh waters than in marine; and
- Included macroalgae overgrowth using existing readily available data provided in the NYSDEC PWL Fact Sheets, which was weighted the same as chlorophyll-*a*.

2.1.7.3.3 Priority Ranking Adjustments

Raw priority rank outputs for select water bodies were adjusted in some cases to address poorly characterized water bodies and evaluation outliers. A brief description of the adjustment process is provided below. The adjustment methodology was selected to provide a transparent, unbiased, and objective approach for ranking water bodies with insufficient data to support accurate ranking through the primary EVAMIX approach.

Poorly Characterized Water Bodies - The raw outputs from EVAMIX indicated that the ranking of water bodies that were poorly characterized (e.g., do not have sufficient water quality data to provide an accurate evaluation of their overall water quality) were inconsistent with the rankings of adjacent water bodies with similar predicted nitrogen loads and flushing times. This correlation indicated that the original ranking of poorly characterized water bodies was potentially biased or inaccurate in some cases. To resolve this concern, the following ranking adjustment methodology was applied uniformly to the poorly characterized water bodies:

- For draining systems (e.g., rivers, lakes, etc.) connected to well-characterized downgradient water bodies, the poorly characterized water body rank was reassigned the ranking of the connected downgradient water body OR the poorly characterized water body's sensitivity ranking was based upon predicted nitrogen load and residence time only. This methodology ensured that, at a minimum, the priority ranking of the poorly characterized water body was protective of its downgradient receiving water body.
- For undrained freshwater only systems, the original priority rank was utilized.
- For undrained coastal ponds that were evaluated using both the marine and freshwater weighting factors, the higher (more conservative) of the two original priority ranks was used, consistent with the original approach.

Use of the adjustment methodology described above further ensured that there was a consistent, unbiased, and objective approach to prioritizing water bodies with insufficient data to properly characterize them. A list of the poorly characterized water bodies and their final ranking is provided in **Table 2-32** at the end of this section. It should be noted that in many cases, the original rank was the same as the final rank identified.

Well Characterized Water Body Ranking Outliers and Exceptions - Individual rankings for two well characterized water bodies were also adjusted based upon their unique circumstances. Specifically, it was observed that the direct groundwater baseflow contributing area (and associated nitrogen load from groundwater baseflow) for the Huntington Bay and Smithtown Bay subwatersheds were minimal when compared to the overall contributing area and nitrogen loads of their connected water bodies. To accommodate this unique circumstance, the individual rankings were adjusted to be consistent with their adjacent connected water bodies. A summary of the two adjustments is provided in **Table 2-33** below.

Table 2-33 SCDHS Recommended Changes to Rankings Identified by the Decision Support Tool

Subwatershed	Reasoning	Score Assigned
Huntington Bay	Reflects the average ranking of contributing subwatersheds (Huntington Bay, Centerport Harbor, Lloyd Harbor, Huntington Harbor, and Northport Bay)	Yellow (2)
Smithtown Bay	Reflects the average ranking of contributing subwatersheds (Long Island Sound, West, Nissequogue River Lower, Crab Meadow Creek, and Smithtown Bay).	Green (3)

Fire Island - According to the USGS publication entitled "Analysis of the Shallow Groundwater Flow System at Fire Island National Seashore" (Schubert, 2009), over 80 percent of the nitrogen load conveyed to surface waters by groundwater on Fire Island discharges to the back bays. In addition, most hamlets on Fire Island are in close proximity to Priority Rank 1 embayments. Based on this data, all parcels on Fire Island are presumed to fall within Priority rank 1.

Block Island Sound - Because neither residence time nor water quality were characterized for Block Island Sound which is adjacent to and flushed by the Atlantic Ocean, it was not included in the rankings. It was however recognized that the nitrogen load to Block Island Sound will be reduced as a result of reducing nitrogen loading to the subwatersheds contributing to Long Island Sound and the Peconic Estuary. In all, 190 of the 191 subwatersheds were ranked.

2.1.7.3.4 Subwatershed Priority Ranking Results

The final subwatershed rankings based upon the final subwatershed characterizations, weighting criteria, and the updates based on the methodology described in Section 2.1.7.3.3, were linked to a geodatabase to be displayed geographically in GIS. Using the consolidated set of the subwatershed mappings developed in Task 2A as the base, subwatersheds were color-coded to identify Priority 1 (red), Priority 2 (yellow), Priority 3 (green) and Priority 4 (blue) areas for nitrogen reduction via wastewater management. **Figure 2-34** shows the final rankings. The subwatersheds shown in red are Priority 1 for nitrogen load reduction, those in yellow are Priority 2, those in green are Priority 3 and those shown in blue are Priority 4 for nitrogen load reduction. Areas already served by sanitary wastewater collection and treatment systems are delineated in white. **Table 2-34** at the end of this section lists each subwatershed within the four categories, in alphabetical order and **Table 2-35** identifies the subwatersheds in Priority Rank 1.

Table 2-35 Priority Rank 1 Subwatersheds

Subwatershed Name	Subwatershed Name	Subwatershed Name
Abets Creek	Great South Bay, West	Peconic River, Lower, and Tidal Tribs
Agawam Lake	Green Creek, Upper, and Tribs	Penataquit Creek
Amityville Creek	Halsey Neck Pond	Penniman Creek and Tidal Tribs
Aspatuck Creek and River	Heady and Taylor Creeks and Tribs	Phillips Creek, Lower, and Tidal Tribs
Awixa Creek	Howell's Creek	Quantuck Bay
Beaverdam Creek	James Creek	Quantuck Canal/Moneybogue Bay
Beaverdam Pond	Kellis Pond	Quantuck Creek and Old Ice Pond
Bellport Bay	Lake Ronkonkoma	Quogue Canal
Belmont Lake	Lawrence Creek/Lakes, O-co-nee	Red Creek Pond and Tidal Tribs
Brightwaters Canal	Mattituck (Marratooka) Pond	Sagaponack Pond
Brown Creek	Mecox Bay and Tribs	Sampawams Creek
Brushes Creek	Meetinghouse Creek and Tribs	Sans Souci Lakes
Carlls River	Mill Pond	Santapogue Creek
Carmans River Lower, and Tribs	Mill Pond and Sevens Ponds	Scallop Pond
Carmans River Upper, and Tribs	Moriches Bay East	Seatuck Cove and Tidal Tribs
Champlin Creek	Mud Creek, Robinson Pond, and Tribs	Shinnecock Bay West
Connetquot River, Lower, and Tribs	Neguntatogue Creek	Speonk River
Connetquot River, Upper, and Tribs	Nicoll Bay	Stillman Creek
Corey Lake and Creek, and Tribs	Nissequogue River Upper	Swan River, Swan Lake, and Tidal Tribs

Subwatershed Name	Subwatershed Name	Subwatershed Name
Deep Hole Creek	Northport Bay	Terry's Creek and Tribs
Dunton Lake, Upper, and Tribs	Northport Harbor	Tuthills Creek
Flanders Bay, West/Lower Sawmill Creek	Ogden Pond	Wading River
Forge River and Tidal Tribs		
Georgica Pond	Old Town Pond	Wainscott Pond/Fairfield Pond
Goldsmith Inlet (inlet closed)	Pardees, Orowoc Lakes, Creek, & Tribs	Weesuck Creek and Tidal Tribs
Grand Canal	Patchogue Bay	West Creek and Tidal Tribs
Great Cove	Patchogue River	West Neck Bay and Creek
Great Peconic Bay and minor coves	Peconic River Middle, and Tribs	Wickapogue Pond
Great South Bay, East	Peconic River Upper, and Tribs	Willets Creek
Great South Bay, Middle		

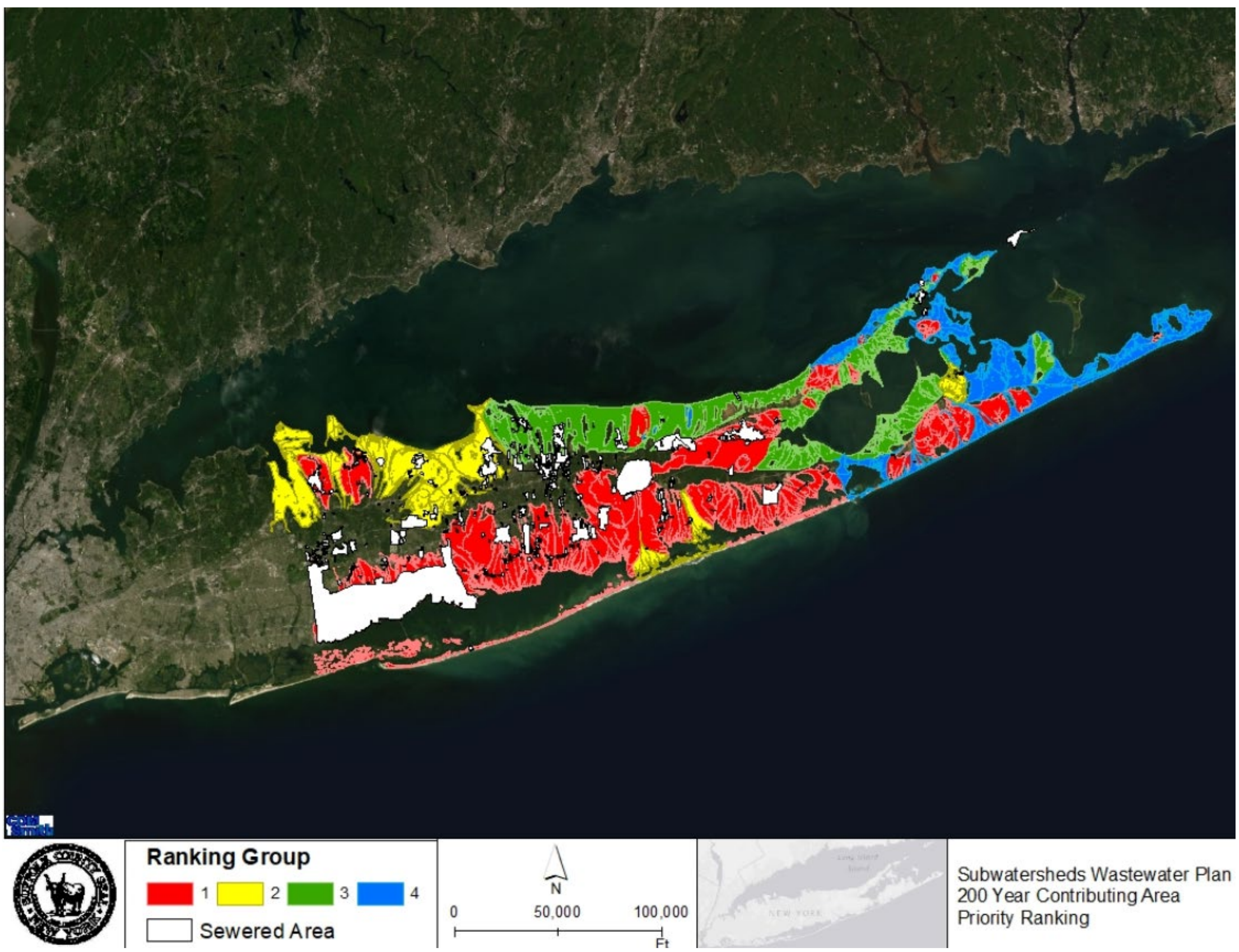


Figure 2-34 Subwatershed Priorities for Nitrogen Load Reduction

Table 2-36 provides a summary of the subwatersheds that fall within each nitrogen load reduction category for each of the estuary programs. The highest percentage of subwatersheds that were determined to be in critical need of nitrogen load reduction are located within the South Shore Estuary Reserve, while less than ten percent of the SSER subwatersheds are ranked as Priority 3 and 4. This is consistent with the high population density of the SSER watershed and the long residence times in receiving water bodies such as Great South Bay.

Table 2-36 Number of Subwatersheds within each Priority Category for Nitrogen Load Reduction

Subwatershed Location	Priority Rank 1 (Red)	Priority Rank 2 (Yellow)	Priority Rank 3 (Green)	Priority Rank 4 (Blue)	Total
Long Island Sound	6 (22%)	5 (19%)	13 (48%)	3 (11%)	27
Peconic Estuary	15 (20%)	10 (14%)	21 (28%)	28 (38%)	74[(1)]
South Shore Estuary	55 (74%)	13 (18%)	3 (4%)	3 (4%)	74
Other (Fresh and Coastal Ponds)	10 (67%)	1 (7%)	2 (13%)	2 (13%)	15
Total	86 (45%)	29 (15%)	39 (21%)	36 (19%)	190[(1)]

(1) Block Island Sound water quality and residence time were not characterized, and it was not ranked.

The highest percentage of subwatersheds with Priority Rank 4 are located within the Peconic Estuary. Most of the Priority Rank 4 subwatersheds are located in the eastern part of the estuary where the nitrogen load from sanitary wastewater is low, consistent with the lower residential population and where the surface waters benefit from flushing due to the close proximity of the open waters of Block Island Sound and the ocean. Nearly a quarter of the Peconic Estuary subwatersheds were ranked Priority 1; these subwatersheds are located in the more densely populated and poorly flushed western areas of the Estuary. Priority rankings for subwatersheds contributing to Long Island Sound also reflect the contributing land uses, population density and flushing. Only six subwatersheds were ranked Priority 1; five of these are in the western part of the watershed in the poorly flushed Nissequogue River/Northport Bay area. The majority of the Long Island Sound subwatersheds (48%) were ranked Priority 3, as a result of shorter residence time and flushing with the Sound. Further details of the subwatershed characterizations used to establish the rankings and need for nitrogen load reductions may be found on the subwatershed-specific scorecards described on the following page and included in **Appendix D**.

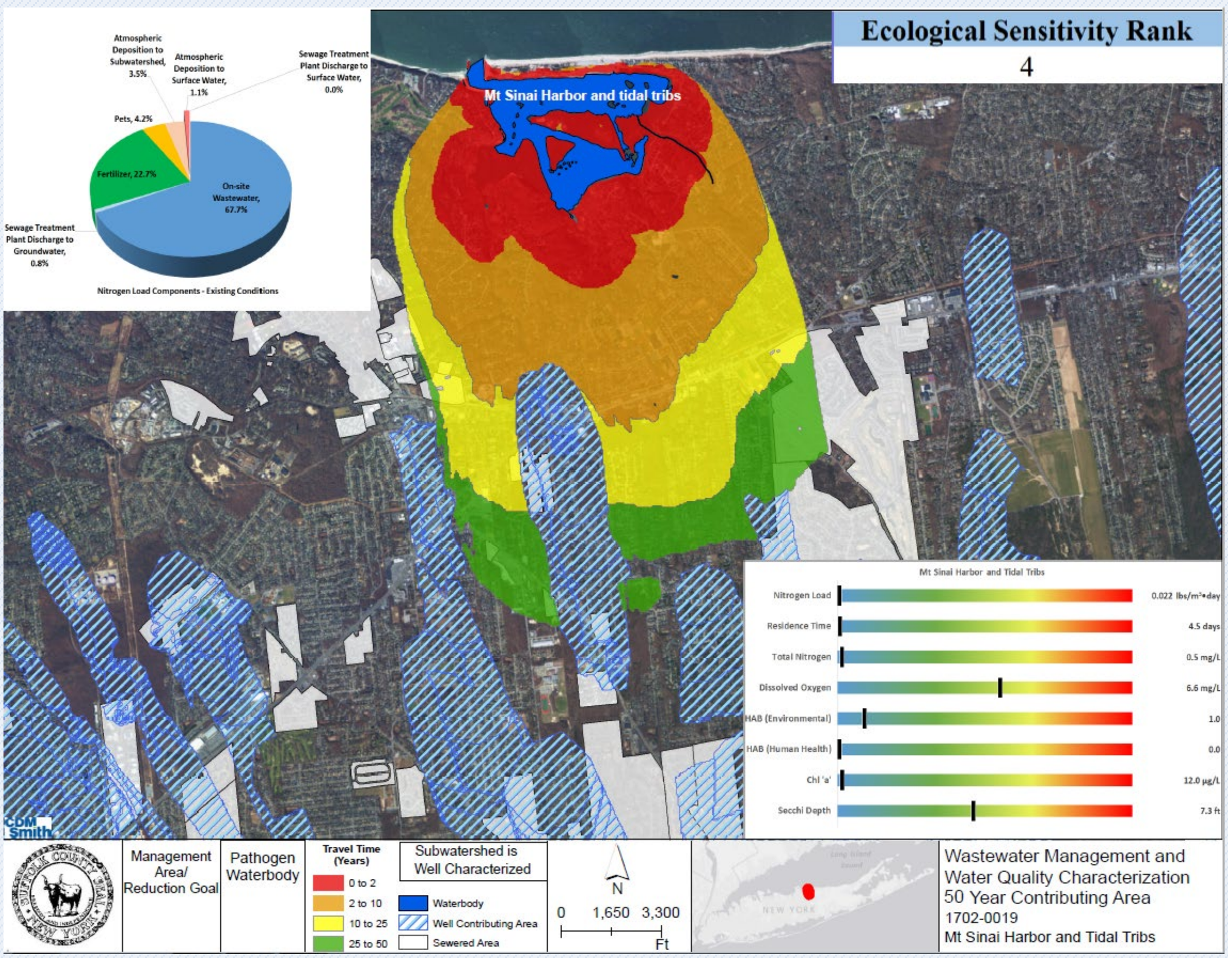
2.1.8 Identification of Ecological Endpoints

Before nitrogen load reduction goals could be established, the ecological endpoints which the load reduction goals are targeted to achieve needed to be defined. While nitrogen is an essential nutrient for healthy ecosystems, too much nitrogen can fuel excess algal growth and productivity, which can result in a variety of negative consequences.

Desired ecological endpoints were identified building on the work completed with the assistance of the Priority Areas/Endpoints Focus Area Work Group and documented in the Task 6 Technical

Subwatershed "Score Cards"

Subwatershed-specific score cards summarize the information used to characterize each contributing area and receiving water. An example score card for the Mt. Sinai Harbor subwatershed is included here. Subwatershed-specific score cards for the 190 subwatersheds evaluated may be found in the Task 6 technical memorandum. The score cards depict the area contributing groundwater baseflow and/or underflow to the surface water (e.g., 25-year groundwater contributing area or 50-year groundwater contributing area) and summarize the subwatershed characterizations. They also include a nitrogen load summary or "pie chart" indicating the fraction of each nitrogen load component (including the loading to all upstream subwatersheds) discharging from groundwater based on the entire groundwater contributing area (up to 200 years). A chart summarizing the characteristics of the subwatershed that were used to guide the priority ranking for nitrogen load reduction as compared to all of the other subwatersheds is also included. For each parameter, the charts display the subwatershed-specific value within the range of values observed for all subwatersheds. Values vary between the "best" water quality on the left of the chart (blue) to the "worst" water quality on the right side of the chart (red), to provide a quick visual overview of the subwatershed characterization with respect to the entire set of Suffolk County subwatersheds evaluated. The score cards provide a quick summary of each subwatershed for future resource manager use, including a depiction of the groundwater contributing area, the relative contributions of nitrogen loads and resulting water quality as well as the ranking priority for nitrogen load reduction and the wastewater management area.



Example Score Card for Mt. Sinai Harbor

Memorandum entitled **Tiered Priority Area Services**. The following ecological endpoints were evaluated for correlation with nitrogen loads:

- Dissolved oxygen
- Chlorophyll-*a*
- Presence or absence of harmful algal blooms
- Secchi depth

In addition, although coverage of seagrasses such as eelgrass were not quantified sufficiently to use for subwatershed priority ranking, the presence of eelgrass was identified as an important desirable ecological endpoint indicative of estuarine health. Seagrasses, including eel grass, provide essential habitat and nursery areas for locally important fish and shellfish species and play a significant role in carbon and nutrient cycling. They also stabilize bottom sediments and act as wave and storm surge barriers by reducing wave energy and amplitude, reducing water velocity and protecting coastal communities from storm surge. Ultimately, load reduction goals for the protection of eelgrass were established indirectly by identifying the acceptable chlorophyll-*a* concentration that facilitates sufficient bottom light for the growth of eelgrass. Relationships between predicted nitrogen loads and chlorophyll-*a* were then established as described within this report.

2.1.8.1 Dissolved Oxygen Concentrations

Low dissolved oxygen levels are one of the most direct impacts of nitrogen loading on poorly flushed surface waters. Recognizing that dissolved oxygen concentrations may be very variable, dissolved oxygen levels greater than NYSDEC's chronic water quality standard of a daily average of 4.8 mg/L in 90 percent of all samples was selected as a desired ecological endpoint for evaluation using the statistical approaches discussed herein. The identification of water bodies with no dissolved oxygen excursions below NYSDEC's acute standard of 3.0 mg/L in all samples was selected as the criterion for the identification of dissolved oxygen reference water bodies. Dissolved oxygen concentrations are reported in mg/L.

The long-term objective of the SWP initial load reduction goal for dissolved oxygen is to minimize the frequency of excursions below NYSDEC's acute standard of 3.0 mg/L that would not have occurred under natural conditions (without anthropogenic influence) to the maximum extent possible.

2.1.8.2 Chlorophyll-*a* Concentrations

Excessive primary productivity, as indicated by elevated chlorophyll-*a* concentrations, can contribute to low dissolved oxygen levels as well as to reduced light penetration (as indicated by secchi depth) and reduced light availability to support seagrasses. A range of chlorophyll-*a* concentrations that support seagrass habitat have been reported in the literature, as summarized in the **Final Report of the New York State Seagrass Task Force,** from the range of 4.6 to 13.2 µg/L reported by Greening et al (Tampa Bay), up to < 15 µg/L reported by Batiuk for Chesapeake Bay. A maximum chlorophyll-*a* concentration of 5.5 µg/L was selected as a desired ecological endpoint, based on the recent Long Island Sound based studies completed by Vaudry and by Yarish, and further corroborated by the relationship between natural log of secchi depth and chlorophyll-*a* concentrations measured in marine water bodies during the growing season shown by **Figure 2-35.** Based on data collected in Suffolk County marine waters, a chlorophyll-*a* target of 5.3 µg/L is associated with the 6.56-foot (two-meter) secchi depth identified as protective of eelgrass (please see Section 2.1.8.4).

The SWP evaluates load reduction goals for chlorophyll-*a* under two approaches. Both approaches are intended to result in sufficient water clarity for sustaining healthy eelgrass beds as follows:

1) Minimum goal (chlorophyll-*a* probabilistic approach) - Create conditions conducive for achieving a target chlorophyll-*a* target of 5.5 µg/L with an 80 percent probability; and,

2) Maximum goal (reference approach) – Achieve a chlorophyll-a target of 5.5 µg/l 90 percent of the time or maintain an average chlorophyll-*a* target of 5.5 µg/l during the blooming season.

All approaches allow for occasional excursions of chlorophyll-*a* above the target threshold to accommodate beneficial algal productivity.

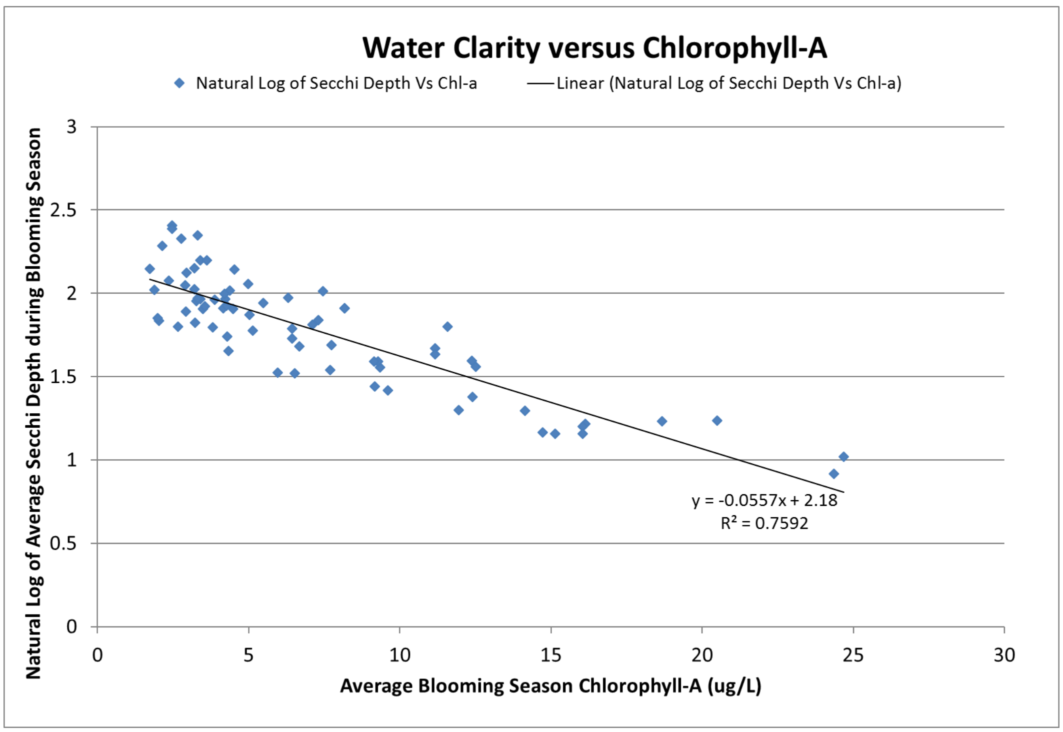


Figure 2-35 Water Clarity and Chlorophyll-*a*

2.1.8.3 Absence of Harmful Algal Blooms

Both harmful algal blooms (HABs) with primarily health impacts and HABs with primarily environmental impacts are monitored in Suffolk County water bodies. The number of years of HABs with primarily health impacts and the number of years of HABs with primarily environmental impacts over the past ten years of water quality monitoring were reviewed for each subwatershed where HAB monitoring was conducted as described in Section 2.1.7.3.

The long-term objective of the SWP initial load reduction goal for HABs is to create nutrient enrichment-related conditions (e.g., nitrogen loads to surface waters) that minimize the intensity and frequency of HABs in Suffolk County with the ultimate ("ideal") goal of no HABs with primarily health impacts and no more than one HAB with primarily environmental impacts over a ten year period. As discussed throughout the SWP, it is acknowledged that nutrient enrichment is just one factor contributing to the occurrence, intensity, and frequency of HABs in Suffolk County.

2.1.8.4 Secchi Depth

Water clarity was identified as another desirable ecological endpoint. SCDHS measures secchi disk depth, one measure of water clarity, as part of their water quality sampling program. Published information, including the **Final Report of the New York State Seagrass Task Force**, 2009, identifies a secchi depth of two meters as protective of eelgrass, a flowing aquatic plant that is important to marine habitats. Maintenance of secchi depths at two meters or greater was identified as a desired ecological endpoint for the protection of eelgrass based upon previous studies including the above referenced **New York State Seagrass Task Force Final Rep**ort, Dahl and Simpson's **Eelgrass and Water Quality: A Prospective Indicator for Long Island Nitrogen Pollution Management Planning** (2017), and Vaudrey's **Establishing Restoration Objectives for Eelgrass in Long Island Sound** (2008).

The long-term objective of the SWP initial load reduction goal for secchi depth is to maintain an average secchi depth of at least two meters during the growing season.

2.1.8.5 Water Body Groupings

As previously described in Section 2.1.7.2, the subwatersheds were grouped into marine/mixed and mixed/fresh groups for priority ranking purposes. Initial nitrogen load reduction evaluations considered all subwatersheds (e.g., marine, mixed and fresh) together; as the evaluations were further advanced, nitrogen load/ecological endpoints and subsequent nitrogen load reductions were considered separately for marine/mixed subwatersheds and for fresh subwatersheds. It was also recognized that the thirteen coastal ponds included in the evaluation represented unique ecosystems; the normally fresh water ponds may experience abrupt changes in salinity, temperature and other water quality parameters when a passage to a bay or the ocean is opened, allowing exchange with salt water.

Nitrogen load reduction goals were established for the nineteen fresh water bodies included in **Table 2-37** and the thirteen coastal ponds listed in **Table 2-38.**

Table 2-37 Fresh Water Bodies

Subwatershed	SWP PWL Number
Belmont Lake	1701-0021+0089
Big/Little Fresh Ponds	1701-0125
Carmans River Upper, and Tribs	1701-0102-rev+0322+0323
Connetquot River, Upper, and Tribs	1701-0095+0339

Subwatershed	SWP PWL Number
Deep Pond	1701-0270
Fresh Pond Creek and Tribs	1702-0244
Kellis Pond	1701-0290
Lake Panamoka (Long Pond)	1701-0134
Lake Ronkonkoma	1701-0020
Laurel Pond	1701-0128
Ligonee Brook and Tribs	1701-0352+0353
Little Long, Long, and Shorts Pond	1701-0291
Mattituck (Marratooka) Pond	1701-0129
Mill Pond and Sevens Ponds	1701-0113+0289
Nissequogue River Upper, and Tribs	1702-0235 +0013+0238+0237+0236
Peconic River Middle, and Tribs	1701-0261+0262+0269
Peconic River Upper, and Tribs	1701-0108+0265+0266+0269
Sans Souci Lakes	1701-0336+0335
Wildwood Lake (Great Pond)	1701-0264

Table 2-38 Coastal Ponds

PWL Name	SWP PWL Number
Wainscott Pond/Fairfield Pond	1701-0144
Agawam Lake	1701-0117
Wickapogue Pond	1701-0119
Hook Pond	1701-0131
Old Town Pond	1701-0118
Big Reed Pond	1701-0281
Fort Pond	1701-0122
Oyster Pond/Lake Munchogue	1701-0169
Marion Lake	1701-0229
Sagaponack Pond and Poxabogue Pond	1701-0146+0286
Halsey Neck Pond	1701-0355
Georgica Pond	1701-0145
Mecox Bay and Tribs	1701-0034+0289+0292

2.1.9 Nitrogen Load Reduction Goals

The recommendations provided in the SWP are intended to improve water quality in Suffolk County waters so that they can be used for their full environmental, recreational and economic potential as currently classified under NYSDEC designated uses. In support of satisfying the NYSDEC Nine Elements Watershed Plan requirements, **Table D-4** in Appendix D summarizes each aggregated water body's classification along with the classification of select freshwater and coastal ponds, and includes each water body's designated and desired uses. The following water quality endpoints were identified to support achievement of these uses:

- Dissolved oxygen,
- Chlorophyll-*a,*
- Presence or absence of harmful algal blooms and
- Secchi depth.

In New York State marine waters, nitrogen is regulated based on the following narrative standard:

> *"None in amounts that result in the growths of algae, weeds and slimes that will impair the waters for their best usages. "*

Because there are no established nitrogen criteria, several alternative approaches were evaluated to identify the nitrogen load reductions required to protect and/or restore the County's surface waters. The benefits of establishing preliminary nitrogen load reduction goals within the SWP include:

- Provide initial, "first ever", nitrogen load reduction goals to improve water quality in Suffolk County for a variety of endpoints;
- Provide an additional line of evidence to support prioritization of wastewater upgrades;
- Support identification of wastewater technology (I/A OWTS, sewering, clustering); and,
- Identification of water bodies where other interventions may be necessary (e.g., water bodies where nitrogen reductions from wastewater management alone may not reach targeted endpoints).

It should be noted that the load reduction goals presented in the SWP are not intended to be Total Maximum Daily Limits (TMDL) or regulatory limits. They are solely intended to be used as a guide for the reasons described above. In addition, these goals should be periodically revisited and evaluated as new data becomes available and actual nitrogen load reductions are realized through wastewater management and other nitrogen mitigation measures.

Three approaches were identified and implemented for the establishment of load reduction goals within the SWP, including:

- Reference water body approach – this approach assumes that nitrogen loading to the priority subwatersheds should be reduced to the level of existing loading to subwatersheds with observed good water quality within Suffolk County.
- Development of stress-response relationships – this approach assumes that mathematical relationships between nitrogen loads and desired water quality can be identified based on existing data, and that these relationships can be used to identify the nitrogen load reductions required to achieve the desired water quality outcomes.

- Use of published guidance values – this approach was to be used if the reference water body approach and the stress-response relationships were not successful in the identification of nitrogen load reduction goals. In addition, they provide a frame of reference against which the results of the first two approaches can be assessed.

Descriptions of the three load reduction goal methods along with their findings are presented in the following subsections.

2.1.9.1 Reference Water Body Approach

2.1.9.1.1 Subwatershed Nitrogen Load Establishment

The reference water body approach relies on establishing nitrogen load reduction goals by comparing local reference water bodies that achieve the water quality standards and ecological endpoints identified above to all water bodies included in the SWP. An unbiased way to characterize the subwatersheds was necessary to compare all subwatersheds. Each subwatershed's unit nitrogen load was multiplied by the residence time. This "unit nitrogen load * residence time" was calculated as:

$$\frac{\text{Pounds}}{\text{Day-m}^3} \times \text{Residence time (days)} \times 453592 \frac{\text{milligrams}}{\text{pound}} \times .001 \frac{\text{m}^3}{\text{liter}}$$

The unit nitrogen load * residence time, expressed as mg/L, represents the incremental nitrogen load generated directly by the subwatershed loads, atmospheric deposition, and sewage treatment plant (STP) outfalls above the water body's boundary condition (or background load). It should be noted that this calculation DOES NOT represent an in-water concentration despite having the units of milligrams per liter. It merely represents a subwatershed's relative nitrogen enrichment/loading times its respective residence time.

2.1.9.1.2 Identification of Ecological Endpoints and Reference Water Bodies

The reference water bodies were established by identifying water bodies with at least ten sampling events over the past ten years that achieved all of the following desirable water quality criteria:

- Dissolved oxygen levels greater than NYSDEC's chronic water quality standard of a daily average of 4.8 mg/L in 90 percent of all samples;

- Chlorophyll-*a* levels less than 5.5 µg/L in 90 percent of all samples collected, OR average blooming season chlorophyll-a levels less than 5.5 µg/L. Elevated chlorophyll-*a* concentrations can contribute to low dissolved oxygen and to reduced light penetration (as indicated by secchi depth) and reduced light availability to support seagrasses. The blooming season for marine waters was defined as the period from April 1 through October 31. The blooming season was determined by evaluating trends in chlorophyll-*a* concentrations with time in all marine waters;

- Water clarity (as measured by secchi depth) greater than two meters (6.56 feet) during the blooming season for protection of eelgrass;

- No HABs with primarily health impacts during the past ten years, and

- A maximum of one HAB with primarily environmental impacts in the past ten years.

The reference water body approach was utilized to identify reference marine and mixed water bodies. Twenty-eight marine/mixed water bodies in Suffolk County met all of the water quality criteria identified; the reference water bodies are shown on **Figure 2-36** and their respective unit nitrogen loads and residence times are provided in **Table 2-39.**

Table 2-39 Reference Water Bodies Achieving All Ecological Endpoints

Subwatershed	SWP PWL Number	Residence Time (days)	Unit Nitrogen Load (mg/L/day)	Unit Nitrogen Load * Residence Time (mg/L)
Coecles Harbor	1701-0163	39.6	0.002	0.089
Cold Spring Pond and Tribs	1701-0127	11.4	0.022	0.249
Gardiner's Bay	1701-0164	5.3	0.001	0.005
Goose Creek	1701-0236	10.8	0.028	0.305
Hallock/Long Beach Bay and Tidal Tribs	1701-0227	39.3	0.010	0.379
Lake Montauk	1701-0031	13.8	0.005	0.073
Little Peconic Bay	1701-0126+0172	80.8	0.002	0.122
Little Sebonac Creek	1701-0253	7.5	0.012	0.089
Long Island Sound, Suffolk County, East	1702-0266	45.5	0.000	0.002
Long Island Sound, Suffolk County, West	1702-0098+0232	45.8	0.000	0.016
Mill Creek and Tidal Tribs	1701-0238+	9.3	0.028	0.259
Mt Sinai Harbor and Tidal Tribs	1702-0019	4.5	0.027	0.122
Napeague Harbor and Tidal Tribs	1701-0166	19.1	0.004	0.084
North Sea Harbor and Tribs	1701-0037	5.7	0.019	0.106
Northwest Creek and Tidal Tribs	1701-0046	7.1	0.032	0.225
Northwest Harbor	1701-0368+0275+0276	8.0	0.003	0.027
Noyack Bay	1701-0167-rev	28.3	0.001	0.022
Sag Harbor	1701-0035-SH+0239	6.5	0.009	0.057
Sebonac Creek/Bullhead Bay and Tidal Tribs	1701-0051	5.0	0.028	0.104
Shelter Island Sound, North and Tribs	1701-0170	35.9	0.001	0.049
Shelter Island Sound, South and Tribs	1701-0365-rev+0240	41.0	0.001	0.058
Shinnecock Bay – Bennet Cove (Cormorant Cove)	1701-0033-BC+0252+0296	17.3	0.014	0.248
Shinnecock Bay East	1701-0033-E	18.6	0.004	0.070
Southold Bay	1701-0044	1.2	0.015	0.005
Stirling Creek and Basin	1701-0049	14.9	0.027	0.219
Town/Jockey Creeks and Tidal Tribs	1701-0235	12.3	0.004	0.336

Subwatershed	SWP PWL Number	Residence Time (days)	Unit Nitrogen Load (mg/L/day)	Unit Nitrogen Load * Residence Time (mg/L)
West Neck Harbor	1701-0132-rev	8.9	0.046	0.038
Wooley Pond	1701-0048+	4.7	0.046	0.212
Average				**0.128**

The average unit nitrogen load * residence time of the reference water bodies is 0.128 mg/L. As described in more detail in Section 2.1.9.4, the 25th percentile of marine water bodies' unit nitrogen load * residence time was calculated based upon USEPA's **National Strategy for the Development of Regional Nutrient Criteria** (USEPA 1998) identifying the 25th percentile of Total Nitrogen data as representative of the acceptable water quality threshold where a sufficient range of existing water quality data exists in an ecoregion. The 25th percentile unit nitrogen load * residence time for marine water bodies in Suffolk County is 0.122 mg/L which is consistent with the 0.128 mg/L target developed based on the reference water bodies.

The average unit nitrogen load * residence time of 0.128 mg/L was then compared to the unit nitrogen load * residence time for all marine subwatersheds within the County. Some water bodies already achieve a unit nitrogen load * residence time of 0.128 mg/L or below and therefore were assigned a nitrogen load reduction goal of zero. All other water bodies were assigned a nitrogen load reduction goal which represents the percent reduction in nitrogen load required to achieve overall good water quality.

2.1.9.1.3 Nitrogen Load Reductions Based upon Reference Water Body Approach for Marine/Mixed Water Bodies

The reference water body approach of determining nitrogen load reduction goals considered the unit nitrogen load multiplied by the residence time, referred to as the "unit nitrogen load * residence time" described previously. The average unit nitrogen load * residence time for all of the Suffolk County reference water bodies was compared to the unit nitrogen load * residence time of all marine and mixed subwatersheds, to identify the percent reduction in nitrogen load needed to achieve the reference water body unit nitrogen load * residence time. The load reduction goal was calculated as the reference unit nitrogen load * residence time multiplied by the residence time equivalent to the average unit nitrogen load * residence time multiplied by the residence time of water bodies with acceptable water quality in Suffolk County. Since the residence time of a subwatershed is fixed, the resulting percentage indicates the necessary total nitrogen load reduction to the subwatershed. The required load reduction is calculated as follows:

$$\frac{\text{Subject Waterbody's Nitrogen Residence Time} - \text{Average Reference Waterbody Nitrogen Residence Time}}{\text{Subject Waterbody's Nitrogen Residence Time}} = \text{\% Load Reduction Goal}$$

As described in Sections 2.1.8.1 and 2.1.9.1, this approach relies on identification of Suffolk County water bodies that consistently achieve all of the desired ecological responses. As such, this approach represented the most conservative method of nitrogen load reduction goal development.

Insufficient water quality data was available to establish reference fresh water bodies; nitrogen load reduction goals for fresh waters were developed as described below in Section 2.1.9.4.

2.1.9.3.4 Individual Endpoint Evaluations

A series of evaluations was completed in an effort to quantify relationships between unit nitrogen load * residence time and individual ecological endpoints. Establishment of reference water bodies that achieve the desired dissolved oxygen and HAB endpoints identified in Section 2.1.8 are described here.

Recognizing that it will take time to realize the nitrogen load reductions required to achieve all of the desired water quality outcomes (e.g. "ideal water quality"), a similar reference water body approach was used to identify the nitrogen load reductions required to achieve individual dissolved oxygen and HAB endpoints. The evaluation of individual endpoints also sheds light on the potential for incremental benefits in water quality that can be realized through incremental nitrogen load reductions.

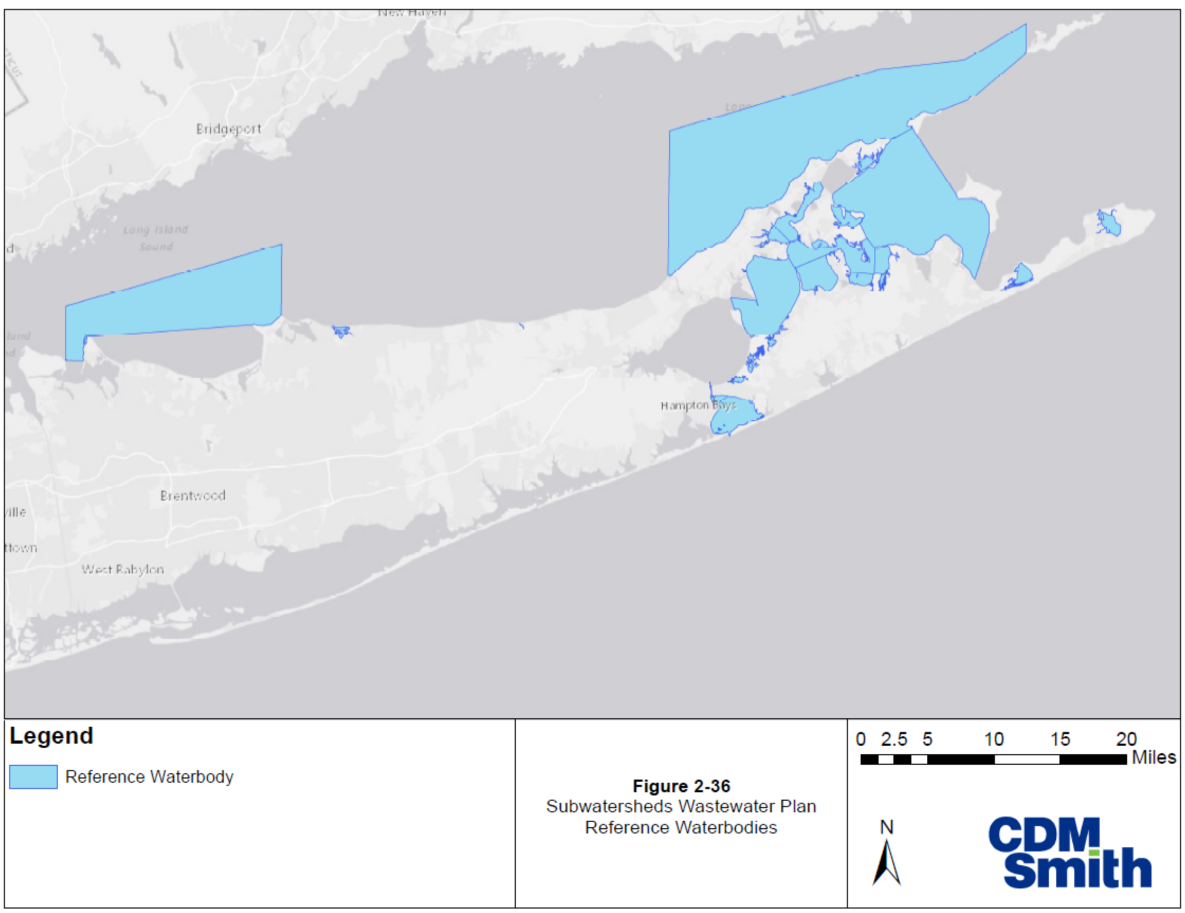


Figure 2-36 Reference Water Bodies

Reference Water Bodies Achieving Dissolved Oxygen Criteria - The 58 marine water bodies with no dissolved oxygen measurements less than 3.0 mg/L based on grab samples collected and analyzed monthly or quarterly are listed in **Table 2-40**. The unit nitrogen load * residence time of water bodies with no documented anoxic conditions varied from 0.002 to 1.257 mg/L, and averaged 0.252 mg/L. It should be noted that the results of the various continuous data sensors installed in Suffolk County waters were not used in this analysis. Ultimately, this approach requires that the sampling frequency be relatively consistent amongst the sampling stations evaluated. The sampling frequency of continuous data sensors is far greater than used for grab samples; and, there are far fewer sampling stations with continuous data loggers when compared to grab sample sampling stations. If the number of continuous data sensors increases in Suffolk County across a wider range of water bodies (including water bodies with both poor and acceptable water quality), the analysis should be re-visited and consideration should be given to using the continuous data sensor data as a parallel evaluation.

Harmful Algal Bloom Reference Water Bodies for Harmful Algal Blooms - Linkages between HABs and nitrogen loads were also considered. Four types of HABs are monitored within the marine water bodies of Suffolk County: brown tide (*Aureococcus anophagefferens*), two types of red tides (*Alexandrium fundyense* and *Dinophysis acuminata*), and rust tide (*Cochlodinium polykrikoides*), which is not regularly monitored. The 39 marine water bodies that had no documented occurrences of these HABs were identified as the HAB reference water bodies and are listed in **Table 2-41**. The unit nitrogen load * residence times of these water bodies was quite variable, but averaged 0.24 mg/L, which is very close to the average unit nitrogen load * residence time identified for the dissolved oxygen reference water bodies.

Since the average unit nitrogen load * residence times for the dissolved oxygen and harmful algal blooms reference water bodies are similar, a single HAB/DO threshold target was selected to represent both endpoints. The unit nitrogen load * residence time used for the combined dissolved oxygen and harmful algal bloom approach of 0.248 mg/L was compared to the unit nitrogen load * residence time for all marine subwatersheds within the County.

While the average predicted nitrogen load for water bodies with HABs in Suffolk County is significantly higher than the average predicted nitrogen load for water bodies without HABs, it should be noted that HABs represent one of the most complex endpoints evaluated within the SWP. Specifically, the presence of HABs in Suffolk County is likely the result of several covariates including nutrient loading, water temperature, nutrient species (e.g., inorganic versus organic), and other factors. Therefore, the HAB reduction goal should be considered a preliminary first order target that should be revisited in the future through the adaptive management plan.

Table 2-40 Dissolved Oxygen Reference Water Bodies

Subwatershed	Residence Time (days)	Unit Nitrogen Load (mg/L/day)	Unit Nitrogen Load * Residence Time (mg/L)
Long Island Sound, Suffolk County, East	45.5	0.000	0.002
Smithtown Bay	2.9	0.001	0.003
Southold Bay	1.2	0.004	0.005
Duck Island Harbor	2.5	0.004	0.010

Subwatershed	Residence Time (days)	Unit Nitrogen Load (mg/L/day)	Unit Nitrogen Load * Residence Time (mg/L)
Orient Harbor and minor Tidal Tribs	11.1	0.001	0.012
Huntington Bay	3.3	0.006	0.020
Cutchogue Harbor	4.5	0.005	0.021
Noyack Bay	28.3	0.001	0.022
Northwest Harbor	8.0	0.003	0.027
Lloyd Harbor	16.0	0.002	0.033
Port Jefferson Harbor, North, and Tribs	4.3	0.008	0.036
West Neck Harbor	8.9	0.004	0.038
Shelter Island Sound, North, and Tribs	35.9	0.001	0.049
Sag Harbor	6.5	0.009	0.057
Shelter Island Sound, South, and Tribs	41.0	0.001	0.058
Shinnecock Bay East	18.6	0.004	0.070
Lake Montauk	13.8	0.005	0.073
Centerport Harbor	3.3	0.022	0.074
Napeague Harbor and Tidal Tribs	19.1	0.004	0.084
Port Jefferson Harbor, South, and Tribs	2.6	0.033	0.087
Coecles Harbor	39.6	0.002	0.089
North Sea Harbor and Tribs	5.7	0.019	0.106
Northport Bay	15.0	0.008	0.114
Harts Cove	6.4	0.019	0.118
Mt Sinai Harbor and Tidal Tribs	4.5	0.027	0.122
Little Peconic Bay	80.8	0.002	0.122
Shinnecock Bay Central	14.0	0.009	0.128
Three Mile Harbor	14.5	0.013	0.181
Moriches Bay West	10.4	0.019	0.196
Great South Bay, West	27.0	0.008	0.204
Gull Pond	4.5	0.046	0.205
Wooley Pond	4.7	0.046	0.212
Great Cove	19.2	0.011	0.213
Stirling Creek and Basin	14.9	0.015	0.219
Northwest Creek and Tidal Tribs	7.1	0.032	0.225
Shinnecock Bay - Bennet Cove (Cormorant Cove)	17.3	0.014	0.248
Mill Creek and Tidal Tribs	9.3	0.028	0.259
Conscience Bay and Tidal Tribs	12.8	0.023	0.296
Goose Creek	10.8	0.028	0.305
Setauket Harbor	7.7	0.041	0.318
Town/Jockey Creeks and Tidal Tribs	12.3	0.027	0.336

Subwatershed	Residence Time (days)	Unit Nitrogen Load (mg/L/day)	Unit Nitrogen Load * Residence Time (mg/L)
Stony Brook Harbor and West Meadow Creek	12.4	0.027	0.340
Mattituck Inlet/Cr, Low, and Tidal Tribs	6.8	0.054	0.368
Hallock/Long Beach Bay and Tidal Tribs	39.3	0.010	0.379
Forge River Cove and Tidal Tribs	8.6	0.046	0.398
Narrow Bay	13.5	0.030	0.403
Acabonack Harbor	11.8	0.036	0.419
Shinnecock Bay West	21.0	0.021	0.432
Flanders Bay, East/Center, and Tribs	22.3	0.019	0.434
Noyack Creek and Tidal Tribs	13.4	0.034	0.454
Great Peconic Bay and minor coves	221.9	0.002	0.468
Nissequogue River Lower/Sunken Meadow Creek	5.0	0.114	0.576
Moriches Bay East	45.0	0.013	0.578
Goldsmith Inlet	76.3	0.008	0.599
Sag Harbor Cove and Tribs	35.5	0.018	0.648
Hashamomuck Pond/Long Creek and Budd's Pond	45.0	0.015	0.680
Bellport Bay	31.2	0.038	1.175
James Creek	4.6	0.272	1.257
Average			**0.252**

Table 2-41 Harmful Algal Bloom Reference Water Bodies

Subwatershed	Residence Time (days)	Unit Nitrogen Load (mg/L/day)	Unit Nitrogen Load * Residence Time (mg/L)
Southold Bay	1.2	0.004	0.005
Cutchogue Harbor	4.5	0.005	0.021
Noyack Bay	28.3	0.001	0.022
Northwest Harbor	8.0	0.003	0.027
Lloyd Harbor	16.0	0.002	0.033
West Neck Harbor	8.9	0.004	0.038
Mecox Bay and Tribs	1.7	0.025	0.043
Shelter Island Sound, North, and Tribs	35.9	0.001	0.049
Sag Harbor	6.5	0.009	0.057
Shelter Island Sound, South, and Tribs	41.0	0.001	0.058
Lake Montauk	13.8	0.005	0.073
Napeague Harbor and Tidal Tribs	19.1	0.004	0.084
Port Jefferson Harbor, South, and Tribs	2.6	0.033	0.087
Coecles Harbor	39.6	0.002	0.089
North Sea Harbor and Tribs	5.7	0.019	0.106

Subwatershed	Residence Time (days)	Unit Nitrogen Load (mg/L/day)	Unit Nitrogen Load * Residence Time (mg/L)
Cedar Beach Creek and Tidal Tribs	5.2	0.021	0.109
Mt Sinai Harbor and Tidal Tribs	4.5	0.027	0.122
Little Peconic Bay	80.8	0.002	0.122
Scallop Pond	72.1	0.002	0.139
Sebonac Cr/Bullhead Bay and Tidal Tribs	5.0	0.028	0.140
Penniman Creek and Tidal Tribs	4.6	0.038	0.177
Wooley Pond	4.7	0.046	0.212
Shinnecock Bay - Bennet Cove (Cormorant Cove)	17.3	0.014	0.248
Cold Spring Pond and Tribs	11.4	0.022	0.249
Mill Creek and Tidal Tribs	9.3	0.028	0.259
Goose Creek	10.8	0.028	0.305
Cutchogue Harbor - East Creek	9.3	0.035	0.328
Flanders Bay, West/Lower Sawmill Creek	4.6	0.071	0.328
Town/Jockey Creeks and Tidal Tribs	12.3	0.027	0.336
Stony Brook Harbor and West Meadow Creek	12.4	0.027	0.340
Corey Creek and Tidal Tribs	7.2	0.048	0.344
Richmond Creek and Tidal Tribs	11.8	0.031	0.362
Hallock/Long Beach Bay and Tidal Tribs	39.3	0.010	0.379
West Neck Bay and Creek	73.1	0.005	0.392
Noyack Creek and Tidal Tribs	13.4	0.034	0.454
Hog Creek and Tidal Tribs	7.5	0.075	0.565
Pattersquash Creek	4.4	0.161	0.703
Peconic River, Lower, and Tidal Tribs	16.0	0.054	0.865
Beaverdam Pond	8.3	0.132	1.094
Average			**0.24**

2.1.9.2 Stress-Response Relationship Approach

The second general approach used to estimate nitrogen load reduction goals includes the development of stress-response relationships to establish statistical relationships between water quality data for specific endpoints and their corresponding predicted nitrogen load * residence time. A variety of statistical approaches were initiated to identify an approach that would use the wealth of data available to characterize the County's subwatersheds to explore potential relationships between nitrogen load and/or in-body nitrogen concentration and resulting ecological endpoints. The statistical evaluations considered include:

- Pearson Correlations

- Spearman Correlations
- Linear Regressions
- Random Forest
- Neural Networks
- Probabilistic Approach

The water quality database used to characterize the subwatersheds was previously described in Section 2.1.3, above.

The probabilistic approach was the most successful in establishing meaningful relationships between nitrogen loads and ecological endpoints and is described here. Frequency based-prediction is an alternative approach to regression-based predictions. Rather than attempt to mathematically characterize the relationship between inputs (e.g., nitrogen) and outputs (e.g., water quality indicators or ecological endpoints), the frequency distribution of an output variable within a certain range of an input variable is examined. Based on the distribution of results within each input range, the exceedance occurrence of a certain threshold value of the output variable can be characterized. Chlorophyll-*a*, dissolved oxygen and secchi disk depth data were grouped by the unit nitrogen load * residence time of the sampled subwatersheds. The distribution of data within each grouping was then examined as a box and whiskers plot.

Before examining water quality parameters with respect to the unit nitrogen load * residence time, the database was first filtered to ensure data were adequately comparable and representative. Because marine and freshwater biological growth are conventionally believed to be limited by different nutrients (nitrogen and phosphorus respectively), a subset of data was created consisting of only marine samples. Additionally, data was only considered from subwatersheds with at least 10, but no more than 1000, samples of the constituent of interest since January 2007. A subwatershed with too few samples may have unrepresentative data for its unit nitrogen load * residence time group and if there is not much other data characterizing subwatersheds with similar unit nitrogen load * residence times, the statistics may be skewed. Conversely, if a subwatershed has an overwhelming amount of data for a certain parameter, the statistics for the corresponding unit nitrogen load group will tend towards the statistics of that subwatershed rather than reflect the variability within the group.

2.1.9.2.1 Chlorophyll-a

Of the statistical methods and endpoints evaluated, the probabilistic approach for chlorophyll-a provided the best relationship between the stress (unit nitrogen load*residence time) and the response (chlorophyll-*a*). Therefore, chlorophyll-*a* load reduction goals were successfully evaluated and calculated for the protection of eelgrass. As described above, based upon regional studies and corroborated with Suffolk County data, a chlorophyll-*a* concentration of 5.5 μg/L provides sufficient water clarity and ultimately light, at approximately two meters water depth to maintain healthy eelgrass beds. After filtering chlorophyll-*a* data for marine subwatersheds with 10 to 1000 samples since 2007 within the growing season months of April through October, 11,361 samples remained out of the total 18,464 samples, 16,154 of which are marine.

Unit nitrogen load * residence time groups were used to categorize the observed water quality data. Four unit nitrogen load * residence time groups were created; the groups and number of watersheds and chlorophyll-*a* data within each group are presented in **Table 2-42** and the distribution of data for each load group is presented in **Figure 2-37**. Placement of the endpoint data (e.g., chlorophyll *a*, secchi depth, dissolved oxygen) into discrete unit nitrogen load * residence time groups enabled statistical testing to determine if the data between the groups was significantly different. Grouping the water quality data by broad unit nitrogen load * residence time ranges also provided better visualization of the vast amount of data as the box plots illustrate trends that may be obscured in a noisy scatter plot.

The horizontal lines in the boxes indicate the median chlorophyll-*a* values detected in the subwatersheds within each of the unit nitrogen load * residence time groups. The boxplots show how the median chlorophyll-*a* values increase with increasing unit nitrogen load-residence times. The frequency of high chlorophyll-*a* concentrations is higher for subwatersheds with higher unit nitrogen loads * residence times.

Table 2-42 Groupings of Unit Nitrogen Load *Residence Times and Chlorophyll-*a* Data

Unit Nitrogen Load * Residence Time Group	Count of Subwatersheds	Count of Chlorophyll-*a* Data
0 – 0.15 mg/L	32	4,888
0.15 – 0.4 mg/L	25	4,290
0.5 – 1.5 mg/L	17	1,924
>1.5 mg/L	4	728

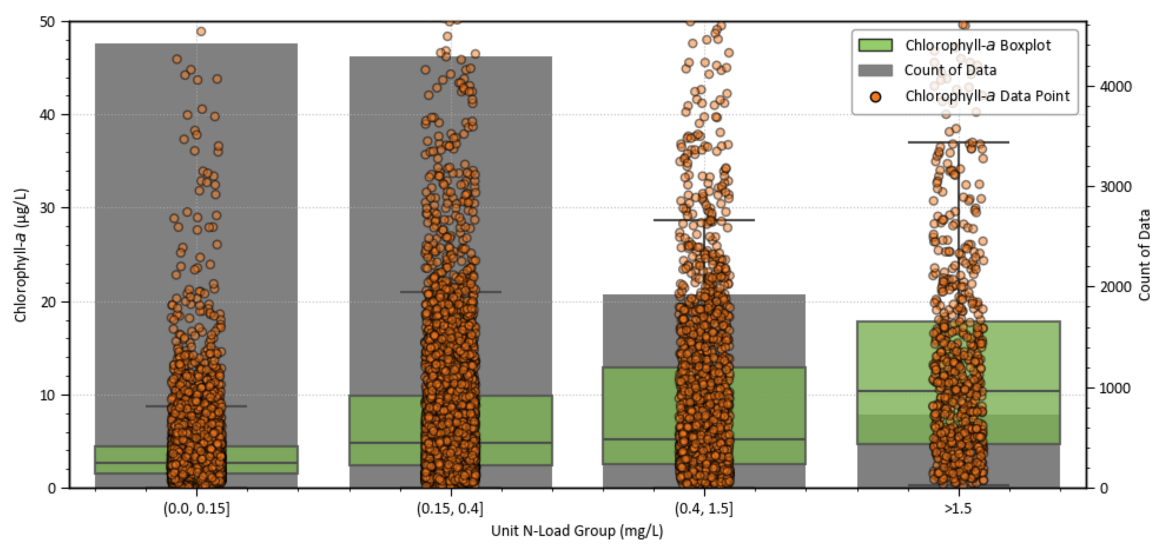


Figure 2-37 Unit Nitrogen Load * Residence Time Group and Chlorophyll-*a*

With the data segmented into four unit nitrogen load * residence time groups, percentile values of chlorophyll-*a* were calculated for each group.

The data was bootstrap resampled 10,000 times to estimate the 5th and 95th confidence interval around each percentile value in each unit nitrogen load * residence time group. (Because our data set is only a sample of the entire population of values that would result from monitoring continuously everywhere, bootstrap resampling can be implemented to evaluate similarity of the dataset and the population distributions. By taking many different samples from the population and calculating the statistic for each of them, the variance in the resulting values can help identify the true statistic of the population. Because access to the entire population is not available, we use the data set that is available; bootstrap resampling treats the one sample as the population. The first step is to randomly sample the sample dataset (resample) with replacement many, many times. The resampled data sets (resamples) will have similar – but not identical - distributions to the original sample. Statistics are calculated on each of the resamples and a histogram estimating the distribution of the statistic across the resamples is developed.) **Figure 2-38** shows cumulative frequency distributions (CFDs) of chlorophyll-*a* for each unit nitrogen load * residence time group. The bootstrap 5th-95th percentile confidence interval is shaded around the plot. The CFDs do not intersect, indicating that for any given percentile, the chlorophyll-*a* concentration is always higher for the higher load group. Additionally, the bootstrap confidence intervals are relatively narrow for the lowest three load groups, indicating that the percentile values are adequately representative.

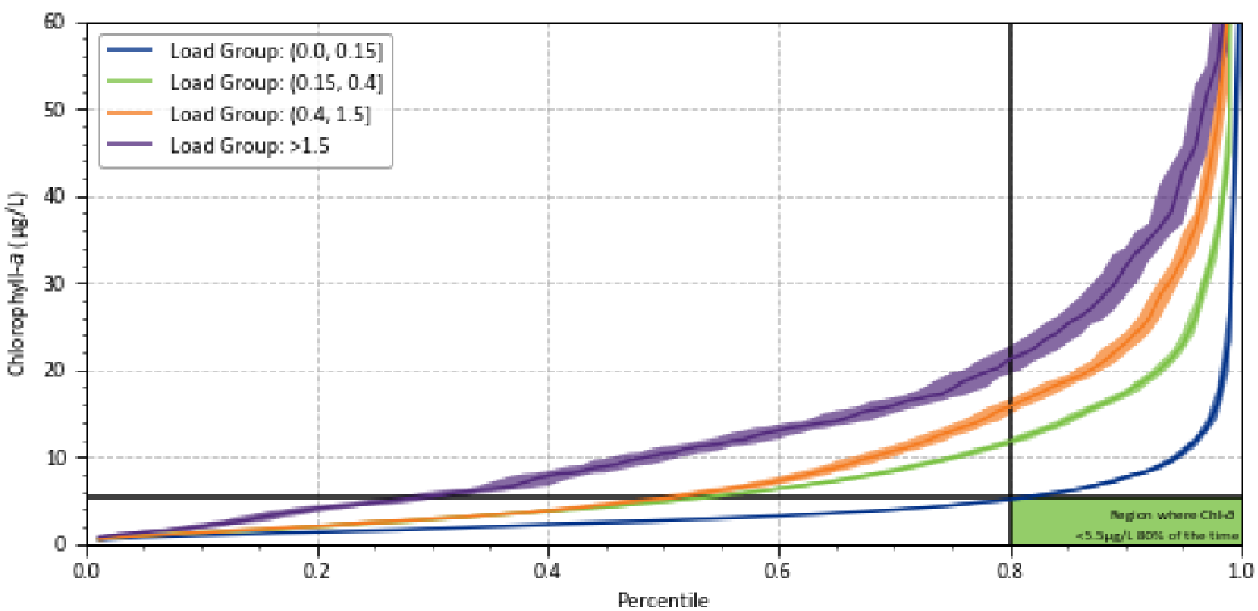


Figure 2-38 Cumulative Frequency Distributions of Chlorophyll-*a*

The probabilistic approach using the chlorophyll-*a* endpoint described in section 2.1.8 was also used to develop nitrogen load reduction goals. A chlorophyll-*a* concentration of 5.5 µg/L has been found to be indirectly protective of eelgrass through an inverse correlation with secchi disk depth. Mechanistically, as chlorophyll-*a* is reduced, water clarity increases, and eelgrass receives more solar radiation for photosynthesis.

For the purposes of developing nitrogen load reduction goals, a chlorophyll-*a* target of less than 5.5 µg/L 80 percent of the time was established. As shown by **Figure 2-37**, when chlorophyll-*a* data is segmented by the unit nitrogen load * residence time of the sampled water body, the lowest nitrogen load * residence time group of 0 to 0.15 mg/L achieves the target of 5.5 µg/L 80 percent of the time. Chlorophyll-*a* data for each marine and mixed subwatershed was systematically evaluated to determine if a load reduction goal is necessary; **Figure 2-39** shows a flow chart of the process.

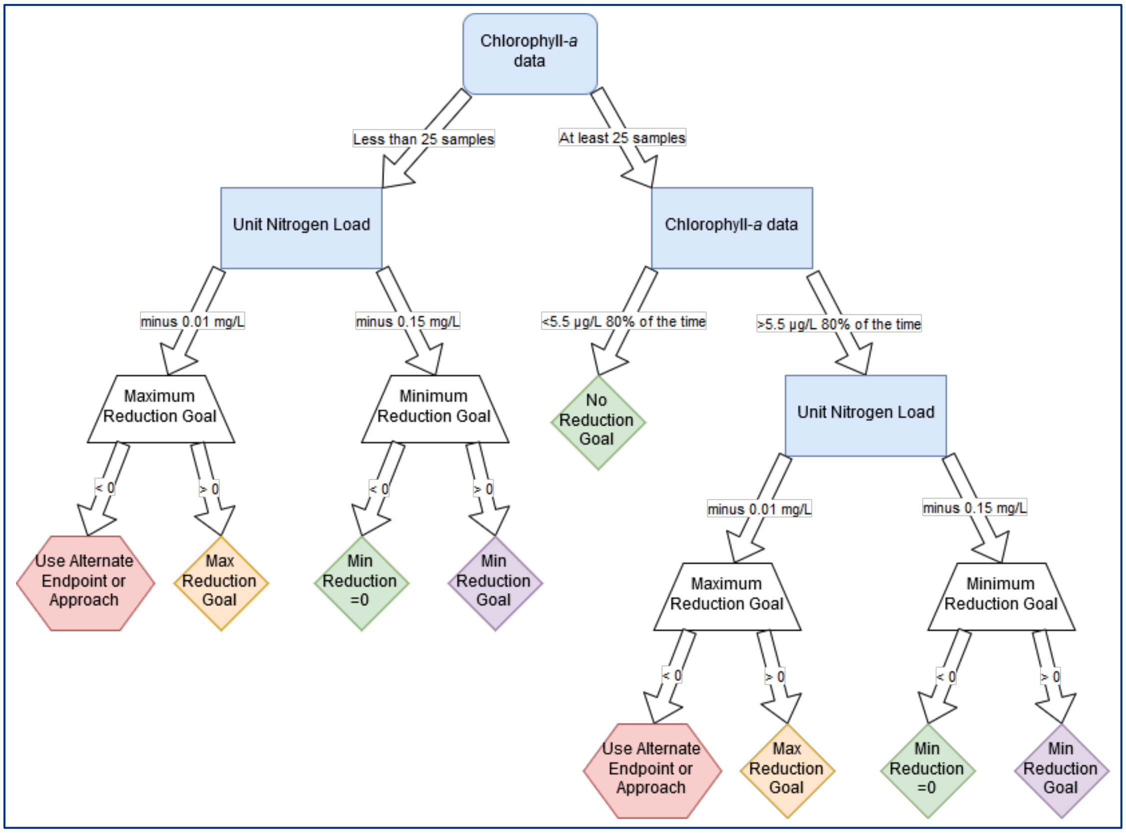


Figure 2-39 Nitrogen Load Reduction Goals Using Probabilistic Approach with Chlorophyll-*a* Endpoint

The flowchart identifies the first step in the process as identification of water bodies with an adequate number of chlorophyll-*a* samples. Because phytoplankton dynamics are complex and involve many interconnected processes, it is possible for a subwatershed to have a high unit nitrogen load * residence time but still meet the chlorophyll-*a* threshold criteria. If a receiving water body is already meeting the threshold criteria, it may not be appropriate to develop a load reduction goal based solely on unit nitrogen load.

After considering existing observed data, the unit nitrogen load * residence times of the subwatersheds were reviewed. The statistical analysis of all chlorophyll-*a* data showed that data from subwatersheds with unit nitrogen loads * residence times between 0 and 0.15 mg/L met the chlorophyll-*a* threshold criteria of less than 5.5 µg/L 80 percent of the time, thus nitrogen load reductions are those necessary to move each subwatershed into the lowest unit nitrogen load group. Since a unit nitrogen load of zero is not feasible, a lower boundary of 0.01 mg/L was chosen and is the 5th percentile unit nitrogen load * residence time out of the total 191 subwatersheds in the study.

The necessary load reduction in pounds of nitrogen per day was calculated for each subwatershed to achieve either the high boundary unit nitrogen load * residence time of 0.15 mg/L or low boundary unit nitrogen load * residence time of 0.01 mg/L, which yielded a load reduction range for each subwatershed. If a subwatershed was not already meeting threshold criteria based on observed chlorophyll-*a* data and had a unit nitrogen load less than the low boundary of 0.01 mg/L no reduction goal was identified using the probabilistic approach and an alternative approach was selected.

2.1.9.2.2 Water Clarity (Secchi Depth)

As discussed in Section 2.1.8, recent published data (e.g., **Final Report of the New York State Seagrass Task Force**, 2009) identifies a secchi depth of 2 meters as protective of eelgrass, a flowing aquatic plant that is important to marine habitats. If secchi depth is significantly correlated to subwatershed nitrogen load, target nitrogen load reductions that are protective of eelgrass can be established.

Out of the total 14,202 secchi disk depth samples in the database, 12,587 are from marine waters. After filtering for marine subwatershed samples collected since 2007 within the growing season months of April to October, 28 subwatersheds were excluded from the analysis based on data count or season as summarized in **Table 2-43**, leaving 8,446 data points. The data was segmented into four unit nitrogen load * residence time groups and the distribution of each was plotted as shown in **Figure 2-40**, which shows a negative trend. Unit nitrogen load * residence time groups were used to categorize the observed water quality data.

Table 2-43 Subwatersheds Not Included in Secchi Depth Evaluations

Subwatershed	Exclusion Reason	Subwatershed	Exclusion Reason
Goose Neck Creek	No data during growing season	Dering Harbor	Data Count: 1
Block Island Sound	No data during growing season	Heady and Taylor Creeks and Tribs	Data Count: 1
Dam Pond	No data during growing season	Middle Pond	Data Count: 1
Far Pond	No data during growing season	Ogden Pond	Data Count: 1
Napeague Bay	No data during growing season	Orchard Neck Creek	Data Count: 1
Penny Pond, Wells, Smith, and Gilbert Creeks	No data during growing season	Pattersquash Creek	Data Count: 3
Fish Cove	Data Count: 1	Quogue Canal	Data Count: 1
Grand Canal	Data Count: 1	Red Creek Pond and Tidal Tribs	Data Count: 1
Gull Pond	Data Count: 6	Scallop Pond	Data Count: 6
James Creek	Data Count: 5	Spring Pond	Data Count: 1
Mud and Senix Creeks	Data Count: 1	Tiana Bay and Tidal Tribs	Data Count: 5
Phillips Creek, Lower, and Tidal Tribs	Data Count: 1	Tuthill Cove	Data Count: 1
Sheepen Creek	Data Count: 1	Unchachogue/Johns Neck Creeks	Data Count: 3
Conscience Bay and Tidal Tribs	Data Count: 3	Weesuck Creek and Tidal Tribs	Data Count: 1

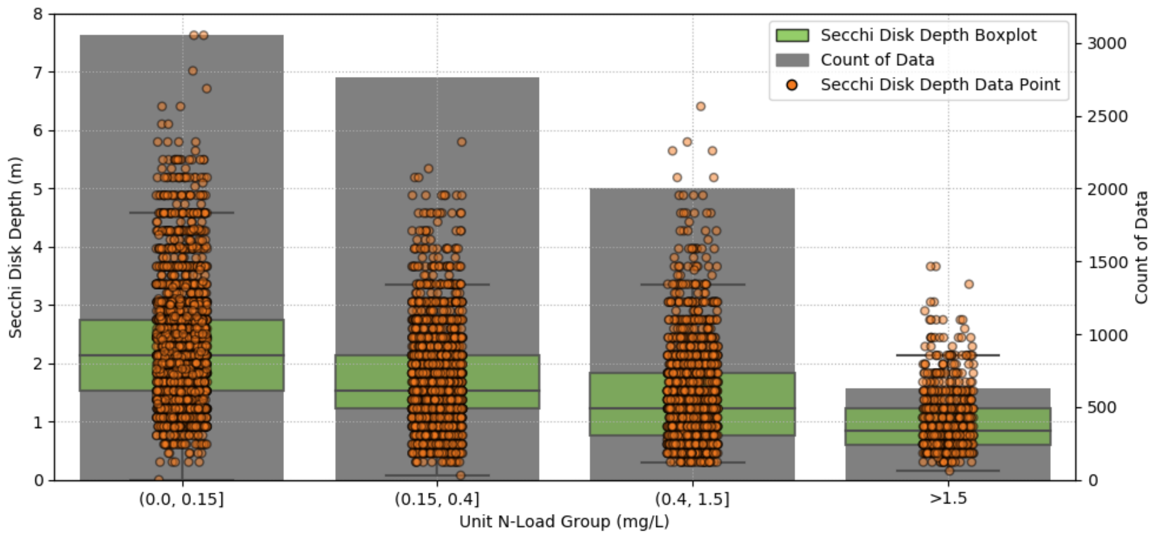


Figure 2-40 Unit Nitrogen * Residence Time Load Groups and Secchi Depth

The data shows that chlorophyll-*a* trends positively with unit nitrogen load * residence time and that chlorophyll-*a* and secchi depth are mildly negatively associated. Consequently, through the transitive property, secchi depth should trend negatively with unit nitrogen, which it does. With the data segmented in four unit nitrogen load * residence time groups, the frequency of secchi depth falling below two meters was examined for each grouping.

Similar to the secchi depth evaluation the data was bootstrap resampled 10,000 times to estimate the 5th and 95th confidence interval around each percentile concentration. **Figure 2-41** shows the CFDs of secchi depth for each unit nitrogen load * residence time group. The CFDs do not intersect, indicating that for any given percentile, the secchi depth is always lower for the higher load group. Additionally, the bootstrap confidence intervals are relatively narrow for the lowest three load groups, indicating that the percentile values are adequately representative. None of the CDFs enter the region where secchi depth is greater than two meters 80 percent of the time. When the data is examined on a subwatershed basis, only five water bodies currently meet such a threshold, shown in **Table 2-44**.

Table 2-44 Subwatersheds with 80 Percent of Secchi Depth Measurements Greater than Two Meters

Subwatershed	Percent of Time Secchi Disk Depth > 2m	Count of Samples in Analysis	Unit Nitrogen Load -Residence Time (mg/L)
Three Mile Harbor	97%	38	0.181
Lake Montauk	92%	38	0.073
Long Island Sound, Suffolk County, East	92%	25	0.002
Gardiners Bay and minor Tidal Tribs	89%	136	0.005
Long Island Sound, Suffolk Co, Central	86%	133	0.003

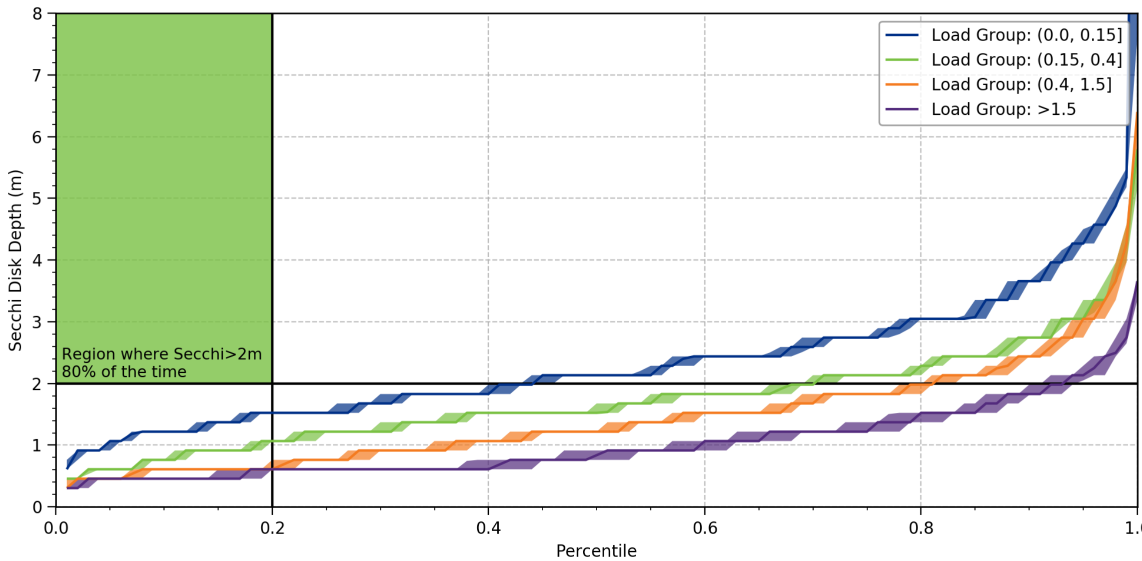


Figure 2-41 Cumulative Frequency Distributions of Secchi Depth

Based on existing observed data, the average unit nitrogen load * residence time necessary to achieve a secchi depth of two meters 80 percent of the time threshold is exceptionally low and the unit nitrogen load groups would need to be revised to accommodate this threshold. (1) Additionally, secchi depth is limited by the depth of the sampling location itself. If the sampling location is less than two meters deep and the secchi depth is measured at the bottom of the water column, then light penetration should still be sufficient to support eel grass growth. The small number of subwatersheds currently meeting the two-meter, 80 percent of the time threshold, along with the subjective nature of its measurement make the secchi depth endpoint inadequate for deriving nitrogen load reduction goals, although the evaluation is consistent in concluding that reduced nitrogen loading is associated with better water quality.

Ultimately, while the direct relationship of secchi depth alone versus unit nitrogen load * residence time is insufficient to establish load reduction goals for secchi depth, the relationship of secchi depth versus *chlorophyll-a* shown on **Figure 2-35** corroborates the use of 5.5 µg/L *chlorophyll-a* as a surrogate endpoint for secchi depth.

2.1.9.2.3 Dissolved Oxygen

Trends in dissolved oxygen concentrations with unit nitrogen load * residence time were investigated for marine subwatersheds using both grab sample data and continuous dissolved oxygen data. Out of the substantial database including 31,114 dissolved oxygen grab samples, 26,387 were collected from marine water bodies after 2007. After filtering for marine subwatersheds with 10 to 1000 samples within the growing season months of April through October, 36 subwatersheds were excluded from the analysis based on data count, leaving 15,211 data points.

(1) Note that the reference water body approached considered the average secchi depth during the growing season, while the probabilistic approach incorporated a more rigorous requirement that the secchi depth was achieved 80 percent of the time.

Continuous dissolved oxygen data was available at 28 monitoring stations within 15 marine water bodies. Maximum and minimum daily data for growing season months after 2007 were calculated from the continuous monitoring data and examined for trends with unit nitrogen load * residence time. The sample count for each of the 15 subwatersheds is shown in **Table 2-45**. To ensure each nitrogen load group contains more than one subwatershed, subwatersheds with less than 10 or more than 1000 samples were kept for this analysis.

Table 2-45 Number of Daily Maximum and Minimum Dissolved Oxygen Samples in Water Bodies with Continuous Dissolved Oxygen Measurements

Subwatershed	Sample Count	Subwatershed	Sample Count
Bellport Bay	212	Northport Harbor	32
Connetquot River, Lower, and Tribs	177	Orient Harbor and minor Tidal Tribs	1051
Flax Pond	1530	Penniman Creek and Tidal Tribs	151
Great South Bay, East	1337	Quantuck Bay	202
Great South Bay, Middle	360	Quantuck Canal/Moneybogue Bay	204
Huntington Harbor	32	Scallop Pond	1
Mattituck Inlet/Cr, Low, and Tidal Tribs	174	Shinnecock Bay Central	136
Nicoll Bay	487		

The strongest trend existed within the minimum daily dissolved oxygen data, which is shown in **Figure 2-42**. The results from this analysis were assessed against the instantaneous dissolved oxygen criteria set in section 703.3 of the New York Codes, Rules and Regulations. **Table 2-46** shows the % occurrence of data below the standards for each of the four unit nitrogen load * residence time groups. The data show that even the lowest unit nitrogen load resident time group has some non-compliant events.

Table 2-46 Unit Nitrogen Load * Residence Time Groups and Non-Compliance with Dissolved Oxygen Criteria

Dissolved Oxygen Criteria	0 – 0.15 mg/L	0.15 – 0.4 mg/L	0.4 – 1.5 mg/L	>1.5 mg/L
4 mg/L for Class A, B and C water	8%	35%	49%	49%
3 mg/L for Class D water	4%	18%	34%	35%

The lowest unit nitrogen load * residence time group was further divided to better understand the dissolved oxygen data less than 3 mg/L. The lowest nitrogen load * residence time group consists of data from three water bodies; Shinnecock Bay Central, Orient Harbor and minor Tidal Tribs and Scallop Pond. Orient Harbor and minor Tidal Tribs has the lowest unit nitrogen load of 0.012 mg/L as well as the most data, with 1051 minimum daily measurements since 2007.

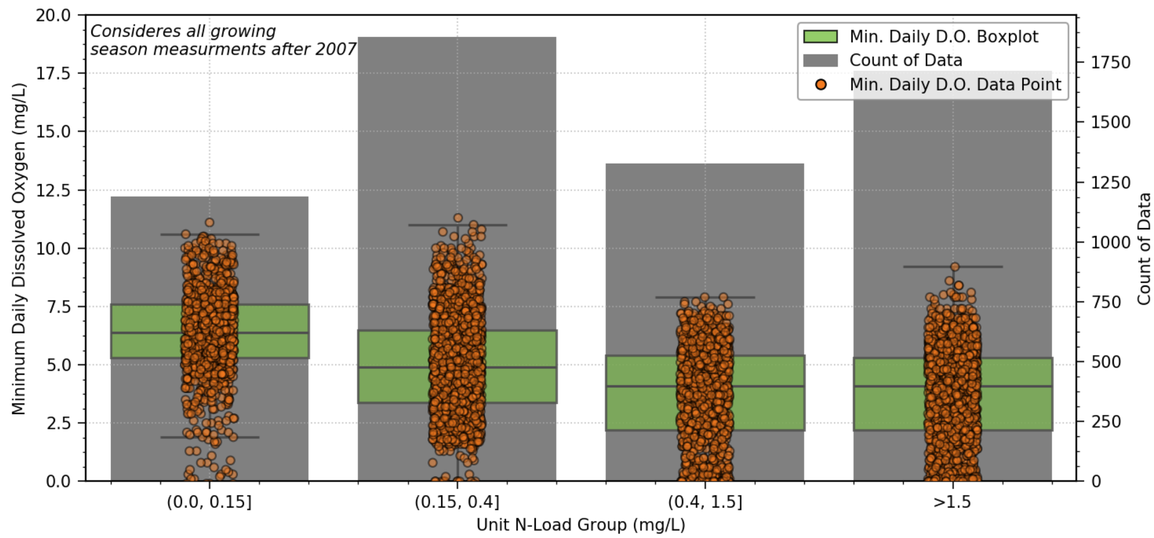


Figure 2-42 Unit Nitrogen Load * Residence Time and Minimum Daily Dissolved Oxygen

Figure 2-43 shows minimum daily dissolved oxygen box plots for each of the three water bodies in the lowest load group (0-0.15 mg/L). The inverse relationship between minimum daily dissolved oxygen and unit nitrogen load * residence time is evident. However, dissolved oxygen concentrations in Orient Harbor and minor Tidal Tribs still dipped below 4 mg/L three percent of the time and below 3 mg/L one percent of the time. The data presented in **Figure 2-43** suggest that although reducing nitrogen loading may significantly improve water body dissolved oxygen compliance, it is unlikely to achieve compliance with standards 100 percent of the time.

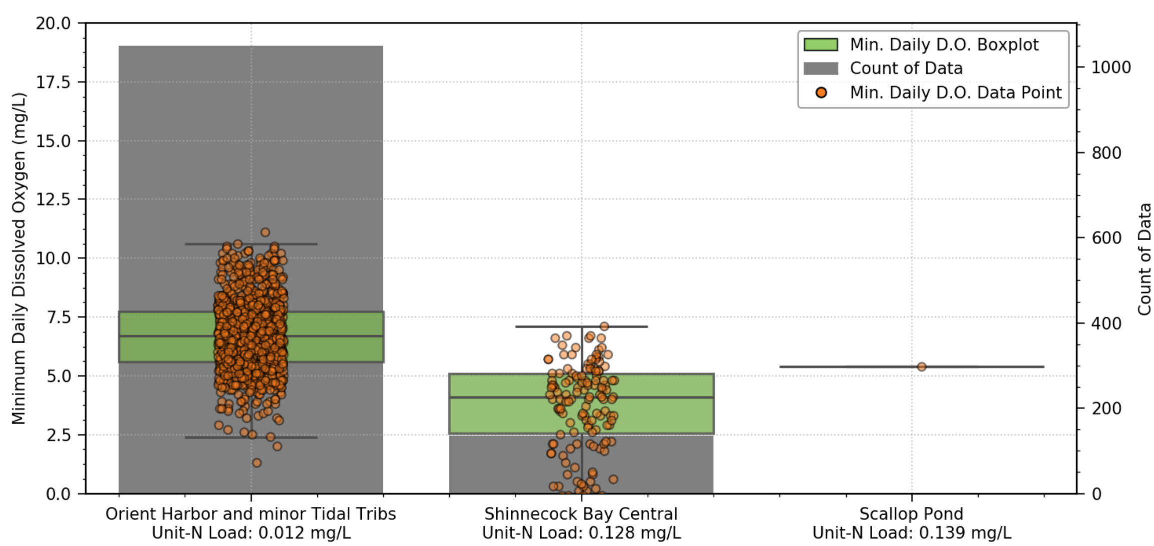


Figure 2-43 Minimum Daily Dissolved Oxygen and Water Bodies with Low Unit Nitrogen Load * Residence Times

2.1.9.2.4 Harmful Algal Blooms

Harmful algal blooms (HABs) harmful to either aquatic life or human health have been identified during the past ten years for a number of water bodies included in the SWP. Since they are a significant ecological endpoint that directly impacts the designated use of a water body, the relationship between HABs and subwatershed nitrogen load was investigated. The total number of HAB events for each marine subwatershed was compared to the corresponding unit nitrogen load * residence time. The marine subwatersheds were grouped into four groups based on the number of years with HAB events in the past ten years; the unit nitrogen loads are plotted as box plots for each HAB group in **Figure 2-44.** The data show decent variation in unit nitrogen load * residence time for each HAB group, but the group means exhibit a statistically significant monotonic relationship with the unit nitrogen load * residence time that has a p-value of about 0.03. The relationship shown in **Figure 2-44** suggests that subwatersheds with lower unit nitrogen loads * residence time are less likely to have a HAB event and consequently maintain their designated use.

As discussed earlier within the SWP, the presence of HABs in Suffolk County is a complex function of several covariates including nutrient loading, water temperature, nutrient species (e.g., inorganic versus organic), and other factors. **Figure 2-44** underscores this complexity by showing while there is a general average trend in reduced number of HABs with decreasing unit nitrogen load, there is a very wide range of unit nitrogen loads where HABs occur. Therefore, the HAB reduction goal should be considered a preliminary first order target that should be revisited in the future through the adaptive management plan.

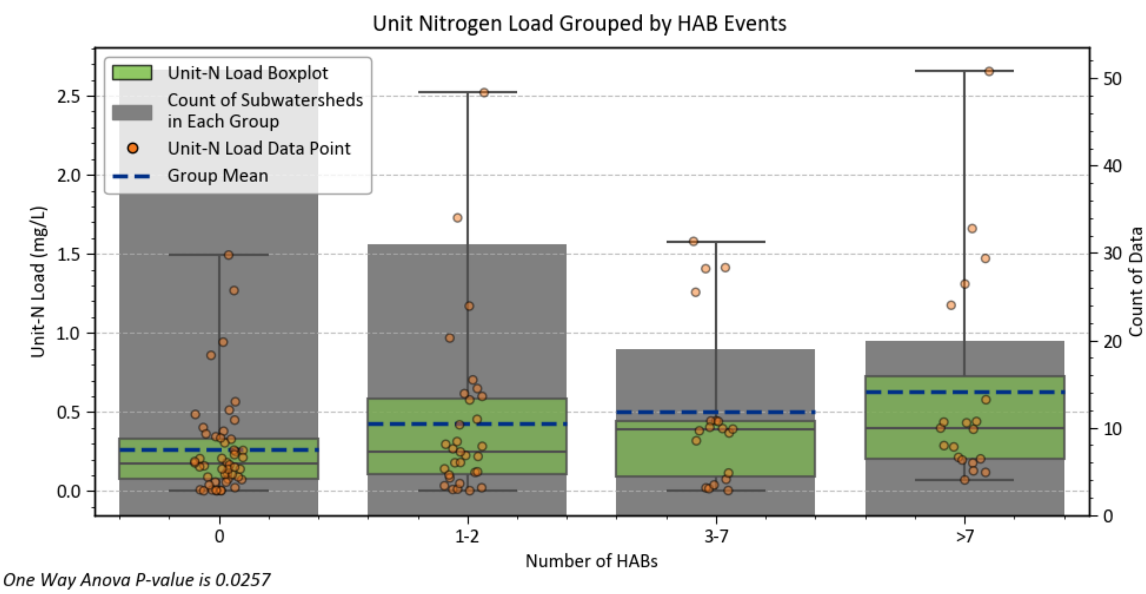


Figure 2-44 Number of HAB Events and Unit Nitrogen Load * Residence Times

HAB reduction goals could be refined in future SWP evaluations through:

- Addition of benthic flux loads, should they become available in the future;
- Additional long-term HAB data collection and expanded HAB monitoring program;

- New literature/science that supports development of a revised approach; and,
- Development of a HAB water quality model that attempts to mimic the complex hydrodynamic, chemical, physical, and biological processes that affect HAB development.

2.1.9.3 Comparison to Existing Guidance and Literature Values

The third and final approach to evaluating load reduction goals included the use of readily available existing published guidance methods and comparison of those results to the SWP reference water body approach. The U.S. EPA has been working with states for several decades to establish nutrient criteria. The initial approach documented in the **National Strategy for the Development of Regional Nutrient Criteria** (USEPA 1998) identified Ecoregions (see **Figure 2-45**) that provided initial starting points for nutrient criteria based on ecoregion, water body type and identification of reference water bodies.

The approach presumed that the 25th percentile of all concentrations provided an estimate of reference water body conditions and the remaining 75 percent of the subwatersheds were impaired. as shown on **Figure 2-46**. Florida developed water-body specific criteria using the 10th (or 90th) percentile to establish reference water bodies.

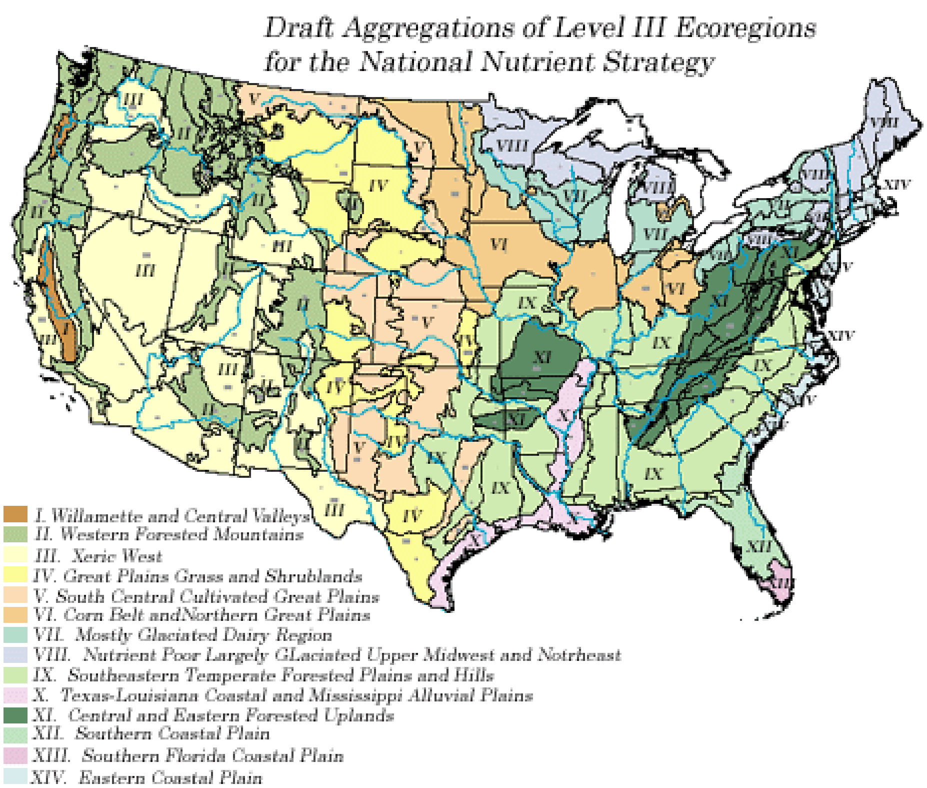


Figure 2-45 Ecoregions Identified for the National Nutrient Strategy (USEPA)

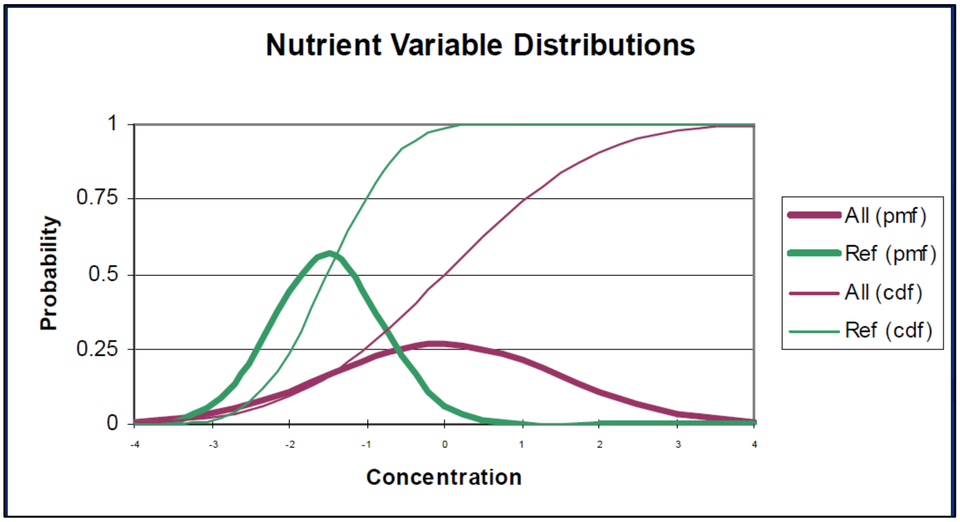


Figure 2-46 Nutrient Distributions Illustrating Reference Water Bodies @ 25th Percentile (Source TetraTech)

The 25th percentile of the unit nitrogen load * residence times of all marine and mixed Suffolk County subwatersheds was calculated and compared to the unit nitrogen load * residence time calculated for the reference water body approach. The unit nitrogen load * residence time in the reference water body approach was based on water bodies meeting a set of thresholds that represent good water quality. The 25th percentile of all marine and mixed water bodies was 0.122 mg/L, consistent with the 0.128 of the reference water body approach unit nitrogen load * residence time. The consistent results between EPA's 25th percentile method and the County's reference water body approach supports validity of the Suffolk County reference water body approach.

EPA's subsequent guidance documents identified more flexibility in the nutrient criteria development approach. The **Nutrient Criteria Technical Guidance Manual – Rivers and Streams** (USEPA, 2000) confirmed the lack of clear understanding of the relationships among nutrients, algal growth and other factors including flow, light, etc. and provided some nutrient criteria development alternatives.

While there are published nitrogen criteria identified in other jurisdictions, experience indicates that a one-size fits all approach to defining a total nitrogen endpoint in marine or fresh waters is not appropriate, and site-specific considerations must be incorporated.

The Long Island Nitrogen Action Plan presented a summary of guidance values and approaches developed during other studies, including a table developed by USEPA (2005) that documented ranges of water quality indicators based on a water body's ecological health; that table is included here as **Table 2-47**.

Table 2-47 Water Quality Indicators and Ecological Health

Indicator	Good Water Quality	Fair Water Quality	Poor Water Quality
Dissolved Inorganic Nitrogen	< 0.1 mg/L	0.1 – 0.5 mg/L	> 0.5 mg/L

Indicator	Good Water Quality	Fair Water Quality	Poor Water Quality
Dissolved Inorganic Phosphorus	< 0.01 mg/L	0.01-0.05 mg/L	> 0.05 mg/L
Chlorophyll-a	< 5 µg/L	2 – 20 µg/L	>20 µg/L
Water clarity	> 2 meters	1-2 meters	< 1 meter
Dissolved Oxygen	> 5 mg/L	2-5 mg/L	< 2 mg/L

The Long Island Nitrogen Action Plan summarized the endpoints associated with nitrogen loading and used in other studies (e.g., chlorophyll-*a* and water clarity in Tampa Bay, dissolved oxygen in the Long Island Sound and Peconic Estuary) and also referenced the 1978 208 Study identification of a total nitrogen concentration of 0.35 to 0.40 mg/L as an indicator of the overall status of the water body. The studies identified in the LINAP were used along with additional literature values to guide development of the ecological endpoints used to establish reference water bodies and water quality targets considered in the probabilistic evaluations. Hence, while the SWP referenced work completed across the country, the database of Suffolk County water quality data assembled for this project provided the primary source of ecological endpoints and nitrogen load reduction goals.

2.1.9.4 Existing Fresh Water Bodies & Coastal Ponds

As identified in Section 2.1.7.2, fresh water bodies were evaluated separately from marine water bodies both because of their physical differences to the tidally-flushed marine water bodies and because their responses to nitrogen loads are often different. The principles applied to marine water bodies to establish nitrogen-ecological endpoints (and nitrogen load reduction goals) could not be duplicated for fresh water bodies because there are fewer fresh water bodies than marine water bodies addressed in the SWP, a smaller range of water quality types (good versus poor), and insufficient water quality data to characterize Suffolk County fresh water bodies to establish responses to nitrogen loading. Although data on cyanobacteria HABs found in Suffolk County fresh water bodies is available, insufficient HAB data characterizing fresh water systems was available to determine a HAB reference threshold for fresh water bodies. In addition, fresh water bodies in the analysis include both flowing streams and rivers as well as closed systems like ponds and lakes; these also required distinct load reduction goal methods. The nineteen fresh water bodies included in the SWP were previously identified in **Table 2-37**.

Coastal ponds are enclosed, fresh water bodies that are nearby the shoreline where inlets are sometimes created, both naturally and artificially, to allow tidal water to flush into the pond. These water bodies respond differently than marine and fresh water bodies to nitrogen loading. The thirteen coastal ponds included in the SWP were previously identified in **Table 2-38**.

Nitrogen endpoints considered for fresh water bodies and coastal ponds include the following:

- Published guidance values of in-water total nitrogen concentrations resulting in good water quality (for both ponds and flowing streams);
- 25th percentile of in-water total nitrogen concentration of the freshwater and coastal ponds included in the SWP as local reference values for ponded and flowing systems.

Nitrogen endpoints were identified for those fresh water bodies that had at least ten in-water total nitrogen samples within the last ten years based on a comparison to published guidance values and local water quality data.

Because of the data limitations described above for fresh water bodies, no 25th percentile of in-water total nitrogen concentrations for Suffolk County waters could be calculated. Therefore, based on the strong correlation between the calculated Suffolk County-specific reference water unit nitrogen load * residence time to the USEPA's recommended 25th percentile, the Ambient Water Quality Criteria Recommendations for Lakes and Reservoirs in Nutrient Ecoregion XIV, the 25th percentile of all nitrogen data within Ecoregion XIV (including Suffolk County), 0.32 mg/L, was identified as a reference threshold for undrained fresh water bodies in Suffolk County. Load reduction goals were established based on the nitrogen reduction required to achieve the USEPA 25th percentile threshold of 0.32 mg/L for lakes and ponds for Agawam Lake, Georgica Pond, Big/Little Fresh Ponds and Lake Ronkonkoma.

USEPA's Ambient Water Quality Criteria Recommendations for Rivers and Streams in Nutrient Ecoregion XIV identify a total nitrogen concentration of 0.71 mg/L as the 25th percentile of all nitrogen data within Ecoregion XIV (including Suffolk County). Load reduction goals based on the nitrogen load reduction required to achieve the US EPA 25th percentile threshold of 0.71 mg/L for rivers and streams were established for Carmans River Upper and Tribs, Connetquot River Upper and Tribs, Ligonee Brook and Tribs and Nissequogue River Upper and Tribs.

Insufficient total nitrogen data existed to use the reference value method for the remaining fresh water bodies and coastal ponds. Instead, the nitrogen load reduction goal assigned to the downstream marine water body or the nitrogen load reduction goal assigned to the subwatershed within which the unconnected pond is located was assigned. In general, the land uses within the contributing areas of the downgradient marine water body and the upgradient fresh water body are similar.

2.1.9.5 Summary of Recommended Subwatershed - Specific Nitrogen Load Reduction Goals

A range of nitrogen load reduction targets was established based on the relationships between nitrogen loading and desired ecological endpoints described above. Nitrogen load reductions considered:

- Nitrogen load reductions for marine and mixed water bodies that would be required to achieve all desired ecological endpoints based on the 28 Suffolk County marine reference water bodies described in Section 2.1.9.1;
- Nitrogen load reductions for marine and mixed water bodies that would be required to achieve a specific desired ecological endpoint (e.g., achievement of dissolved oxygen criteria, HABs) based on Suffolk County marine reference water bodies;
- Nitrogen load reductions for marine and mixed water bodies that were based on probability evaluations identifying nitrogen loads that had a specific probability of achieving a desired chlorophyll-*a* endpoint of 5.5 µg/L for the protection of eelgrass;

- Nitrogen load reductions for marine, mixed and fresh water bodies based upon existing published guidance values; and,
- Nitrogen load reductions for fresh water bodies also considered the nitrogen load reductions required for downstream mixed/marine water bodies.

The target nitrogen load reductions resulting from the approaches described above were compared for each subwatershed. As shown by **Table 2-48** (please see tables at the end of this section), the different approaches considered result in a range of nitrogen load reduction targets for each subwatershed. Achievement of each nitrogen load reduction target shown is anticipated to result in incremental benefit to observed water quality, with the reference water body approach based on achievement of all ecological indicators and the probability-based nitrogen reduction goals based upon maintenance of chlorophyll-*a* levels less than 5.5 µg/L resulting in the greatest anticipated water quality benefits. Also included where applicable in **Table 2-48** is the required nitrogen reduction for the protection of downgradient water bodies for reference. For example, streams that are hydraulically connected to Patchogue Bay show the load reduction goal required to achieve endpoints in Patchogue Bay under the "Nitrogen Reduction Goal for Protection of Downgradient Water Bodies" column.

For comparison, the nitrogen load reduction achievable with I/A OWTS implementation at each unsewered parcel in each subwatershed is also listed in the last column of the table. Based on data collected by SCDHS as part of the Septic Improvement Program (SIP), the I/A OWTS systems are assumed to remove an average of 70 percent of the influent nitrogen concentration. These values represent a conservative value as it is anticipated that some parcels will ultimately be connected to sewers capable of achieving load reductions of greater than 85 percent and it is expected that the removal efficiency of I/A systems will increase as new technologies emerge and the market demand for these systems in Suffolk County increases.

The subwatersheds identified in bold type have been well-characterized based upon the existing water quality database, while the shaded subwatersheds' nitrogen reduction goals are based upon less available water quality data, and hence are presented with less confidence. Nevertheless, except in a few cases, the reference water body nitrogen load reduction goals identified for overall water quality improvement for the poorly characterized subwatersheds are consistent with the nitrogen reduction goals defined by the probabilistic approach. Because the probabilistic nitrogen load reduction goals were developed based on the full suite of water quality data characterizing all 191 subwatersheds, goal development for a particular subwatershed was not affected by whether or not it had been well characterized.

Those subwatersheds where nitrogen load reductions from implementation of I/A OWTS systems in the 25-year or 50-year contributing areas will not be sufficient to completely achieve the nitrogen load reductions identified are listed in **Table 2-49** (please see tables at the end of this section). In some cases, there are currently very few residential parcels contributing nitrogen from sanitary wastewater to the subwatershed; in others, nitrogen loading from fertilizer and/or atmospheric deposition may also be significant. Although I/A OWTS system implementation may not remove sufficient nitrogen to completely achieve all of the desired ecological endpoints, it will result in improved water quality and increased compliance with the ecological endpoints.

2.2 Evaluation of Wastewater Management Methods

As documented within this SWP, 74 percent of the County utilizes onsite sewage disposal systems such as septic systems or cesspools that are not designed to remove nitrogen from wastewater. The 2015 Comp Water Plan identified the need for a Countywide wastewater upgrade program to arrest and reverse negative water quality trends in Suffolk County and provided an integrated framework of wastewater management recommendations to kick-start the upgrade program. The recommended wastewater management strategy included the use of three primary wastewater management means consisting of:

1. New onsite technologies capable of significantly reducing nitrogen (e.g., I/A OWTS);
2. Expansion of sewering; and,
3. Expanded use of privatized/decentralized sewer systems (e.g., "clustered" systems).

The following subsection summarizes an evaluation of wastewater management tools and methods available for use in Suffolk County. The findings of the evaluation were used to support the development of the recommended Countywide wastewater management strategy, identify data gaps where additional data is needed to support recommendations for alternate management methods, provide an initial platform of information regarding "other" nitrogen mitigation strategies (e.g., permeable reactive barriers [PRBs], hydromodifications, etc.) that can be used to support parallel initiatives such as the LINAP; and, can be used as planning tool for design professionals and stakeholders. Specifically, this section includes:

- Summary of wastewater management methods considered;
- A cost-benefit analysis of wastewater management methods and other nitrogen mitigation strategies to identify the most cost-effective methods of wastewater management in Suffolk County and evaluate cost-effectiveness on a geographic priority basis;
- Summary of pilot area evaluations to address areas with unique challenges;
- Consideration of upzoning in Hydrogeologic Zone IV;
- A preliminary evaluation of pathogen impacts and
- Preliminary recommendations for constrained sites.

Each of these topics is summarized below.

2.2.1 Wastewater Management Methods Considered

Four general categories of wastewater management were evaluated to develop recommendations as to the most cost-effective and feasible approaches to provide nitrogen load reductions to achieve the nitrogen loading endpoints. These treatment alternatives include the three primary recommendations of the Comp Water Plan (e.g., traditional sewage treatment plants, I/A OWTS and associated polishing units, and clustering/decentralized STPs) plus the use of alternative leaching systems, which were approved for use by SCDHS subsequent to the release of the Comp

Water Plan and that can provide several potential benefits to wastewater treatment as discussed below. Finally, an initial discussion of other emerging/experimental wastewater technologies and other nitrogen reduction strategies (e.g., methods that do not consist of direct treatment of wastewater) is provided as an initial discussion.

2.2.1.1 Wastewater Collection and Treatment at a Sewage Treatment Plants

Sanitary sewers collect wastewater from residences, businesses and other developed parcels and convey the wastewater to a wastewater treatment plant (WWTP), also called a sewage treatment plant (STP) or water resource recovery facility (WRRF). Various types of collection systems exist; gravity systems are most frequently utilized, although low pressure sewers and vacuum sewers may be used for some applications. Conventional wastewater treatment typically includes physical, biological and chemical processes, including primary treatment where solids are settled out of the incoming wastewater stream by gravity, secondary treatment to remove organic components of the wastewater stream, and disinfection to inactivate pathogens. WWTPs discharging to sensitive surface waters may also be required to include additional treatment processes to remove contaminants of particular concern such as nitrogen or phosphorus.

2.2.1.2 Wastewater Collection and Treatment at Clustered/Decentralized Systems

As described in Section 1.1.6, most of the existing STPs located within Suffolk County are considered to be decentralized or clustered STPs. Decentralized STPs are designed to operate on a smaller scale than centralized STPs and do not require one or more remote pump stations to convey sewage to the treatment plant. The historical use of decentralized STPs in the County has been to serve single lots containing condominium complexes, apartment complexes, hotels, and/or industrial/commercial buildings.

Referred to as "Appendix A systems" the decentralized or cluster systems represent an important tool in the toolbox of wastewater management in Suffolk County because they can accommodate reduced setbacks, are capable of achieving less than 10 mg/L total nitrogen and can be used as a central wastewater treatment method for existing properties where implementation of full-scale sewering (e.g., Appendix B systems) and/or upgrades to individual properties through I/A OWTS are not viable options. Currently, the maximum flow to an Appendix A system is 15,000 gallons per day (gpd) and SCDHS has estimated that approximately 47 Appendix A systems are operating in the County. The existing administrative/permitting framework for Appendix A systems is cumbersome, particularly for existing parcels with multiple owners who wish to install a new Appendix A treatment plant. As part of this SWP, recommendations to make implementation of clustered systems more feasible have been developed.

2.2.1.3 I/A OWTS and Polishing Units

2.2.1.3.1 General Overview

I/A OWTSs are used to treat wastewater from an individual home or business and include advanced treatment processes to reduce nitrogen in the wastewater. I/A OWTS approved for provisional use in Suffolk County, as defined in Article 19 of the Suffolk County Sanitary Code, have demonstrated the ability to reduce effluent nitrogen to 19 mg/L which represents a significant nitrogen reduction when compared to conventional OSDS (estimated nitrogen reduction of only 6 percent in the septic tank). As discussed further within this SWP, I/A OWTS represent the most cost effective means of removing nitrogen from existing onsite wastewater disposal systems under most site conditions; however, there are locations that might benefit more from connection to new or existing STPs and/or clustered/decentralized locations.

Removal of nitrogen from sanitary wastewater is a two-step process. Ammonia is the primary form of nitrogen in sanitary wastewater. In the presence of oxygen, bacteria can convert the ammonia to nitrate (nitrification) for the first step of the process. Nitrification is the biological oxidation of ammonia to nitrite followed by oxidation of nitrite to nitrate that happens under aerobic conditions. The second step, conversion of nitrate to nitrogen gas that is released to the atmosphere is completed by other bacteria that can only thrive in the absence of oxygen (or very low levels). Denitrification is the biological reduction of nitrate that occurs under anaerobic conditions and results in the production of molecular nitrogen (gas).

I/A OWTSs utilize various treatment options, providing aerobic and anaerobic environments to complete nitrification and denitrification of wastewater to reduce nitrogen. The various technologies employed by I/A OWTS have been used for large-scale wastewater treatment plants and have been scaled to service individual properties. These technologies employ trickling filters, extended aeration, suspended growth, activated sludge, membrane bioreactors, and/or filtration.

Thirteen I/A OWTS technologies tested in Suffolk County's Septic Demonstration Program have been evaluated to determine application of the systems for varying site conditions in Suffolk County. **Table 2-50** provides a side-by-side view of a comparative analysis for each I/A OWTS technology with regards to the evaluation criteria discussed in Section 2.2.1.6. Further information on the individual technologies can be found in the Technical section of Suffolk County's Reclaim Our Water Website (https://reclaimourwater.info/Technical.aspx).

Polishing units may be added to the primary I/A OWTS to provide additional tertiary treatment of nitrogen and other pollutants such as phosphorus and pathogens. Polishing units for denitrification utilize a filter media that provides an environment for either heterotrophic or autotrophic denitrification bacteria and are used in conjunction with I/A OWTS to further reduce the concentration of nitrogen in the effluent. The polishing unit is placed downstream of the I/A OWTS and is the last treatment process prior to wastewater discharge. Polishing units have been found to achieve high percentages of nitrogen reduction. Different types of polishing units include a sulfur/limestone filter, woodchip filter or boxed nitrogen removing biofilter, and a recirculating gravel filter and vegetated bed. It should be noted that the overall efficiency of polishing units depends on the degree of nitrification obtained by the I/A OWTS. The benefit of a polishing unit is that lower levels of effluent nitrogen concentration are achieved. A limited number of polishing units have been tested in Suffolk County for additional denitrification. Initial data indicate that polishing units can be very effective in further reducing nitrogen, however, due to the limited number of test sites, it is recommended that additional testing be completed before recommendations are made regarding widespread use in Suffolk County.

2.2.1.3.2 I/A OWTS Performance In Suffolk County

Suffolk County has the most rigorous testing and approval standards for the use of I/A OWTS in the United States. Article 19 of the Suffolk County Sanitary Code sets forth these requirements and the Suffolk County Septic Improvement Program provides additional fail-safes. Examples of the fail-safes in place to ensure optimal I/A OWTS performance are provided below.

- Article 19 of the Suffolk County Sanitary Code and Related Construction Standards establish the regulatory framework for the use and performance of I/A OWTS in Suffolk County including:

    1. The establishment of a Responsible Management Entity (RME), currently the SCDHS, that is required to ensure the operation, maintenance, management, and monitoring of all I/A OWTS in Suffolk County;

    2. The most comprehensive and rigorous I/A OWTS technology approval process in the United States requires that individual technologies demonstrate performance that meets or exceeds the 19 mg/L total nitrogen standard before being allowed for widespread use in the County;

    3. Detailed procedures documenting the corrective actions to be taken if individual technologies do not continue to meet the minimum performance standards along with the ability to remove individual technologies from the program if non-compliance is not corrected; and,

    4. An active operation and maintenance contract must be in-place between the property owner and a licensed liquid waste professional endorsed to perform operation and maintenance in Suffolk County, which contract must be registered with the RME.

- Suffolk County Septic Improvement Program provides grants and low interest loans to homeowners who upgrade to I/A OWTS. The program helps facilitate and optimize I/A OWTS performance in Suffolk County by:

    1. Including the first three years of operation and maintenance in the price for installation of the I/A OWTS; and,

    2. Promoting voluntary installation of I/A OWTS in Suffolk County which supports industry training and readiness and builds a robust data set that demonstrates the ability of I/A OWTS to perform in Suffolk County.

Suffolk County has documented the effectiveness of I/A OWTS in the following annual reports: **2016 Report on the Performance of Innovative and Alternative Onsite Wastewater Treatment Systems** (SCDHS, 2017), the **2017 Annual Technology Review of Innovative/Alternative OWTS prepared for the NYSDEC** (SCDHS and CCWT, December 2018) and the **2018 Report on the Performance of Innovative and Alternative Onsite Wastewater Treatment Systems** (SCDHS, October 2019), all located on the County's Reclaim our Waters website at the following web links:

https://reclaimourwater.info/Portals/60/docs/2016_Performance_Evaluation_Of_IAOWTS.pdf,

https://reclaimourwater.info/Portals/60/docs/DRAFT%202018%2012%2031%20-%202017%20DEC%20TECH%20REVIEW%20(CO-AUTHORED).pdf; and,

https://reclaimourwater.info/Portals/60/docs/2018_Performance_Evaluation_of_IAOWTS_Appendices_11-18-2019.pdf respectively.

Figure 2-47 below includes the performance results of the initial 20 installations of all eight provisionally-approved I/A OWTS technologies throughout their history in the Suffolk County approval process as of fall, 2019. The graphic also includes the cumulative average effluent total nitrogen of all provisional I/A OWTS technologies, which shows a decreasing trend as additional technologies are approved and increased management and monitoring ensure that corrective actions are taken when necessary. **As shown on the graph, over 400 samples have been collected as of October 2019, with the cumulative average of all samples lower than the 19 mg/l (average = 18.35 mg/l) required under Article 19 of the Suffolk County Sanitary Code.**

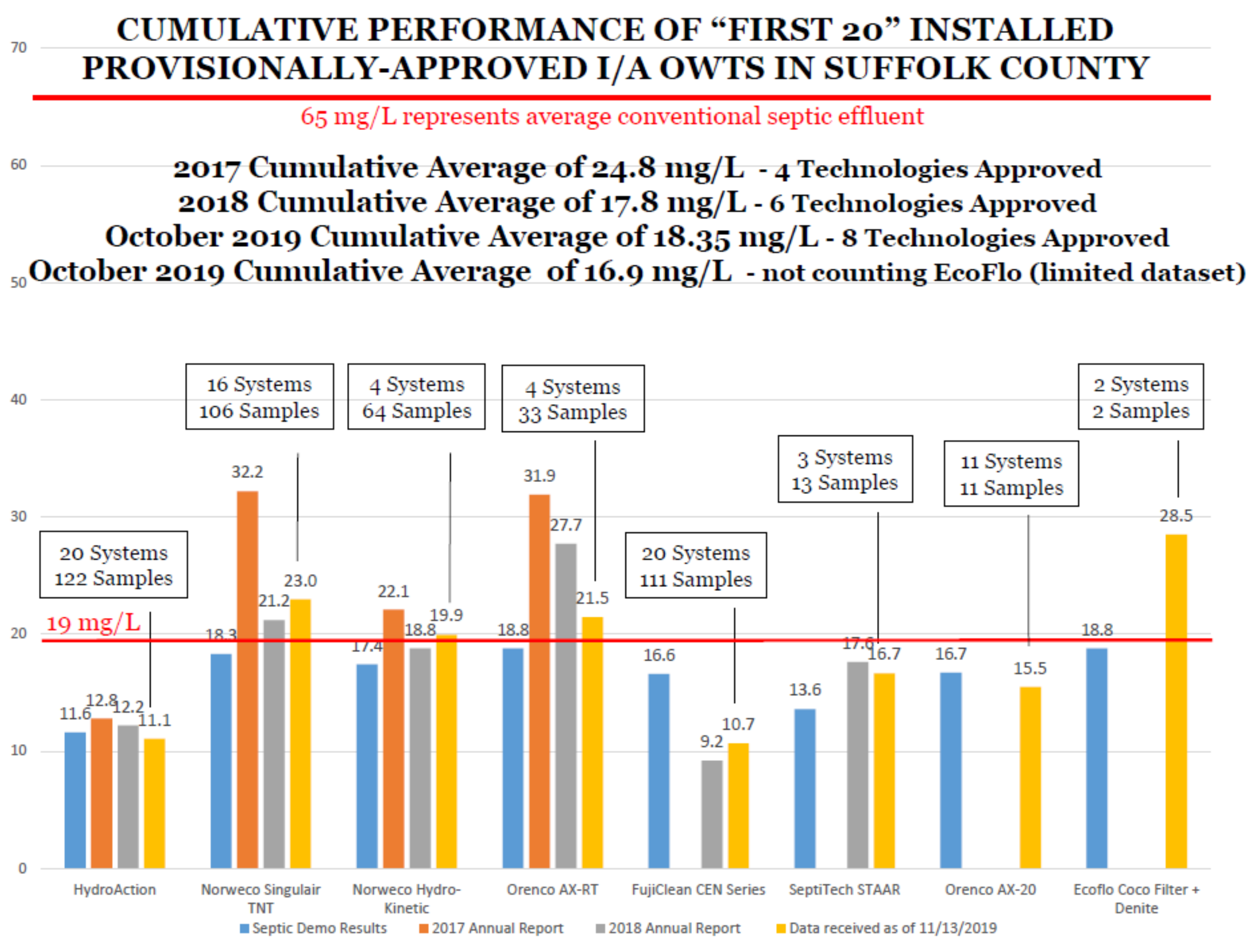


Figure 2-47 Average Annual Effectiveness of Provisionally Approved I/A OWTS

2.2.1.4 Leaching Systems

Leaching systems are subsurface wastewater disposal systems that are used to distribute liquid effluent from a septic tank or I/A OWTS to the subsurface. There are two types of leaching systems permitted for use in Suffolk County– gravity leaching and pressurized shallow drainfields (PSD). Gravity leaching uses the force of gravity to dispose of the effluent. Gravity leaching systems may include retaining wall systems, leaching pools and galleys, and gravelless trenches and geotextile sand filters. Gravity leaching systems do not require electricity or mechanical equipment and thus have minimal operation and maintenance requirements and associated costs as there is no mechanical equipment. Gravelless leaching systems avoid potential issues that can arise when using gravel in leaching systems such as compaction of soil below the weight of the gravel inhibiting leaching and fines in the gravel clogging the drainfields. Gravelless trench systems are typically constructed of a plastic open bottom leaching chamber while gravelless geotextile sand filters are typically constructed of a perforated pipe wrapped in geotextile filter fabric. Both gravelless systems incorporate sand to prevent clogging that may occur when discharging directly to soil.

Pressurized shallow drainfields use pressure to dose treated effluent into a shallow drainfield. They are typically only used in conjunction with I/A OWTS as they require low total suspended solids (TSS) and biochemical oxygen demand (BOD) to prevent fouling. Examples of PSDs include drainfields, various configurations including the half-pipe configuration (using half of a PVC pipe), a chamber configuration (using proprietary, pre-fabricated products), and a geotextile configuration (using a core of fused, entangled plastic filaments wrapped with a geotextile fabric). The ability to install PSDs in the upper soil layers is the main benefit of the system because this maximizes vertical separation distance between the effluent discharge and the groundwater table and allows for maximum treatment by dispersing the water in the biologically active soil zone. Shallow placement enables the use of this system in areas of high groundwater and results in a longer residence time for the effluent in the unsaturated zone enhancing natural soil treatment prior to reaching the groundwater table. **Table 2-51** summarizes the advantages, disadvantages and applications for alternative leaching technologies.

Table 2-51 Alternative Leaching Systems for I/A OWTS

Leaching system	Advantages	Disadvantages	When to Use
Gravity leaching pools and galleys	Highly implementable, easy onsite installation Low cost	Use is limited in areas of high groundwater table; Provides minimal nitrogen removal	Sites where the potential for clogging or depth to groundwater is not an issue
Gravity Gravelless Trench and Geotextile Sand Filter	Low maintenance costs Prevents clogging drainfields Removes up to 30 percent of the remaining nitrogen	Capital costs Surface area required for installation	Use at sites where clogging is a potential issue and space is available for installation Sites within areas that have high nitrogen load reduction goals
Pressurized Shallow Drainfields	Shallow profile Removes approximately 50 percent of the remaining nitrogen	Capital costs Electrical costs	Use at sites with high depth to groundwater Can only be used in conjunction with I/A OWTS Sites within areas that have high nitrogen load reduction goals

2.2.1.5 Emerging and New Technologies

Emerging technologies include those technologies that have not yet been widely implemented in Suffolk County with proven results to reduce nitrogen concentrations in wastewater. These include constructed wetlands, nitrogen removing biofilters/layered soil treatment, composting toilets, and source separation. For the purposes of this SWP, emerging technologies have been subdivided into two categories: 1) Experimental, as defined in Article 19 of the Sanitary Code; and, 2) Other. While Suffolk County has a robust foundation of successful provisionally approved I/A OWTS that currently achieve the 19 mg/l total nitrogen threshold, the County remains committed to continuing to advance and promote the use of new technologies through partners such as the Center for Clean Water Technology (CCWT) operated and managed by Stony Brook University (SBU).

2.2.1.5.1 Experimental Technologies

Experimental technologies include technologies currently being tested as experimental systems in Suffolk County as defined in Article 19. These include constructed wetlands and the nitrogen reducing biofilters (NRBs) currently being developed by the SBU CCWT. Sampling and approval requirements for experimental systems are described in the Article 19 Construction Standards.

Constructed wetlands are artificial wetlands that can be used to treat wastewater by utilizing the microbial environment created by the wetland environment for nitrification and denitrification. Nitrogen concentrations in the wastewater are further reduced by other processes in the wetland including adsorption, plant uptake, and volatilization (Lee 2009). The use of constructed wetlands has other benefits including creation of wildlife habitat and providing an area for environmental education or recreation. The Nature Conservancy installed a constructed wetland to reduce nitrogen in wastewater at the Uplands Farms Sanctuary. A photo of the wetland immediately after construction is presented in **Figure 2-48**. Effluent from the constructed wetland enters a woodchip denitrification chamber and a shallow drainfield for disposal which also serve to reduce nitrogen concentrations in the wastewater. It is the first of its kind in western Suffolk County.

Figure 2-48 Completed Construction of Constructed Wetland at The Nature Conservancy's Upland Farms

The two types of constructed wetlands are free water surface wetlands and subsurface flow wetlands. Because free water surface wetlands have visible standing water, subsurface flow wetlands are recommended for wastewater treatment (Hazen and Sawyer 2016). **Figure 2-49** presents a cross-sectional diagram of a subsurface flow constructed wetland.

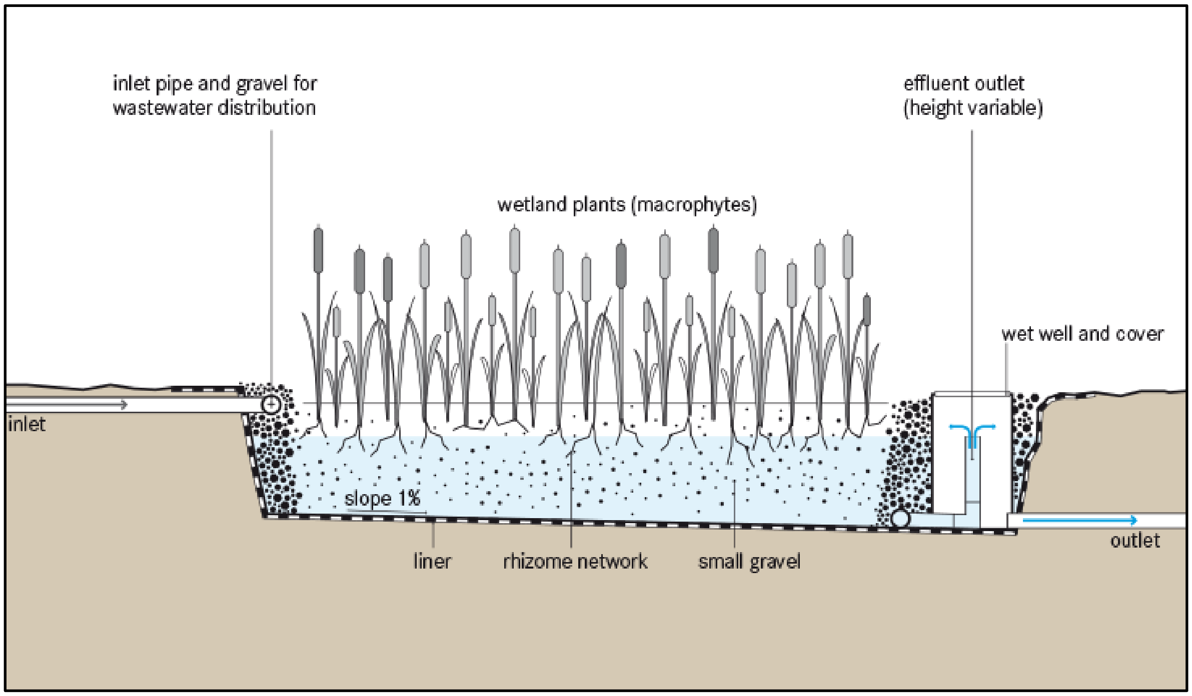


Figure 2-49 Cross-Section of Subsurface Flow Constructed Wetland (Tilley et al. 2014)

The nitrogen removing biofilter (NRB) is also known as layered soil treatment; it is a passive wastewater treatment system comprised of a nitrification layer made of sand underlain by a denitrification layer of ground wood (wood chips or sawdust) mixed with sand. The nitrification process occurs in the upper sand layers of the NRB while the denitrification process takes place moving deeper through the filter into the wood chip/sawdust layer which provides the carbon source for denitrifying bacteria to enable denitrification of the wastewater. NRBs are being developed and implemented by the New York State Center for Clean Water Technology (CCWT, Stony Brook University 2016). CCWT has installed three different variations of NRBs: a lined (saturated) NRB, an unlined (unsaturated) NRB, and a lined sand filter/wood chip box NRB. The configurations of each are presented in **Figure 2-50** below. **Figure 2-51** presents the nitrogen concentrations in effluent from a lined (saturated) NRB installed as part of a performance demonstration for CCWT, Stony Brook University.

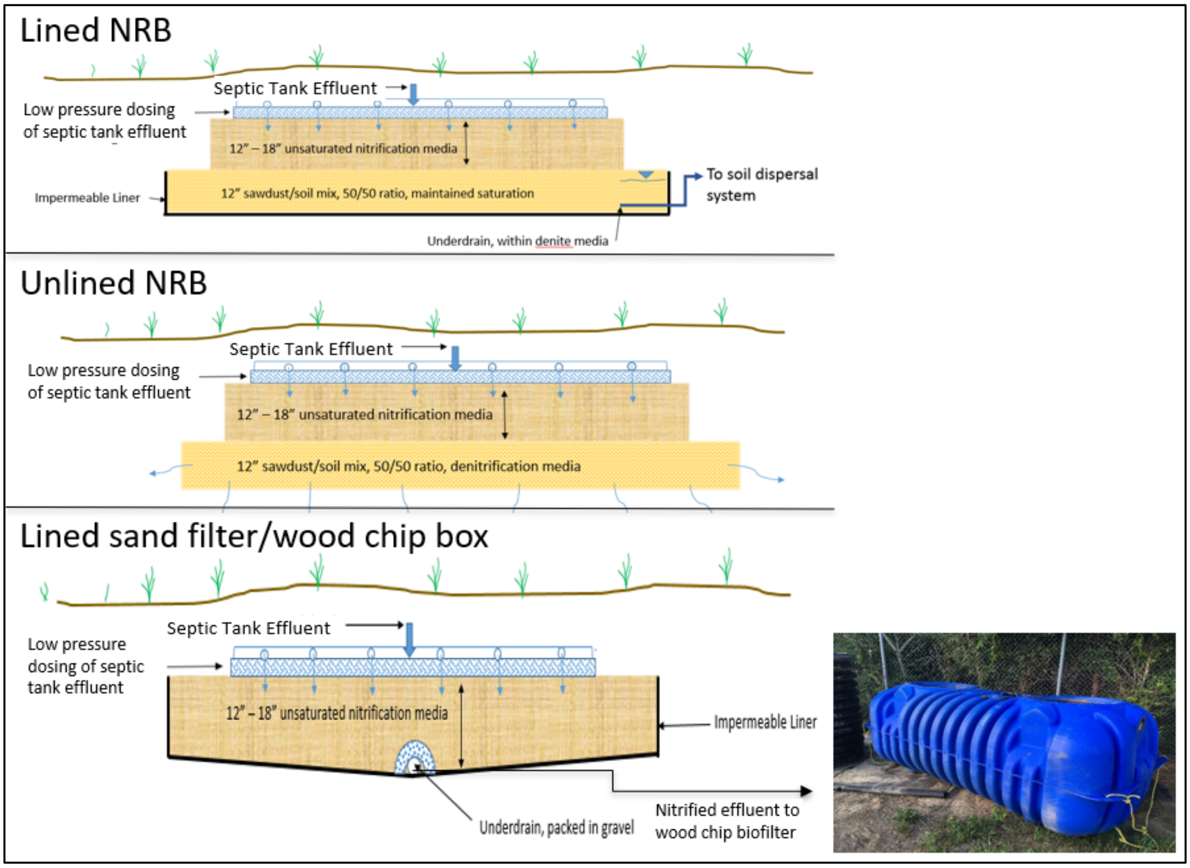


Figure 2-50 Variations of NRBs (Adapted from Stony Brook University 2018)

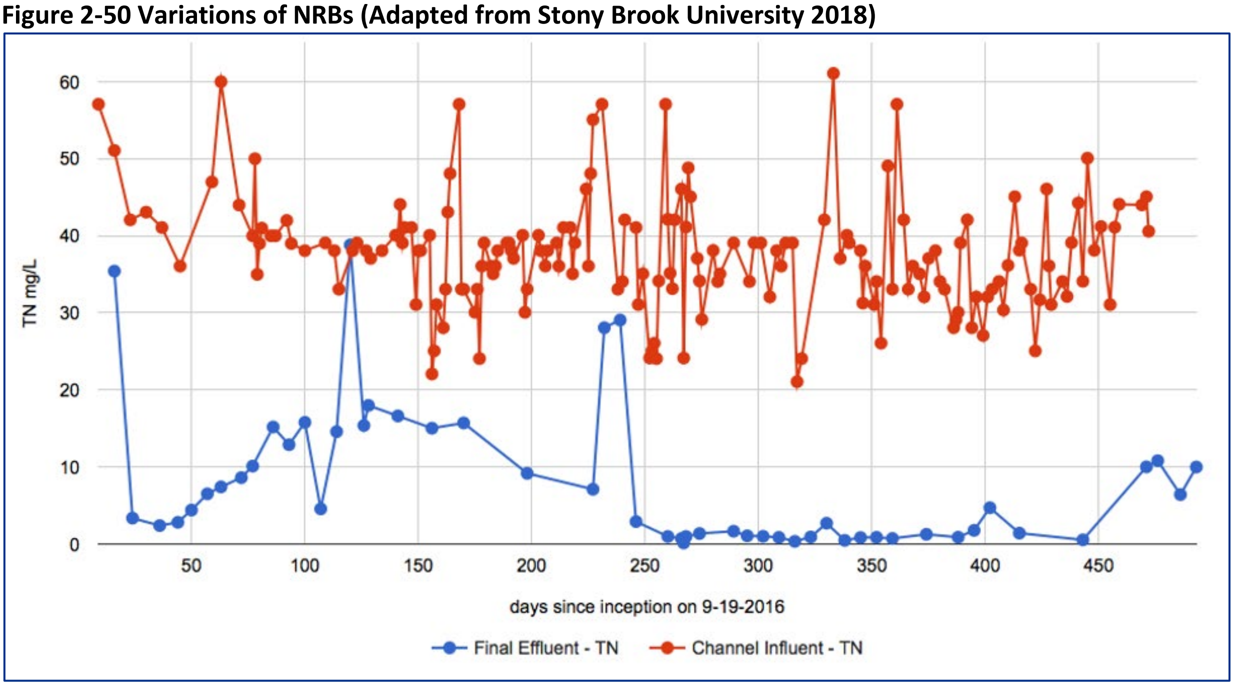


Figure 2-51 Influent and Effluent Nitrogen Concentrations for a Lined (Saturated) NRB (Adapted from Stony Brook University 2018)

2.2.1.5.2 Other Technologies

Other technologies include technologies that are not currently being experimentally tested per the requirements of Article 19 and include composting toilets and source separation methods.

Composting toilets utilize natural microbial processes to treat human waste solids and convert into a soil amendment. Composting toilets are not connected to septic tanks or sewer systems. Implementation of this technology would require replacing conventional toilets with composting toilets that are designed to contain the waste safely while converting it into usable compost. Since a composting toilet should not be too wet, sawdust is typically used to soak up the urine, or the urine is diverted away from the compost tank. If the urine is diverted away from the composting tank, it must be handled and treated separately to prevent release of nitrogen to the groundwater. If the urine is treated separately to prevent release of nitrogen, then the majority of the wastewater nitrogen load would be removed from groundwater at that site.

However, if the sawdust is used to soak up the urine in the compost tank, the nitrogen will remain in the compost. Composting toilet tanks must be emptied depending on usage. There are no current regulations stipulating how homeowners handle or dispose of their compost. One option is that the homeowner uses the compost as a soil amendment in their yards. In this case, plants will uptake a portion of the nitrogen in the compost. However, another fraction of the nitrogen in compost would be expected to enter the groundwater due to nitrogen leaching during precipitation events or watering. A diagram of the composting toilet system is presented in **Figure 2-52**.

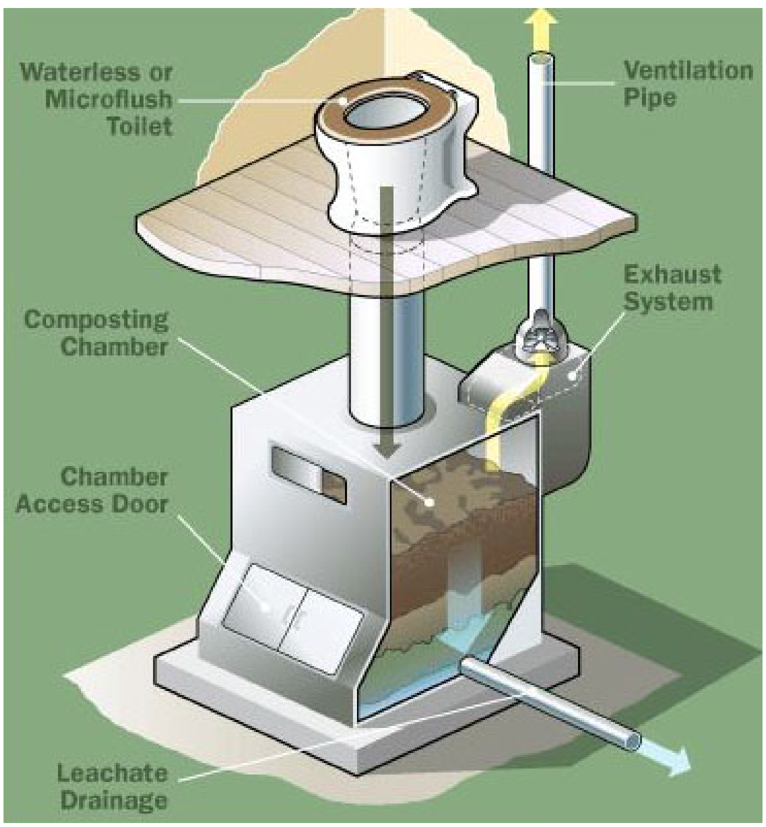


Figure 2-52 Composting Toilet System (Edmonds 2008)

Source separation would also require installation of new source separation toilets. Like composting toilets, source separation toilets would not be connected to septic tanks or sewer systems if installed for the purpose of reducing the nitrogen load from sanitary wastewater to groundwater. Source separation involves separate collection and handling of the two waste streams (e.g. feces and urine) generated. Like composting toilets, the urine would need to be handled and treated separately in order to remove the majority of the nitrogen in the waste stream. If it is not treated to reduce nitrogen, depending on the final destination of the urine, nitrogen could still enter the groundwater. Since separate collection systems are required to achieve the goal of the source separation toilets, an additional benefit of this system is that the house could capture the greywater generated in the house for other uses.

In order to treat the nitrogen in the waste stream from both composting toilets (if urine is diverted away from the composting tank) and source separation toilets, the urine in the waste stream would need to be stored and treated and discharged elsewhere. There is currently no public works system to manage this separate waste stream or regulatory infrastructure governing the handling and treatment of either the compost or the urine-only waste stream to ensure that the nitrogen wastewater-to-groundwater pathway is removed. The Suffolk County Sanitary Code does not allow for on-site wastewater storage for subsequent off-site treatment (e.g., “hold and haul”). Because installation of composting toilets or source separation toilets does not in itself guarantee the prevention of nitrogen from entering groundwater or surface water, these technologies are not considered for further evaluation. However, these technologies could be explored further if work towards establishing a public works system and building a regulatory infrastructure to manage the waste streams is successful.

Table 2-52 Experimental Technologies

Experimental Technology	Advantages	Disadvantages
Composting Toilets	If urine is handled and treated separately, a large portion of the nitrogen loading to groundwater would be removed. Compost is generated for use by the home owner.	This technology does not treat the nitrogen and only serves as an intermediary step. If nitrogen reduction is the goal, the separated urine must be treated. No regulations to manage how homeowners would manage their separated urine or compost to prevent the nitrogen from entering the groundwater currently exist. Nitrogen leaching from compost is possible.
Source Separation Toilets	If urine is handled and treated separately, a large portion of the nitrogen loading to groundwater would be removed.	This technology does not treat the nitrogen and only serves as an intermediary step. If nitrogen reduction is the goal, the separated urine must be treated. No regulations to manage how homeowners would handle their separated urine to prevent the nitrogen from entering the groundwater currently exist.

2.2.1.6 Wastewater Treatment Technology Summary

Several criteria were used to compare each technology’s effectiveness at reducing nitrogen to 19 mg/L, implementability, long-term reliability, and public acceptance. The compiled information for each criterion is presented in **Table 2-52.**

Data from SCDHS’s I/A OWTS pilot programs were used to assess the I/A OWTS’ effectiveness at achieving the target nitrogen load reduction in the effluent stream, with and without polishing units. Suffolk County regulations and literature values were used to determine the probability of the remaining technologies achieving the target nitrogen load reductions. Another criterion to evaluate the technology's effectiveness was its ability to handle seasonal variations and whether the technology could function during a power outage. This table can be used as a guide to design professionals and others when evaluating site designs, local policy development, and/or to support any other initiatives related to wastewater management in Suffolk County. It should be updated periodically as part of the adaptive management plan discussed in Section 8.4.11 of this SWP. The criteria and characterization approach are summarized on **Table 2-53**.

Table 2-53 Alternative Technology Characterization

Evaluation Criterion	Scoring Approach
Demonstration Results	Average Effluent Nitrogen Concentration from Suffolk County's Septic Improvement Program
Percent Nitrogen Removal	Nitrogen Removal based on SCDHS' Assumed Influent Concentration of 65 mg/L and Measured Average Effluent Concentrations
Ability to Consistently Achieve 19 mg/L	High, Medium, Low, based on available data
Technology Footprint	Square feet; based on SCDHS information and vendor data
Depth to Groundwater Required for Installation	Feet, based on SCDHS information and vendor data
Ability to Site on Lots < 5,000 square feet	Based on system footprint and SCDHS' input
Ability to site on Lots < 10,000 square feet	Based on system footprint and SCDHS' input
Visibility (aesthetics)	High – Three or more access ports, large hatch or above ground system Medium – Three access ports Low – No more than two access ports
Ability to Retrofit Existing Septic System	Based on Vendor or County information
Ability to Handle Seasonal Variability in Loading	Based on Vendor or County information
Frequency of Required Maintenance	Very High – Monthly or More Frequently High – Quarterly Medium – Every six months Low - Annually
Component Replacement Frequency	Based on Vendor or County information
Capital Cost (individual treatment unit only)	Very High - > $21,000 High - $18,000 to $21,000 Medium - $15,000 to $18,000 Low - < $15,000
Maintenance Contract Cost	Based on Vendor or County information
Estimated Annual Electric Costs	Power usage at $.22/kwh
Ability to Function during a Power Outage	Based on Vendor or County information

Three specific criteria were applied to evaluate the technologies' implementability based on different conditions that may be applicable at parcels across the County including parcel size and depth to groundwater. These criteria were the footprint of the technology, the lot size the technology can be implemented at based on the footprint, and the depth of unsaturated zone needed for the system. The depth of the unsaturated zone specifically impacts the leaching technologies. Demonstrations completed by SCDHS have shown that depth to groundwater does not impact the I/A OWTS since engineering controls can be designed to weigh down and enclose the system, rendering the system water tight, in areas of high groundwater.

O&M frequency and the time until a key component of the system needs to be replaced were evaluated to determine the system's long-term reliability.

The evaluation of the treatment technologies presented in Section 2.2.1 (**Table 2-50**) weighed public acceptance by considering each technology's visibility/aesthetics and its costs including capital costs, O&M contract cost, and annual electric costs based on the power requirement for the technology. Where possible, the system information used to inform each category was obtained from SCDHS and the Reclaim Our Water website to provide information representative of what owners in Suffolk County should expect

2.2.2 Cost-Benefit Analysis

The following subsection presents the results of an initial cost-benefit analysis that compares the cost per pound of nitrogen removed from wastewater and other mitigation options under a variety of strategies. These results were used to support general recommendations within this SWP, but can also be used to provide policymakers, project partners, related initiatives, and stakeholders with an initial framework of relative nitrogen removal costs to support current/parallel or future nitrogen mitigation initiatives.

The findings of the cost-benefit analysis support the following conclusions:

- The use of I/A OWTS generally represents the lowest cost nitrogen removal option of the wastewater management strategies evaluated;
- The cost for sewering/clustered systems approaches the cost of I/A OWTS under certain conditions. Specifically, the cost to install I/A OWTS at near shore areas with small parcel size and high groundwater approaches the cost for sewer expansion, particularly in areas within close proximity to existing sewer collection infrastructure;
- The geographic area with the lowest cost-benefit assuming the use of I/A OWTS is located within the 0-2 year groundwater contributing area;
- Initial analysis indicates that where source control by wastewater management alone is insufficient to meet nitrogen load reduction goals, alternate strategies such as PRBs, hydromodifications, and nutrient bioextraction are potentially viable, cost-effective strategies that can be considered to provide the remaining nitrogen reductions required to meet endpoints; and,
- As expected, the cost per pound of nitrogen removed for conventional OSDS is significantly higher than all other mitigation options.

A detailed summary of the analysis and results is provided below.

2.2.2.1 Wastewater Treatment Methods Cost-Benefit Assumptions

A wastewater treatment cost-benefit analysis was completed for a variety of wastewater management strategies and technologies. The evaluation compared each technology's cost per pound of nitrogen removed based on the 20-year cost (capital cost and operation and maintenance costs for 20 years) and the total mass of nitrogen removed by the technology over the same 20-year period.

The nitrogen removal costs consider only nitrogen removed from sanitary wastewater. (Total nitrogen loading to the aquifer and subwatersheds is comprised of nitrogen from sanitary wastewater, atmospheric deposition, fertilizer, and pets as described in the Task 11a **Equilibrium Simulations and Existing Conditions** technical memorandum (SCDHS 2018), the Task 4a deliverable **Nitrogen Load Model** (SCDHS, 2018) and the Task 9a technical memorandum **Determine Future Impacts, Priority Areas and Nitrogen Load Reductions for Public Supply Wells and Groundwater** (SCDHS, 2018).

The mass of nitrogen removed was calculated for each wastewater management method as follows:

- Centralized Sewer Systems: The nitrogen removed is the assumed sanitary component of the nitrogen loading for each parcel less the nitrogen in the effluent of the centralized sewer systems. The nitrogen effluent criterion for wastewater treatment plants discharging to groundwater is assumed to be 10 mg/L. The nitrogen loads from atmospheric deposition, fertilizer, and pets remain the same.

- Cluster Systems: This calculation was based on the costs for the Mattituck and Shinnecock pilot areas described below in Section 2.2.3. Cluster systems are Appendix A and Appendix B systems. The nitrogen removed is the assumed sanitary component of the nitrogen loading for each parcel less the nitrogen in the effluent of the Appendix A and Appendix B systems. The nitrogen effluent criterion for these systems discharging to groundwater is assumed to be 10 mg/L. The nitrogen loads from atmospheric deposition, fertilizer, and pets remain the same.

- I/A OWTS: This calculation assumes that I/A OWTS would be installed at every parcel in Suffolk County that is not connected to centralized sewer systems. The nitrogen removed is the assumed sanitary component of the nitrogen loading for each parcel less the nitrogen in the effluent of the I/A OWTS. Approved I/A OWTS in Suffolk County must meet a nitrogen effluent criterion of 19 mg/L; SCDHS has determined that based on a typical septic system influent concentration of 65 mg/L, 70 percent of the nitrogen is removed. The nitrogen loads from atmospheric deposition, fertilizer, and pets remain the same.

- Additional nitrogen removal provided by polishing units and drainfields was also considered. Based on information provided by SCDHS, a range of nitrogen removal is presented. The range shown depicts the additional nitrogen removal provided by polishing units from zero to 86 percent, while the addition of drainfields to I/A OWTS provided an additional nitrogen removal of zero to 50 percent.

- Conventional OSDS: Nitrogen removal by existing on-site sanitary wastewater disposal systems has been reported as approximately 6 percent ((e.g., NLM, the Nature Conservancy, Vaudrey and Stinnette).

Capital and operation costs for alternative wastewater treatment approaches were calculated using the information described below. To support I/A OWTS related cost evaluations used throughout the SWP, a Countywide Microsoft Access database was assembled to include many of the characteristics of each and every Suffolk County parcel considered in the Nitrogen Loading Model. Characteristics included physical parameters such as size and parcel-use and modeled parameters such as depth to groundwater and nitrogen load. This database enabled estimation of nitrogen load reductions and associated costs for specific areas. The database is described in **Appendix F.**

- **Centralized Sewer Systems/Sewer System Expansion:** Costs are based on currently planned sewering projects in Suffolk County, including the Forge River Watershed project. Suffolk County estimates capital costs ranging between $39,250 per home for sewer system expansion (assuming gravity sewers with no dewatering required and connection to an existing sewage treatment plant) to $87,800 per home for implementation of a new sewer district (assumes construction of gravity sewers requiring dewatering and a new sewage treatment plant). Operational costs were obtained from the Forge River Watershed Sewer Project website (https://www.forgewatershedsewers.com/) at $356/year at a 3 percent escalation rate, $114/debt service and $25/year annual fee. Escalation for these costs was varied between 2 and 3 percent for lower and upper boundaries of estimated 20-year costs. The lower boundary also assumes 100 percent removal of the nitrogen load from wastewater to represent locations where the treated effluent is discharged to the ocean, while the upper boundary assumes the effluent nitrogen concentration is reduced to 10 mg/L (85 percent reduction from an assumed influent concentration of 65 mg/L) discharged to groundwater.

- **Cluster Systems**: Costs for cluster systems are based on preliminary capital cost estimates for the Appendix A pilot at Mattituck and Appendix B pilot at Shinnecock Shores. Annual operation and maintenance costs for Suffolk County sewer districts are approximately $3.00 per gallon treated County- wide excluding Bergen Point. The Bergen Point WWTP discharges to the ocean and does not reduce nitrogen to 10 mg/L. Inclusion of Bergen Point operation and maintenance costs reduces the average cost to $1.76/gallon. Therefore, the lower and upper boundaries for Cluster system operation and maintenance costs are based on the range of operation and maintenance costs of $1.76/gal to $3.00/gal.

- **I/A OWTS:** The variation in cost between I/A OWTS installation near the coast and further inland is attributable to the additional engineering and infrastructure required to install the system in areas of high groundwater typically found at near-shore parcels. Inland systems range between Tier 4 residential systems at $19,475.07 to Tier 2 commercial systems at $33,405.10. Near shore systems range between Tier 3 residential systems at $26,385.99 to Tier 1 commercial systems at $60,451.49. Capital costs for residential I/A OWTS are based on actual installed costs provided by SCDHS as summarized in **Table 2-54**. **Table 2-54** also includes SCDHS estimates for commercial I/A OWTS installations (based on flows provided for the Mattituck pilot area described in **Appendix E**.) Operation and maintenance for these systems are based on the costs shown in **Table 2-55** and the 20-year costs include a two percent escalation rate.

Table 2-54 I/A OWTS Capital Cost Estimates

Parcel Type	I/A OWTS Capital Cost	Parcel Description
Tier 1	$40,300.99	Residential parcel <5,000 ft^2 and mean depth to groundwater <10ft, includes I/A OWTS system, designer, soil evaluation, and additional installation costs using smaller equipment, narrow access, pruning and plywood, dewatering during construction and anti-floatation for the I/A OWTS.
Tier 2	$22,270.07	Residential parcel <5,000 ft^2 and mean depth to groundwater > 10ft, includes I/A OWTS system, designer, soil evaluation, and additional installation costs using smaller equipment, narrow access, pruning and plywood.
Tier 3	$26,385.99	Residential parcel > 5,000 ft^2 and mean depth to groundwater <10ft; Includes I/A OWTS system, designer, soil evaluation, dewatering during construction and anti-floatation I/A OWTS
Tier 4	$19,475.07	Residential parcel > 5,000 ft^2 and mean depth to groundwater > 10ft; includes I/A OWTS, designer and soil evaluation costs.
Tier 1_C	$60,451.49	Commercial parcel <5,000 ft^2 and mean depth to groundwater < 10ft; SCDHS estimate of 150% of Tier 1
Tier 2_C	$33,405.10	Commercial parcel <5,000 ft^2 and mean depth to groundwater > 10ft; SCDHS estimate of 150% of Tier 2
Tier 3_C	$39,578.98	Commercial parcel > 5,000 ft^2 and mean depth to groundwater <10ft; SCDHS estimate of 150% of Tier 3
Tier 4_C	$29,212.61	Commercial parcel > 5,000 ft^2 and mean depth to groundwater > 10ft; SCDHS estimate of 150% of Tier 4

Table 2-55 I/A OWTS Operation and Maintenance Costs

Item	Annual I/A Cost	Frequency
Electrical	$175	Annual
O&M Contract	$300	Annual
Pump out	$300	Every 5 years

Item	Annual I/A Cost	Frequency
Component Replacement	$700	Every 10 years

- Capital costs for polishing units and drainfields were provided by SCDHS as $5,000 with no additional operation and maintenance costs. The range of costs per lb.-N removed for I/A OWTS with polishing units was based on additional nitrogen removals of zero to 86 percent, while the range for I/A OWTS with drainfields was based on an additional nitrogen removal of zero to 50 percent.
- Capital costs for a conventional OSDS were estimated to range from $6,000 to $8,000 and it was assumed that septic tanks were pumped every five years at a cost of $300.

2.2.2.2 Wastewater Treatment Methods Cost Benefit Results

Figure 2-53 shows the 20-year cost per pound of nitrogen removed for each of the wastewater treatment-based nitrogen removal approaches, based on the specific Suffolk County-based costs identified above. The 20-year nitrogen removal costs are the lowest for inland (e.g., areas where the groundwater table is more than ten feet below the ground surface) and coastal I/A OWTS and highest for conventional septic systems that do not typically remove significant concentrations of nitrogen. At an average of $156 per pound of nitrogen removed, nitrogen removal costs via cluster systems are more than twice the average cost per pound of nitrogen removal via I/A OWTS installed at in-land parcels. Based on the limited number of projects used to characterize nitrogen removal via centralized STPs, the per pound cost of nitrogen removal is similar to the costs for I/A OWTS with a polishing unit or drainfield. Based on the estimated cost of the Forge River Sewering project, the cost of removing each pound of nitrogen would be $140.

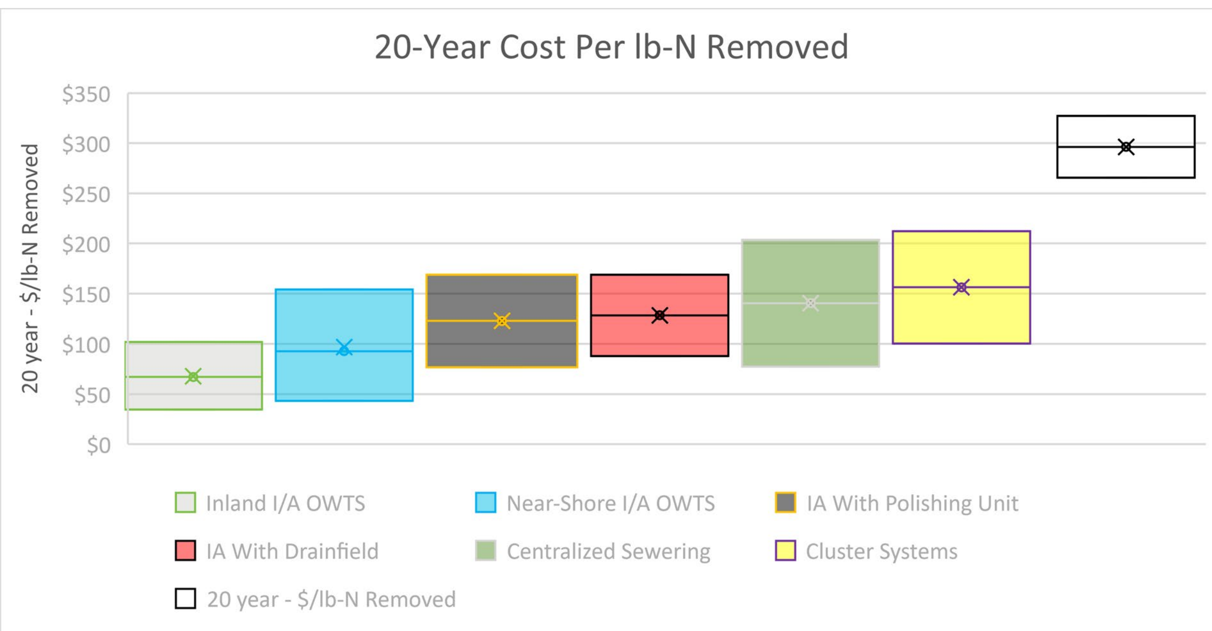


Figure 2-53 Comparison of Nitrogen Removal Costs for Wastewater Treatment Alternatives

2.2.2.3 Other Methods of Nitrogen Reduction

Other methods of nitrogen load reduction to groundwater and surface waters were also considered. These range from elimination of the sanitary wastewater source of nitrogen by open space preservation to removal of nitrogen from groundwater by permeable reactive barriers to removal of the impacts of nitrogen on surface waters by reducing water body residence time by hydromodification. Nitrogen removed was calculated for the following nitrogen reduction methods:

- Permeable Reactive Barriers (PRBs): A PRB is an underground permeable wall composed of media designed to treat groundwater as it passes through the wall, reducing nitrogen concentrations in groundwater prior to discharging to surface water. This scenario assumes that PRBs would be installed along the shores of Suffolk County. The nitrogen removed is the total nitrogen load to groundwater including the sanitary wastewater, atmospheric deposition, fertilizer, and pet nitrogen loadings less the amount of nitrogen treated by the PRB.

- Hydro-Modification: Hydromodification does not reduce nitrogen loading, but does remove it from the surface water body more quickly. These rates are water-body specific; the range of nitrogen removal costs provided as a reference for comparison does not identify the basis for the nitrogen removal estimates.

- Nutrient Bioextraction: Nitrogen bioextraction rates vary over an order of magnitude based on species, cultivation approach and other factors. Rose at al reports annual nitrogen removal rates from 113 pounds per acre by pacific oysters in Sanggou Bay, China to 1,356 pounds/acre by Manila Clams in Samish Bay.

Capital and operation costs for alternative approaches to reduce nitrogen in groundwater or surface water, or to reduce the impacts of nitrogen were based on the information described below:

- Permeable Reactive Barriers (PRBs): Costs for PRBs were determined using Capital Costs from the CDM Smith Falmouth, MA PRB demonstration project. Using the injection well method for PRB installation, construction costs ranged from $450 to $3,350 per lb.-N removed for the first year. O&M costs include monitoring, reporting, and media changeout and were based on EPA's *Economic Analysis of Implementation of Permeable Reactive Barriers for Remediation of Groundwater (EPA, 2002).* The cost per pound of nitrogen removed over 20 years is estimated to range from $23 to $168 per pound. Costs can vary considerably based on site-specific conditions. This alternative is not implementable in many locations and must be assessed critically for feasibility.

- Nutrient Bioextraction: SCDHS provided a range of nitrogen removal costs from aquaculture as $5.7/pound of nitrogen removed to $150/pound of nitrogen removed based on Rose, et al, 2014 and Rose et al, 2015.

- Hydromodification – SCDHS provided an estimate of $37.92/pound of nitrogen removed to $94.80/pound of nitrogen removed. Cost estimates were guided with actual dredging costs provided by the SCDPW.

Figure 2-54 summarizes displays ranges of the 20-year unit cost for nitrogen reduction for each alternative nitrogen removal approach, along with the nitrogen removal costs for wastewater management. Costs are ordered by the expected average costs shown by the inner line within each box. Based on the cost information used, hydromodification to increase tidal flushing and installation of I/A OWTS are the most cost-effective options. Bio-extraction, PRBs and installation of I/A OWTS in coastal areas are the next most cost-effective approaches to reduced nitrogen based upon available cost information. Unit nitrogen removal costs for I/A OWTS with drainfields or polishing units are slightly higher, followed by centralized sewering (based on limited data) and cluster systems. Conventional OSDS are the most expensive treatment option per pound of nitrogen removed.

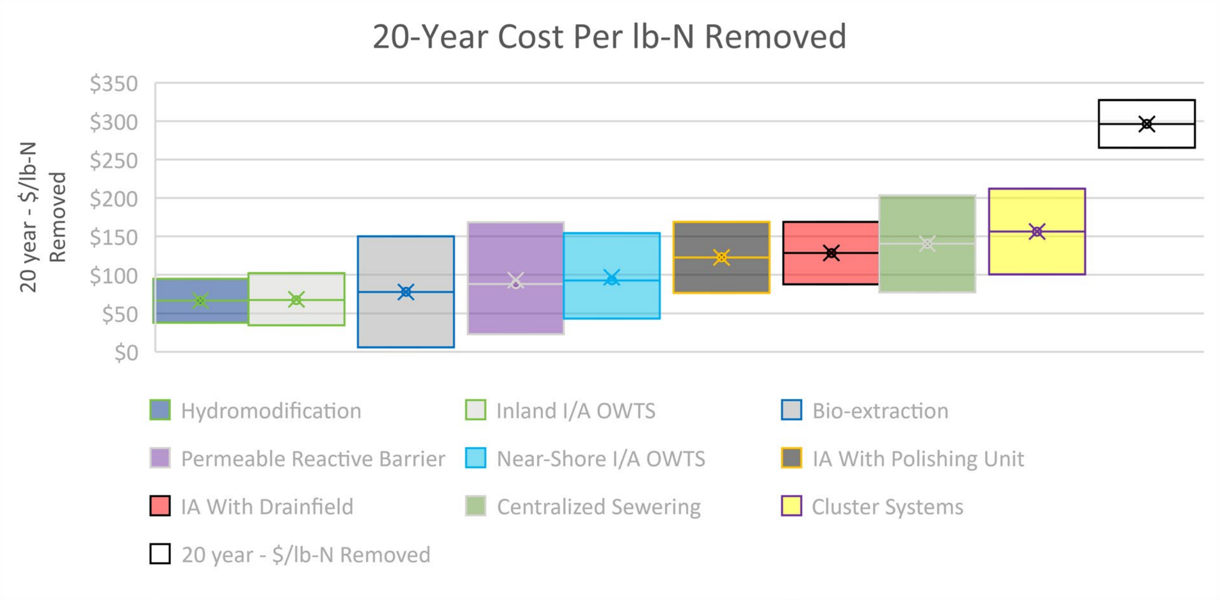


Figure 2-54 Comparison of 20-Year Unit Nitrogen Removal Costs for Nitrogen Reduction

2.2.2.4 Geographic Cost-Benefit Considerations

Using the Microsoft Access cost database described previously (**Appendix F**), an analysis was completed to evaluate the relative cost-benefit of wastewater upgrades using I/A OWTS at various groundwater travel time intervals Countywide (e.g., 0-2 year, 2-10 year, 10-25 year, 25-50 year, 50 to 100 year, and 100 to 200 year travel times). The analysis calculated the average cost to remove a pound of nitrogen by I/A OWTS from each travel-time interval to the County's surface waters over a 50 year time interval. The purpose of the analysis was to identify the geographic location, relative to groundwater travel time, that provided the most benefit to support development of a Countywide wastewater upgrade strategy. Because the cumulative load entering a water body from the 0 to two year travel time is significantly higher than the cumulative load from areas with longer travel times, the cost per pound of nitrogen removed by I/A OWTS implementation is significantly lower for the near-shore areas.

Figure 2-55 shows that the greatest reduction in annual nitrogen loading to the surface waters would be achieved by implementation of I/A OWTS within the 0 to 2-year groundwater contributing area, followed sequentially by the longer contributing area travel times. This information supported incorporation of the Countywide 0 to 2-year groundwater travel time contributing area as a high priority for SWP implementation. In addition to maximizing the nitrogen load reduction realized from I/A OWTS investment, reducing the nitrogen load in the near shore areas will accelerate the benefits of I/A OWTS installations.

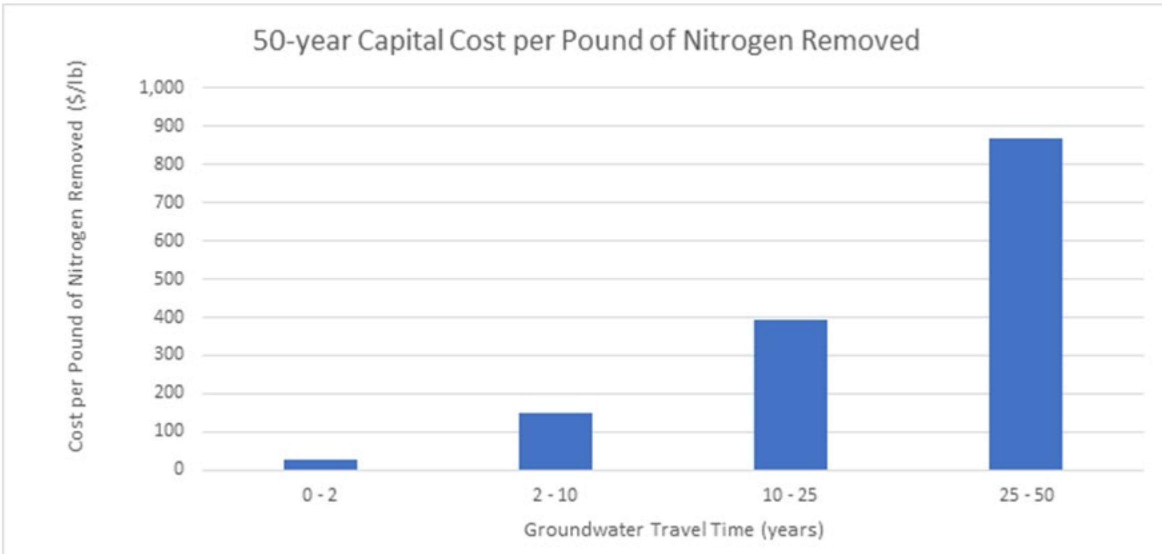


Figure 2-55 50-Year Capital Cost Per Pound of Nitrogen Removed by I/A OWTS Implementation in Each Groundwater Travel Time Interval

Ultimately, implementing I/A OWTS in the coastal areas incorporating the relatively short 0 to 2-year travel time from the water table to surface water discharge represents the most cost-effective approach to remove nitrogen from surface waters and will also enable the County to begin to realize improved water quality as quickly as possible.

2.2.3 Pilot Area Evaluations

2.2.3.1 Purpose

Feasibility analyses were conducted on pilot test areas identified by SCDHS and its stakeholders through the WPAC. The pilot areas were selected to evaluate wastewater management strategies for areas with unique challenges such as downtown hamlets with minimal land availability for wastewater upgrades, freshwater lakes with phosphorus and/or pathogen concerns, clustering/decentralized treatment for existing residential developments in sea level rise prone areas, and the unique challenges associated with wastewater management on the barrier islands. The preferred treatment alternative and recommendations for the pilot areas were developed in conjunction with SCDHS and under current Suffolk County Department of Public Works and SCDHS standards, where applicable. The pilot study objectives and findings are summarized in **Table 2-56** and provided in **Appendix E**.

Table 2-56 Pilot Study Overview

Pilot Area	Objectives	Summary of Results
Shinnecock Shores	▪ Demonstrate implementation of a clustered treatment system in an existing residential community ▪ Identify potential required variances ▪ Compare estimated cost per pound of nitrogen removed by a cluster system to cost per pound of nitrogen removed by an I/A OWTS	▪ A potential layout for a clustered system incorporating a low-pressure sewer system, small footprint treatment system and recharge system was developed. ▪ Waivers from current Suffolk County design standards would be required for this application because the distance from the sewage treatment plant to the property line would be less than 150 feet and the distance from the sewage treatment plant to nearby homes would be less than 200 feet. ▪ Preliminary estimated 20-year cost per pound of nitrogen removed by a cluster system ranges from \$191 to \$212 while the preliminary estimated 20-year cost to remove a pound of nitrogen by an I/A OWTS at this site would be approximately \$119.
Mattituck	▪ Demonstrate implementation of a clustered treatment system in an existing commercial area with small lots ▪ Identify potential required variances and feasibility of reduced setbacks ▪ Compare estimated cost per pound of nitrogen removed by a cluster system to the cost per pound of nitrogen removed by an I/A OWTS and consider increasing allowable Appendix A design flow ▪ The primary purpose of this pilot is to document how and why reduced setbacks are potentially feasible along with an increase in allowable flow to 30,000 gpd.	▪ A potential layout for a collection system, Bioclere Appendix A system and recharge system was developed. ▪ Increase of allowable Appendix A flow up to 30,000 gpd should be considered to accommodate downtown cluster systems. ▪ Waivers from current Suffolk County design standards would be required for this application because the distance from the sewage treatment plant to habitable buildings would be less than 75 feet, the distance from the sewage treatment plant to the property line would be less than 75 feet, waiver for not including an expansion area, a waiver for the installation of leaching galleys below the parking lot. ▪ Reduced setbacks would be required to implement Appendix A systems in downtown areas. ▪ Preliminary estimated 20-year cost per pound of nitrogen removed by the Appendix A system would range from \$100 to \$110 while the preliminary estimated 20-year cost to remove a pound of nitrogen by an I/A OWTS at this site would range from \$34 to \$60 depending on parcel size and depth to groundwater. ▪ SCDHS and SCDPW requirements for Appendix A implementation should be coordinated and streamlined as described further in Section 8.1.2.4.
Davis Park	▪ Demonstrate installation of an I/A OWTS on Fire Island; ▪ Explore concerns with the following: ▪ I/A OWTS installation on small lots with high groundwater;	▪ All parcels on Fire Island National Seashore are located within the Surface Water Priority Rank 1 area defined by the SWP; ▪ Fiberglass I/A OWTS systems are recommended for shipping management; ▪ Pressurized shallow drainfields and geotextile sand filters both provide the required leaching

Pilot Area	Objectives	Summary of Results
	▪ I/A OWTS performance at seasonal locations; ▪ Transportation of materials and equipment to the barrier island for construction; ▪ Maintenance options, with particular focus on long-term pump-out requirements, for I/A OWTS. ▪ Estimate capital costs and the cost per pound of nitrogen removed for the installation of the I/A OWTS on Fire Island using various I/A OWTS and leaching designs; and, ▪ Provide preliminary recommendations for protection against sea level rise.	area for typical sites and can be installed in shallow depth to groundwater areas; ▪ Pressurized shallow drainfields do require power. In the case of a power outage, leaching can still be achieved with geotextile sand filters. ▪ An approach to implement the routine pump-outs required by the Sanitary Code should be developed; ▪ Revisions to the Construction Standards for the Approval of Plans and Construction of Sewage Disposal Systems for Single-Family Residences that would accommodate the unique site conditions of residences at Davis Park and the FINS should be explored, including: ▪ Provisions to accommodate the installation of I/A OWTS beneath raised houses constructed on pilings/stilts; and, ▪ Provisions to accommodate the installation of I/A OWTS beneath decking. ▪ Potential impacts of sea level rise should be considered within the framework of an overall sea level rise protection strategy for wastewater management, including the potential for: ▪ Increase in the minimum separation distance to groundwater in sea level rise "protection areas" based on the objective of maintaining a minimum 3-foot separation distance based on the projected groundwater table elevation in Year 2100; ▪ Clustering/sewering of parcels in sea level protection areas and relocating the recharge of collected/treated wastewater outside of the sea level rise protection area; ▪ Purchasing parcels in the sea level protection area through Open Space; and, ▪ Providing incentives to property owners for making parcels in the sea level rise protection areas TDR sending parcels.
Lake Ronkonkoma	▪ Evaluate the potential sources of phosphorus and pathogen impairments; ▪ Demonstrate the installation of a recommended I/A OWTS at a typical residential property with challenging site conditions; ▪ Assess potential benefits of I/A OWTS on Lake water quality; ▪ Estimate capital costs for I/A OWTS implementation ▪ Identify potential options for	▪ The limited available data indicate that both phosphorus and nitrogen concentrations were significantly greater than values associated with eutrophic conditions; ▪ The following information should be collected so that a nutrient balance for both phosphorus and nitrogen can be developed: ▪ Phosphorus and nitrogen concentrations in Lake Ronkonkoma should be monitored to assess nutrient levels; ▪ Phosphorus concentrations in groundwater downgradient of residential areas should be monitored to assess whether phosphorus attenuation in soils is occurring; ▪ Phosphorus concentrations in stormwater runoff should be characterized; ▪ Nutrient levels in lake sediment should be characterized.

Pilot Area	Objectives	Summary of Results
	phosphorus and pathogen from on-site wastewater, and ▪ Provide preliminary recommendations for further evaluation.	▪ Documented high pathogen levels have prompted beach closings at the Lake; ▪ Pathogen loading and source tracking should be conducted to develop targeted response plans. Data collection should include characterization of pathogen indicator concentrations in the Lake and in stormwater runoff. ▪ If OSDS are a suspected source of pathogen contamination, DNA source tracking studies should be considered. ▪ If phosphorus removal is required, phosphorus removal polishing filters should be identified, demonstrated and tested for effectiveness. ▪ If pathogen reduction is required, pathogen reduction technologies should be identified, demonstrated and evaluated for effectiveness. ▪ Phosphorus polishing filters and disinfection systems can be incorporated into the on-site I/A OWTS system layouts.

2.2.3.2 Summary of Preliminary Recommendations

Suffolk County identified pilot areas to identify wastewater management alternatives that could be implemented in areas with unique site challenges.

While I/A OWTS are the most cost-effective means of nitrogen reduction from sanitary wastewater for most unsewered areas of the County, there are areas where cluster systems may be a more appropriate nitrogen reduction treatment approach as described in Sections 1.1.4.5 and 8.1.2. To accommodate flows from existing areas, where appropriate, the maximum flow for an Appendix A system should be increased to 30,000 gpd. In existing developed downtown areas, it may be impossible to meet existing Appendix A setback requirements. In these instances, with incorporation of engineering controls to mitigate noise and odor impacts, reduced setbacks from Appendix A facilities to other commercial properties should be considered.

In addition, the installation cost for conventional OSDS and I/A OWTS are higher in communities located on Fire Island National Seashore (FINS) when compared to comparable lots on the mainland of Suffolk County. The increased construction cost results from the increase in labor required for shipping/transport of materials, installation of the systems themselves (typically requiring hand labor), and increased shipping/freight costs for shipping over waterways, sand, and limited access boardwalks. One possible option for reducing the capital cost associated with installation of I/A OWTS is the use of clustered systems wherein two or more homes are connected to a single, common, I/A OWTS. The existing regulatory framework for permitting, approval(s) to construct, and the long-term management for clustering of existing parcels to a new common treatment system typically involves a complicated process that generally precludes the use of clustering for small projects. The existing process can involve multi-jurisdictional review of construction plans, the need for sewer agency agreements, the potential need for creation of a District, and additional significant financial burden associated with multiple permit fees and financial assurance requirements.

The existing administrative and permitting framework for Appendix A systems requires coordination with and compliance with both SCDHS and SCDPW requirements. County requirements and permitting should be coordinated and streamlined such that:

- The system is based on one set of design standards (e.g., SCDHS or SCDPW, but not both);
- The applicant coordinates with a single lead agency for review and permitting; and,
- An approach for operation and maintenance (O&M) financial assurance and overall O&M responsibility is developed.

2.2.4 Hydrogeologic Zone IV Evaluation

2.2.4.1 Background and Objective

In 1980, SCDHS established Groundwater Management Zones (GMZ) to protect the aquifer system from nitrogen contamination. Article 6 of the Suffolk County Sanitary Code permits residential development in unsewered areas within GMZ III, V and VI on parcels of 1-acre (40,000 square feet) or larger to limit groundwater nitrogen concentrations within those GMZs to 4 mg/L. Residential development in GMZs I, II, IV and VIII is limited to parcels of ½-acre (20,000 square feet) or larger to limit groundwater nitrogen concentrations within those GMZs to 6 mg/L. For other than residential developments, Article 6 of the Suffolk County Sanitary Code (760-607) allows individual sewerage systems on parcels where the population density equivalent is < 40,000 square feet within GMZs III, V or VI, and the population density equivalent is < 20,000 square feet outside of GMZs I, II, IV and VIII (please refer to Sections 1.4.1, 1.1.4.2 and 3.1.1 for further explanation) .

The 2015 Suffolk County Comprehensive Water Resources Management Plan (Comp Plan) recommended extending the protections afforded to GMZs III, V and VI to GMZ IV for the protection of groundwater in coastal areas to protect downgradient surface waters. As shown on **Figure 2-56**, GMZ IV is primarily located within the five East Towns including East Hampton, Riverhead, Shelter Island, Southampton and Southold. To quantify and evaluate the potential benefits associated with this recommendation in the context of this SWP, the potential benefits of modifying Article 6 of the County's Sanitary Code to require a minimum of 40,000 square feet for residential development in GMZ IV was evaluated by comparing the nitrogen load from full build-out at the current allowable density (1/2 acre) to the nitrogen load resulting from build-out at a minimum parcel size of 1 acre.

Part of all of 100 subwatersheds are located within GMZ IV. **Table 2 57** (please see tables at the end of this section) lists all of the subwatersheds that are entirely or partially located within GMZ IV, along with the number of vacant parcels and the number of additional residences that could be added based on the Suffolk County Department of Economic Development and Planning's (SCDEDP) projections of ultimate future build-out (Columns 1 and 2, 3 and 4). In all, SCDEDP projected that 7,490 additional residences could be constructed in GMZ IV at full build-out in the future. Based on an average household size of three people per residence, this would amount to over 190,000 additional pounds of nitrogen loading per year.

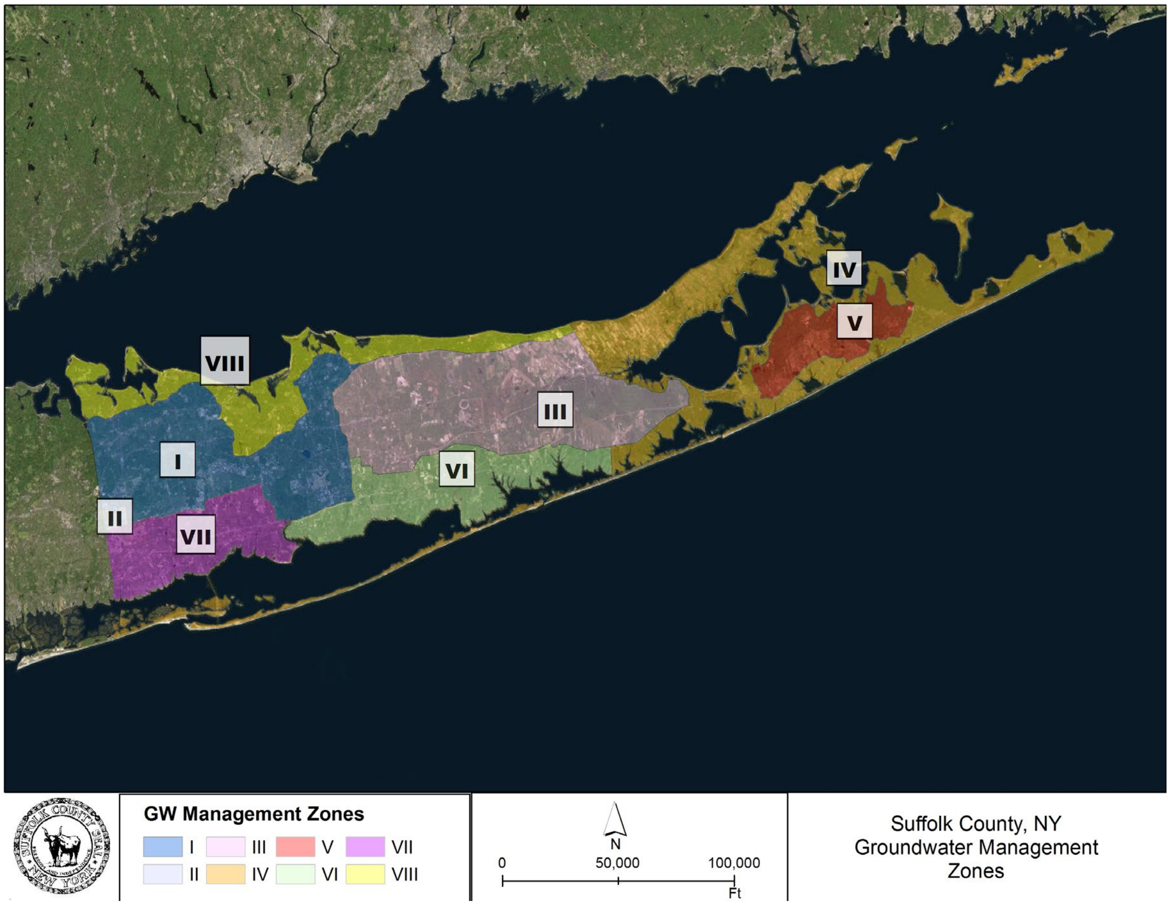


Figure 2-56 Groundwater Management Zones

The SCDEDP projection of build-out land uses considered Town zoning, which in some cases results in a more restrictive development density (e.g., 1-acre or 2-acre density) than would have been possible based on Article 6 of the Sanitary Code. Consequently, modification of Article 6 would not result in fewer residential parcels in GMZ IV in these areas. Even with modification of Article 6, residences could continue to be constructed on some parcels that are smaller than 1 acre if they existed as single and separate tax lots prior to 1981 (e.g., grandfathered parcels). Because it was not possible to identify these parcels, a range of potential new residences and nitrogen load reductions is presented here. The first estimates (please see column 5) assume that none of the residential development projected by SCDEDP could be constructed on parcels less than 1 acre in size (e.g., no grandfathering of smaller properties). This would represent the largest potential benefit associated with implementation of the potential sanitary code change. If none of the parcels were grandfathered (column 6), the number of residences that could be built would be reduced by 2,761 to 4,729. The second estimate is that existing parcels less than one acre are grandfathered in, and only sub-division of larger parcels (for example, those currently in agricultural use) would be affected by the change. However, if all of the parcels less than 1 acre were grandfathered in, a total of 7,476 parcels could be developed. (The difference of 14 parcels between SCDEDP's projection of 7,490 and this estimate of 7,476 is believed to result from SCDEDP's knowledge of grandfathered subdivisions of parcels greater than one acre that were not captured in this evaluation.)

Finally, the last column in **Table 2-57** is the difference in the number of residences that could be built in GMZ IV if a minimum parcel size of 1 acre was required, and if smaller parcels were not grandfathered. This assumption is the basis for the 'best case' nitrogen load impact.

2.2.4.2 Potential Benefits of Changing GMZ IV Parcel Size

The subwatersheds where the number of potential residences could be reduced by modification of the minimum parcel size in GMZ IV are listed in **Table 2-58** (columns 1 and 2). **Table 2-58** (please see tables at the end of this section) also summarizes the nitrogen load reduction targets for each subwatershed (based on aggregated subwatershed loads and the Wastewater Management Zone nitrogen load reduction percentages) along with the nitrogen load reductions that would result from reduction of future development density to a minimum of 1 acre (with a conservative assumption of no grandfathering); this estimate provides the largest reduction in nitrogen loading that could be anticipated from a change in development density requirements (please see columns 3 and 4, respectively). These values are not nitrogen load reductions from existing conditions, but the amount of nitrogen load increases that would be mitigated by establishing a minimum parcel size of 1 acre.

For comparison, the last column in **Table 2-58** presents the reduction in nitrogen loading from baseline conditions that would be provided by I/A OWTS implementation throughout each of the individual subwatersheds.

Review of **Table 2-58** shows that establishment of a one-acre minimum zoning target in GMZ IV (and assuming no grandfathered properties), would result in a reduced annual nitrogen loading of over 70,000 pounds; which represents only about 1 percent of the nitrogen load reduction required for the achievement of the ideal water quality as represented by the reference water bodies. (Please note that the nitrogen load reduction targets are not additive, as they are representative of aggregated subwatersheds and an individual upstream subwatershed may also be included in several downstream subwatersheds.) It is also important to remember that the nitrogen load reduction targets are based upon the existing estimated nitrogen loads, rather than the future projected nitrogen loads.

Because **Table 2-58** mixes nitrogen load reduction targets (which are based on existing conditions and aggregated subwatersheds) with nitrogen load "reductions" that would be achieved based on potential future build-out, the values shown merely provide a frame of reference within which the potential impact of new developments can be considered. While the predicted nitrogen load reductions that could result from the requirement that no parcels less than 1 acre in GMZ IV could be developed are generally much lower than the nitrogen load reductions that are anticipated to result from I/A OWTS implementation, they exceed ten percent of the goal in some subwatersheds.

2.2.4.3 Recommendations for GMZ IV

The potential impacts of development on nitrogen loading should be considered in the context of wastewater management requirements and surface water impacts. Recommendations for consideration include:

- Revision to Article 6 of the Suffolk County Sanitary Code to require a minimum of 40,000 square foot lot size in all of GWMZ IV;
- Revision to Article 6 of the Suffolk County Sanitary Code to identify special groundwater protection areas in select subwatersheds where a minimum of 40,000 square foot lot size would be required; and,
- Towns/Villages could incorporate revised zoning with a minimum lot size of one acre in select subwatersheds, as appropriate, based upon the findings presented in this SWP.

2.2.5 Pathogens Evaluation

2.2.5.1 Background and Objectives

While the reduction of nitrogen from on-site sanitary wastewater disposal is the primary focus of the subwatershed priority rankings for wastewater management identified in this SWP, it was recognized that pathogens from sanitary wastewater could also be a significant public health concern in certain areas. In areas where the water table is high and the travel time to nearby surface waters is short, it is possible that pathogens could migrate with groundwater to contaminate downgradient surface water bodies. Pathogens including bacteria, viruses and protozoans can cause human disease by consumption of contaminated water, recreational contact, or ingestion of contaminated shellfish. The impacts of projected sea level rise are anticipated to amplify this concern in the future. This section of the SWP includes:

- A summary of available information documenting pathogen indicator concentrations (1) and impairments in Suffolk County's surface water bodies;
- Comparison of pathogen indicator levels to regulatory thresholds;
- Documentation of preliminary conclusions regarding potential sanitary impacts and
- Identification of preliminary recommendations.

It should be noted that sanitary wastewater is just one potential source of observed contamination by pathogen indicators –in many cases, observed contamination may also be caused by stormwater runoff, wildlife populations or pets.

2.2.5.2 Data Sources and Approach

2.2.5.2.1 Data Sources

Three readily available data sources were incorporated into a Microsoft Excel-based database for characterization of each surface water evaluated within the SWP including:

- SCDHS
- New York State Park Beach Program and
- Stony Brook SoMAS.

(1) The pathogen indicators fecal coliform, enterococcus and e. coli are monitored, regulated and evaluated in this document. For additional background, please see www.epa.gov/wqc/2012-recreational-water-quality-criteria

Figure 2-57 shows a count of datapoints from each source (New York State Park Beach Program, SCDHS and SoMAS). SoMAS data was used only for the characterization of Georgica Pond where no other pathogen indicator data was available.

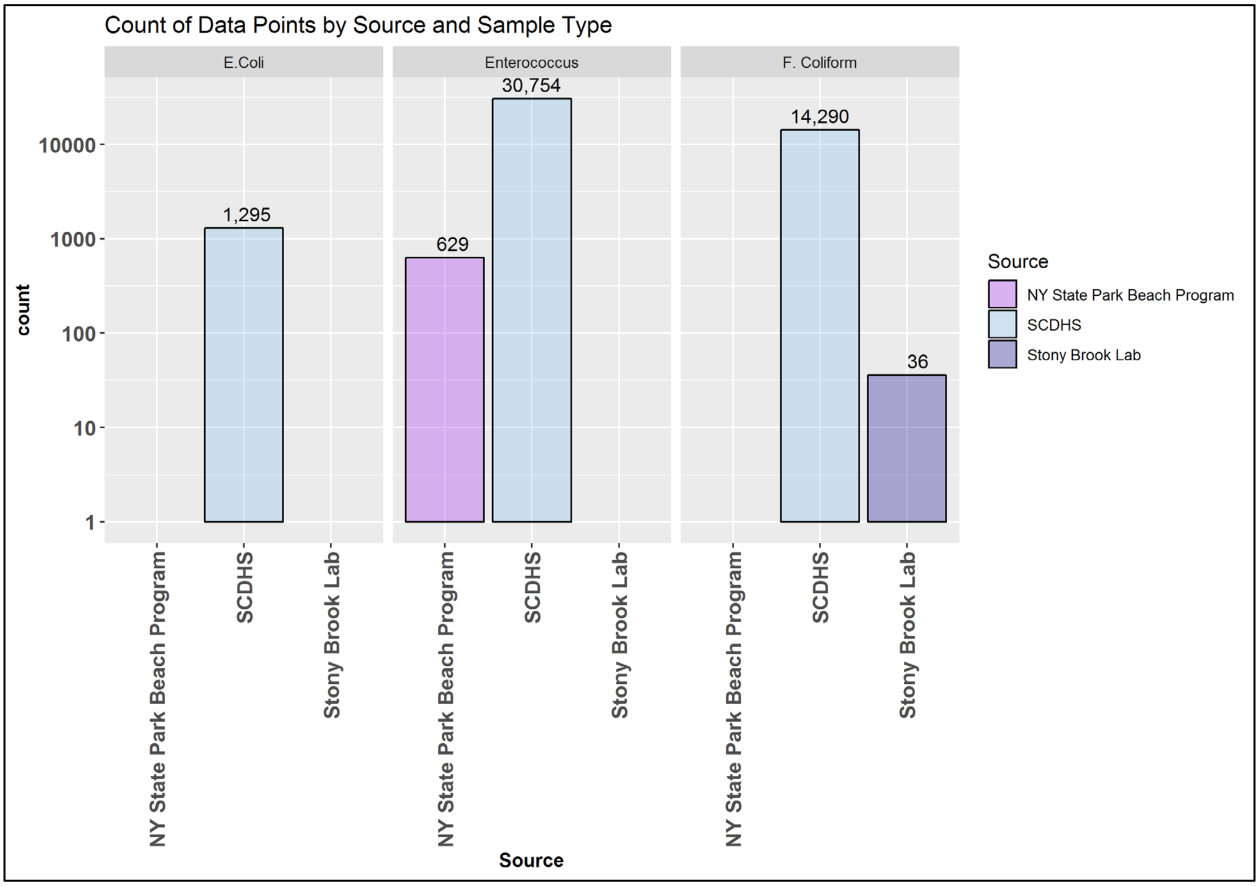


Figure 2-57 Data Sources and Parameters

NYSDEC shellfish closure maps were also incorporated into the evaluation. Shellfish closure data obtained from the NYSDEC identified locations within water bodies where unsanitary conditions trigger advisories for shellfish consumption. This monitoring program is conducted year-round to ensure human health regarding shellfish consumption. Shellfish harvesting restrictions vary seasonally due to changes in seasonal conditions, including sources (e.g., boating), temperatures, precipitation, sunlight intensity, etc. which promote elevated levels of coliform bacteria. Seasonal shellfish closure advisories issued by NYSDEC in 2018 are shown in **Table 2-59**. **Figure 2-58** shows the overall shellfish map used to identify potential pathogenic impacts to the Suffolk County's 191 subwatersheds included in this SWP.

Table 2-59 Seasonal Shellfish Closures by NYSDEC as of March 2018

Shellfish Harvest Area	Closure Dates (both dates inclusive)
Little Peconic Bay: Richmond Creek	April 1 - Oct 31
Shelter Island Sound: Gull Pond	April 1 - Dec 14
Lake Montauk: southern portion	April 1 - Dec 14

Shellfish Harvest Area	Closure Dates (both dates inclusive)
Noyack Bay: Mill Creek	April 1 - Dec 14
Quantuck Bay: Moneybogue Bay, Quantuck Canal, Quantuck Creek, Aspatuck Creek, Quogue Canal	April 1 - Dec 14
Southold Bay: Goose Creek, Town & Jockey Creek	April 15 - Dec 31
Narrow Bay: easterly of Cranberry Dr. and westerly of 39 Washington Dr., Mastic Beach	April 15 - Dec 31
Mattituck Inlet, Mattituck Creek	April 16 - Jan 14

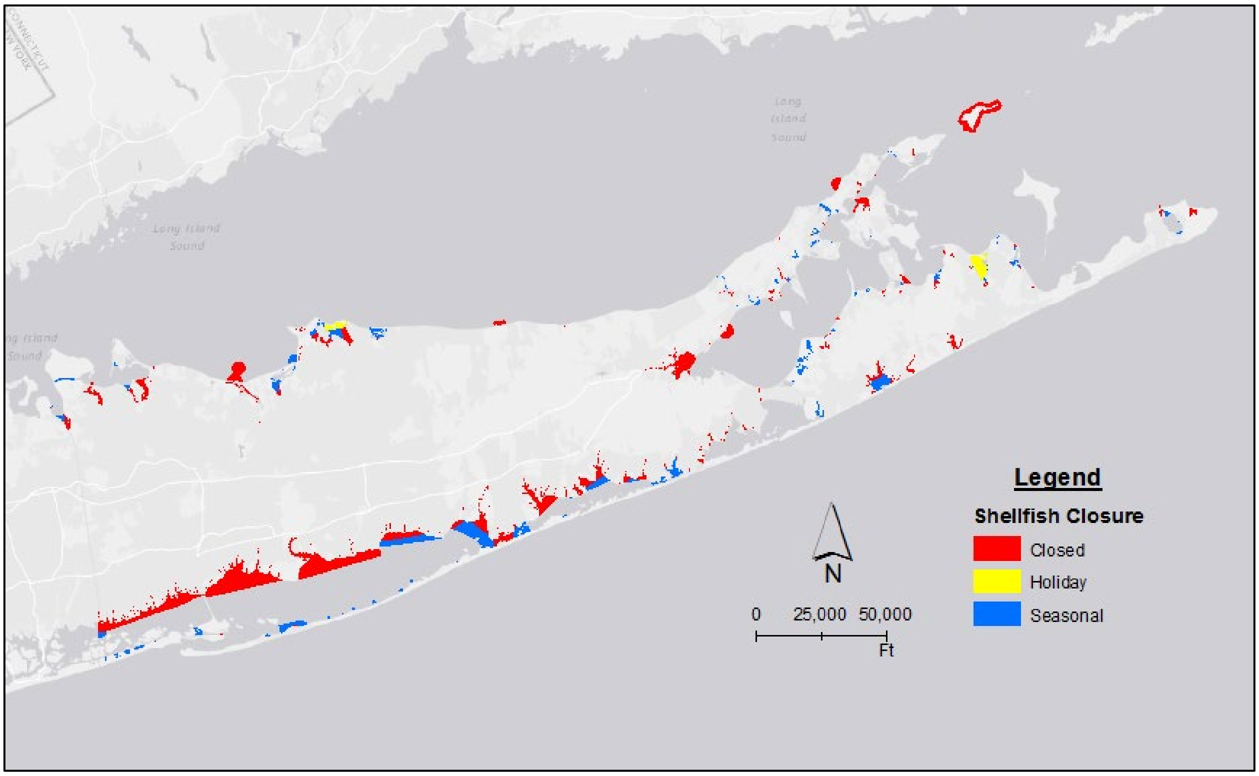


Figure 2-58 NYSDEC Shellfish Closures

2.2.5.2.2 Pathogen Indicator Thresholds for Mapping

In November 2012, EPA published the 2012 recreational water quality criteria (RWQC) recommendations in fulfillment of the Beaches Environmental Assessment and Coastal Health (BEACH) Act of 2000, which directed EPA to study pathogens and human health and publish new or revised criteria recommendations based on the study results. These criteria were developed to "protect primary contact recreation, including swimming, bathing, surfing, water skiing, tubing, water play by children, and similar water contact activities where a high degree of bodily contact with the water, immersion and ingestion are likely." The 2012 RWQC includes both a geometric mean and a statistical threshold value (STV) for each pathogen indicator; it also defines a magnitude, duration and frequency of excursion for both the geometric mean and the STV. The geometric mean should not be exceeded in any 30-day period, and the STV, which approximates the 90th percentile of the distribution of samples, should not be exceeded by more than ten percent of the samples collected during that 30-day interval. For purposes of this analysis, data was not analyzed monthly due to the sporadic nature of the dataset. Geometric means and 90th percentiles were computed for all available data by subwatershed regardless of non-consecutive sampling days. Subwatersheds with less than 30 samples for a parameter were flagged.

Units for the RWQC thresholds are measured in colony forming units (CFU/100mL) while samples from the database are reported as most probable number (MPN/100mL). The primary difference between these units is based upon the enumeration methodology used to analyze samples and there is considered to be a 1:1 correspondence between the two measurements. Both units are recognized by the USEPA.

Table 2-60 shows the recommendations used to guide beach notification programs with slight adjustments explained herein. While the fecal coliform limit is 14 cfu/100mL this was adjusted to 21cfu/100mL for purposes of this analysis due to the minimum detection limit of 20 cfu/100mL reported for SCDHS samples. Adjusting the limit allows the identification of subwatersheds where geometric means surpassed 20 cfu/100mL.

Table 2-60 Water Quality Pathogenic Criteria

Parameter	Geometric mean (cfu/100mL)	STV (cfu/100mL)	Basis
Fecal Coliform[1]	21	49	EPA/SCDHS
Enterococcus	35	110	EPA
E. Coli	100	320	EPA

[1] – Fecal limit adjusted from 14 to 21 cfu/100mL due to sampling threshold of 20 MPN/100mL for Suffolk County data

2.2.5.3 Preliminary Conclusions and Recommendations

2.2.5.3.1 Preliminary Identification of Subwatersheds with Potential Sanitary Impacts

Available pathogen indicator data and NYSDEC shellfish closure mappings were mapped onto subwatershed-specific figures that included subwatershed land use types and depth to groundwater less than ten feet (please see Task 8C memorandum entitled **Pathogen Fine Tuning**, 2019). Based on consideration of all of the data sources, 164 subwatersheds were identified to be impacted by pathogens as summarized on **Table 2-61**. As previously mentioned, storm water runoff (e.g., see urban/storm runoff citations on the New York State 303d list), wildlife and birds are the most likely sources of observed pathogen contamination in many surface waters. This preliminary evaluation provides an initial identification of pathogen-impacted waters that could potentially be caused by on-site disposal of sanitary wastewater based on the presence of residential land use within the area where the depth to groundwater is less than 10 feet.

Table 2-61 Number of Subwatersheds Impacted by Pathogenic Indicators

Count of Subwatersheds Experiencing Exceedances or Closures	
Fecal Coliform	120

Count of Subwatersheds Experiencing Exceedances or Closures	
Enterococcus	23
E. Coli	2
Shellfish Closure (excluding holiday and seasonal)	135

The land use types located in areas where the average annual depth to the water table is less than 10 feet were compiled for each subwatershed. Subwatersheds where 50 percent of the parcels or 50 percent of the total area with depth to groundwater less than 10 feet were identified as unsewered medium density residential or high-density residential parcels were identified as areas of potential concern for pathogen contamination from on-site sanitary wastewater disposal. The number of subwatersheds in each category is summarized in **Table 2-62** and each is listed in **Table 2-63** (please see tables at the end of this section). Orange highlighted cells indicate potential pathogenic impacts from on-site sanitary wastewater disposal.

It is emphasized that this is a preliminary screening of potentially impacted subwatersheds. Evaluation of other potential pathogen sources and site-specific evaluations are beyond the scope of this SWP.

Table 2-62 Summary of Subwatershed Pathogenic Impacts

Summary Of Subwatershed Pathogenic Impacts	
Number of Subwatersheds with Potential Pathogenic Impact	164
Number of Subwatersheds where Number of Residential Parcels >50% in Shallow DTGW Area	148
Number of Subwatersheds where Residential Acreage >50% in Shallow DTGW Area	82

Of the 164 surface waters with documented observations of pathogen indicators, the contributing areas of 42 percent of the subwatersheds (69 out of 164 subwatersheds) were comprised of more than 50 percent medium or high-density residential land, of which more than 50 percent had a depth to groundwater of less than ten feet under average annual conditions. This observation does not mean that sanitary wastewater is the source of the observed pathogen indicators but suggests that the potential for sanitary wastewater impacts exists.

Conversely, the contributing areas of 44 percent of the subwatersheds (twelve out of 27 subwatersheds) without a documented pathogenic impact also were comprised of more than 50 percent medium or high-density residential land, of which more than 50 percent had a depth to groundwater of less than ten feet under average annual conditions.

SCDHS provided a summary of pathogen indicator source tracking studies completed in Suffolk County; these are summarized on **Table 2-64**.

Table 2-64 Summary of Pathogen Indicator Source Tracking Studies

Name of Study/Reference	Authors	Water Body Studied/ PWL ID	Study Findings
Setauket Harbor Coliform Enumeration	Cornell Cooperative Extension: Lorne Brousseau, Scott	Setauket Harbor (1702-0242)	* Of 16 samples, 11 were found to have human isolates.

Name of Study/Reference	Authors	Water Body Studied/ PWL ID	Study Findings
and DNA Source Tracking. 2016	Curatolo-Wagemann and Christie Pfoertner		* Human isolates were greater than 50% of the DNA sources in 2 of the 16 samples. * Human isolates could be attributed to failing septic systems or recreational activity such as emptying of boat septic holding tanks. * The greatest fecal contamination sources from the samples collected were from birds and humans with significantly lesser inputs from wildlife and domestic animals (dogs, horses). * Fecal contamination was high during wet weather events in the interior area of Setauket Harbor, but stormwater does not account for all fecal coliform loading.
Bacterial Source Tracking at Lake Ronkonkoma. 2005	Cornell Cooperative Extension: Emerson C. Hasbrouck and Scott Curatolo-Wagemann	Lake Ronkonkoma (1701-0020)	* Human DNA isolates were predicted in 11% of samples. * Bird DNA isolates were predicted in 72% of samples. * Overall, non-human animal DNA isolates were predicted in 89% of 54 samples.
Source tracking of fecal bacteria in Georgica Pond. 2018.	SoMAS: Dr. Christopher J. Gobler, Jennifer Jankowiak, M.S., and Dr. Theresa Hattenrath-Lehmann	Georgica Pond (1701-0145)	* Human-derived bacteria comprised less than 5%. * Animal-derived bacteria, mainly dog and bird, dominated fecal surveys within Georgica Pond tributaries.
Lake Montauk DNA Source Tracking. 2009-2011	Cornell Cooperative Extension: Scott Curatolo-Wagemann	Lake Montauk (1701-0031)	* Human DNA isolates were predicted in 2% of samples. * Non-human animals DNA isolates were predicted in 98% of 86 samples.
Goldsmiths Inlet Coliform Enumeration and DNA Source Tracking. 2013	Cornell Cooperative Extension: Lorne Brousseau and Scott Curatolo-Wagemann	Goldsmith Inlet (1702-0026)	* The majority of the isolates were from humans in 1 of 12 samples, collected from Autumn Pond (hydrologically

Name of Study/Reference	Authors	Water Body Studied/ PWL ID	Study Findings
			connected to Goldsmith's Inlet) * The source of pathogens as determined through DNA analysis indicated in the majority of samples (11 of 12) the isolates could be attributed to birds, wildlife and to a small extent domestic animals and no human isolates.
Coliform Bacteriological Impact Analysis at MS4 Locations Discharging Storm Water Runoff to Cold Spring, Huntington, Centerport and Northport Harbors Located in the Town of Huntington. 2011	Cornell Cooperative Extension: Lorne Brousseau	Northport Harbor (1702-0230) Northport Harbor, Centerport Harbor, Mill Pond, Huntington Harbor, Cold Spring Harbor were part of enumeration study but only Northport Harbor was sampled for DNA source pathogen tracking.	* Human DNA were predicted in 9% of isolates. * 4 of 10 Northport Harbor samples contained some human DNA isolates. * Overall, non-human animal DNA were predated in 91% of all isolates, of which 46% was bird DNA. * Samples collected from stormwater runoff pipes and surface water grab samples in Northport Harbor.
West Creek, Wickham Creek, East Creek, Mud Creek and New Suffolk Coliform Enumeration and DNA Bacterial Source Tracking. 2014	Cornell Cooperative Extension: Scott Curatolo-Wagemann	Cutchogue Harbor - East Creek (1701-0045-EC)	* One DNA sample, which was found to be of wildlife origin.
West Creek, Wickham Creek, East Creek, Mud Creek and New Suffolk Coliform Enumeration and DNA Bacterial Source Tracking. 2014	Cornell Cooperative Extension: Scott Curatolo-Wagemann	Cutchogue Harbor - Mud Creek (1701-0045-MC)	* Human sources (100% and 10%) found in both DNA samples at two locations on same sample date.
West Creek, Wickham Creek, East Creek, Mud Creek and New Suffolk Coliform Enumeration and DNA Bacterial Source Tracking. 2014	Cornell Cooperative Extension: Scott Curatolo-Wagemann	Cutchogue Harbor - Wickham Creek (1701-0045-WC)	* One DNA sample, which was found to be of bird origin.
West Creek, Wickham Creek, East Creek, Mud Creek and New Suffolk Coliform Enumeration and DNA Bacterial Source Tracking. 2014	Cornell Cooperative Extension: Scott Curatolo-Wagemann	Cutchogue Harbor (1701-0045-CH)	* One sample contained human source (100%) * 2nd sample contained bird source and possibly some domestic animal. * 2 total DNA samples

Name of Study/Reference	Authors	Water Body Studied/ PWL ID	Study Findings
			came from one station, sampled 2 weeks apart.
West Creek, Wickham Creek, East Creek, Mud Creek and New Suffolk Coliform Enumeration and DNA Bacterial Source Tracking. 2014	Cornell Cooperative Extension: Scott Curatolo-Wagemann	West Creek and Tidal Tribs (1701-0242-WB)	* Station 1 had three DNA samples run; showing evidence of human (40%, 35.7% and 0%), bird and domestic animal. * Station 2 had two samples analyzed for DNA - both showing a majority of wildlife, but also bird. * Station 3 had one DNA sample, and contained mostly bird, but also some wildlife and domestic animal. * 6 total DNA samples coming from 3 different dates and stations.
New Suffolk and West Creek Coliform Enumeration and DNA Bacterial Source Tracking. 2015	Cornell Cooperative Extension: Scott Curatolo-Wagemann	Cutchogue Harbor (1701-0045-CH)	* One sample contained 80% human source and 20% bird source. * One sample contained 100% bird source. * Two DNA samples came from one station, sampled approximately three weeks apart.
New Suffolk and West Creek Coliform Enumeration and DNA Bacterial Source Tracking. 2015	Cornell Cooperative Extension: Scott Curatolo-Wagemann	West Creek and Tidal Tribs (1701-0242-WB)	* One sample contained 20% human source and 80% bird source. * One sample contained 29% human and 71% mix of bird and wildlife * One sample contained 100% mix of bird or wildlife * Five samples were taken but only three resulted in a predicted source.
Village of Port Jefferson Bacterial Source Tracking of Stormwater Outfalls. 2015	Cornell Cooperative Extension: Scott Curatolo-Wagemann and Lorne Brousseau	Port Jefferson Harbor, South, and Tribs (1702-0241)	* No human source isolates were found in the four samples. * DNA isolates were determined to be from bird, wildlife and dog sources.

2.2.5.4 Preliminary Recommendations for Further Evaluation

Pathogen indicator concentrations in a particular water body are often quite variable in time and space and there are a variety of potential pathogen sources. Additional data collection and analysis would be required to confirm the source(s) of the observed pathogen contamination for the subwatersheds identified in **Table 2-63**. The preliminary evaluation described above is a first step in the evaluation which identifies ***potential*** pathogen migration pathways only. Storm sewer outfall discharges provide a direct pathway of pathogens to surface waters as do pathogen inputs from animals and bids. Further evaluations would include one or more of the following:

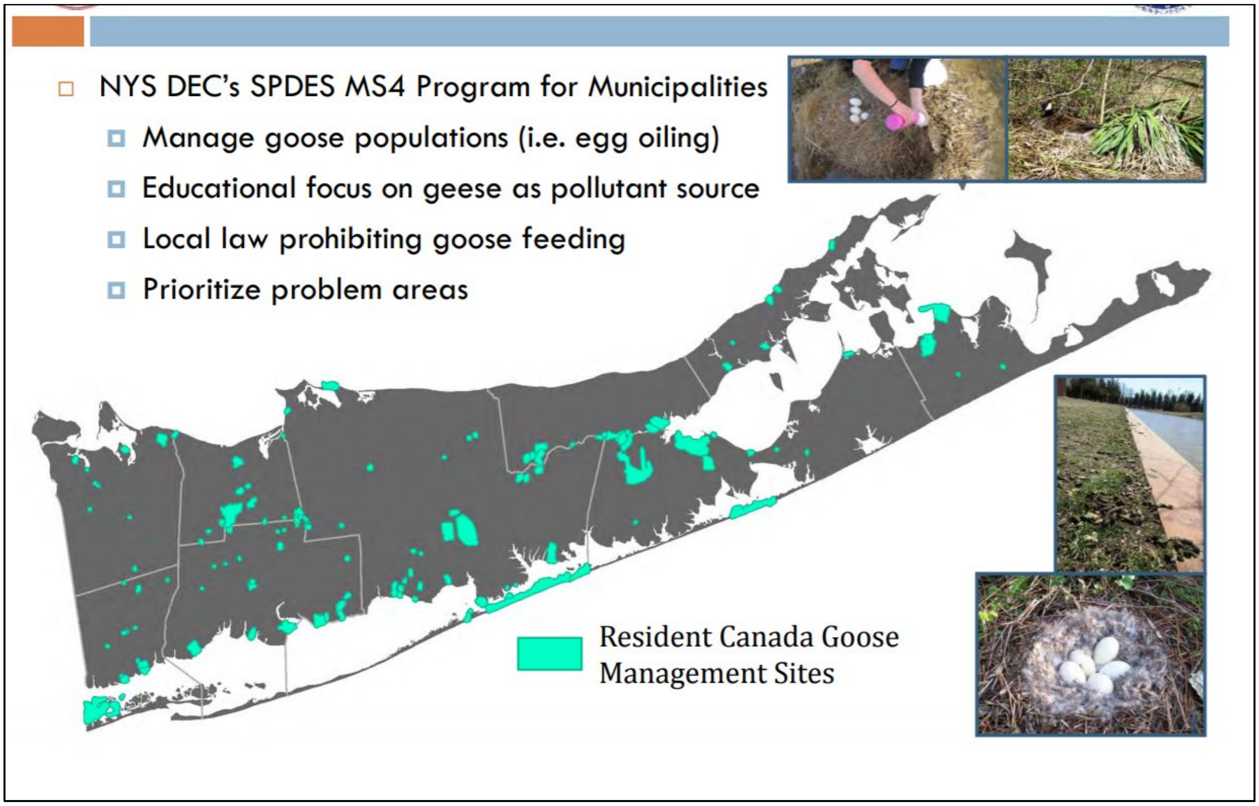
- Storm sewer discharges should be mapped with respect to the surface water sampling locations to identify whether or not discharge of stormwater is the source of the pathogen impairment. Suffolk County's Stormwater Management Program identifies 380 storm sewer outfalls that directly convey stormwater runoff to surface waters. Many more storm system outfalls owned by Towns, Villages and the State also discharge to surface waters, providing a direct conduit to the surface waters. Mapping of the stormwater outfalls with respect to the sampling stations identified in the mappings included in this memo would help to identify these potentially direct sources of pathogen contamination.

- Site-specific field surveys of wildlife, birds or pet populations. For example, Suffolk County Department of Public Works, Suffolk County Department of Economic Development and Planning and Cornell Cooperative Extension have embarked on a program to reduce the impacts of the resident goose population on the quality of stormwater runoff. The existing goose management sites shown on **Figure 2-59** coincide with a number of the water bodies in **Table 2-63**; further site-specific evaluation would be required to discern which potential source of the pathogen indicators is causing the observed impairments.

- Bacterial Source Tracking (BST) to identify whether the source of observed pathogen indicators is human, other mammal or avian in origin. For example, Cornell Cooperative Extension had developed a DNA library specific to Long Island; coliform samples could be evaluated to identify the probable source, and even the host species (e.g., Canada goose). A data collection and evaluation program incorporating BST would help to more definitively identify the source(s) of observed fecal coliform contamination.

Initial sampling locations for BST could be focused within the subwatersheds identified in this analysis as they are believed to represent the subwatersheds with the highest potential for pathogen impacts from onsite wastewater sources. Statistical analysis could then be completed against the findings presented herein to see if there is a direct correlation between the estimated percent of pathogens from sanitary wastewater and the planning criteria used in this evaluation.

All work should be coordinated with the NYSDEC who is currently completing a Countywide BST study in support of developing a revised pathogen TMDL for Suffolk County waters.



Source: Suffolk County Stormwater Management Program

Figure 2-59 Suffolk County Resident Canada Goose Management Locations

2.2.5.4.1 Preliminary Treatment Considerations

Pathogen removal from onsite wastewater treatment systems primarily occurs when the microorganisms experience die-off as they are sorbed to soil media. The sediment in the unsaturated subsurface is typically an inhospitable habitat for pathogens that originate in the human body. Required travel times through environmental buffers downstream of indirect potable reuse systems in California and Massachusetts range from six months to twelve months for example. Increasing the distance between the on-site wastewater discharge depth and the groundwater table and/or the distance between an I/A OWTS discharge and a surface water is one potential approach to reduce pathogen impacts on downgradient surface waters.

2.2.6 Recommendations for Constrained Sites

While implementation of I/A OWTS is the presumptive wastewater management approach for most parcels in Suffolk County, other alternatives may be more appropriate for constrained sites or sites with other unique conditions. Due to site conditions such as small parcel size and shallow depth to groundwater, I/A OWTS implementation will be challenging on approximately one percent of the unsewered parcels in the County. Based on available information, there are currently approximately 2,946 unsewered residential parcels and 211 commercial parcels that are less than 5,000 square feet with a depth to groundwater greater than 10 feet.

As summarized by **Table 2-56** and Section 2.2.3 and presented in more detail in Appendix E, cluster systems should be considered as potentially more appropriate for constrained sites where parcel sizes and/or a high groundwater table make I/A OWTS implementation difficult.

In addition, special considerations (e.g., use of alternative leaching systems and/or incorporation of best fit construction allowances for leaching facilities) will be required for I/A OWTS implementation in some areas such as Fire Island National Seashore.

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Section 2 Tables

Table 2-1 Subwatersheds Wastewater Plan Subwatersheds List

Waterbody ID	ID Source	Contributing PWL ID(s)	Proposed PWL ID	Town/Village	Estuary Program	Notes
Abets Creek	SCDHS_Estuary_Stream	1701-0327	1701-0327-AC	Brookhaven	SSER	Disaggregated from Tidal Tribs to patchogue bay; note, PWL in Google Earth incorrect identifies this as Little Nortwest Creek
Acabonack Harbor	PWL_Estuary		1701-0047	East Hampton	PEP	No change
Agawam Lake	PWL_Lake		1701-0117	Southampton	NA	No change
Amityville Creek	SCDHS_Estuary_Stream	1701-0087, 1701-0372	1701-0087+0372	Babylon	SSER	Aggregated with Tidal Tribs to great south bay, west.
Aspatuck Creek and River	SCDHS_Estuary_Stream	1701-0303	1701-0303-AC	Southampton	SSER	Disaggregated from Tidal Tribs to Quantuck Bay
Awixa Creek	SCDHS_Estuary_Stream	1701-0093, 1701-0338	1701-0093+0338	Islip	SSER	Aggregated with Tidal Tribs to great south bay, middle.
Beaverdam Pond	SCDHS_Estuary_Stream	1701-0307, 1701-0306	1701-0307+0306	Southampton	SSER	Aggregated with Tidal Tribs to East Moriches Bay
Beaverdam Creek	SCDHS_Estuary_Stream	1701-0104, 1701-0324	1701-0324+0104	Brookhaven	SSER	Aggregated with Beaverdam Creek and Tribs (Headwaters)
Bellport Bay	PWL_Estuary		1701-0320+0325	Brookhaven	SSER	No change
Belmont Lake	PWL_Lake		1701-0021+0089	Babylon	SSER	No change
Big Reed Pond	PWL_Lake		1701-0281	East Hampton	PEP	No change
Big/Little Fresh Ponds	PWL_Lake		1701-0125	Southampton	NA	No change
Block Island Sound	PWL_Estuary		1701-0278	East Hampton, Southold	PEP	No change
Brightwaters Canal, Nosreka, Mirror, and Cascade Lakes	SCDHS_Estuary_Stream	1701-0342, 1701-0338	1701-0338-BC+0342	Babylon	SSER	Disaggregated from Tidal Tribs to great south bay, middle and aggregated with Cascade Lake
Brown Creek	SCDHS_Estuary_Stream	1701-0097, 1701-0333	1701-0097+0333	Islip	SSER	Aggregated with Brown Creek Upper and Trib, Mill Pond and Tidal Section downgradient
Brushes Creek	SCDHS_Estuary	1701-0247	1701-0247-BC+0249	Southold	PEP	Disaggregated from Tidal Tribs to Great Peconic Bay North Shore due to PSP event(s)
Carlls River	SCDHS_Estuary_Stream	1701-0089, 1701-0346, 1701-0345, 1701-0344, 1701-0372	1701-0089+0346+0345+0344+0372	Babylon	SSER	Aggregated with Elda Lake, Southards Pond, and Memorial pond and Tribs to Great South Bay, Middle
Carmans River Lower, and Tribs	PWL_Estuary		1701-0321-rev	Brookhaven	SSER	No change
Carmans River Upper, and Tribs	PWL_Stream	1701-0102, 1701-0323, 1701-0322	1701-0102-rev+0322+0323	Brookhaven	SSER	Aggregated with Upper Lake and Lower Lake
Cedar Beach Creek and Tidal Tribs	PWL_Estuary		1701-0243	Southold	PEP	No change
Centerport Harbor	PWL_Estuary		1702-0229	Huntington	LISS	No change
Champlin Creek	SCDHS_Estuary_Stream	1701-0019, 1701-0340, 1701-0338	1701-0019+0338+0340	Islip	SSER	Aggregated with Lower/Upper Winganhauppauge, Knapp Lakes, and Tribs to Great South Bay, Middle
Coecles Harbor	PWL_Estuary		1701-0163	Shelter Island	PEP	No change
Cold Spring Harbor, and Tidal Tribs	PWL_Estuary		1702-0018+0156	Huntington	LISS	No change
Cold Spring Pond and Tribs	PWL_Estuary		1701-0127	Southampton	PEP	No change
Connetquot River, Lower, and Tribs	PWL_Estuary		1701-0337	Brookhaven	SSER	To be Disaggregated from Grand Canal
Connetquot River, Upper, and Tribs	PWL_Stream	1701-0095, 1701-0339	1701-0095+0339	Islip	SSER	Aggregated with West Brook Pond
Conscience Bay and Tidal Tribs	PWL_Estuary		1702-0091	Brookhaven	LISS	No change
Corey Creek and Tidal Tribs	PWL_Estuary		1701-0244	Southold	PEP	No change
Corey Lake and Creek, and Tribs	SCDHS_Estuary_Stream	1701-0327	1701-0329+0327-CL	Brookhaven	SSER	Disaggregate from Tidal Tribs to Patchogue Bay
Crab Meadow Creek	SCDHS_Estuary_Stream	1702-0232	1702-0232-CMC+0234	Huntington	LISS	Disaggregated from Tidal Tribs to Long Island Sound
Cutchogue Harbor	PWL_Estuary		1701-0045-CH	Southold	PEP	No change
Cutchogue Harbor - East Creek	SCDHS_Estuary	1701-0045	1701-0045-EC	Southold	PEP	Disaggregated from Cutchogue Harbor based upon geometry and land use.
Cutchogue Harbor - Mud Creek	SCDHS_Estuary	1701-0045	1701-0045-MC	Southold	PEP	Disaggregated from Cutchogue Harbor based upon geometry and land use.
Cutchogue Harbor - Wickham Creek	SCDHS_Estuary	1701-0045	1701-0045-WC	Southold	PEP	Disaggregated from Cutchogue Harbor based upon geometry and land use.
Dam Pond	PWL_Estuary		1701-0228	Southold	PEP	No change
Deep Hole Creek	SCDHS_Estuary	1701-0247	1701-0247-DHC+0249	Southold	PEP	Disaggregated from Tidal Tribs to Great Peconic Bay North Shore
Deep Pond	PWL_Lake		1701-0270	Riverhead	NA	No change
Dering Harbor	PWL_Estuary		1701-0050+	Shelter Island	PEP	No change
Dickerson Creek	SCDHS_Estuary	1701-0242	1701-0242-DC	Shelter Island	PEP	Disaggregated from Dickerson, West Neck, and Menantic Creek PWL
Duck Island Harbor	PWL_Estuary		1702-0262	Huntington	LISS	No change
Dunton Lake, Upper, and Tribs and Hedges Creek	SCDHS_Estuary_Stream	1701-0330, 1701-0327	1701-0330-HC+0327	Brookhaven	SSER	Aggregate with Tidal Tribs to patchogue bay
Far Pond	SCDHS_Estuary	1701-0295	1701-0295-FP	Southampton	SSER	Disaggregated from Old Fort, Middle, and Far Ponds due to differences in adacent land use.
Fish Cove	SCDHS_Estuary	1701-0037	1701-0037-FC	Southampton	PEP	Disaggregated from North Sea Harbor based on shoreline geography and land use. Note - not currently on PWL list.
Flanders Bay, East/Center, and Tribs	PWL_Estuary		1701-0030+0255+0273	Riverhead, Southampton	PEP	No change
Flanders Bay, West/Lower Sawmill Creek	PWL_Estuary		1701-0254+0257	Riverhead, Southampton	PEP	No change
Flax Pond	PWL_Estuary		1702-0240	Brookhaven	LISS	No change
Forge River and Tidal Tribs	SCDHS_Estuary	1701-0316, 1701-0312	1701-0316-FR+0312+0026	Brookhaven	SSER	Aggregated with Tidal Tribs to West Moriches Bay and West and East Mill Ponds and Disaggregated from Forge River Cove
Forge River Cove and Tidal Tribs	SCDHS_Estuary	1701-0316, 1701-0312	1701-0316-FRC+0312	Brookhaven	SSER	Aggregated with Tidal Tribs to West Moriches Bay and Disaggregated from Forge River Lower (includes Areskonk Creek)
Fort Pond	PWL_Lake		1701-0122	East Hampton	PEP	No change
Fort Pond Bay	PWL_Estuary		1701-0370	East Hampton	PEP	No change
Fresh Pond	PWL_Estuary		1701-0279	East Hampton	PEP	No change

Table 2-1 Subwatersheds Wastewater Plan Subwatersheds List

Waterbody ID	ID Source	Contributing PWL ID(s)	Proposed PWL ID	Town/Village	Estuary Program	Notes
Abets Creek	SCDHS_Estuary_Stream	1701-0327	1701-0327-AC	Brookhaven	SSER	Disaggregated from Tidal Tribs to patchogue bay; note, PWL in Google Earth incorrect identifies this as Little Nortwest Creek
Fresh Pond Creek and Tribs	PWL_Stream		1702-0244	Riverhead	LISS	No change
Gardiners Bay and minor Tidal Tribs	PWL_Estuary		1701-0164	East Hampton, Shelter Island, Southold	PEP	No change
Georgica Pond	PWL_Estuary		1701-0145	East Hampton	NA	No change
Goldsmith Inlet	PWL_Estuary		1702-0026	Southold	LISS	No change
Goose Creek	PWL_Estuary		1701-0236	Southold	PEP	No change
Goose Neck Creek	SCDHS_Estuary	1701-0272	1701-0272-GNC	Southampton	PEP	Disaggregated from Reeves Bay due to geography and land use.
Grand Canal	SCDHS_Estuary	1701-0337	1701-0337-GC	Islip	SSER	Disaggregated from Connetquot River Lower due to significant impairments.
Great Cove	PWL_Estuary		1701-0376+0338	Islip	SSER	No change
Great Peconic Bay and minor coves	PWL_Estuary	1701-0251, 1701-0247, 1701-0165	1701-0165+0247+0249+0251	Riverhead, Southampton, Southold	PEP	Aggregated with Squire Pond and select Tribs to Great Peconic Bay Northshr that have not been disaggregated herein
Great South Bay, East	PWL_Estuary		1701-0039-rev+0333	Brookhaven	SSER	No change
Great South Bay, Middle	PWL_Estuary		1701-0040-rev	Babylon, Brookhaven, Islip	SSER	No change
Great South Bay, West	PWL_Estuary		1701-0173+0372	Babylon, Islip	SSER	No change
Green Creek, Upper, and Tribs	PWL_Stream		1701-0096+0333	Islip	SSER	No change
Gull Pond	PWL_Estuary		1701-0231	Southold	PEP	No change
Hallock/Long Beach Bay and Tidal Tribs	PWL_Estuary		1701-0227	Southold	PEP	No change
Halsey Neck Pond	PWL_Estuary		1701-0355	Southampton	SSER	No change
Harts Cove	SCDHS_Estuary	1701-0309	1701-0309-HC	Brookhaven	SSER	Disaggregated fromTuthill, Harts, and Seatuck PWL based upon geometry and land use.
Hashamomuck Pond/Long Creek and Budd's Pond	PWL_Estuary	1701-0162, 1701-0234	1701-0162+0234	Southold	PEP	Aggregated with Budd's Pond
Heady and Taylor Creeks and Tribs	PWL_Estuary		1701-0294	Southampton	SSER	No change
Hog Creek and Tidal Tribs	PWL_Estuary		1701-0277	East Hampton	PEP	No change
Hook Pond	PWL_Lake		1701-0131	East Hampton	NA	No change
Howell's Creek	SCDHS_Estuary	1701-0327	1701-0327-HC	Brookhaven	SSER	Disaggregated from Tidal Tribs to Patchogue Bay.
Huntington Bay	PWL_Estuary		1702-0014	Huntington	LISS	No change
Huntington Harbor	PWL_Estuary		1702-0228+0231	Huntington	LISS	No change
James Creek	SCHDS_Estuary	1701-0247	1701-0247-JC+0249	Southold	PEP	Disaggregated from Tidal Tribs Great Peconic Bay due to PSP event(s)
Kellis Pond	PWL_Lake		1701-0290	Southampton	NA	No change
Lake Montauk	PWL_Estuary		1701-0031	East Hampton	PEP	No change
Lake Panamoka (Long Pond)	PWL_Lake		1701-0134	Brookhaven	NA	No change
Lake Ronkonkoma	PWL_Lake		1701-0020	Brookhaven, Islip, Smithtown	NA	No change
Laurel Pond	PWL_Lake		1701-0128	Southold	PEP	No change
Lawrence Creek, O-co-nee and Lawrence Lakes	SCDHS_Estuary_Stream	1701-0372	1701-0338-LC	Babylon	SSER	Disaggregated with Tidal Tribs to Great South Bay, West
Ligonee Brook and Tribs	PWL_Stream	1701-0353, 1701-0352	1701-0352+0353	Southampton	PEP	Aggregated with Long, Crooked, Little Long Ponds
Little Long, Long, and Shorts Pond			1701-0291	Southampton	LISS	New
Little Peconic Bay	PWL_Estuary	1701-0126, 1701-0172	1701-0126+0172	Southampton, Southold	PEP	Aggregated with Little Fresh Pond (appears to be estuarine)
Little Sebonac Creek	PWL_Estuary		1701-0253	Southampton	PEP	No change
Lloyd Harbor	PWL_Estuary		1702-0227	Huntington	LISS	No change
Long Island Sound, Suffolk Co, Central	PWL_Estuary		1702-0265	Brookhaven, Riverhead, Southold	LISS	No change
Long Island Sound, Suffolk County, East	PWL_Estuary		1702-0266	Southold	LISS	No change
Long Island Sound, Suffolk County, West	PWL_Estuary		1702-0098+0232	Brookhaven, Huntington, Smithtown	LISS	No change
Marion Lake	PWL_Estuary		1701-0229	Southold	PEP	No change
Mattituck (Marratooka) Pond	PWL_Lake		1701-0129	Southold	PEP	No change
Mattituck Inlet/Cr, Low, and Tidal Tribs	PWL_Estuary	1702-0245, 1702-0020	1702-0020+0245	Southold	LISS	Aggregated with Tribs to Mattituck Creek
Mecox Bay and Tribs	PWL_Estuary	1701-0289, 1701-0292, 1701-0034	1701-0034+0289+0292	Southampton	NA	Aggregated with Tribs (fresh) to Mecox Bay and Channel Pond
Meetinghouse Creek and Tribs	SCDHS_Estuary	1701-0256	1701-0256-MC	Riverhead	PEP	Disaggregated from Meetinghouse/Terry's Creek PWL ID to account for differences in water quality.
Menantic Creek			1701-0242-MC	Shelter Island	PEP	New
Middle Pond	SCDHS_Estuary	1701-0295	1701-0295-MP	Southampton	SSER	Disaggregated from Old Fort, Middle, and Far Ponds due to differences in adacent land use.
Mill Creek and Tidal Tribs	PWL_Estuary		1701-0238+	Southampton	PEP	Aggregated with Trout Pond (not on PWL)
Mill Pond	SCDHS_Estuary	1702-0229	1702-0261	Huntington	LISS	Added based on 2016 fish kills; no existing PWL
Mill Pond and Sevens Ponds	PWL_Lake		1701-0113+0289	Southampton	NA	No change
Moriches Bay East	PWL_Estuary		1701-0305-rev+0306	Brookhaven, Southampton	SSER	No change
Moriches Bay West	PWL_Estuary		1701-0038-rev	Brookhaven	SSER	No change
Mt Sinai Harbor and Tidal Tribs	PWL_Estuary		1702-0019	Brookhaven	LISS	No change

Table 2-1 Subwatersheds Wastewater Plan Subwatersheds List

Waterbody ID	ID Source	Contributing PWL ID(s)	Proposed PWL ID	Town/Village	Estuary Program	Notes
Abets Creek	SCDHS_Estuary_Stream	1701-0327	1701-0327-AC	Brookhaven	SSER	Disaggregated from Tidal Tribs to patchogue bay; note, PWL in Google Earth incorrect identifies this as Little Nortwest Creek
Mud and Senix Creeks	SCDHS_Estuary	1701-0316	1701-0312-MSC	Brookhaven	SSER	Disaggregated from Forge River, Lower and Cove.
Mud Creek, Robinson Pond, and Tidal Tribs	SCDHS_Estuary_Stream	1701-0101, 1701-0331, 1701-0327	1701-0101+0331+0327	Brookhaven	SSER	Aggregated with Tidal Tribs to Patchogue Bay and Mud Creek
Napeague Bay	PWL_Estuary		1701-0369	East Hampton	PEP	No change
Napeague Harbor and Tidal Tribs	PWL_Estuary		1701-0166	East Hampton	PEP	No change
Narrow Bay	PWL_Estuary		1701-0318+0319	Brookhaven	SSER	No change
Neguntatogue Creek	SCDHS_Estuary_Stream	1701-0088, 1701-0372	1701-0088+0372	Babylon	SSER	Aggregated with Tidal Tribs to Great South Bay, West
Nicoll Bay	PWL_Estuary		1701-0375+0333	Brookhaven, Islip	SSER	No change
Nissequogue River Lower/Sunken Meadow Creek	PWL_Estuary	1702-0234, 1702-0025	1702-0025+0234+0232	Smithtown	LISS	Aggregated with Sunken Meadow Creek (Tribs (freshwater) to Long Island Sound)
Nissequogue River Upper, and Tribs	PWL_Stream	1702-0235, 1702-0013, 1702-0238, 1702-0237, 1702-0236	1702-0235+0013+0238+0237+023	Islip, Smithtown	LISS	Aggregated with Philips Mill Pond, Willow Pond, New Mill Pond, and Millers Pond
North Sea Harbor and Tribs	PWL_Estuary		1701-0037	Southampton	PEP	No change
Northport Bay	PWL_Estuary		1702-0256	Huntington	LISS	No change
Northport Harbor	PWL_Estuary		1702-0230	Huntington	LISS	No change
Northwest Creek and Tidal Tribs	PWL_Estuary		1701-0046	East Hampton	PEP	No change
Northwest Harbor	PWL_Estuary	1701-0276, 1701-0275, 1701-0368	1701-0368+0275+0276	East Hampton, Shelter Island	PEP	Includes Alewife Brook/Pond and Scoy Pond
Noyack Bay	PWL_Estuary		1701-0167-rev	Shelter Island, Southampton, Southold	PEP	No change
Noyack Creek and Tidal Tribs	PWL_Estuary		1701-0237	Southampton	PEP	No change
Ogden Pond	PWL_Estuary		1701-0302	Southampton	SSER	No change
Old Fort Pond	SCDHS_Estuary	1701-0295	1701-0295-OFP	Southampton	SSER	Disaggregated from Old Fort, Middle, and Far Ponds due to differences in adacent land use.
Old Town Pond	PWL_Lake		1701-0118	Southampton	NA	No change
Orchard Neck Creek	SCDHS_Estuary	1701-0316	1701-0312-ONC	Brookhaven	SSER	Disaggregated from Forge River, Lower and Cove.
Orient Harbor and minor Tidal Tribs	PWL_Estuary		1701-0168	Shelter Island, Southold	PEP	No change
Oyster Pond/Lake Munchogue	PWL_Estuary		1701-0169	East Hampton	PEP	No change
Pardees, Orowoc Lakes, Creek, and Tidal Tribs	SCDHS_Estuary_Stream	1701-0094, 1701-0341, 1701-0338	1701-0094+0341+0338	Islip	SSER	Aggregated with Pardees, Orowoc Lakes and Tidal Tribs to Great South Bay, Middle
Patchogue Bay	PWL_Estuary		1701-0326	Brookhaven	SSER	No change
Patchogue River	SCDHS_Estuary_Stream	1701-0099, 1701-0018, 1701-0055, 1701-0327	1701-0099+0018+0055+0327	Brookhaven	SSER	Aggregated with Patchogue River Upper and Tribs, Canaan lake, Patchogue lake and Tidal Tribs to patchogue bay
Pattersquash Creek	SCDHS_Estuary	1701-0319	1701-0319-PC	Brookhaven	SSER	Disaggregated from Tidal Tribs to Narrow Bay based on size and adjacent land use; remaining Tribs to be aggregated into Narrow Bay
Peconic River Middle, and Tribs	PWL_Stream	1701-0269, 1701-0262, 1701-0261	1701-0261+0262+0269	Brookhaven, Riverhead	PEP	Aggregated with associated Tribs to Peconic River, Peconic Lake and Swan Pond
Peconic River Upper, and Tribs	PWL_Stream	1701-0265, 1701-0266, 1701-0269, 1701-0108	1701-0108+0265+0266+0269	Brookhaven, Riverhead, Southampton	PEP	Aggregated with Tribs to Peconic River and Minor Lakes in Upper Peconic Watershed and Swan Pond
Peconic River, Lower, and Tidal Tribs	PWL_Estuary	1701-0259,1701-0263	1701-0259+0263	Riverhead, Southampton	PEP	Aggregated with associated Tribs to Peconic
Penataquit Creek	SCDHS_Estuary_Stream	1701-0092, 1701-0338	1701-0092+0338	Islip	SSER	Aggregated with Tidal Tribs to Great South Bay, Middle
Penniman Creek and Tidal Tribs	PWL_Estuary		1701-0300	Southampton	SSER	No change
Penny Pond, Wells, Smith, and Gilbert Creeks	PWL_Estuary		1701-0298-rev+0033	Southampton	SSER	Aggregated in Gilbert Creek; adjusted administrative boundary to include cove.
Phillips Creek, Lower, and Tidal Tribs	PWL_Estuary		1701-0299	Southampton	SSER	No change
Pipes Cove	PWL_Estuary		1701-0366	Shelter Island, Southold	PEP	No change
Port Jefferson Harbor, North, and Tribs	PWL_Estuary		1702-0015	Brookhaven	LISS	No change
Port Jefferson Harbor, South, and Tribs	PWL_Estuary		1702-0241	Brookhaven	LISS	No change
Quantuck Bay	PWL_Estuary		1701-0042+0303	Southampton	SSER	No change
Quantuck Canal/Moneybogue Bay	PWL_Estuary		1701-0371	Southampton	SSER	No change
Quantuck Creek and Old Ice Pond	SCDHS_Estuary_Stream	1701-0303, 1701-0304	1701-0303-QC+0304	Southampton	SSER	Disaggregated from Tidal Tribs to Quantuck Bay and Aggregated with Old Ice Pond
Quogue Canal	PWL_Estuary		1701-0301	Southampton	SSER	No change
Red Creek Pond and Tidal Tribs	PWL_Estuary		1701-0250	Southampton	PEP	No change
Reeves Bay and Tidal Tribs	PWL_Estuary		1701-0272-RB	Southampton	PEP	No change
Richmond Creek and Tidal Tribs	PWL_Estuary		1701-0245	Southold	PEP	No change
Sag Harbor	SCDHS_Estuary	1701-0035, 1701-0239	1701-0035-SH+0239	East Hampton	PEP	Disaggregated from Sag Harbor/Sag Harbor Cove PWL and aggregated with Little Northwest Creek and Tribs
Sag Harbor Cove and Tribs	SCDHS_Estuary_Stream	1701-0035	1701-0035-SHC	East Hampton, Southampton	PEP	Disaggregated from Sag Harbor/Sag Harbor Cove PWL based upon geometry/land use.
Sagaponack Pond and Poxabogue Pond	PWL_Estuary		1701-0146+0286	Southampton	PEP	No change
Sampawams Creek	SCDHS_Estuary_Stream	1701-0090, 1701-0372	1701-0090+0372+0343	Babylon, Islip	SSER	Aggregated with Tidal Tribs to great south bay, west

Table 2-1 Subwatersheds Wastewater Plan Subwatersheds List

Waterbody ID	ID Source	Contributing PWL ID(s)	Proposed PWL ID	Town/Village	Estuary Program	Notes
Abets Creek	SCDHS_Estuary_Stream	1701-0327	1701-0327-AC	Brookhaven	SSER	Disaggregated from Tidal Tribs to patchogue bay; note, PWL in Google Earth incorrect identifies this as Little Nortwest Creek
Sans Souci Lakes	SCDHS_Lake	1701-0336, 1701-0335	1701-0336+0335	Islip	SSER	Aggregated with Lotus Lake
Santapogue Creek	SCDHS_Estuary_Stream	1701-0016, 1701-0372	1701-0016+0372	Babylon	SSER	Aggregated with Tidal Tribs to great south bay, west
Scallop Pond	PWL_Estuary		1701-0354	Southampton	PEP	No change
Seatuck Cove and Tidal Tribs	SCDHS_Estuary	1701-0309	1701-0309-SC+0306+0311	Brookhaven/Southampton	SSER	Disaggregated fromTuthill, Harts, and Seatuck PWL; includes Unnamed (Eastport) Pond
Sebonac Cr/Bullhead Bay and Tidal Tribs	PWL_Estuary		1701-0051	Southampton	PEP	No change
Setauket Harbor	PWL_Estuary		1702-0242	Brookhaven	LISS	No change
Sheepen Creek	SCDHS_Estuary	1701-0319	1701-0319-SC	Brookhaven	SSER	Disaggregated from Tidal Tribs to Narrow Bay based on size and adjacent land use; remaining Tribs to be aggregated into Narrow Bay
Shelter Island Sound, North, and Tribs	PWL_Estuary		1701-0170	Shelter Island, Southold	PEP	No change
Shelter Island Sound, South, and Tribs	PWL_Estuary	1701-0240, 1701-0365	1701-0365-rev+0240	East Hampton, Shelter Island, Southampton, Southold	PEP	Aggregated with Crab Creek and Tidal Tribs
Shinnecock Bay - Bennet Cove (Cormorant Cove)	SCDHS_Estuary	1701-0033, 1701-0252, 1701-0296	1701-0033-BC+0252+0296	Southampton	SSER	Disaggregated from Shinnecock Bay; aggregated with Shinnecock Canal
Shinnecock Bay Central	SCDHS_Estuary	1701-0033	1701-0033-C	Southampton	SSER	Disaggregated from Shinnecock Bay (and Inlet)
Shinnecock Bay East	SCDHS_Estuary	1701-0033	1701-0033-E	Southampton	SSER	Disaggregated from Shinnecock Bay (and Inlet)
Shinnecock Bay West	SCDHS_Estuary	1701-0033	1701-0033-W	Southampton	SSER	Disaggregated from Shinnecock Bay (and Inlet)
SI Sound Trib/Moores Drain, Lower, Tribs	PWL_Estuary		1701-0232+0233	Shelter Island, Southold	PEP	No change
Smithtown Bay	PWL_Estuary	1702-0233	1702-0023+0233+0234	Brookhaven, Huntington, Smithtown	LISS	Aggregate in Fresh Pond (Fort Salonga)
Southold Bay	PWL_Estuary		1701-0044	Southold	PEP	No change
Speonk River	SCDHS_Estuary_Stream	1701-0306	1701-0306-SR	Southampton	SSER	Aggregated with Tidal Tribs to East Moriches Bay
Spring Pond	PWL_Estuary		1701-0230	Southold	PEP	No change
Stillman Creek	SCDHS_Estuary_Stream	1701-0329	1701-0329-SC	Brookhaven	SSER	Disaggregated from Minor Tribs to Patchogue bay
Stirling Creek and Basin	PWL_Estuary		1701-0049	Southold	PEP	No change
Stony Brook Harbor and West Meadow Creek	PWL_Estuary		1702-0047+0239	Brookhaven, Smithtown	LISS	No change
Swan River, Swan Lake, and Tidal Tribs	SCDHS_Estuary_Stream	1701-0100, 1701-0332, 1701-0327	1701-0100+0332+0329+0327	Brookhaven	SSER	Aggregated with Swan River, Swan Lake and Tidal Tribs to Patchogue bay
Terrell River	SCDHS_Estuary_Stream	1701-0103, 1701-0314, 1701-0313	1701-0103+0313+0314	Brookhaven	SSER	Aggregated with Mill Pond, upper, and lower river
Terry's Creek and Tribs	SCDHS_Estuary	1701-0256	1701-0256-TC	Riverhead	PEP	Disaggregated from Flanders Bay, East/Center, and Tribs
Three Mile Harbor	PWL_Estuary		1701-0036	East Hampton	PEP	No change
Tiana Bay and Tidal Tribs	PWL_Estuary		1701-0112	Southampton	SSER	No change
Town/Jockey Creeks and Tidal Tribs	PWL_Estuary		1701-0235	Southold	PEP	No change
Tuthill Cove	SCDHS_Estuary	1701-0309	1701-0309-TC	Brookhaven	SSER	Disaggregated fromTuthill, Harts, and Seatuck PWL.
Tuthills Creek	SCDHS_Estuary_Stream	1701-0098, 1701-0334, 1701-0329, 1701-0327	1701-0098+0327+0329+0334	Brookhaven, Islip	SSER	Aggregated with West Lake, Minor Tribs to Patchogue Bay, and Tidal Tribs to Patchogue Bay
Unchachogue/Johns Neck Creeks	SCDHS_Estuary	1701-0319	1701-0319-UC	Brookhaven	SSER	Disaggregated from Tidal Tribs to Narrow Bay based on size and adjacent land use; remaining Tribs to be aggregated into Narrow Bay
Wading River	SCDHS_Estuary_Stream	1702-0243, 1702-0099	1702-0099+0243	Brookhaven, Riverhead	LISS	Aggregated upper and lower segments.
Wainscott Pond/Fairfield Pond	PWL_Lake		1701-0144	East Hampton	NA	No change
Weesuck Creek and Tidal Tribs	PWL_Estuary		1701-0111-rev	Southampton	SSER	No change
West Creek and Tidal Tribs	PWL_Estuary		1701-0246	Southold	PEP	No change
West Neck Bay and Creek	SCDHS_Estuary	1701-0242	1701-0242-WB	Shelter Island	PEP	Disaggregated from Dickerson, West Neck, and Menantic Creek PWL
West Neck Harbor	PWL_Estuary	1701-0242, 1701-0132	1701-0132-rev	Shelter Island	PEP	Aggregated with Menantic Creek
Wickapogue Pond	PWL_Lake		1701-0119	Southampton	NA	No change
Wildwood Lake (Great Pond)	PWL_Lake		1701-0264	Southampton	PEP	No change
Willets Creek	SCDHS_Estuary_Stream	1701-0091, 1701-0175, 1701-0372	1701-0091+0175+0372	Islip	SSER	Aggregated with Lake Capri and Tidal Tribs to great south bay, west
Wooley Pond	PWL_Estuary		1701-0048+	Southampton	PEP	No change

Notes:

1. ALL NYSDEC PWL estuaries are incorporated as either no change, aggregated, or disaggregated, as described in notes
2. All freshwater ponds which drain to estuaries are incorporated through aggregation, except as noted. Undrained ponds and/or streams are not included except as identified by PWL_Lake.
3. SCDHS_ designations represents identification of SCDHS aggregated PWL systems or new waterbodies added based upon SCDHS data.

Table 2-3 Subwatersheds Characterized Using Averages for One or More Parameters

(Parameters shaded light blue identify use of average values)

Subwatershed Name	SWP PWL Number	90th Percentile TN (mg/L)	90th Percentile TP (mg/L)	10th Percentile D.O. (mg/L)	90th Percentile Chl-a (µg/L)	Average Secchi Depth (ft)
Amityville Creek	1701-0087+0372	1.38	0.10	0.53	15.30	5.37
Beaverdam Creek	1701-0324+0104	3.65	0.05	3.98	28.29	3.30
Belmont Lake	1701-0021+0089	0.46	0.10	5.77	28.29	4.01
Big/Little Fresh Ponds	1701-0125	0.76	0.05	5.77	26.55	8.59
Block Island Sound	1701-0278	0.37	0.10	7.34	3.06	11.70
Brushes Creek	1701-0247-BC+0249	6.93	0.06	7.16	28.29	3.25
Champlin Creek	1701-0019+0338+0340	3.43	0.10	6.90	9.30	3.28
Connetquot River, Upper, and Tribs	1701-0095+0339	2.88	0.01	9.70	28.29	5.37
Crab Meadow Creek	1702-0232-CMC+0234	1.51	0.09	5.20	3.06	5.37
Cutchogue Harbor - Mud Creek	1701-0045-MC	3.93	0.05	4.60	28.29	5.37
Cutchogue Harbor - Wickham Creek	1701-0045-WC	3.86	0.22	5.26	28.29	5.37
Dickerson Creek	1701-0242-DC	0.28	0.05	6.51	4.39	5.37
Dunton Lake, Upper, and Tribs and Hedges Creek	1701-0330-HC+0327	0.87	0.08	6.60	25.00	5.37
Flax Pond	1702-0240	0.48	0.07	3.90	9.78	5.37
Fort Pond	1701-0122	0.79	0.05	7.78	46.78	5.37
Fort Pond Bay	1701-0370	0.36	0.05	10.26	6.65	5.37
Fresh Pond	1701-0279	0.57	0.05	6.63	11.40	5.37
Fresh Pond Creek and Tribs	1702-0244	0.67	0.06	14.30	2.41	5.37
Georgica Pond	1701-0145	0.92	0.05	6.41	27.02	5.37
Halsey Neck Pond	1701-0355	2.20	0.05	1.23	2.20	5.37
Hog Creek and Tidal Tribs	1701-0277	0.42	0.05	7.60	6.85	5.37
Howell's Creek	1701-0327-HC	2.66	0.05	7.53	33.44	5.37
Kellis Pond	1701-0290	1.44	0.05	5.23	136.57	5.37

Table 2-3 Subwatersheds Characterized Using Averages for One or More Parameters

Subwatershed Name	SWP PWL Number	90th Percentile TN (mg/L)	90th Percentile TP (mg/L)	10th Percentile D.O. (mg/L)	90th Percentile Chl-a (µg/L)	Average Secchi Depth (ft)
Little Long, Long, and Shorts Pond	1701-0291	0.57	0.04	5.77	4.58	4.60
Marion Lake	1701-0229	0.89	0.05	5.62	15.90	5.37
Mecox Bay and Tribs	1701-0034+0289+0292	1.14	0.10	5.77	28.29	5.37
Mill Pond	1702-0261	1.98	0.11	6.40	28.29	5.37
Mill Pond and Sevens Ponds	1701-0113+0289	2.10	0.19	7.04	60.26	5.37
Mud Creek, Robinson Pond, and Tidal Tribs	1701-0101+0331+0327	1.40	0.58	3.40	28.29	5.37
Neguntatogue Creek	1701-0088+0372	1.14	0.10	5.77	28.29	5.37
Old Fort Pond	1701-0295-OFP	0.92	0.07	7.36	28.29	5.37
Old Town Pond	1701-0118	1.44	0.14	7.90	321.40	5.37
Oyster Pond/Lake Munchogue	1701-0169	1.14	0.10	5.77	28.29	5.25
Patchogue River	1701-0099+0018+0055+0327	4.01	0.12	5.05	22.00	5.37
Peconic River Middle, and Tribs	1701-0261+0262+0269	1.01	0.42	8.40	28.29	1.83
Peconic River Upper, and Tribs	1701-0108+0265+0266+0269	0.31	0.05	6.77	28.29	5.37
Penataquit Creek	1701-0092+0338	4.44	0.04	7.60	28.29	5.37
Penny Pond, Wells, Smith, and Gilbert Creeks	1701-0298-rev+0033	1.23	0.14	8.60	28.29	1.50
Pipes Cove	1701-0366	1.21	0.12	1.45	28.29	5.37
Richmond Creek and Tidal Tribs	1701-0245	2.98	0.06	5.85	28.29	5.37
Sagaponack Pond and Poxabogue Pond	1701-0146+0286	1.14	0.10	8.26	28.29	5.37
Sampawams Creek	1701-0090+0372+0343	2.07	0.10	3.40	22.46	5.37
Santapogue Creek	1701-0016+0372	1.80	0.18	3.70	54.11	5.37
SI Sound Trib/Moores	1701-0232+0233	1.23	0.08	2.79	28.29	5.37

Table 2-3 Subwatersheds Characterized Using Averages for One or More Parameters

Subwatershed Name	SWP PWL Number	90th Percentile TN (mg/L)	90th Percentile TP (mg/L)	10th Percentile D.O. (mg/L)	90th Percentile Chl-a (µg/L)	Average Secchi Depth (ft)
Drain, Lower, Tribs						
Stillman Creek	1701-0329-SC	2.41	0.08	5.59	16.91	5.37
Swan River, Swan Lake, and Tidal Tribs	1701-0100+0332+0329+0327	2.78	0.15	5.10	34.24	5.37
Tiana Bay and Tidal Tribs	1701-0112	0.32	0.05	8.20	28.29	4.82
Tuthills Creek	1701-0098+0327+0329+0334	1.25	0.06	6.64	28.29	2.75
Wading River	1702-0099+0243	0.84	0.05	4.60	2.06	5.37
Wainscott Pond/Fairfield Pond	1701-0144	1.14	0.18	7.25	473.73	5.37
West Creek and Tidal Tribs	1701-0246	3.86	0.22	5.26	28.29	5.37

Table 2-4 Subwatersheds Characterized Using Less than 10 Data Points
(Parameters shaded light blue identify use of average values)

Subwatershed Name	SWP PWL Number	90th Percentile TN (mg/L)	90th Percentile TP (mg/L)	10th Percentile D.O. (mg/L)	90th Percentile Chl-a (µg/L)	Average Secchi Depth (ft)
Abets Creek	1701-0327-AC	1.86	0.05	7.02	18.35	2.50
Agawam Lake	1701-0117	3.15	0.05	7.22	40.80	1.31
Amityville Creek	1701-0087+0372	1.38	0.10	0.53	15.30	5.37
Aspatuck Creek and River	1701-0303-AC	1.31	0.06	4.78	24.24	1.50
Awixa Creek	1701-0093+0338	1.08	0.05	11.60	2.82	4.00
Beaverdam Pond	1701-0307+0306	0.68	0.10	6.59	36.44	3.00
Beaverdam Creek	1701-0324+0104	3.65	0.05	3.98	28.29	3.30
Belmont Lake	1701-0021+0089	0.46	0.10	5.77	28.29	4.01
Big Reed Pond	1701-0281	0.78	0.05	6.70	7.15	4.60
Big/Little Fresh Ponds	1701-0125	0.76	0.05	5.77	26.55	8.59
Block Island Sound	1701-0278	0.37	0.10	7.34	3.06	11.70
Brightwaters Canal, Nosreka, Mirror, and Cascade Lakes	1701-0338-BC+0342	1.07	0.05	12.80	3.49	3.00
Brown Creek	1701-0097+0333	1.93	0.05	4.99	7.01	3.25
Brushes Creek	1701-0247-BC+0249	6.93	0.06	7.16	28.29	3.25
Carmans River Upper, and Tribs	1701-0102-rev+0322+0323	1.91	0.06	8.75	13.99	6.20
Cedar Beach Creek and Tidal Tribs	1701-0243	0.47	0.05	4.96	2.05	6.20
Champlin Creek	1701-0019+0338+0340	3.43	0.10	6.90	9.30	3.28
Cold Spring Harbor, and Tidal Tribs	1702-0018+0156	0.61	0.07	2.94	19.93	5.90
Connetquot River, Upper, and Tribs	1701-0095+0339	2.88	0.01	9.70	28.29	5.37
Conscience Bay and Tidal Tribs	1702-0091	0.34	0.05	6.26	8.89	4.58
Corey Creek and Tidal Tribs	1701-0244	0.35	0.05	7.40	2.72	5.63
Corey Lake and Creek, and Tribs	1701-0329+0327-CL	0.93	0.05	4.39	7.97	3.17
Crab Meadow Creek	1702-0232-CMC+0234	1.51	0.09	5.20	3.06	5.37
Cutchogue Harbor - Mud Creek	1701-0045-MC	3.93	0.05	4.60	28.29	5.37
Cutchogue Harbor - Wickham Creek	1701-0045-WC	3.86	0.22	5.26	28.29	5.37

Table 2-4 Subwatersheds Characterized Using Less than 10 Data Points

Subwatershed Name	SWP PWL Number	90th Percentile TN (mg/L)	90th Percentile TP (mg/L)	10th Percentile D.O. (mg/L)	90th Percentile Chl-a (µg/L)	Average Secchi Depth (ft)
Dam Pond	1701-0228	0.50	0.05	6.60	4.69	5.20
Deep Pond	1701-0270	0.66	0.05	6.43	5.58	9.50
Dering Harbor	1701-0050+	0.35	0.05	6.54	3.67	4.50
Dickerson Creek	1701-0242-DC	0.28	0.05	6.51	4.39	5.37
Dunton Lake, Upper, and Tribs and Hedges Creek	1701-0330-HC+0327	0.87	0.08	6.60	25.00	5.37
Far Pond	1701-0295-FP	0.73	0.09	6.57	10.92	1.00
Fish Cove	1701-0037-FC	1.19	0.05	4.86	9.22	4.00
Flax Pond	1702-0240	0.48	0.07	3.90	9.78	5.37
Fort Pond	1701-0122	0.79	0.05	7.78	46.78	5.37
Fort Pond Bay	1701-0370	0.36	0.05	10.26	6.65	5.37
Fresh Pond	1701-0279	0.57	0.05	6.63	11.40	5.37
Fresh Pond Creek and Tribs	1702-0244	0.67	0.06	14.30	2.41	5.37
Georgica Pond	1701-0145	0.92	0.05	6.41	27.02	5.37
Goose Neck Creek	1701-0272-GNC	0.72	0.05	6.51	3.90	8.00
Grand Canal	1701-0337-GC	1.40	0.12	1.70	17.28	1.51
Green Creek, Upper, and Tribs	1701-0096+0333	3.75	0.05	4.73	11.53	4.00
Gull Pond	1701-0231	1.02	0.06	5.40	7.47	3.83
Halsey Neck Pond	1701-0355	2.20	0.05	1.23	2.20	5.37
Heady and Taylor Creeks and Tribs	1701-0294	0.45	0.05	4.11	6.54	5.00
Hog Creek and Tidal Tribs	1701-0277	0.42	0.05	7.60	6.85	5.37
Hook Pond	1701-0131	1.60	0.05	9.39	126.51	0.98
Howell's Creek	1701-0327-HC	2.66	0.05	7.53	33.44	5.37
James Creek	1701-0247-JC+0249	1.03	0.06	5.40	7.67	3.70
Kellis Pond	1701-0290	1.44	0.05	5.23	136.57	5.37
Lake Panamoka (Long Pond)	1701-0134	0.46	0.05	4.60	0.66	7.87
Laurel Pond	1701-0128	0.80	0.05	5.81	30.94	9.19
Lawrence Creek, O-co-nee and Lawrence Lakes	1701-0338-LC	0.82	0.10	1.81	24.27	1.93
Ligonee Brook and Tribs	1701-0352+0353	2.16	0.03	3.86	3.12	8.63
Little Long, Long, and Shorts Pond	1701-0291	0.57	0.04	5.77	4.58	4.60
Marion Lake	1701-0229	0.89	0.05	5.62	15.90	5.37

Table 2-4 Subwatersheds Characterized Using Less than 10 Data Points

Subwatershed Name	SWP PWL Number	90th Percentile TN (mg/L)	90th Percentile TP (mg/L)	10th Percentile D.O. (mg/L)	90th Percentile Chl-a (µg/L)	Average Secchi Depth (ft)
Mattituck (Marratooka) Pond	1701-0129	9.54	2.86	4.80	212.01	2.68
Mecox Bay and Tribs	1701-0034+0289+0292	1.14	0.10	5.77	28.29	5.37
Middle Pond	1701-0295-MP	0.42	0.05	5.32	15.84	1.50
Mill Pond	1702-0261	1.98	0.11	6.40	28.29	5.37
Mill Pond and Sevens Ponds	1701-0113+0289	2.10	0.19	7.04	60.26	5.37
Mud and Senix Creeks	1701-0312-MSC	0.70	0.09	7.14	93.70	4.00
Mud Creek, Robinson Pond, and Tidal Tribs	1701-0101+0331+0327	1.40	0.58	3.40	28.29	5.37
Napeague Bay	1701-0369	0.32	0.12	6.98	4.99	9.18
Neguntatogue Creek	1701-0088+0372	1.14	0.10	5.77	28.29	5.37
Nissequogue River Upper, and Tribs	1702-0235+0013+0238+0237+0236	3.25	0.13	4.12	20.42	2.98
Ogden Pond	1701-0302	0.65	0.07	4.88	33.05	2.00
Old Fort Pond	1701-0295-OFP	0.92	0.07	7.36	28.29	5.37
Old Town Pond	1701-0118	1.44	0.14	7.90	321.40	5.37
Orchard Neck Creek	1701-0312-ONC	1.76	0.11	6.54	50.67	3.00
Oyster Pond/Lake Munchogue	1701-0169	1.14	0.10	5.77	28.29	5.25
Pardees, Orowoc Lakes, Creek, and Tidal Tribs	1701-0094+0341+0338	2.56	0.11	4.70	22.00	3.25
Patchogue River	1701-0099+0018+0055+0327	4.01	0.12	5.05	22.00	5.37
Pattersquash Creek	1701-0319-PC	1.05	0.07	4.70	35.32	3.50
Peconic River Middle, and Tribs	1701-0261+0262+0269	1.01	0.42	8.40	28.29	1.83
Peconic River Upper, and Tribs	1701-0108+0265+0266+0269	0.31	0.05	6.77	28.29	5.37
Penataquit Creek	1701-0092+0338	4.44	0.04	7.60	28.29	5.37
Penny Pond, Wells, Smith, and Gilbert Creeks	1701-0298-rev+0033	1.23	0.14	8.60	28.29	1.50
Phillips Creek, Lower, and Tidal Tribs	1701-0299	1.01	0.09	4.82	63.15	1.50
Pipes Cove	1701-0366	1.21	0.12	1.45	28.29	5.37
Quantuck Creek and Old Ice Pond	1701-0303-QC+0304	0.56	0.08	5.74	35.95	1.75
Quogue Canal	1701-0301	0.65	0.07	4.82	21.29	1.50

Table 2-4 Subwatersheds Characterized Using Less than 10 Data Points

Subwatershed Name	SWP PWL Number	90th Percentile TN (mg/L)	90th Percentile TP (mg/L)	10th Percentile D.O. (mg/L)	90th Percentile Chl-a (µg/L)	Average Secchi Depth (ft)
Red Creek Pond and Tidal Tribs	1701-0250	0.45	0.05	6.22	9.13	6.25
Richmond Creek and Tidal Tribs	1701-0245	2.98	0.06	5.85	28.29	5.37
Sagaponack Pond and Poxabogue Pond	1701-0146+0286	1.14	0.10	8.26	28.29	5.37
Sampawams Creek	1701-0090+0372+0343	2.07	0.10	3.40	22.46	5.37
Sans Souci Lakes	1701-0336+0335	3.19	0.05	3.76	24.82	1.00
Santapogue Creek	1701-0016+0372	1.80	0.18	3.70	54.11	5.37
Scallop Pond	1701-0354	0.48	0.05	5.66	8.13	3.17
Sheepen Creek	1701-0319-SC	0.72	0.07	7.72	21.36	1.85
SI Sound Trib/Moores Drain, Lower, Tribs	1701-0232+0233	1.23	0.08	2.79	28.29	5.37
Speonk River	1701-0306-SR	0.76	0.17	5.00	63.26	2.00
Spring Pond	1701-0230	0.52	0.05	5.52	4.63	2.75
Stillman Creek	1701-0329-SC	2.41	0.08	5.59	16.91	5.37
Swan River, Swan Lake, and Tidal Tribs	1701-0100+0332+0329+0327	2.78	0.15	5.10	34.24	5.37
Terrell River	1701-0103+0313+0314	0.92	0.28	6.10	249.97	3.00
Tiana Bay and Tidal Tribs	1701-0112	0.32	0.05	8.20	28.29	4.82
Tuthill Cove	1701-0309-TC	0.39	0.05	5.52	11.08	3.50
Tuthills Creek	1701-0098+0327+0329+0334	1.25	0.06	6.64	28.29	2.75
Unchachogue/Johns Neck Creeks	1701-0319-UC	1.05	0.07	4.70	35.30	3.50
Wading River	1702-0099+0243	0.84	0.05	4.60	2.06	5.37
Wainscott Pond/Fairfield Pond	1701-0144	1.14	0.18	7.25	473.73	5.37
Weesuck Creek and Tidal Tribs	1701-0111-rev	0.83	0.11	6.52	78.09	3.13
West Creek and Tidal Tribs	1701-0246	3.86	0.22	5.26	28.29	5.37
Wickapogue Pond	1701-0119	0.74	0.12	3.72	128.58	1.02
Wildwood Lake (Great Pond)	1701-0264	0.42	0.05	5.54	6.15	12.80
Willets Creek	1701-0091+0175+0372	1.05	0.09	5.60	26.01	4.00

Table 2-6 Groundwater Baseflow

Water Body	SWP PWL Number	0 to 2 Years	0 to 10 Years	0 to 25 Years	0 to 50 Years	0 to 100 Years	0 to 200 Years
Abets Creek	1701-0327-AC	28.75%	65.02%	88.70%	92.29%	93.16%	100.00%
Acabonack Harbor	1701-0047	35.07%	66.17%	82.25%	88.91%	95.37%	100.00%
Agawam Lake	1701-0117	21.85%	54.64%	81.09%	94.26%	98.24%	100.00%
Amityville Creek	1701-0087+0372	39.01%	80.46%	92.73%	92.89%	96.27%	100.00%
Aspatuck Creek and River	1701-0303-AC	23.97%	56.43%	77.05%	85.61%	90.60%	100.00%
Awixa Creek	1701-0093+0338	31.23%	68.45%	78.93%	79.13%	91.51%	100.00%
Beaverdam Pond	1701-0307+0306	22.44%	50.01%	72.77%	81.68%	88.86%	100.00%
Beaverdam Creek	1701-0324+0104	24.26%	58.80%	81.30%	88.88%	94.01%	100.00%
Bellport Bay	1701-0320+0325	32.86%	70.76%	92.58%	95.32%	97.58%	100.00%
Belmont Lake	1701-0021+0089	40.08%	85.96%	100.00%	100.00%	100.00%	100.00%
Big Reed Pond	1701-0281	28.26%	80.98%	98.96%	100.00%	100.00%	100.00%
Big/Little Fresh Ponds	1701-0125	46.47%	86.10%	98.95%	99.32%	99.99%	100.00%
Block Island Sound	1701-0278	43.61%	77.94%	92.16%	96.36%	99.07%	100.00%
Brightwaters Canal, Nosreka, Mirror, and Cascade Lakes	1701-0338-BC+0342	21.53%	45.30%	64.66%	73.37%	86.96%	100.00%
Brown Creek	1701-0097+0333	24.08%	58.03%	84.66%	93.47%	95.38%	100.00%
Brushes Creek	1701-0247-BC+0249	28.40%	66.79%	69.45%	81.37%	95.11%	100.00%
Carlls River	1701-0089+0346+0345+0344+0372	29.93%	61.54%	82.65%	89.94%	95.57%	100.00%
Carmans River Lower, and Tribs	1701-0321-rev	26.84%	62.60%	84.24%	92.29%	95.91%	100.00%
Carmans River Upper, and Tribs	1701-0102-rev+0322+0323	17.10%	46.55%	71.34%	82.11%	88.97%	100.00%
Cedar Beach Creek and Tidal Tribs	1701-0243	67.60%	88.88%	89.95%	93.01%	99.73%	100.00%
Centerport Harbor	1702-0229	20.09%	47.75%	68.95%	78.83%	92.41%	100.00%
Champlin Creek	1701-0019+0338+0340	32.18%	73.81%	90.28%	91.55%	94.25%	100.00%
Coecles Harbor	1701-0163	41.48%	78.13%	95.42%	99.74%	100.00%	100.00%

Table 2-6 Groundwater Baseflow

Water Body	SWP PWL Number	0 to 2 Years	0 to 10 Years	0 to 25 Years	0 to 50 Years	0 to 100 Years	0 to 200 Years
Cold Spring Harbor, and Tidal Tribs	1702-0018+0156	13.68%	41.58%	68.30%	81.50%	96.70%	100.00%
Cold Spring Pond and Tribs	1701-0127	36.78%	75.59%	96.12%	99.15%	99.59%	100.00%
Connetquot River, Lower, and Tribs	1701-0337	24.19%	56.38%	79.31%	86.40%	92.10%	100.00%
Connetquot River, Upper, and Tribs	1701-0095+0339	20.88%	45.20%	67.68%	85.25%	95.21%	100.00%
Conscience Bay and Tidal Tribs	1702-0091	22.33%	46.48%	65.52%	76.55%	92.67%	100.00%
Corey Creek and Tidal Tribs	1701-0244	62.96%	86.42%	88.67%	93.16%	99.79%	100.00%
Corey Lake and Creek, and Tribs	1701-0329+0327-CL	27.28%	64.36%	93.77%	98.64%	98.70%	100.00%
Crab Meadow Creek	1702-0232-CMC+0234	27.83%	53.73%	76.03%	89.64%	99.96%	100.00%
Cutchogue Harbor	1701-0045-CH	91.78%	99.84%	99.96%	100.00%	100.00%	100.00%
Cutchogue Harbor - East Creek	1701-0045-EC	75.00%	91.34%	91.99%	97.24%	99.92%	100.00%
Cutchogue Harbor - Mud Creek	1701-0045-MC	37.70%	56.08%	59.49%	84.75%	98.71%	100.00%
Cutchogue Harbor - Wickham Creek	1701-0045-WC	62.57%	84.79%	85.82%	88.90%	97.89%	100.00%
Dam Pond	1701-0228	79.72%	87.80%	94.11%	98.05%	100.00%	100.00%
Deep Hole Creek	1701-0247-DHC+0249	55.92%	81.07%	82.52%	84.81%	97.63%	100.00%
Deep Pond	1701-0270	27.94%	88.63%	100.00%	100.00%	100.00%	100.00%
Dering Harbor	1701-0050+	37.78%	73.96%	93.41%	98.73%	99.30%	100.00%
Dickerson Creek	1701-0242-DC	44.61%	72.93%	93.52%	99.62%	99.97%	100.00%
Duck Island Harbor	1702-0262	38.50%	73.02%	88.06%	95.21%	98.35%	100.00%
Dunton Lake, Upper, and Tribs and Hedges Creek	1701-0330-HC+0327	26.90%	61.86%	87.73%	94.85%	96.05%	100.00%
Far Pond	1701-0295-FP	41.27%	83.81%	99.20%	100.00%	100.00%	100.00%

Table 2-6 Groundwater Baseflow

Water Body	SWP PWL Number	0 to 2 Years	0 to 10 Years	0 to 25 Years	0 to 50 Years	0 to 100 Years	0 to 200 Years
Fish Cove	1701-0037-FC	22.41%	43.12%	77.82%	90.39%	93.88%	100.00%
Flanders Bay, East/Center, and Tribs	1701-0030+0255+0273	25.47%	54.86%	71.04%	77.89%	88.77%	100.00%
Flanders Bay, West/Lower Sawmill Creek	1701-0254+0257	35.81%	73.84%	83.20%	84.04%	89.01%	100.00%
Flax Pond	1702-0240	40.07%	66.09%	78.76%	86.55%	88.52%	100.00%
Forge River and Tidal Tribs	1701-0316-FR+0312+0026	18.48%	47.78%	72.42%	84.56%	91.14%	100.00%
Forge River Cove and Tidal Tribs	1701-0316-FRC+0312	36.76%	69.10%	80.97%	89.28%	96.82%	100.00%
Fort Pond	1701-0122	25.19%	63.54%	88.00%	98.08%	100.00%	100.00%
Fort Pond Bay	1701-0370	37.37%	67.51%	87.44%	98.29%	99.87%	100.00%
Fresh Pond	1701-0279	18.98%	48.01%	72.42%	93.36%	99.56%	100.00%
Fresh Pond Creek and Tribs	1702-0244	21.96%	64.30%	97.90%	100.00%	100.00%	100.00%
Gardiners Bay and minor Tidal Tribs	1701-0164	60.10%	84.09%	93.93%	98.44%	99.53%	100.00%
Georgica Pond	1701-0145	25.13%	54.56%	75.82%	87.70%	98.77%	100.00%
Goldsmith Inlet	1702-0026	41.21%	79.74%	92.04%	92.35%	96.21%	100.00%
Goose Creek	1701-0236	66.28%	89.68%	90.64%	95.58%	99.71%	100.00%
Goose Neck Creek	1701-0272-GNC	23.63%	51.81%	64.04%	77.93%	91.53%	100.00%
Grand Canal	1701-0337-GC	37.34%	60.46%	67.29%	82.26%	85.30%	100.00%
Great Cove	1701-0376+0338	37.52%	66.05%	76.32%	83.00%	89.69%	100.00%
Great Peconic Bay and minor coves	1701-0165+0247+0249+0251	34.04%	64.55%	75.92%	81.06%	91.46%	100.00%
Great South Bay, East	1701-0039-rev+0333	46.59%	76.73%	92.85%	97.36%	98.40%	100.00%
Great South Bay, Middle	1701-0040-rev	88.28%	91.39%	94.13%	96.87%	99.50%	100.00%
Great South Bay, West	1701-0173+0372	48.27%	78.42%	86.34%	87.72%	92.63%	100.00%
Green Creek, Upper, and Tribs	1701-0096+0333	27.39%	67.63%	94.72%	99.82%	99.86%	100.00%
Gull Pond	1701-0231	73.37%	86.68%	93.48%	98.24%	99.80%	100.00%

Table 2-6 Groundwater Baseflow

Water Body	SWP PWL Number	0 to 2 Years	0 to 10 Years	0 to 25 Years	0 to 50 Years	0 to 100 Years	0 to 200 Years
Hallock/Long Beach Bay and Tidal Tribs	1701-0227	71.25%	93.91%	95.78%	98.14%	99.95%	100.00%
Halsey Neck Pond	1701-0355	45.12%	74.74%	90.75%	98.36%	98.47%	100.00%
Harts Cove	1701-0309-HC	17.47%	49.50%	77.05%	92.08%	94.14%	100.00%
Hashamomuck Pond/Long Creek and Budd's Pond	1701-0162+0234	60.68%	88.74%	91.70%	97.20%	99.90%	100.00%
Heady and Taylor Creeks and Tribs	1701-0294	29.17%	62.35%	85.42%	95.82%	99.14%	100.00%
Hog Creek and Tidal Tribs	1701-0277	32.27%	69.88%	89.81%	97.52%	99.40%	100.00%
Hook Pond	1701-0131	15.49%	44.75%	71.84%	81.66%	97.28%	100.00%
Howell's Creek	1701-0327-HC	21.66%	61.80%	87.36%	95.51%	96.34%	100.00%
Huntington Bay	1702-0014	19.79%	46.67%	65.36%	78.47%	90.73%	100.00%
Huntington Harbor	1702-0228+0231	19.21%	48.55%	76.03%	87.69%	99.22%	100.00%
James Creek	1701-0247-JC+0249	54.01%	86.76%	95.80%	96.20%	97.45%	100.00%
Kellis Pond	1701-0290+0291	46.79%	94.96%	98.45%	100.00%	100.00%	100.00%
Lake Montauk	1701-0031	37.31%	74.21%	92.47%	97.00%	99.06%	100.00%
Lake Panamoka (Long Pond)	1701-0134	52.57%	99.76%	100.00%	100.00%	100.00%	100.00%
Lake Ronkonkoma	1701-0020	72.27%	100.00%	100.00%	100.00%	100.00%	100.00%
Laurel Pond	1701-0128	25.83%	69.08%	83.90%	94.08%	100.00%	100.00%
Lawrence Creek, O-co-nee and Lawrence Lakes	1701-0338-LC	26.04%	50.30%	70.17%	74.17%	79.80%	100.00%
Ligonee Brook and Tribs	1701-0352+0353	39.86%	70.06%	88.89%	96.69%	99.75%	100.00%
Little Long, Long, and Shorts Pond	1701-0291	52.60%	98.28%	100.00%	100.00%	100.00%	100.00%
Little Peconic Bay	1701-0126+0172	42.05%	63.11%	70.09%	83.75%	95.48%	100.00%
Little Sebonac Creek	1701-0253	64.82%	85.26%	87.07%	92.67%	97.84%	100.00%
Lloyd Harbor	1702-0227	22.10%	39.80%	57.81%	85.79%	95.89%	100.00%

Table 2-6 Groundwater Baseflow

Water Body	SWP PWL Number	0 to 2 Years	0 to 10 Years	0 to 25 Years	0 to 50 Years	0 to 100 Years	0 to 200 Years
Long Island Sound, Suffolk Co, Central	1702-0265	13.82%	36.33%	59.07%	69.46%	82.53%	100.00%
Long Island Sound, Suffolk County, East	1702-0266	42.88%	82.36%	92.65%	93.01%	96.02%	100.00%
Long Island Sound, Suffolk County, West	1702-0098+0232	26.96%	38.50%	49.97%	78.53%	91.81%	100.00%
Marion Lake	1701-0229	44.57%	60.76%	78.14%	97.85%	100.00%	100.00%
Mattituck (Marratooka) Pond	1701-0129	34.67%	80.00%	85.60%	85.76%	98.46%	100.00%
Mattituck Inlet/Cr, Low, and Tidal Tribs	1702-0020+0245	40.92%	77.37%	89.62%	90.49%	98.50%	100.00%
Mecox Bay and Tribs	1701-0034+0289+0292	40.28%	76.75%	88.85%	95.62%	97.33%	100.00%
Meetinghouse Creek and Tribs	1701-0256-MC	24.32%	61.50%	70.41%	77.26%	91.47%	100.00%
Menantic Creek	1701-0242-MC	38.13%	70.90%	94.62%	99.69%	99.99%	100.00%
Middle Pond	1701-0295-MP	51.52%	83.92%	99.03%	100.00%	100.00%	100.00%
Mill Creek and Tidal Tribs	1701-0238+	43.97%	57.75%	72.05%	89.01%	97.18%	100.00%
Mill Pond	1702-0261	19.02%	53.08%	76.59%	99.12%	100.00%	100.00%
Mill Pond and Sevens Ponds	1701-0113+0289	22.88%	59.00%	78.56%	94.47%	97.50%	100.00%
Moriches Bay East	1701-0305-rev+0306	37.59%	73.20%	89.37%	94.12%	96.32%	100.00%
Moriches Bay West	1701-0038-rev	83.95%	92.69%	98.15%	99.66%	100.00%	100.00%
Mt Sinai Harbor and Tidal Tribs	1702-0019	18.43%	46.13%	66.11%	80.69%	96.23%	100.00%
Mud and Senix Creeks	1701-0312-MSC	23.84%	58.54%	84.29%	94.55%	95.23%	100.00%
Mud Creek, Robinson Pond, and Tidal Tribs	1701-0101+0331+0327	30.23%	69.74%	87.52%	89.20%	93.92%	100.00%
Napeague Bay	1701-0369	41.31%	69.86%	84.17%	95.68%	99.20%	100.00%
Napeague Harbor and Tidal Tribs	1701-0166	57.72%	89.17%	98.63%	99.77%	100.00%	100.00%

Table 2-6 Groundwater Baseflow

Water Body	SWP PWL Number	0 to 2 Years	0 to 10 Years	0 to 25 Years	0 to 50 Years	0 to 100 Years	0 to 200 Years
Narrow Bay	1701-0318+0319	44.52%	72.31%	86.60%	94.19%	99.99%	100.00%
Neguntatogue Creek	1701-0088+0372	37.29%	77.59%	87.01%	87.01%	96.76%	100.00%
Nicoll Bay	1701-0375+0333	30.68%	55.44%	71.00%	83.83%	88.19%	100.00%
Nissequogue River Lower/Sunken Meadow Creek	1702-0025+0234+0232	35.89%	58.93%	72.76%	83.41%	95.10%	100.00%
Nissequogue River Upper, and Tribs	1702-0235+0013+0238+0237+0236	41.30%	59.40%	71.54%	83.92%	91.82%	100.00%
North Sea Harbor and Tribs	1701-0037	34.18%	62.02%	77.26%	90.96%	95.99%	100.00%
Northport Bay	1702-0256	25.52%	58.03%	76.20%	86.15%	94.96%	100.00%
Northport Harbor	1702-0230	19.11%	52.33%	75.31%	89.09%	96.91%	100.00%
Northwest Creek and Tidal Tribs	1701-0046	19.90%	41.23%	62.17%	82.60%	98.30%	100.00%
Northwest Harbor	1701-0368+0275+0276	35.09%	59.16%	74.14%	85.24%	96.76%	100.00%
Noyack Bay	1701-0167-rev	45.91%	72.81%	85.87%	94.70%	98.30%	100.00%
Noyack Creek and Tidal Tribs	1701-0237	21.72%	38.38%	56.90%	82.40%	97.13%	100.00%
Ogden Pond	1701-0302	19.46%	52.93%	76.25%	89.61%	97.90%	100.00%
Old Fort Pond	1701-0295-OFP	27.82%	64.68%	86.44%	95.45%	99.58%	100.00%
Old Town Pond	1701-0118	16.94%	49.63%	76.89%	92.80%	98.51%	100.00%
Orchard Neck Creek	1701-0312-ONC	23.33%	61.87%	89.35%	93.33%	96.34%	100.00%
Orient Harbor and minor Tidal Tribs	1701-0168	66.65%	89.89%	94.18%	98.34%	99.99%	100.00%
Oyster Pond/Lake Munchogue	1701-0169	22.02%	64.48%	85.46%	93.47%	97.74%	100.00%
Pardees, Orowoc Lakes, Creek, and Tidal Tribs	1701-0094+0341+0338	35.82%	74.39%	86.63%	89.84%	95.18%	100.00%
Patchogue Bay	1701-0326	31.31%	69.83%	87.77%	94.90%	96.48%	100.00%
Patchogue River	1701-0099+0018+0055+0327	21.69%	47.38%	71.67%	79.12%	88.59%	100.00%
Pattersquash Creek	1701-0319-PC	27.50%	69.13%	91.37%	98.92%	100.00%	100.00%

Table 2-6 Groundwater Baseflow

Water Body	SWP PWL Number	0 to 2 Years	0 to 10 Years	0 to 25 Years	0 to 50 Years	0 to 100 Years	0 to 200 Years
Peconic River Middle, and Tribs	1701-0261+0262+0269	20.26%	53.40%	75.37%	79.90%	89.79%	100.00%
Peconic River Upper, and Tribs	1701-0108+0265+0266+0269	25.43%	66.73%	92.72%	96.21%	97.70%	100.00%
Peconic River, Lower, and Tidal Tribs	1701-0259+0263	23.42%	51.08%	68.50%	76.53%	86.19%	100.00%
Penataquit Creek	1701-0092+0338	35.96%	73.15%	86.74%	87.43%	90.04%	100.00%
Penniman Creek and Tidal Tribs	1701-0300	23.28%	63.20%	85.23%	92.50%	97.01%	100.00%
Penny Pond, Wells, Smith, and Gilbert Creeks	1701-0298-rev+0033	36.47%	67.37%	83.95%	93.94%	97.33%	100.00%
Phillips Creek, Lower, and Tidal Tribs	1701-0299	23.16%	52.89%	76.26%	83.33%	90.37%	100.00%
Pipes Cove	1701-0366	62.29%	92.77%	93.29%	94.33%	98.87%	100.00%
Port Jefferson Harbor, North, and Tribs	1702-0015	18.94%	35.78%	46.57%	56.07%	79.31%	100.00%
Port Jefferson Harbor, South, and Tribs	1702-0241	18.33%	43.68%	67.71%	89.50%	99.99%	100.00%
Quantuck Bay	1701-0042+0303	37.93%	72.60%	91.79%	95.68%	98.48%	100.00%
Quantuck Canal/Moneybogue Bay	1701-0371	43.93%	75.82%	93.19%	95.63%	97.10%	100.00%
Quantuck Creek and Old Ice Pond	1701-0303-QC+0304	20.86%	50.87%	74.18%	82.33%	89.51%	100.00%
Quogue Canal	1701-0301	41.89%	68.33%	85.38%	93.56%	98.95%	100.00%
Red Creek Pond and Tidal Tribs	1701-0250	27.03%	59.35%	81.81%	84.62%	92.64%	100.00%
Reeves Bay and Tidal Tribs	1701-0272-RB	22.49%	47.47%	53.88%	66.88%	85.70%	100.00%
Richmond Creek and Tidal Tribs	1701-0245	57.03%	86.85%	89.27%	92.94%	99.07%	100.00%
Sag Harbor	1701-0035-SH+0239	27.36%	54.64%	75.23%	91.54%	97.32%	100.00%
Sag Harbor Cove and Tribs	1701-0035-SHC	47.56%	68.27%	76.71%	84.25%	96.50%	100.00%

Table 2-6 Groundwater Baseflow

Water Body	SWP PWL Number	0 to 2 Years	0 to 10 Years	0 to 25 Years	0 to 50 Years	0 to 100 Years	0 to 200 Years
Sagaponack Pond and Poxabogue Pond	1701-0146+0286	33.12%	65.27%	83.31%	95.25%	97.33%	100.00%
Sampawams Creek	1701-0090+0372+0343	32.58%	67.19%	89.24%	93.12%	97.82%	100.00%
Sans Souci Lakes	1701-0336+0335	40.20%	94.43%	100.00%	100.00%	100.00%	100.00%
Santapogue Creek	1701-0016+0372	28.20%	62.88%	76.39%	78.52%	88.33%	100.00%
Scallop Pond	1701-0354	68.39%	94.98%	99.82%	100.00%	100.00%	100.00%
Seatuck Cove and Tidal Tribs	1701-0309-SC+0306+0311	17.11%	50.92%	79.22%	88.52%	94.28%	100.00%
Sebonac Cr/Bullhead Bay and Tidal Tribs	1701-0051	26.50%	58.81%	81.16%	89.35%	96.71%	100.00%
Setauket Harbor	1702-0242	19.48%	43.97%	65.89%	82.35%	99.19%	100.00%
Sheepen Creek	1701-0319-SC	35.99%	74.17%	89.72%	97.44%	100.00%	100.00%
Shelter Island Sound, North, and Tribs	1701-0170	60.01%	90.42%	97.16%	99.16%	99.81%	100.00%
Shelter Island Sound, South, and Tribs	1701-0365-rev+0240	54.34%	87.37%	97.88%	99.94%	100.00%	100.00%
Shinnecock Bay - Bennet Cove (Cormorant Cove)	1701-0033-BC+0252+0296	33.91%	65.19%	84.23%	92.13%	97.19%	100.00%
Shinnecock Bay Central	1701-0033-C	78.78%	93.42%	97.35%	98.52%	99.98%	100.00%
Shinnecock Bay East	1701-0033-E	48.59%	73.96%	90.37%	96.43%	98.03%	100.00%
Shinnecock Bay West	1701-0033-W	38.99%	68.45%	82.83%	89.05%	94.17%	100.00%
SI Sound Trib/Moores Drain, Lower, Tribs	1701-0232+0233	51.70%	89.15%	96.32%	97.79%	99.41%	100.00%
Smithtown Bay	1702-0023+0233+0234	19.42%	37.30%	45.31%	52.39%	73.23%	100.00%
Southold Bay	1701-0044	73.00%	92.27%	94.41%	98.67%	99.92%	100.00%
Speonk River	1701-0306-SR	19.15%	56.24%	85.19%	97.59%	98.13%	100.00%
Spring Pond	1701-0230	98.80%	100.00%	100.00%	100.00%	100.00%	100.00%
Stillman Creek	1701-0329-SC	26.34%	70.03%	94.87%	99.87%	99.95%	100.00%

Table 2-6 Groundwater Baseflow

Water Body	SWP PWL Number	0 to 2 Years	0 to 10 Years	0 to 25 Years	0 to 50 Years	0 to 100 Years	0 to 200 Years
Stirling Creek and Basin	1701-0049	71.02%	92.40%	95.75%	97.58%	99.22%	100.00%
Stony Brook Harbor and West Meadow Creek	1702-0047+0239	35.48%	59.32%	67.26%	81.01%	95.73%	100.00%
Swan River, Swan Lake, and Tidal Tribs	1701-0100+0332+0329+0327	24.52%	57.73%	81.56%	86.91%	94.27%	100.00%
Terrell River	1701-0103+0313+0314	19.37%	53.91%	79.99%	95.87%	97.54%	100.00%
Terry's Creek and Tribs	1701-0256-TC	24.50%	60.53%	73.31%	76.29%	91.71%	100.00%
Three Mile Harbor	1701-0036	31.38%	55.38%	71.06%	85.71%	96.84%	100.00%
Tiana Bay and Tidal Tribs	1701-0112	23.96%	53.97%	76.95%	86.36%	92.72%	100.00%
Town/Jockey Creeks and Tidal Tribs	1701-0235	60.81%	85.68%	87.30%	94.91%	99.17%	100.00%
Tuthill Cove	1701-0309-TC	23.84%	58.63%	80.05%	94.47%	97.79%	100.00%
Tuthills Creek	1701-0098+0327+0329+0334	25.50%	61.56%	89.69%	92.24%	93.91%	100.00%
Unchachogue/ Johns Neck Creeks	1701-0319-UC	35.08%	72.50%	89.67%	96.78%	100.00%	100.00%
Wading River	1702-0099+0243	13.60%	41.90%	70.39%	76.38%	91.66%	100.00%
Wainscott Pond/Fairfield Pond	1701-0144	14.45%	42.13%	69.07%	82.90%	99.05%	100.00%
Weesuck Creek and Tidal Tribs	1701-0111-rev	20.75%	50.02%	76.21%	84.60%	91.81%	100.00%
West Creek and Tidal Tribs	1701-0246	72.08%	88.44%	89.32%	91.55%	98.41%	100.00%
West Neck Bay and Creek	1701-0242-WB	46.43%	84.38%	97.59%	99.92%	100.00%	100.00%
West Neck Harbor	1701-0132-rev	65.88%	90.43%	96.57%	99.96%	100.00%	100.00%
Wickapogue Pond	1701-0119	18.22%	53.54%	79.48%	91.38%	95.75%	100.00%
Wildwood Lake (Great Pond)	1701-0264	26.95%	80.04%	99.50%	100.00%	100.00%	100.00%
Willets Creek	1701-0091+0175+0372	38.38%	71.88%	83.09%	85.44%	93.17%	100.00%
Wooley Pond	1701-0048+	25.20%	52.08%	63.06%	81.54%	96.07%	100.00%

Table 2-17 Nitrogen Loads to Each Subwatershed (Unaggregated)

PWL ID	Subwatershed	On Site Sanitary Wastewater (lbs/day)	Fertilizer (lbs/day)	Pets (lbs/day)	Atmospheric Deposition to Subwatershed (lbs/day)	STP Discharge to GW (lbs/day)	Total Nitrogen Load from GW (lbs/day)	STP Discharge to Surface Water (lbs/day)	Atmospheric Deposition to Surface Water (lbs/day)	Total Nitrogen Load (lbs/day)
1701-0327-AC	Abets Creek	75.1	18.8	4.3	3.2	11.1	112.6	0.0	0.05	112.7
1701-0047	Acabonack Harbor	86.5	29.5	4.1	6.7	0.0	126.7	0.0	4.29	131.0
1701-0117	Agawam Lake	76.5	7.5	1.5	1.6	0.0	87.1	0.0	0.79	87.9
1701-0087+0372	Amityville Creek	5.3	13.1	5.6	2.9	0.0	27.0	0.0	0.75	27.7
1701-0303-AC	Aspatuck Creek and River	57.0	18.3	2.5	3.1	0.0	80.9	0.0	0.85	81.8
1701-0093+0338	Awixa Creek	41.0	13.3	4.8	2.6	0.0	61.7	0.0	4.21	65.9
1701-0307+0306	Beaverdam Pond	43.7	13.0	2.0	5.0	0.0	63.7	0.0	1.34	65.0
1701-0324+0104	Beaverdam Creek	93.7	25.7	4.5	8.2	1.1	133.1	0.0	0.35	133.4
1701-0320+0325	Bellport Bay	176.5	35.2	7.8	6.4	29.1	255.0	0.0	31.16	286.2
1701-0021+0089	Belmont Lake	87.8	9.5	3.7	1.9	0.0	102.9	0.0	0.38	103.3
1701-0281	Big Reed Pond	0.0	0.0	0.0	0.2	0.0	0.2	0.0	0.66	0.8
1701-0125	Big/Little Fresh Ponds	15.79	4.88	0.81	2.07	0.0	23.55	0.0	1.27	24.82
1701-0278	Block Island Sound	31.4	21.9	1.3	3.0	0.0	57.6	0.0	1878.10	1935.7
1701-0338-BC+0342	Brightwaters Canal, Nosreka, Mirror, and Cascade Lakes	59.3	26.3	8.0	4.3	0.0	97.9	0.0	0.25	98.2
1701-0097+0333	Brown Creek	403.3	57.8	15.7	11.0	8.9	496.7	0.0	1.43	498.1
1701-0247-BC+0249	Brushes Creek	10.7	56.7	0.5	3.0	0.0	70.9	0.0	0.07	71.0
1701-0089+0346+0345+0344+0372	Carlls River	409.2	76.0	42.2	15.7	2.6	545.7	0.0	1.71	547.4

Table 2-17 Nitrogen Loads to Each Subwatershed (Unaggregated)

PWL ID	Subwatershed	On Site Sanitary Wastewater (lbs/day)	Fertilizer (lbs/day)	Pets (lbs/day)	Atmospheric Deposition to Subwatershed (lbs/day)	STP Discharge to GW (lbs/day)	Total Nitrogen Load from GW (lbs/day)	STP Discharge to Surface Water (lbs/day)	Atmospheric Deposition to Surface Water (lbs/day)	Total Nitrogen Load (lbs/day)
1701-0321-rev	Carmans River Lower, and Tribs	446.7	111.0	16.7	23.7	16.8	614.9	0.0	2.69	617.6
1701-0102-rev+0322+0323	Carmans River Upper, and Tribs	319.1	189.2	17.3	35.3	23.2	584.1	0.0	0.87	585.0
1701-0243	Cedar Beach Creek and Tidal Tribs	9.3	6.5	0.5	1.0	0.0	17.3	0.0	0.38	17.7
1702-0229	Centerport Harbor	183.6	40.9	8.9	5.9	0.0	239.4	0.0	4.41	243.8
1701-0019+0338+0340	Champlin Creek	80.4	52.3	15.1	8.5	0.0	156.2	0.0	4.21	160.4
1701-0163	Coecles Harbor	25.5	14.4	1.4	4.9	0.0	46.2	0.0	14.60	60.8
1702-0018+0156	Cold Spring Harbor, and Tidal Tribs	460.4	150.2	23.8	32.3	0.0	666.7	0.0	28.50	695.2
1701-0127	Cold Spring Pond and Tribs	30.7	15.7	1.2	2.1	0.0	49.7	0.0	2.71	52.4
1701-0337	Connetquot River, Lower, and Tribs	198.6	58.1	16.6	10.3	0.0	283.6	0.0	5.46	289.0
1701-0095+0339	Connetquot River, Upper, and Tribs	1041.9	225.0	42.0	42.5	47.7	1399.1	0.0	0.18	1399.3
1702-0091	Conscience Bay and Tidal Tribs	62.2	21.8	3.0	4.0	0.0	91.0	0.0	2.79	93.8
1701-0244	Corey Creek and Tidal Tribs	23.2	9.2	1.3	1.5	0.0	35.1	0.0	1.10	36.2
1701-0329+0327-CL	Corey Lake and Creek, and Tribs	53.1	11.1	3.2	2.3	0.2	69.8	0.0	2.38	72.2
1702-0232-CMC+0234	Crab Meadow Creek	104.0	29.8	4.8	7.5	0.0	146.2	0.0	0.25	146.4

Table 2-17 Nitrogen Loads to Each Subwatershed (Unaggregated)

PWL ID	Subwatershed	On Site Sanitary Wastewater (lbs/day)	Fertilizer (lbs/day)	Pets (lbs/day)	Atmospheric Deposition to Subwatershed (lbs/day)	STP Discharge to GW (lbs/day)	Total Nitrogen Load from GW (lbs/day)	STP Discharge to Surface Water (lbs/day)	Atmospheric Deposition to Surface Water (lbs/day)	Total Nitrogen Load (lbs/day)
1701-0045-CH	Cutchogue Harbor	17.8	6.9	1.0	1.1	0.0	26.8	0.0	12.05	38.9
1701-0045-EC	Cutchogue Harbor - East Creek	17.8	10.0	1.0	1.3	0.0	30.0	0.0	1.10	31.1
1701-0045-MC	Cutchogue Harbor - Mud Creek	35.7	41.2	1.6	4.9	0.0	83.4	0.0	0.69	84.1
1701-0045-WC	Cutchogue Harbor - Wickham Creek	11.8	17.3	0.6	1.2	0.0	30.8	0.0	0.51	31.3
1701-0228	Dam Pond	1.1	1.0	0.1	0.4	0.0	2.5	0.0	0.56	3.1
1701-0247-DHC+0249	Deep Hole Creek	20.9	22.4	1.1	1.9	0.0	46.4	0.0	0.43	46.8
1701-0270	Deep Pond	3.4	1.7	0.2	0.8	0.0	6.0	0.0	0.31	6.3
1701-0050+	Dering Harbor	18.3	8.2	1.1	2.8	0.0	30.4	0.0	2.91	33.3
1701-0242-DC	Dickerson Creek	4.3	2.5	0.3	0.6	0.0	7.6	0.0	0.28	7.8
1702-0262	Duck Island Harbor	14.1	4.6	0.7	1.1	0.0	20.4	0.0	2.98	23.4
1701-0330-HC+0327	Dunton Lake, Upper, and Tribs and Hedges Creek	61.4	10.1	3.4	2.4	0.0	77.2	0.0	0.20	77.4
1701-0295-FP	Far Pond	6.6	2.4	0.3	0.4	0.0	9.7	0.0	0.21	9.9
1701-0037-FC	Fish Cove	19.0	11.5	1.0	3.0	0.0	34.5	0.0	0.35	34.9
1701-0030+0255+0273	Flanders Bay, East/Center, and Tribs	54.1	89.6	2.8	14.9	0.0	161.3	0.0	26.51	187.8
1701-0254+0257	Flanders Bay, West/Lower Sawmill Creek	35.1	15.2	2.3	3.4	0.0	56.1	92.5	1.69	150.2
1702-0240	Flax Pond	10.2	4.6	0.5	1.4	0.0	16.8	0.0	0.61	17.4

Table 2-17 Nitrogen Loads to Each Subwatershed (Unaggregated)

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1701-0316-FR+0312+0026	Forge River and Tidal Tribs	605.9	126.4	27.8	28.4	6.3	794.8	0.0	6.13	801.0
1701-0316-FRC+0312	Forge River Cove and Tidal Tribs	29.3	8.4	1.2	1.1	0.0	40.0	0.0	8.51	48.5
1701-0122	Fort Pond	9.1	2.3	0.4	0.4	0.0	12.1	0.0	1.1	13.2
1701-0370	Fort Pond Bay	16.4	5.2	1.2	2.9	1.2	26.8	0.0	11.21	38.0
1701-0279	Fresh Pond	15.2	10.3	0.8	4.0	0.0	30.3	0.0	0.22	30.5
1702-0244	Fresh Pond Creek and Tribs	1.1	5.0	0.1	2.2	0.0	8.4	0.0	0.29	8.6
1701-0164	Gardiners Bay and minor Tidal Tribs	88.0	40.4	3.2	6.0	0.0	137.6	0.0	499.34	637.0
1701-0145	Georgica Pond	82.0	58.9	4.1	10.9	0.0	155.9	0.0	3.12	159.0
1702-0026	Goldsmith Inlet	6.0	3.8	0.3	1.1	0.0	11.2	0.0	0.24	11.5
1701-0236	Goose Creek	30.0	13.9	1.7	1.8	0.0	47.4	0.0	0.88	48.3
1701-0272-GNC	Goose Neck Creek	16.5	2.6	0.7	1.9	0.0	21.7	0.0	0.38	22.1
1701-0337-GC	Grand Canal	73.2	16.6	4.1	2.8	0.7	97.4	0.0	0.17	97.6
1701-0376+0338	Great Cove	158.8	152.7	27.5	24.9	0.0	363.9	0.0	42.83	406.7
1701-0165+0247+0249+0251	Great Peconic Bay and minor coves	140.7	168.4	6.5	15.9	0.0	331.4	0.0	235.82	567.2
1701-0039-rev+0333	Great South Bay, East	356.1	92.8	17.8	14.5	5.1	486.3	0.0	321.47	807.7
1701-0040-rev	Great South Bay, Middle	26.3	27.7	5.7	5.1	0.0	64.7	9.9	200.96	275.6
1701-0173+0372	Great South Bay, West	48.3	117.7	64.7	25.4	0.0	256.1	0.0	138.40	394.5
1701-0096+0333	Green Creek, Upper, and Tribs	148.2	23.4	6.0	4.8	0.1	182.4	0.0	1.43	183.8

Table 2-17 Nitrogen Loads to Each Subwatershed (Unaggregated)

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1701-0231	Gull Pond	8.6	9.1	0.5	0.5	0.0	18.7	0.0	0.14	18.9
1701-0227	Hallock/Long Beach Bay and Tidal Tribs	9.6	74.9	0.6	5.8	0.0	90.9	0.0	7.83	98.7
1701-0355	Halsey Neck Pond	3.3	2.2	0.2	0.5	0.0	6.2	0.0	0.11	6.3
1701-0309-HC	Harts Cove	72.6	35.6	3.3	6.6	0.0	118.2	0.0	4.52	122.7
1701-0162+0234	Hashamomuck Pond/Long Creek and Budds Pond	26.4	18.8	1.3	2.8	0.0	49.2	0.0	1.96	51.2
1701-0294	Heady and Taylor Creeks and Tribs	91.8	33.3	4.4	5.8	0.4	135.7	0.0	2.88	138.6
1701-0277	Hog Creek and Tidal Tribs	34.8	11.7	1.7	1.4	0.0	49.7	0.0	0.43	50.1
1701-0131	Hook Pond	139.3	41.1	5.5	6.5	0.0	192.4	0.0	1.01	193.4
1701-0327-HC	Howell's Creek	63.8	17.4	3.6	2.3	0.0	87.1	0.0	0.07	87.2
1702-0014	Huntington Bay	46.9	13.0	2.2	2.2	0.0	64.3	0.0	17.11	81.4
1702-0228+0231	Huntington Harbor	428.6	77.2	23.9	15.1	0.0	544.8	72.2	4.17	621.2
1701-0247-JC+0249	James Creek	36.5	9.7	1.4	1.7	0.0	49.3	0.0	0.20	49.5
1701-0290	Kellis Pond	5.7	3.2	0.1	0.9	0.0	9.9	0.0	0.47	10.4
1701-0031	Lake Montauk	66.6	29.8	2.7	4.9	0.0	104.0	0.0	13.26	117.3
1701-0134	Lake Panamoka (Long Pond)	5.5	1.5	0.3	0.2	0.0	7.5	0.0	0.56	8.1
1701-0020	Lake Ronkonkoma	17.5	4.1	0.9	0.6	0.0	23.1	0.0	2.80	25.9
1701-0128	Laurel Pond	1.4	1.3	0.1	0.7	0.0	3.5	0.0	0.36	3.9

Table 2-17 Nitrogen Loads to Each Subwatershed (Unaggregated)

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1701-0338-LC	Lawrence Creek, O-co-nee and Lawrence Lakes	30.6	15.5	5.5	2.7	0.0	54.2	0.0	0.26	54.5
1701-0352+0353	Ligonee Brook and Tribs	12.9	6.0	0.7	2.7	0.0	22.3	0.0	1.36	23.7
1701-0291	Little Long, Long, and Shorts Pond	2.4	6.3	0.1	1.4	0.0	10.2	0.0	0.62	10.8
1701-0126+0172	Little Peconic Bay	80.1	56.5	4.4	8.3	0.0	149.3	0.0	158.71	308.1
1701-0253	Little Sebonac Creek	7.9	5.6	0.4	2.0	0.0	16.0	0.0	2.33	18.3
1702-0227	Lloyd Harbor	16.3	21.8	0.9	4.4	0.0	43.4	0.0	8.15	51.5
1702-0265	Long Island Sound, Suffolk Co, Central	1158.3	745.6	69.6	94.3	24.2	2092.0	0.0	2237.25	4329.3
1702-0266	Long Island Sound, Suffolk County, East	110.2	159.3	6.3	19.7	0.0	295.5	46.1	1236.90	1578.5
1702-0098+0232	Long Island Sound, Suffolk County, West	35.2	37.8	1.7	7.0	0.0	81.8	0.0	549.23	631.0
1701-0229	Marion Lake	14.0	6.0	0.8	0.8	0.0	21.5	0.0	0.28	21.8
1701-0129	Mattituck (Marratooka) Pond	1.2	3.3	0.1	0.2	0.0	4.7	0.0	0.28	5.0
1702-0020+0245	Mattituck Inlet/Cr, Low, and Tidal Tribs	69.0	53.7	3.1	7.5	0.0	133.3	0.0	1.61	135.0
1701-0034+0289+0292	Mecox Bay and Tribs	103.8	149.1	5.0	17.7	0.0	275.6	0.0	14.02	289.6
1701-0256-MC	Meetinghouse Creek and Tribs	28.4	29.0	0.9	2.9	0.0	61.1	0.0	1.08	62.2

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1701-0242-MC	Menantic Creek	20.7	7.8	1.0	1.5	0.0	31.0	0.0	0.70	31.7
1701-0295-MP	Middle Pond	12.9	3.1	0.6	0.5	0.0	17.0	0.0	0.52	17.5
1701-0238+	Mill Creek and Tidal Tribs	10.7	5.6	0.6	0.8	0.0	17.7	0.0	0.44	18.1
1702-0261	Mill Pond	123.9	21.5	5.7	4.8	0.0	155.9	0.0	0.94	156.8
1701-0113+0289	Mill Pond and Sevens Ponds	39.5	74.8	2.1	8.4	0.0	124.8	0.0	1.44	126.3
1701-0305-rev+0306	Moriches Bay East	156.0	61.3	7.4	10.3	1.1	236.1	0.0	26.15	262.3
1701-0038-rev	Moriches Bay West	9.6	15.3	0.5	2.1	0.0	27.5	0.0	48.60	76.1
1702-0019	Mt Sinai Harbor and Tidal Tribs	240.4	80.5	15.1	12.4	2.7	351.1	0.0	3.79	354.9
1701-0312-MSC	Mud and Senix Creeks	133.1	29.3	5.4	6.1	0.4	174.4	0.0	1.04	175.4
1701-0101+0331+0327	Mud Creek, Robinson Pond, and Tidal Tribs	75.9	22.9	3.7	4.9	3.5	110.9	0.0	0.11	111.0
1701-0369	Napeague Bay	15.1	9.8	0.8	7.2	0.0	32.9	0.0	236.41	269.3
1701-0166	Napeague Harbor and Tidal Tribs	14.2	3.1	0.4	3.8	0.0	21.5	0.0	11.47	32.9
1701-0318+0319	Narrow Bay	130.6	28.0	6.3	4.1	0.0	168.9	0.0	12.53	181.5
1701-0088+0372	Neguntatogue Creek	5.7	13.7	12.5	4.0	0.0	35.9	0.0	0.70	36.6
1701-0375+0333	Nicoll Bay	157.5	30.6	4.6	6.0	1.4	200.1	0.0	13.63	213.7
1702-0025+0234+0232	Nissequogue River Lower/Sunken Meadow Creek	606.8	188.5	35.2	32.9	3.5	866.8	6.2	2.84	875.9

Table 2-17 Nitrogen Loads to Each Subwatershed (Unaggregated)

PWL ID	Subwatershed	On Site Sanitary Wastewater (lbs/day)	Fertilizer (lbs/day)	Pets (lbs/day)	Atmospheric Deposition to Subwatershed (lbs/day)	STP Discharge to GW (lbs/day)	Total Nitrogen Load from GW (lbs/day)	STP Discharge to Surface Water (lbs/day)	Atmospheric Deposition to Surface Water (lbs/day)	Total Nitrogen Load (lbs/day)
1702-0235+0013+0238+0237+0236	Nissequogue River Upper, and Tribs	421.7	126.3	20.7	22.2	11.3	602.2	0.0	2.28	604.4
1701-0037	North Sea Harbor and Tribs	56.9	29.0	3.0	4.7	0.3	94.0	0.0	2.44	96.4
1702-0256	Northport Bay	115.3	24.1	5.7	3.7	0.0	148.8	0.0	22.98	171.8
1702-0230	Northport Harbor	345.7	63.1	17.4	12.4	1.1	439.8	10.1	4.97	454.9
1701-0046	Northwest Creek and Tidal Tribs	44.8	25.8	2.3	8.0	0.0	80.9	0.0	2.27	83.1
1701-0368+0275+0276	Northwest Harbor	34.8	16.7	1.7	7.1	0.0	60.1	0.0	17.11	77.3
1701-0167-rev	Noyack Bay	37.0	13.7	2.1	2.4	0.0	55.1	0.0	43.06	98.2
1701-0237	Noyack Creek and Tidal Tribs	18.3	23.4	1.0	4.0	0.0	46.8	0.0	1.18	47.9
1701-0302	Ogden Pond	7.7	3.4	0.4	0.6	0.0	12.1	0.0	0.15	12.3
1701-0295-OFP	Old Fort Pond	28.9	8.5	1.1	2.2	0.0	40.7	0.0	0.94	41.7
1701-0118	Old Town Pond	13.9	3.3	0.6	0.6	0.8	19.2	0.0	0.10	19.3
1701-0312-ONC	Orchard Neck Creek	73.6	17.9	3.5	3.3	0.0	98.2	0.0	0.27	98.5
1701-0168	Orient Harbor and minor Tidal Tribs	21.8	16.2	1.3	1.7	0.0	41.0	0.0	34.30	75.3
1701-0169	Oyster Pond/Lake Munchogue	0.3	0.1	0.02	1.2	0.0	1.6	0.0	1.73	3.4
1701-0094+0341+0338	Pardees, Orowoc Lakes, Creek, and Tidal Tribs	156.8	52.0	18.1	9.4	0.0	236.3	0.0	0.19	236.4
1701-0326	Patchogue Bay	186.8	32.0	8.8	4.7	49.9	282.2	0.0	25.94	308.1

Table 2-17 Nitrogen Loads to Each Subwatershed (Unaggregated)

PWL ID	Subwatershed	On Site Sanitary Wastewater (lbs/day)	Fertilizer (lbs/day)	Pets (lbs/day)	Atmospheric Deposition to Subwatershed (lbs/day)	STP Discharge to GW (lbs/day)	Total Nitrogen Load from GW (lbs/day)	STP Discharge to Surface Water (lbs/day)	Atmospheric Deposition to Surface Water (lbs/day)	Total Nitrogen Load (lbs/day)
1701-0099+0018+0055+0327	Patchogue River	554.5	80.8	27.6	14.5	10.6	688.0	31.9	1.50	721.4
1701-0319-PC	Pattersquash Creek	112.4	14.4	5.3	2.4	0.0	134.5	0.0	0.65	135.2
1701-0261+0262+0269	Peconic River Middle, and Tribs	21.9	70.3	1.3	14.1	3.0	110.5	0.0	1.65	112.2
1701-0108+0265+0266+0269	Peconic River Upper, and Tribs	4.0	6.6	0.2	7.3	0.0	18.1	0.0	2.60	20.8
1701-0259+0263	Peconic River, Lower, and Tidal Tribs	132.3	164.7	7.7	28.8	0.0	333.4	0.0	2.84	336.3
1701-0092+0338	Penataquit Creek	97.2	35.6	14.3	8.6	0.0	155.6	0.0	0.87	156.5
1701-0300	Penniman Creek and Tidal Tribs	15.5	8.9	0.8	1.6	0.0	26.8	0.0	0.63	27.5
1701-0298-rev+0033	Penny Pond, Wells, Smith, and Gilbert Creeks	85.7	20.1	4.1	2.6	0.0	112.5	0.0	3.54	116.0
1701-0299	Phillips Creek, Lower, and Tidal Tribs	45.8	21.4	2.3	4.0	0.0	73.5	0.0	0.50	74.0
1701-0366	Pipes Cove	14.6	3.1	1.0	0.7	0.0	19.4	0.0	4.41	23.8
1702-0015	Port Jefferson Harbor, North, and Tribs	150.2	39.4	8.9	6.5	3.6	208.7	0.0	11.76	220.4
1702-0241	Port Jefferson Harbor, South, and Tribs	125.8	29.8	8.4	7.2	0.8	172.0	62.0	1.40	235.4
1701-0042+0303	Quantuck Bay	17.1	6.3	0.8	1.2	0.0	25.3	0.0	3.09	28.4

Table 2-17 Nitrogen Loads to Each Subwatershed (Unaggregated)

PWL ID	Subwatershed	On Site Sanitary Wastewater (lbs/day)	Fertilizer (lbs/day)	Pets (lbs/day)	Atmospheric Deposition to Subwatershed (lbs/day)	STP Discharge to GW (lbs/day)	Total Nitrogen Load from GW (lbs/day)	STP Discharge to Surface Water (lbs/day)	Atmospheric Deposition to Surface Water (lbs/day)	Total Nitrogen Load (lbs/day)
1701-0371	Quantuck Canal/Moneybogue Bay	38.5	10.6	1.3	1.7	0.0	52.1	0.0	1.26	53.3
1701-0303-QC+0304	Quantuck Creek and Old Ice Pond	42.5	26.5	1.8	7.3	0.0	78.1	0.0	1.92	80.0
1701-0301	Quogue Canal	16.5	6.5	0.9	1.0	0.0	25.0	0.0	0.23	25.2
1701-0250	Red Creek Pond and Tidal Tribs	8.6	4.1	0.4	0.8	0.0	13.9	0.0	0.55	14.4
1701-0272-RB	Reeves Bay and Tidal Tribs	68.9	11.2	3.0	4.8	0.0	87.9	0.0	4.03	91.9
1701-0245	Richmond Creek and Tidal Tribs	14.9	38.3	0.7	3.7	0.0	57.6	0.0	0.89	58.4
1701-0035-SH+0239	Sag Harbor	69.3	47.7	3.8	7.3	0.0	128.2	6.9	11.70	146.9
1701-0035-SHC	Sag Harbor Cove and Tribs	106.7	41.6	6.0	5.8	0.0	160.2	0.0	5.82	166.0
1701-0146+0286	Sagaponack Pond and Poxabogue Pond	87.2	90.0	4.3	12.1	0.0	193.7	0.0	2.41	196.1
1701-0090+0372+0343	Sampawams Creek	133.3	35.0	21.5	8.1	0.0	197.9	0.0	0.76	198.7
1701-0336+0335	Sans Souci Lakes	40.6	9.4	1.7	1.5	0.2	53.5	0.0	0.51	54.0
1701-0016+0372	Santapogue Creek	18.3	29.1	17.5	7.8	0.0	72.7	0.0	0.69	73.4
1701-0354	Scallop Pond	0.9	3.5	0.0	0.7	0.0	5.1	0.0	1.75	6.9
1701-0309-SC+0306+0311	Seatuck Cove and Tidal Tribs	202.3	131.9	10.6	22.6	1.5	369.0	0.0	6.30	375.3
1701-0051	Sebonac Cr/Bullhead Bay and Tidal Tribs	36.4	26.7	1.7	4.2	0.0	69.1	0.0	2.25	71.4
1702-0242	Setauket Harbor	137.7	38.6	5.9	6.8	0.3	189.3	0.0	2.41	191.7

Table 2-17 Nitrogen Loads to Each Subwatershed (Unaggregated)

PWL ID	Subwatershed	On Site Sanitary Wastewater (lbs/day)	Fertilizer (lbs/day)	Pets (lbs/day)	Atmospheric Deposition to Subwatershed (lbs/day)	STP Discharge to GW (lbs/day)	Total Nitrogen Load from GW (lbs/day)	STP Discharge to Surface Water (lbs/day)	Atmospheric Deposition to Surface Water (lbs/day)	Total Nitrogen Load (lbs/day)
1701-0319-SC	Sheepen Creek	23.2	2.5	1.1	0.5	0.0	27.3	0.0	0.22	27.5
1701-0170	Shelter Island Sound, North, and Tribs	23.9	14.8	2.6	3.1	0.0	44.3	1.6	33.14	79.1
1701-0365-rev+0240	Shelter Island Sound, South, and Tribs	36.3	25.1	2.1	7.4	0.0	70.9	0.0	72.19	143.1
1701-0033-BC+0252+0296	Shinnecock Bay - Bennet Cove (Cormorant Cove)	91.1	20.2	4.0	2.9	0.0	118.2	0.0	4.39	122.6
1701-0033-C	Shinnecock Bay Central	4.9	6.7	0.2	0.9	0.0	12.7	0.0	20.47	33.1
1701-0033-E	Shinnecock Bay East	88.2	25.7	4.2	4.5	0.0	122.6	0.0	53.82	176.4
1701-0033-W	Shinnecock Bay West	71.7	29.6	3.7	4.6	0.2	109.8	0.0	15.44	125.2
1701-0232+0233	SI Sound Trib/Moores Drain, Lower, Tribs	4.3	4.0	0.2	1.6	0.0	10.1	0.0	0.42	10.6
1702-0023+0233+0234	Smithtown Bay	420.1	115.8	21.4	20.3	1.1	578.6	0.0	272.21	850.8
1701-0044	Southold Bay	21.5	10.4	1.2	1.6	0.0	34.7	0.0	8.75	43.5
1701-0306-SR	Speonk River	36.3	12.3	1.4	4.1	0.0	54.1	0.0	0.74	54.9
1701-0230	Spring Pond	4.0	1.2	0.2	0.1	0.0	5.5	0.0	0.06	5.5
1701-0329-SC	Stillman Creek	35.7	5.5	1.5	1.1	1.3	45.1	0.0	0.04	45.1
1701-0049	Stirling Creek and Basin	8.9	3.4	1.2	0.6	0.0	14.2	0.0	0.42	14.6
1702-0047+0239	Stony Brook Harbor and	328.6	114.8	21.2	23.2	5.0	492.8	0.0	6.58	499.4

Table 2-17 Nitrogen Loads to Each Subwatershed (Unaggregated)

PWL ID	Subwatershed	On Site Sanitary Wastewater (lbs/day)	Fertilizer (lbs/day)	Pets (lbs/day)	Atmospheric Deposition to Subwatershed (lbs/day)	STP Discharge to GW (lbs/day)	Total Nitrogen Load from GW (lbs/day)	STP Discharge to Surface Water (lbs/day)	Atmospheric Deposition to Surface Water (lbs/day)	Total Nitrogen Load (lbs/day)
	West Meadow Creek									
1701-0100+0332+0329+0327	Swan River, Swan Lake, and Tidal Tribs	319.0	62.8	14.3	11.2	3.8	411.1	0.0	2.38	413.5
1701-0103+0313+0314	Terrell River	37.9	20.5	1.8	4.0	0.6	64.8	0.0	0.94	65.7
1701-0256-TC	Terry's Creek and Tribs	30.7	50.6	1.3	3.9	0.0	86.4	0.0	0.05	86.5
1701-0036	Three Mile Harbor	212.7	84.3	10.3	12.3	3.2	322.8	0.0	12.18	335.0
1701-0112	Tiana Bay and Tidal Tribs	135.5	41.0	6.1	5.7	0.1	188.4	0.0	7.16	195.6
1701-0235	Town/Jockey Creeks and Tidal Tribs	54.2	11.5	2.2	2.2	0.0	70.0	0.0	0.93	70.9
1701-0309-TC	Tuthill Cove	29.9	11.1	1.3	2.5	0.0	44.8	0.0	2.15	47.0
1701-0098+0327+0329+0334	Tuthills Creek	167.7	36.9	11.5	7.1	3.5	226.8	0.0	0.45	227.3
1701-0319-UC	Unchachogue/Johns Neck Creeks	135.9	14.0	6.4	2.4	0.0	158.6	0.0	1.01	159.6
1702-0099+0243	Wading River	84.2	26.0	3.7	11.0	0.0	124.9	0.0	0.21	125.1
1701-0144	Wainscott Pond/Fairfield Pond	10.4	25.8	0.5	2.2	0.0	38.9	0.0	0.44	39.4
1701-0111-rev	Weesuck Creek and Tidal Tribs	37.4	23.9	1.8	4.6	0.0	67.7	0.0	0.73	68.4
1701-0246	West Creek and Tidal Tribs	13.6	15.9	0.7	1.5	0.0	31.7	0.0	0.77	32.4
1701-0242-WB	West Neck Bay and Creek	20.7	10.3	1.2	2.5	0.0	34.8	0.0	2.69	37.5

Table 2-17 Nitrogen Loads to Each Subwatershed (Unaggregated)

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1701-0132-rev	West Neck Harbor	4.1	2.0	0.3	0.4	0.0	6.8	0.0	4.34	11.1
1701-0119	Wickapogue Pond	10.1	4.8	0.5	0.9	0.0	16.3	0.0	0.13	16.5
1701-0264	Wildwood Lake (Great Pond)	8.5	5.0	0.4	1.7	0.0	15.6	0.0	0.79	16.4
1701-0091+0175+0372	Willets Creek	43.5	28.1	11.9	5.1	0.0	88.7	0.0	4.80	93.5
1701-0048+	Wooley Pond	26.1	14.7	1.4	2.4	0.0	44.5	0.0	0.44	45.0

Table 2-20 Build-out Nitrogen Loads to Each Subwatershed

PWL ID	Subwatershed	On Site Sanitary Wastewater (lbs/day)	Fertilizer (lbs/day)	Pets (lbs/day)	Atmospheric Deposition to Subwatershed (lbs/day)	STP Discharge to GW (lbs/day)	Total Nitrogen Load from GW (lbs/day)	STP Discharge to Surface Water (lbs/day)	Atmospheric Deposition to Surface Water (lbs/day)	Total Nitrogen Load (lbs/day)
1701-0327-AC	Abets Creek	83.8	19.5	4.8	3.0	69.9	180.9	0.0	0.0	180.9
1701-0047	Acabonack Harbor	97.9	45.5	4.7	6.5	0.0	154.6	0.0	3.9	158.5
1701-0117	Agawam Lake	77.3	7.7	1.6	1.7	0.0	88.2	0.0	0.7	88.9
1701-0087+0372	Amityville Creek	9.7	13.4	5.8	2.8	0.0	31.7	0.0	0.7	32.4
1701-0303-AC	Aspatuck Creek and River	61.9	18.9	2.8	3.1	0.0	86.7	0.0	0.8	87.4
1701-0093+0338	Awixa Creek	43.3	13.7	4.9	2.4	0.0	64.2	0.0	3.8	68.0
1701-0324+0104	Beaverdam Creeks	103.1	28.5	4.9	8.0	3.3	147.8	0.0	0.3	148.1
1701-0307+0306	Beaverdam Pond	63.1	24.9	2.9	5.3	0.0	96.2	0.0	1.2	97.4
1701-0320+0325	Bellport Bay	195.8	38.5	8.8	6.1	31.7	280.9	0.0	28.0	309.0
1701-0021+0089	Belmont Lake	90.0	9.9	3.7	1.8	0.0	105.5	0.0	0.3	105.9
1701-0281	Big Reed Pond	0.0	1.4	0.0	0.2	0.0	1.6	0.0	0.6	2.2
1701-0125	Big/Little Fresh Ponds	17.6	5.2	0.9	0.8	0.0	24.5	0.0	1.1	25.6
1701-0278	Block Island Sound	32.7	21.9	1.4	2.8	0.0	58.9	0.0	1690.3	1749.2
1701-0338-BC+0342	Brightwaters Canal, Nosreka, Mirror, and Cascade Lakes	61.1	26.5	8.1	4.0	0.0	99.7	0.0	0.2	100.0
1701-0097+0333	Brown Creek	405.8	58.9	15.9	10.3	25.0	515.9	0.0	1.3	517.2
1701-0247-BC+0249	Brushes Creek	22.6	16.8	1.2	2.4	0.0	42.9	0.0	0.1	43.0
1701-0089+0346+0345+0344+0372	Carlls River	422.2	77.1	42.6	14.5	2.5	559.0	0.0	1.5	560.5

Table 2-20 Build-out Nitrogen Loads to Each Subwatershed

PWL ID	Subwatershed	On Site Sanitary Wastewater (lbs/day)	Fertilizer (lbs/day)	Pets (lbs/day)	Atmospheric Deposition to Subwatershed (lbs/day)	STP Discharge to GW (lbs/day)	Total Nitrogen Load from GW (lbs/day)	STP Discharge to Surface Water (lbs/day)	Atmospheric Deposition to Surface Water (lbs/day)	Total Nitrogen Load (lbs/day)
1701-0321-rev	Carmans River Lower, and Tribs	470.1	121.6	17.8	23.1	19.8	652.4	0.0	2.4	654.8
1701-0102-rev+0322+0323	Carmans River Upper, and Tribs	366.3	203.0	19.4	33.0	63.8	685.5	0.0	0.8	686.3
1701-0243	Cedar Beach Creek and Tidal Tribs	11.0	7.0	0.6	1.0	0.0	19.6	0.0	0.3	19.9
1702-0229	Centerport Harbor	190.8	41.2	9.3	5.4	0.0	246.7	0.0	4.0	250.7
1701-0019+0338+0340	Champlin Creek	86.6	52.8	15.3	8.0	0.0	162.8	0.0	3.8	166.5
1701-0163	Coecles Harbor	32.1	15.8	1.8	4.4	0.0	54.1	0.0	13.1	67.2
1702-0018+0156	Cold Spring Harbor, and Tidal Tribs	467.9	151.6	24.2	29.1	0.0	672.8	0.0	25.7	698.5
1701-0127	Cold Spring Pond and Tribs	36.9	16.2	1.5	2.2	0.0	56.8	0.0	2.4	59.2
1701-0337	Connetquot River, Lower, and Tribs	204.9	56.6	17.0	9.2	0.0	287.8	0.0	4.9	292.7
1701-0095+0339	Connetquot River, Upper, and Tribs	1068.0	228.4	43.6	35.5	55.8	1431.3	0.0	0.2	1431.5
1702-0091	Conscience Bay and Tidal Tribs	66.8	22.5	3.3	3.5	0.0	96.2	0.0	2.5	98.7
1701-0244	Corey Creek and Tidal Tribs	28.4	10.0	1.6	1.5	0.0	41.5	0.0	1.0	42.5
1701-0329+0327-CL	Corey Lake and Creek, and Tribs	72.1	11.5	4.1	2.2	0.9	90.8	0.0	2.1	92.9
1702-0232-CMC+0234	Crab Meadow Creek	107.1	29.6	4.9	6.7	0.0	148.3	0.0	0.2	148.5
1701-0045-CH	Cutchogue Harbor	20.5	6.9	1.2	1.0	0.0	29.5	0.0	10.8	40.4
1701-0045-EC	Cutchogue Harbor - East Creek	20.5	9.8	1.1	1.1	0.0	32.5	0.0	1.0	33.5
1701-0045-MC	Cutchogue Harbor - Mud Creek	41.5	36.3	2.1	4.4	0.0	84.3	0.0	0.6	84.9

Table 2-20 Build-out Nitrogen Loads to Each Subwatershed

PWL ID	Subwatershed	On Site Sanitary Wastewater (lbs/day)	Fertilizer (lbs/day)	Pets (lbs/day)	Atmospheric Deposition to Subwatershed (lbs/day)	STP Discharge to GW (lbs/day)	Total Nitrogen Load from GW (lbs/day)	STP Discharge to Surface Water (lbs/day)	Atmospheric Deposition to Surface Water (lbs/day)	Total Nitrogen Load (lbs/day)
1701-0045-WC	Cutchogue Harbor - Wickham Creek	14.4	11.7	0.7	1.1	0.0	27.8	0.0	0.5	28.3
1701-0228	Dam Pond	2.3	2.6	0.1	0.4	0.0	5.4	0.0	0.5	5.9
1701-0247-DHC+0249	Deep Hole Creek	26.9	13.5	1.5	1.6	0.0	43.6	0.0	0.4	44.0
1701-0270	Deep Pond	3.4	6.4	0.2	0.8	0.0	10.7	0.0	0.3	11.0
1701-0050+	Dering Harbor	23.3	9.7	1.4	2.5	0.0	36.9	0.0	2.6	39.5
1701-0242-DC	Dickerson Creek	6.3	2.6	0.4	0.5	0.0	9.7	0.0	0.2	10.0
1702-0262	Duck Island Harbor	16.1	5.1	0.8	1.0	0.0	23.0	0.0	2.7	25.7
1701-0330-HC+0327	Dunton Lake, Upper, and Tribs and Hedges Creek	66.5	10.5	3.7	2.2	0.0	82.9	0.0	0.2	83.1
1701-0295-FP	Far Pond	8.2	2.6	0.4	0.4	0.0	11.6	0.0	0.2	11.8
1701-0037-FC	Fish Cove	26.7	15.6	1.5	3.4	0.0	47.2	0.0	0.3	47.5
1701-0030+0255+0273	Flanders Bay, East/Center, and Tribs	69.0	126.1	3.6	13.7	0.0	212.3	0.0	23.9	236.2
1701-0254+0257	Flanders Bay, West/Lower Sawmill Creek	41.6	21.2	2.6	3.5	0.0	68.9	92.5	1.5	162.9
1702-0240	Flax Pond	9.8	7.9	0.5	1.2	0.0	19.4	0.0	0.5	20.0
1701-0316-FR+0312+0026	Forge River and Tidal Tribs	680.5	141.5	31.1	27.2	27.0	907.2	0.0	5.5	912.7
1701-0316-FRC+0312	Forge River Cove and Tidal Tribs	33.0	8.9	1.4	1.1	0.0	44.4	0.0	7.7	52.1
1701-0122	Fort Pond	20.8	5.0	1.0	0.8	0.0	27.5	0.0	1.9	29.5
1701-0370	Fort Pond Bay	19.2	19.0	1.2	2.7	2.7	44.9	0.0	10.1	54.9

Table 2-20 Build-out Nitrogen Loads to Each Subwatershed

PWL ID	Subwatershed	On Site Sanitary Wastewater (lbs/day)	Fertilizer (lbs/day)	Pets (lbs/day)	Atmospheric Deposition to Subwatershed (lbs/day)	STP Discharge to GW (lbs/day)	Total Nitrogen Load from GW (lbs/day)	STP Discharge to Surface Water (lbs/day)	Atmospheric Deposition to Surface Water (lbs/day)	Total Nitrogen Load (lbs/day)
1702-0244	Fresh Pond Creek and Tribs	18.9	19.3	1.1	3.4	0.0	42.7	0.0	0.3	42.9
1702-0244	Fresh Pond Creek and Tribs	2.2	5.3	0.1	2.2	0.0	9.8	0.0	0.3	10.0
1701-0164	Gardiners Bay and minor Tidal Tribs	99.8	41.5	3.6	5.5	0.0	150.5	0.0	449.4	599.9
1701-0145	Georgica Pond	94.3	58.7	4.8	10.5	0.0	168.3	0.0	2.8	171.2
1702-0026	Goldsmith Inlet	10.4	4.9	0.6	0.9	0.0	16.8	0.0	0.2	17.0
1701-0236	Goose Creek	34.5	12.4	2.0	1.6	0.0	50.5	0.0	0.8	51.3
1701-0272-GNC	Goose Neck Creek	18.6	13.4	0.8	1.8	0.0	34.6	0.0	0.3	34.9
1701-0337-GC	Grand Canal	75.3	17.2	4.2	2.7	8.3	107.7	0.0	0.2	107.9
1701-0376+0338	Great Cove	166.1	154.4	27.0	19.7	0.0	367.2	0.0	38.5	405.8
1701-0165+0247+0249+0251	Great Peconic Bay and minor coves	178.2	118.1	9.0	14.1	0.0	319.4	0.0	212.2	531.6
1701-0039-rev+0333	Great South Bay, East	373.1	100.9	18.7	14.1	19.2	526.0	0.0	289.3	815.3
1701-0040-rev	Great South Bay, Middle	27.4	31.6	5.8	5.1	0.0	69.9	9.4	180.9	260.2
1701-0173+0372	Great South Bay, West	62.1	125.0	65.2	24.0	0.0	276.2	0.0	124.6	400.8
1701-0096+0333	Green Creek, Upper, and Tribs	149.1	24.3	6.0	4.5	0.3	184.2	0.0	1.3	185.5
1701-0231	Gull Pond	10.1	9.4	0.6	0.5	0.0	20.6	0.0	0.1	20.7
1701-0227	Hallock/Long Beach Bay and Tidal Tribs	17.5	64.0	1.1	5.6	0.0	88.2	0.0	7.0	95.3
1701-0355	Halsey Neck Pond	4.1	2.6	0.2	0.4	0.0	7.3	0.0	0.1	7.4
1701-0309-HC	Harts Cove	95.5	39.8	4.6	6.2	0.0	146.1	0.0	4.1	150.2

Table 2-20 Build-out Nitrogen Loads to Each Subwatershed

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1701-0162+0234	Hashamomuck Pond/Long Creek and Budds Pond	34.5	19.2	1.7	2.6	0.0	58.1	0.0	1.8	59.8
1701-0294	Heady and Taylor Creeks and Tribs	99.5	30.9	4.7	5.6	5.6	146.3	0.0	2.6	148.8
1701-0277	Hog Creek and Tidal Tribs	39.5	12.3	1.9	1.8	0.0	55.5	0.0	0.4	55.9
1701-0131	Hook Pond	149.1	40.3	6.1	6.3	0.0	201.7	0.0	0.9	202.6
1701-0327-HC	Howell's Creek	67.5	18.3	3.9	2.2	0.0	91.8	0.0	0.1	91.9
1702-0014	Huntington Bay	50.4	12.9	2.3	1.9	0.0	67.6	0.0	15.4	83.0
1702-0228+0231	Huntington Harbor	438.5	77.6	24.4	13.6	0.0	554.1	87.0	3.8	644.9
1701-0247-JC+0249	James Creek	39.7	10.2	1.6	1.5	0.0	53.0	0.0	0.2	53.2
1701-0290	Kellis Pond	7.0	3.3	0.2	0.9	0.0	11.4	0.0	0.4	11.9
1701-0031	Lake Montauk	73.9	31.2	3.0	4.9	0.0	113.0	0.0	11.9	124.9
1701-0134	Lake Panamoka (Long Pond)	5.6	1.5	0.4	0.2	0.0	7.6	0.0	0.5	8.1
1701-0020	Lake Ronkonkoma	18.0	4.0	0.9	0.6	0.0	23.4	0.0	2.5	25.9
1701-0128	Laurel Pond	2.3	4.3	0.1	0.7	0.0	7.4	0.0	0.3	7.7
1701-0338-LC	Lawrence Creek, O-co-nee and Lawrence Lakes	31.5	15.5	5.5	2.5	0.0	55.0	0.0	0.2	55.2
1701-0352+0353	Ligonee Brook and Tribs	15.6	14.1	0.8	2.6	0.0	33.0	0.0	1.2	34.3
1701-0291	Little Long, Long, and Shorts Pond	4.9	6.2	0.3	1.2	0.0	12.5	0.0	0.6	13.1
1701-0126+0172	Little Peconic Bay	94.6	55.8	5.2	7.9	0.0	163.6	0.0	142.8	306.5

Table 2-20 Build-out Nitrogen Loads to Each Subwatershed

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1701-0253	Little Sebonac Creek	10.0	13.1	0.5	1.8	0.0	25.4	0.0	2.1	27.5
1702-0227	Lloyd Harbor	16.9	22.0	1.0	3.9	0.0	43.8	0.0	7.3	51.1
1702-0265	Long Island Sound, Suffolk Co, Central	1338.9	680.2	79.2	85.7	72.9	2256.9	0.0	2013.5	4270.5
1702-0266	Long Island Sound, Suffolk County, East	166.2	123.1	9.6	17.5	0.0	316.5	11.0	1113.2	1440.7
1702-0098+0232	Long Island Sound, Suffolk County, West	42.9	42.3	2.2	6.5	0.0	93.9	0.0	494.3	588.2
1701-0229	Marion Lake	16.8	6.0	0.9	0.7	0.0	24.4	0.0	0.3	24.7
1701-0129	Mattituck (Marratooka) Pond	1.6	2.9	0.1	0.2	0.0	4.8	0.0	0.3	5.0
1702-0020+0245	Mattituck Inlet/Cr, Low, and Tidal Tribs	80.7	44.9	3.9	7.0	0.0	136.6	0.0	1.4	138.0
1701-0034+0289+0292	Mecox Bay and Tribs	145.7	107.0	7.4	15.5	0.0	275.6	0.0	12.6	288.2
1701-0256-MC	Meetinghouse Creek and Tribs	35.1	19.4	1.4	2.7	12.5	71.1	0.0	1.0	72.0
1701-0242-MC	Menantic Creek	23.0	8.0	1.1	1.4	0.0	33.5	0.0	0.6	34.1
1701-0295-MP	Middle Pond	15.0	3.2	0.7	0.5	0.0	19.3	0.0	0.5	19.7
1701-0238+	Mill Creek and Tidal Tribs	11.7	5.8	0.6	0.8	0.0	18.8	0.0	0.4	19.2
1702-0261	Mill Pond	126.8	21.7	5.9	4.3	0.0	158.7	0.0	0.8	159.6
1701-0113+0289	Mill Pond and Sevens Ponds	58.4	61.3	3.2	7.4	0.0	130.2	0.0	1.3	131.5
1701-0305-rev+0306	Moriches Bay East	177.0	65.2	8.4	10.3	6.1	266.9	0.0	23.5	290.5
1701-0038-rev	Moriches Bay West	10.7	16.6	0.6	2.0	0.0	29.9	0.0	43.7	73.7

Table 2-20 Build-out Nitrogen Loads to Each Subwatershed

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1702-0019	Mt Sinai Harbor and Tidal Tribs	259.8	82.2	16.3	11.3	8.1	377.7	0.0	3.4	381.1
1701-0312-MSC	Mud and Senix Creeks	154.0	33.5	6.3	5.8	1.3	200.9	0.0	0.9	201.9
1701-0101+0331+0327	Mud Creek, Robinson Pond, and Tidal Tribs	84.3	24.7	4.1	4.7	10.0	127.7	0.0	0.1	127.8
1701-0369	Napeague Bay	20.9	48.6	1.2	6.8	0.0	77.5	0.0	212.8	290.3
1701-0166	Napeague Harbor and Tidal Tribs	16.7	26.3	0.6	3.6	0.0	47.2	0.0	10.3	57.5
1701-0318+0319	Narrow Bay	138.0	28.4	6.7	3.7	0.0	176.8	0.0	11.3	188.1
1701-0088+0372	Neguntatogue Creek	7.6	13.8	12.5	3.7	0.0	37.6	0.0	0.6	38.2
1701-0375+0333	Nicoll Bay	160.9	32.4	4.8	5.9	8.9	213.0	0.0	12.3	225.3
1702-0025+0234+0232	Nissequogue River Lower/Sunken Meadow Creek	628.6	193.7	36.4	29.8	26.8	915.3	26.0	2.6	943.9
1702-0235+0013+0238+0237+0236	Nissequogue River Upper, and Tribs	431.9	127.0	21.2	20.1	16.0	616.2	0.0	2.1	618.2
1701-0037	North Sea Harbor and Tribs	66.6	30.4	3.5	4.3	1.3	106.1	0.0	2.2	108.3
1702-0256	Northport Bay	118.2	24.1	5.9	3.3	0.0	151.5	0.0	20.7	172.2
1702-0230	Northport Harbor	355.9	63.7	18.0	11.1	3.6	452.2	10.0	4.5	466.7
1701-0046	Northwest Creek and Tidal Tribs	52.9	47.9	2.7	7.8	0.0	111.3	0.0	2.0	113.3
1701-0368+0275+0276	Northwest Harbor	40.4	47.2	2.0	6.7	0.0	96.3	0.0	15.4	111.7
1701-0167-rev	Noyack Bay	41.2	14.8	2.3	2.2	0.0	60.5	0.0	38.8	99.2
1701-0237	Noyack Creek and	22.6	25.5	1.3	3.9	0.0	53.3	0.0	1.1	54.3

Table 2-20 Build-out Nitrogen Loads to Each Subwatershed

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	Tidal Tribs									
1701-0302	Ogden Pond	8.6	3.7	0.5	0.7	0.0	13.5	0.0	0.1	13.6
1701-0295-OFP	Old Fort Pond	29.9	8.7	1.1	2.1	0.0	41.9	0.0	0.8	42.7
1701-0118	Old Town Pond	14.3	3.5	0.6	0.7	8.7	27.7	0.0	0.1	27.8
1701-0312-ONC	Orchard Neck Creek	82.8	19.1	3.9	2.9	0.0	108.8	0.0	0.2	109.0
1701-0168	Orient Harbor and minor Tidal Tribs	24.7	11.7	1.5	1.6	0.0	39.6	0.0	30.9	70.4
1701-0169	Oyster Pond/Lake Munchogue	0.4	9.0	0.0	1.1	0.0	10.5	0.0	1.6	12.1
1701-0094+0341+0338	Pardees, Orowoc Lakes, Creek, and Tidal Tribs	160.2	52.5	18.2	8.7	0.0	239.6	0.0	0.2	239.8
1701-0326	Patchogue Bay	197.9	34.2	9.5	4.5	99.0	345.0	0.0	23.3	368.4
1701-0099+0018+0055+0327	Patchogue River	588.5	84.3	29.4	13.6	127.8	843.6	30.2	1.3	875.2
1701-0319-PC	Pattersquash Creek	121.1	15.0	5.7	2.2	0.0	144.0	0.0	0.6	144.6
1701-0261+0262+0269	Peconic River Middle, and Tribs	24.0	112.1	1.5	12.3	2.5	152.4	0.0	1.5	153.8
1701-0108+0265+0266+0269	Peconic River Upper, and Tribs	3.8	38.8	0.2	6.4	0.0	49.1	0.0	2.3	51.5
1701-0259+0263	Peconic River, Lower, and Tidal Tribs	145.0	159.9	7.9	25.6	0.0	338.4	0.0	2.6	340.9
1701-0092+0338	Penataquit Creek	104.2	36.1	14.8	8.1	0.0	163.1	0.0	0.8	163.9
1701-0300	Penniman Creek and Tidal Tribs	17.2	9.4	0.9	1.6	0.0	29.2	0.0	0.6	29.7

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1701-0298-rev+0033	Penny Pond, Wells, Smith, and Gilbert Creeks	90.8	20.5	4.3	2.6	0.0	118.2	0.0	3.2	121.4
1701-0299	Phillips Creek, Lower, and Tidal Tribs	50.4	22.3	2.5	4.1	0.0	79.3	0.0	0.5	79.8
1701-0366	Pipes Cove	14.6	3.2	1.1	0.7	0.0	19.7	0.0	4.0	23.6
1702-0015	Port Jefferson Harbor, North, and Tribs	162.0	40.5	9.4	6.1	15.0	233.0	0.0	10.6	243.6
1702-0241	Port Jefferson Harbor, South, and Tribs	137.2	31.0	9.1	6.6	2.8	186.6	39.0	1.3	226.9
1701-0042+0303	Quantuck Bay	18.7	6.5	0.9	1.1	0.0	27.3	0.0	2.8	30.1
1701-0371	Quantuck Canal/Moneybogue Bay	40.6	10.6	1.4	1.7	0.0	54.3	0.0	1.1	55.4
1701-0303-QC+0304	Quantuck Creek and Old Ice Pond	48.5	27.1	2.1	6.8	0.0	84.5	0.0	1.7	86.2
1701-0301	Quogue Canal	18.0	6.9	1.0	0.9	0.0	26.8	0.0	0.2	27.0
1701-0250	Red Creek Pond and Tidal Tribs	10.0	5.9	0.5	0.8	0.0	17.1	0.0	0.5	17.6
1701-0272-RB	Reeves Bay and Tidal Tribs	76.3	35.3	3.3	4.8	0.0	119.8	0.0	3.6	123.4
1701-0245	Richmond Creek and Tidal Tribs	23.3	25.5	1.2	3.3	0.0	53.2	0.0	0.8	54.0
1701-0035-SH+0239	Sag Harbor	76.9	49.6	4.2	7.0	0.0	137.8	17.0	10.5	165.3
1701-0035-SHC	Sag Harbor Cove and Tribs	111.8	41.8	6.3	5.7	0.0	165.6	0.0	5.2	170.8
1701-0146+0286	Sagaponack Pond and Poxabogue Pond	104.7	80.5	5.3	11.0	0.0	201.5	0.0	2.2	203.7

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1701-0090+0372+0343	Sampawams Creek	136.1	35.1	21.5	7.4	0.0	200.1	0.0	0.7	200.8
1701-0336+0335	Sans Souci Lakes	41.2	10.0	1.8	1.4	2.3	56.7	0.0	0.5	57.2
1701-0016+0372	Santapogue Creek	20.5	30.5	17.5	7.4	0.0	75.9	0.0	0.6	76.5
1701-0354	Scallop Pond	1.7	3.0	0.1	0.6	0.0	5.4	0.0	1.6	6.9
1701-0309-SC+0306+0311	Seatuck Cove and Tidal Tribs	252.4	138.3	13.2	21.4	4.0	429.3	0.0	5.7	435.0
1701-0051	Sebonac Cr/Bullhead Bay and Tidal Tribs	46.5	33.4	2.2	4.1	0.0	86.3	0.0	2.0	88.3
1702-0242	Setauket Harbor	144.7	40.0	6.3	6.2	0.9	198.1	0.0	2.2	200.3
1701-0319-SC	Sheepan Creek	27.8	2.7	1.3	0.5	0.0	32.3	0.0	0.2	32.5
1701-0170	Shelter Island Sound, North, and Tribs	34.3	15.7	3.2	2.9	0.0	56.2	4.4	29.8	90.4
1701-0365-rev+0240	Shelter Island Sound, South, and Tribs	44.0	26.5	2.6	6.8	0.0	79.9	0.0	65.0	144.9
1701-0033-BC+0252+0296	Shinnecock Bay - Bennet Cove (Cormorant Cove)	96.8	21.2	4.5	3.1	0.0	125.6	0.0	4.0	129.5
1701-0033-C	Shinnecock Bay Central	5.5	5.5	0.3	0.7	0.0	11.9	0.0	18.4	30.3
1701-0033-E	Shinnecock Bay East	98.8	28.1	4.7	4.7	0.0	136.3	0.0	48.4	184.8
1701-0033-W	Shinnecock Bay West	76.7	30.5	4.0	4.2	0.9	116.2	0.0	13.9	130.1
1701-0232+0233	SI Sound Trib/Moores Drain, Lower, Tribs	5.9	10.8	0.3	1.6	0.0	18.6	0.0	0.4	18.9
1702-	Smithtown Bay	444.5	120.4	22.7	18.3	5.4	611.3	0.0	245.0	856.3

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0023+0233+0234										
1701-0044	Southold Bay	28.6	9.9	1.6	1.5	0.0	41.6	0.0	7.9	49.5
1701-0306-SR	Speonk River	47.5	16.1	2.0	4.1	0.0	69.7	0.0	0.7	70.4
1701-0230	Spring Pond	4.8	1.3	0.3	0.1	0.0	6.6	0.0	0.1	6.6
1701-0329-SC	Stillman Creek	38.9	5.8	1.7	1.1	9.8	57.2	0.0	0.0	57.2
1701-0049	Stirling Creek and Basin	10.5	3.6	1.3	0.6	0.0	16.1	0.0	0.4	16.4
1702-0047+0239	Stony Brook Harbor and West Meadow Creek	323.7	111.6	20.7	20.1	17.3	493.5	82.0	5.9	581.4
1701-0100+0332+0329+0327	Swan River, Swan Lake, and Tidal Tribs	330.4	65.7	15.2	10.4	3.8	425.5	0.0	2.1	427.7
1701-0103+0313+0314	Terrell River	46.1	24.1	2.3	3.8	1.3	77.6	0.0	0.8	78.4
1701-0256-TC	Terry's Creek and Tribs	40.7	33.5	1.9	3.8	0.0	79.9	0.0	0.0	79.9
1701-0036	Three Mile Harbor	237.9	88.7	11.8	11.3	0.0	349.6	0.0	11.0	360.6
1701-0112	Tiana Bay and Tidal Tribs	146.8	42.6	6.7	6.2	0.4	202.7	0.0	6.4	209.1
1701-0235	Town/Jockey Creeks and Tidal Tribs	52.3	12.7	2.3	2.2	0.0	69.5	0.0	0.8	70.3
1701-0309-TC	Tuthill Cove	37.1	12.5	1.7	2.4	0.0	53.7	0.0	1.9	55.6
1701-0098+0327+0329+0334	Tuthills Creek	175.7	39.7	12.0	6.9	13.6	247.9	0.0	0.4	248.3
1701-0319-UC	Unchachogue/Johns Neck Creeks	145.1	14.8	6.8	2.3	0.0	169.0	0.0	0.9	169.9

Table 2-20 Build-out Nitrogen Loads to Each Subwatershed

PWL ID	Subwatershed	On Site Sanitary Wastewater (lbs/day)	Fertilizer (lbs/day)	Pets (lbs/day)	Atmospheric Deposition to Subwatershed (lbs/day)	STP Discharge to GW (lbs/day)	Total Nitrogen Load from GW (lbs/day)	STP Discharge to Surface Water (lbs/day)	Atmospheric Deposition to Surface Water (lbs/day)	Total Nitrogen Load (lbs/day)
1702-0099+0243	Wading River	87.3	63.4	4.0	10.0	0.0	164.7	0.0	0.2	164.9
1701-0144	Wainscott Pond/Fairfield Pond	14.0	17.5	0.7	1.9	0.0	34.0	0.0	0.4	34.4
1701-0111-rev	Weesuck Creek and Tidal Tribs	51.9	31.9	2.5	4.5	0.0	90.9	0.0	0.7	91.5
1701-0246	West Creek and Tidal Tribs	18.1	17.2	1.0	1.6	0.0	37.8	0.0	0.7	38.5
1701-0242-WB	West Neck Bay and Creek	29.6	11.8	1.8	2.3	0.0	45.5	0.0	2.4	47.9
1701-0132-rev	West Neck Harbor	5.0	2.0	0.3	0.4	0.0	7.8	0.0	3.9	11.7
1701-0119	Wickapogue Pond	10.7	4.5	0.5	1.1	0.0	16.9	0.0	0.1	17.0
1701-0264	Wildwood Lake (Great Pond)	8.7	13.2	0.4	1.5	0.0	23.9	0.0	0.7	24.6
1701-0091+0175+0372	Willets Creek	44.9	28.1	11.9	4.7	0.0	89.6	0.0	4.3	93.9
1701-0048+	Wooley Pond	30.4	15.2	1.6	2.4	0.0	49.5	0.0	0.4	49.9

Table 2-25

Marine Flushing Time Results - Suffolk County, LI for SCDHS SWP

EFDC Area	PWL Name (Estuary)	PWL ID (Estuary)	PWL Volume (m3)	PWL Surface Area (m2)	PWL Average Depth (m)	PWL Surface Watershed Area (m2)	GW total (cfs)	SW flow (cfs)	Total Flow (cfs)	Total Flow/ Watershed Area (cfs/mi2)	From model mass output Flushing Time (days) to 37% (1 e-folding)	to 10%
1	Amityville Creek	1701-0087+0372	464690	222340	2.1	11274102	2.7	0.0	2.7	0.63	1.6	4.1
1	Carlls River	1701-0089+0346+0345+ 0344+0372	724330	383710	1.9	100020940	19.7	0.0	19.7	0.51	1.4	3.5
1	Great South Bay, West	1701-0173+0372	71000000	45000000	1.6	<== SBU					12.0	27.7
1	Neguntatogue Creek	1701-0088+0372	374190	238710	1.6	4709848	3.7	0.3	4.0	2.22	1.5	4.1
1	Sampawams Creek	1701-0090+0372+0343	378120	187950	2.0	59448281	8.4	0.0	8.4	0.37	1.5	3.4
1	Santapogue Creek	1701-0016+0372	605710	283290	2.1	18591477	3.0	0.0	3.0	0.42	1.4	3.3
1	Willets Creek	1701-0091+0175+0372	391550	240840	1.6	8531676	3.7	0.0	3.7	1.12	0.3	1.4
2	Awixa Creek	1701-0093+0338	98731	63978	1.5	6081501	2.5	0.0	2.5	1.06	2.4	3.5
2	Brightwaters Canal, Nosreka, Mirror, and Cascade Lakes	1701-0338-BC+0342	131170	63628	2.1	2936527	5.1	0.2	5.3	4.69	1.4	2.5
2	Champlin Creek	1701-0019+0338+0340	494000	214660	2.3	19747897	9.8	0.2	10.0	1.31	3.3	8.5
2	Great Cove	1701-0376+0338	28000000	14000000	2.0	<== SBU			28.6		9.6	22.2
2	Great Cove	1701-0376+0338	30498000	14136000	2.2	89510266	26.7	1.9	28.6	0.83		
2	Great South Bay, Middle	1701-0040-rev	169000000	69000000	2.4	<== SBU					49.8	115.3
2	Lawrence Creek, O-co-nee and Lawrence Lakes	1701-0338-LC	262720	69334	3.8	1566868	2.9	0.1	3.0	5.02	2.6	6.6
2	Pardees, Orowoc Lakes, Creek, and Tidal Tribs	1701-0094+0341+0338	396670	185510	2.1	27006848	5.6	0.0	5.6	0.54	2.3	4.0
2	Penataquit Creek	1701-0092+0338	620190	294020	2.1	17407346	9.0	0.0	9.0	1.33	3.9	9.4
3	Brown Creek	1701-0097+0333	190860	202400	0.9	35471968	13.3	0.0	13.3	0.97	2.0	3.6
3	Connetquot River, Lower, and Tribs	1701-0337	2395200	1905200	1.3	89269679	59.8	0.2	60.0	1.74	3.5	6.7
3	Grand Canal	1701-0337-GC	175180	147110	1.2	1564537	3.9	0.2	4.1	6.72	2.0	3.5
3	Great South Bay, East	1701-0039-rev+0333	226000000	106000000	2.1	<== SBU					151.8	351.5
3	Green Creek, Lower	#N/A	127230	87561	1.5	18623408	4.4	0.0	4.4	0.61	1.5	3.0
3	Nicoll Bay	1701-0375+0333	8962000	4717900	1.9	106114095	12.1	1.1	13.2	0.32		
3	Nicoll Bay	1701-0375+0333	8000000	4000000	2.0	<== SBU			3.6		8.7	20.2
4	Abets Creek	1701-0327-AC	128400	65161	2.0	5669475	3.3	0.4	3.6	1.66	2.4	4.1
4	Corey Lake and Creek, and Tribs	1701-0329+0327-CL	70656	49758	1.4	1977133	2.4	0.2	2.6	3.35	1.5	3.4
4	Dunton Lake, Upper, and Tribs and Hedges Creek	1701-0330-HC+0327	53212	69170	0.8	5158287	1.9	0.2	2.1	1.04	2.4	4.3
4	Howell's Creek	1701-0327-HC	87922	44841	2.0	2308490	2.1	0.2	2.3	2.61	1.3	2.2
4	Mud Creek, Robinson Pond, and Tidal Tribs	1701-0101+0331+0327	273020	138990	2.0	13323619	5.5	0.0	5.5	1.07	2.5	6.2
4	Patchogue Bay	1701-0326	14638000	8699400	1.7	96923616	9.8	1.8	11.6	0.31		
4	Patchogue Bay	1701-0326	15000000	8000000	1.9	<== SBU			11.6		11.6	26.8
4	Patchogue River	1701-0099+0018+0055+0327	260760	161690	1.6	33479270	19.5	0.0	19.5	1.51	2.3	3.6
4	Stillman Creek	1701-0329-SC	12942	40409	0.3	1099964	1.2	0.1	1.3	3.05	1.5	2.6
4	Swan River, Swan Lake, and Tidal Tribs	1701-0100+0332+0329+0327	302140	212780	1.4	21319660	12.3	0.0	12.3	1.49	2.9	6.1
4	Tuthills Creek	1701-0098+0327+0329+0334	137280	100760	1.4	6752010	8.5	0.2	8.6	3.31	1.5	3.4
5	Beaverdam/Motts Creeks	1701-0324+0104+0325	359450	175340	2.1	7776872	7.9	0.0	7.9	2.62	4.0	8.6
5	Bellport Bay	1701-0320+0325	16000000	10000000	1.6	<== SBU			12.2		15.6	36.1
5	Bellport Bay	1701-0320+0325	15284000	10359000	1.5	233446073	11.7	0.5	12.2	0.14		
5	Carmans River Lower, and Tribs	1701-0321-rev	1274200	1223300	1.0	220297106	73.8	0.0	73.8	0.87	3.1	7.1
6	Aspatuck Creek and River	1701-0303-AC	408940	318510	1.3	6144044	4.1	0.0	4.1	1.72	3.5	7.3
6	Beaverdam Pond	1701-0307+0306	237000	129490	1.8	10420629	6.5	0.1	6.6	1.64	2.5	8.3
6	Forge River and Tidal Tribs	1701-0316-FR+0312+0026	3787200	2222700	1.7	39347714	41.7	0.0	41.7	2.75	9.1	19.9
6	Forge River Cove and Tidal Tribs	1701-0316-FRC+0312	5125200	3002300	1.7	47799082	3.5	0.4	3.9	0.21	3.4	8.6
6	Harts Cove	1701-0309-HC	2358100	1594500	1.5	2873829	7.0	0.0	7.0	6.33	2.9	6.4
6	Moriches Bay East	1701-0305-rev+0306	12916000	8733500	1.5	29557711	15.2	0.4	15.6	1.37	6.5	45.0
6	Moriches Bay West	1701-0038-rev	25753000	16628000	1.5	108741252	11.0	0.5	11.4	0.27	2.7	10.4
6	Mud and Senix Creeks	1701-0312-MSC	805420	405670	2.0	5443391	6.6	0.2	6.8	3.23	6.0	13.2
6	Narrow Bay	1701-0318+0319	6285500	4372200	1.4	14423868	4.9	0.1	5.0	0.90	5.8	13.5
6	Ogden Pond	1701-0302	98141	57350	1.7	1064718	0.5	0.1	0.5	1.28	2.0	4.1
6	Orchard Neck Creek	1701-0312-ONC	213320	121820	1.8	1390791	3.5	0.0	3.5	6.53	2.5	7.5
6	Pattersquash Creek	1701-0319-PC	348780	230350	1.5	4097350	2.4	0.0	2.4	1.52	1.4	4.4
6	Quantuck Bay	1701-0042+0303	1768400	1064500	1.7	23152622	1.5	0.1	1.6	0.17	26.3	60.9
6	Quantuck Canal/Moneybogue Bay	1701-0371	1062100	505060	2.1	2141737	2.1	0.1	2.2	2.65	26.3	60.9
6	Quantuck Creek and Old Ice Pond	1701-0303-QC+0304	639000	633330	1.0	15634388	8.9	0.0	8.9	1.48	4.5	12.2
6	Quogue Canal	1701-0301	225450	108810	2.1	1604341	1.0	0.1	1.1	1.77	26.3	60.9
6	Seatuck Cove and Tidal Tribs	1701-0309-SC+0306+0311	2491500	1961500	1.3	47523871	25.0	0.0	25.0	1.36	4.3	14.8
6	Sheepan Creek	1701-0319-SC	138490	84408	1.6	1154245	0.5	0.0	0.5	1.04	0.9	3.4

Table 2-25 Residence Times for Marine Water Bodies

Marine Flushing Time Results - Suffolk County, LI for SCDHS SWP

											From model mass output Flushing Time (days)	
EFDC Area	**PWL Name (Estuary)**	**PWL ID (Estuary)**	**PWL Volume (m3)**	**PWL Surface Area (m2)**	**PWL Average Depth (m)**	**PWL Surface Watershed Area (m2)**	**GW total (cfs)**	**SW flow (cfs)**	**Total Flow (cfs)**	**Total Flow/ Watershed Area (cfs/mi2)**	**to 37% (1 e-folding)**	**to 10%**
6	Speonk River	1701-0306-SR	200650	164020	1.2	5214846	4.2	0.0	4.2	2.08	3.5	8.3
6	Terrell River	1701-0103+0313+0314	408220	295730	1.4	8418168	4.4	0.0	4.4	1.35	3.4	8.2
6	Tuthill Cove	1701-0309-TC	824220	801220	1.0	1577667	2.8	0.0	2.8	4.61	3.5	9.3
6	Unchachogue/Johns Neck Creeks	1701-0319-UC	630030	397240	1.6	2456260	2.3	0.0	2.3	2.39	0.3	1.4
8.9	Far Pond	1701-0295-FP	76337	79728	1.0	554307	0.4	0.0	0.4	1.75	0.9	2.4
8.9	Heady and Taylor Creeks and Tribs	1701-0294	1332700	964670	1.4	15977010	6.1	0.0	6.1	0.99	10.5	25.1
8.9	Middle Pond	1701-0295-MP	197260	192420	1.0	521987	0.6	0.0	0.6	2.82	2.4	6.0
8.9	Old Fort Pond	1701-0295-OFP	524680	340040	1.5	1817114	2.4	0.0	2.4	3.39	4.3	9.2
8.9	Penniman Creek and Tidal Tribs	1701-0300	302680	220360	1.4	1191019	1.5	0.1	1.5	3.36	1.9	4.6
8.9	Penny Pond, Wells, Smith and Gilbert Creeks	1701-0298-rev+0033	1908300	1222700	1.6	6038978	3.2	0.0	3.2	1.35	0.9	4.5
8.9	Phillips Creek, Lower, and Tidal Tribs	1701-0299	210410	156960	1.3	4087405	4.4	0.0	4.4	2.78	1.8	4.4
8.9	Shinnecock Bay - Bennet Cove (Cormorant Cove)	1701-0033-BC+0252+0296	3105300	1502600	2.1	2089450	3.1	0.0	3.1	3.90	3.8	17.3
8.9	Shinnecock Bay Central	1701-0033-C	9.57E+06	6851300	1.4	14588704	2.8	0.0	2.8	0.50	3.2	14.0
8.9	Shinnecock Bay East	1701-0033-E	4.52E+07	17953000	2.5	25928715	9.5	0.1	9.6	0.96	6.8	18.6
8.9	Shinnecock Bay West	1701-0033-W	6.77E+06	5143000	1.3	21736477	6.8	0.3	7.1	0.84	4.4	21.0
8.9	Tiana Bay and Tidal Tribs	1701-0112	3946300	2434600	1.6	8549726	8.2	0.0	8.2	2.49	7.1	19.0
8.9	Weesuck Creek and Tidal Tribs	1701-0111-rev	296560	269000	1.1	10529035	4.5	0.0	4.5	1.11	2.3	4.5
10	*Mecox Bay and Tribs	1701-0034+0289+0292	6593100	4643900	1.4	50068674	32.0	0.0	32.0	1.66	5.1	11.1
12	Brushes Creek	1701-0247-BC+0249	31567	60699	0.5	7658780	2.3	0.0	2.3	0.77	0.6	2.0
12	Cedar Beach Creek and Tidal Tribs	1701-0243	327730	191770	1.7	1275004	0.8	0.1	0.9	1.81	2.5	5.2
12	Coecles Harbor	1701-0163	11862000	4992600	2.4	7629619	8.8	0.0	8.8	2.99	12.3	39.6
12	Cold Spring Pond and Tribs	1701-0127	1074400	906840	1.2	4116488	2.5	0.2	2.6	1.66	4.7	11.4
12	Corey Creek and Tidal Tribs	1701-0244	334460	309620	1.1	1739991	2.2	0.1	2.3	3.44	3.1	7.2
12	Cutchogue Harbor	1701-0045-CH	13688000	3907700	3.5	13668157	0.9	0.2	1.2	0.22	1.0	4.5
12	Cutchogue Harbor - East Creek	1701-0045-EC	389120	281940	1.4	8709099	4.2	0.0	4.2	1.25	4.5	9.3
12	Cutchogue Harbor - Mud Creek	1701-0045-MC	728140	547740	1.3	2068266	1.0	0.0	1.0	1.30	3.6	11.3
12	Cutchogue Harbor - Wickham Creek	1701-0045-WC	145620	191990	0.8	914073	1.1	0.0	1.1	3.05	3.0	5.6
12	Dam Pond	1701-0228	303110	235050	1.3	1220801	0.4	0.0	0.4	0.75	7.2	13.3
12	Deep Hole Creek	1701-0247-DHC+0249	121960	163290	0.7	2987959	2.0	0.0	2.0	1.76	3.5	7.3
12	Dering Harbor	1701-0050+	3613900	908460	4.0	4604057	4.1	0.0	4.1	2.31	0.2	2.3
12	Dickerson Creek	1701-0242-DC	85168	113560	0.7		0.0	0.0	0.0		1.9	4.1
12	Fish Cove	1701-0037-FC	388580	285720	1.4	2424096	1.9	0.0	1.9	1.99	0.8	5.0
12	Flanders Bay, East/Center, and Tribs	1701-0030+0255+0273	19062000	9040400	2.1	315521545	13.9	1.0	15.0	0.12	6.2	22.3
12	Flanders Bay, West/Lower Sawmill Creek	1701-0254+0257	770430	559800	1.4	245368930	5.3	0.1	5.4	0.06	1.2	4.6
12	Gardiners Bay and minor Tidal Tribs	1701-0164	1.65E+09	1.65E+08	10.0						2.3	5.3
12	Goose Creek	1701-0236	735030	372730	2.0	2509220	2.2	0.2	2.5	2.54	6.5	10.8
12	Goose Neck Creek	1701-0272-GNC	99299	136200	0.7	1201249	2.2	0.1	2.3	4.88	1.5	4.1
12	Great Peconic Bay and Minor Coves	1701-0165+0247+0249+0251	3.73E+08	78442000	4.8	54772359	28.9	1.0	29.9	1.41	88.2	221.9
12	Gull Pond	1701-0231	174160	76993	2.3	1712152	0.6	0.0	0.6	0.90	2.5	4.5
12	Hallock/Long Beach Bay and Tidal Tribs	1701-0227	4471300	2721700	1.6	9222617	3.3	0.1	3.3	0.93	12.8	39.3
12	Hashamomuck Pond/Long Creek and Budds Pond	1701-0162+0234	1078320	898600	1.2		2.3	0.0	2.3		4.0	9.3
12	Hog Creek and Tidal Tribs	1701-0277	279830	157900	1.8	1579920	1.4	0.0	1.4	2.29	3.2	7.5
12	James Creek	1701-0247-JC+0249	84754	114900	0.7	2706895	1.9	0.0	1.9	1.78	2.1	4.6
12	Little Peconic Bay	1701-0126+0172	3.57E+08	52823000	6.8	47188681	5.7	0.6	6.3	0.35	25.3	80.8
12	Little Sebonac Creek	1701-0253	788210	590450	1.3	4213189	1.3	0.4	1.7	1.03	1.3	7.5
12	Marion Lake	1701-0229	166470	165320	1.0	1348915	0.8	0.0	0.8	1.52	3.5	7.1
12	Meetinghouse Creek and Tribs	1701-0256-MC	736790	456820	1.6	27424728	5.5	0.0	5.5	0.51	3.6	9.2
12	Menantic Creek	1701-0242-MC	448420	249120	1.8		1.7	0.0	1.7		8.3	14.9
12	Mill Creek and Tidal Tribs	1701-0238+	270620	195310	1.4	3873493	0.7	0.0	0.7	0.49	4.0	9.3
12	North Sea Harbor and Tribs	1701-0037	961490	787050	1.2	13311499	2.0	0.0	2.0	0.38	1.6	5.7
12	Northwest Creek and Tidal Tribs	1701-0046	889550	650350	1.4	6403613	9.1	0.0	9.1	3.68	3.5	7.1
12	Northwest Harbor	1701-0368+0275+0276	17600000	5643700	3.1	12201434	8.3	0.0	8.3	1.76	0.9	8.0
12	Noyack Bay	1701-0167-rev	8.76E+07	14057000	6.2	6668957	2.4	0.0	2.4	0.93	5.1	28.3
12	Noyack Creek and Tidal Tribs	1701-0237	480570	432160	1.1	2532891	4.1	0.0	4.1	4.16	5.1	13.4
12	Orient Harbor and Minor Tidal Tribs	1701-0168	61801000	11462000	5.4	14626592	2.1	0.1	2.2	0.39	2.8	11.1
12	Peconic River, Lower and Tidal Tribs	1701-0259+0263	1663500	906720	1.8	232498644	45.2	0.1	45.3	0.50	8.1	16.0

Table 2-25 Residence Times for Marine Water Bodies

Marine Flushing Time Results - Suffolk County, LI for SCDHS SWP

EFDC Area	PWL Name (Estuary)	PWL ID (Estuary)	PWL Volume (m3)	PWL Surface Area (m2)	PWL Average Depth (m)	PWL Surface Watershed Area (m2)	GW total (cfs)	SW flow (cfs)	Total Flow (cfs)	Total Flow/ Watershed Area (cfs/mi2)	From model mass output Flushing Time (days) to 37% (1 e-folding)	to 10%
12	Pipes Cove	1701-0366	8208200	1708800	4.8	6125734	0.6	0.4	1.0	0.42	0.4	1.0
12	Red Creek Pond and Tidal Tribs	1701-0250	336460	221620	1.5	848682	1.2	0.1	1.3	4.02	3.0	6.7
12	Reeves Bay and Tidal Tribs	1701-0272-RB	1957300	1418400	1.4	8396854	7.0	0.3	7.3	2.24	5.7	17.0
12	Richmond Creek and Tidal Tribs	1701-0245	703520	492290	1.4	5370231	3.3	0.0	3.3	1.61	5.7	11.8
12	Sag Harbor	1701-0035-SH+0239	11634000	3726200	3.1	24115616	7.6	0.1	7.7	0.83	0.9	6.5
12	Sag Harbor Cove and Tribs	1701-0035-SHC	4444900	2091100	2.1	14685017	10.2	0.0	10.2	1.80	14.9	35.5
12	Scallop Pond	1701-0354	1714200	557470	3.1	1349563	0.8	0.1	1.0	1.87	33.0	72.1
12	Sebonac Cr/Bullhead Bay and Tidal Tribs	1701-0051	942230	788330	1.2	4623455	4.9	0.2	5.0	2.81	1.9	5.0
12	Shelter Island Sound, North, and Tribs	1701-0170	1.41E+08	11332000	12.5	34861981	8.3	0.9	9.2	0.68	7.2	35.9
12	Shelter Island Sound, South, and Tribs	1701-0365-rev+0240	1.59E+08	23567000	6.8	57883978	12.8	0.5	13.4	0.60	2.8	41.0
12	SI Sound Trib/Moores Drain, Lower, Tribs	1701-0232+0233	44930	56352	0.8	5618612	1.4	0.4	1.7	0.80	1.3	2.3
12	Southold Bay	1701-0044	15139000	3098400	4.9	9849230	1.1	0.5	1.6	0.41	0.2	1.2
12	Stirling Creek and Basin	1701-0049	441070	198850	2.2	2123609	0.6	0.0	0.6	0.73	8.3	14.9
12	Terry's Creek and Tribs	1701-0256-TC	20788	11549	1.8	12152307	1.8	0.0	1.8	0.38	0.4	1.0
12	Three Mile Harbor	1701-0036	9351700	4245900	2.2	14674036	11.8	0.0	11.8	2.08	7.1	14.5
12	Town/Jockey Creeks and Tidal Tribs	1701-0235	1027800	416010	2.5	5166263	1.9	0.1	2.0	0.98	6.6	12.3
12	West Creek and Tidal Tribs	1701-0246	234880	314560	0.7	2352516	1.9	0.1	2.0	2.15	1.5	3.6
12	West Neck Bay and Creek	1701-0242-WB	3047000	899030	3.4	3761487	2.8	0.0	2.8	1.94	31.4	73.1
12	West Neck Harbor	1701-0132-rev+0242	5222000	1442600	3.6	6316261	2.2	0.0	2.2	0.90	1.8	8.9
12	Wooley Pond	1701-0048+	348330	198050	1.8	1563449	2.0	0.0	2.0	3.26	1.5	4.7
14.16	Acabonack Harbor	1701-0047	1595600	1344800	1.2	12914363	8.0	0.2	8.1	1.63	5.0	11.8
14.16	Fort Pond Bay	1701-0370	41664000	3896900	10.7	3990756	3.5	0.0	3.5	2.28	1.0	2.8
14.16	Fresh Pond	1701-0279	111130	79178	1.4	4818876	4.1	0.0	4.1	2.22	0.5	1.3
14.16	Lake Montauk	1701-0031	9723800	4461700	2.2	10203946	4.9	1.0	5.9	1.50	8.2	13.8
14.16	Napeague Bay	1701-0369	7.28E+08	77864000	9.4		7.5	0.0	7.5		2.0	4.3
14.16	Napeague Harbor and Tidal Tribs	1701-0166	5924300	3644800	1.6	7294585	3.6	0.0	3.6	1.29	9.2	19.1
14.16	Oyster Pond/Lake Munchogue	1701-0169	554550	554550	1.0	4659400	1.4	0.4	1.9	1.04	2.4	6.1
17	Centerport Harbor	1702-0229	6804200	1704800	4.0	8050089	8.4	0.0	8.4	2.69	0.8	3.3
17	Cold Spring Harbor, and Tidal Tribs	1702-0018+0156	63089000	9663000	6.5	30949616	30.2	0.0	30.2	2.53	3.1	10.0
17	Crab Meadow Creek	1702-0232-CMC+0234	170500	123680	1.4	12135111	7.8	0.0	7.8	1.67	0.5	1.0
17	Duck Island Harbor	1702-0262	2605100	1245700	2.1	2264076	1.1	0.0	1.1	1.27	0.5	2.5
17	Huntington Bay	1702-0014	40148000	5735700	7.0	50683193	3.9	0.4	4.2	0.22	1.2	3.3
17	Huntington Harbor	1702-0228+0231	5622000	1702400	3.3	20717831	17.5	0.0	17.5	2.18	5.6	11.3
17	Lloyd Harbor	1702-0227	9991700	3135300	3.2	6103799	4.8	0.0	4.8	2.02	3.5	16.0
17	Mill Pond	1702-0261	73301	122170	0.6		4.0	0.0	4.0		0.4	1.3
17	Northport Bay	1702-0256	38729000	7296400	5.3	20504489	6.6	0.2	6.8	0.86	3.5	15.0
17	Northport Harbor	1702-0230	6376900	2142400	3.0	7926766	14.9	0.2	15.1	4.94	4.5	14.9
18	Flax Pond	1702-0240	113950	300950	0.4	1360000	2.7	0.0	2.7	5.12	1.2	3.0
18	Nissequogue River Lower/Sunken Meadow Creek	1702-0025+0234+0232	4232600	2832100	1.5	104051526	71.5	0.0	71.5	1.78	2.0	5.0
18	Smithtown Bay	1702-0023+0233+0234	1075900000	90562000	11.9	154836081	77.6	0.0	77.6	1.30	1.3	2.9
18	Stony Brook Harbor and West Meadow Creek	1702-0047+0239	6581800	4531700	1.5	18422782	27.4	0.0	27.4	3.85	4.6	12.4
19.20	Conscience Bay and Tidal Tribs	1702-0091	1342100	973760	1.4	12627394	4.5	0.0	4.5	0.92	6.1	12.8
19.20	Mt Sinai Harbor and Tidal Tribs	1702-0019	4957600	1679000	3.0	11915554	22.8	0.0	22.8	4.95	2.0	4.5
19.20	Port Jefferson Harbor, North, and Tribs	1702-0015	21757000	3953500	5.5	28575917	9.3	0.0	9.3	0.85	1.7	4.3
19.20	Port Jefferson Harbor, South, and Tribs	1702-0241	2366400	491150	4.8	3868314	8.1	0.0	8.1	5.42	0.9	2.6
19.20	Setauket Harbor	1702-0242	1769300	833240	2.1	8982368	8.1	0.0	8.1	2.33	3.5	7.7
21	Mattituck Inlet/Cr, Low, and Tidal Tribs	1702-0020+0245	1073800	648110	1.7	12525048	7.2	0.0	7.2	1.49	3.1	6.8
LIS model	Long Island Sound, Suffolk County, West	1702-0098+0232	4.55E+09	1.82E+08	25.0						19.8	45.8
LIS model	Long Island Sound, Suffolk Co, Central	1702-0265	2.19E+10	7.29E+08	30.0						15.9	36.8
LIS model	Long Island Sound, Suffolk County, East	1702-0266	1.62E+10	4.06E+08	40.0						19.7	45.5
no model	Block Island Sound	1701-0278										
no model	*Georgica Pond	1701-0145	1300361	1182146	1.1		11.3	0.0	11.3		0.7	1.7
no model	*Goldsmith Inlet	1702-0026	194293	98073	2.0		0.6	0.0	0.6		0.8	1.9
no model	*Halsey Neck Pond	1701-0355	33492	33492	1.0		0.4	0.0	0.4		0.7	1.6
no model	*Sagaponack Pond and Poxabogue Pond	1701-0146+0286	606508	606508	1.0		7.7	0.0	7.7		0.7	1.6

Table 2-25 Residence Times for Marine Water Bodies

Marine Flushing Time Results - Suffolk County, LI for SCDHS SWP

EFDC Area	PWL Name (Estuary)	PWL ID (Estuary)	PWL Volume (m3)	PWL Surface Area (m2)	PWL Average Depth (m)	PWL Surface Watershed Area (m2)	GW total (cfs)	SW flow (cfs)	Total Flow (cfs)	Total Flow/ Watershed Area (cfs/mi2)	From model mass output Flushing Time (days) to 37% (1 e-folding)	to 10%
no model	Spring Pond	1701-0230	56882	28441	2.0		0.6	0.0	0.6		1.7	3.9
no model	Wading River	1702-0099+0243	27995	55990	0.5		0.6	0.0	0.6		0.2	0.5

* Flushing time for coastal ponds are for the open condition.

Table 2-26

Freshwater Flushing Time Results - Suffolk County, LI for SCDHS SWP

PWL Name (Freshwater)	PWL ID (Freshwater)	PWL Volume (m3)	PWL Surface Area (m2)	PWL Depth (m)	GW total (cfs)	SW flow (cfs)	Total Flow (cfs)	Hydraulic Flushing Time (days)
Agawam Lake	1701-0117	315762	259003	1.2	12.8	0.0	12.8	10.1
Belmont Lake	1701-0021+0089	76265	125113	0.6	1.7	0.0	1.7	18.4
Big Reed Pond	1701-0281	276261	226603	1.2	0.014	0.135	0.149	755.9
Big/Little Fresh Ponds	1701-0125	2695554						81.6
Little Pond		213961	70201	3.0	7.0	0.0	7.0	12.6
Big Pond		2481592	339230	7.3	14.7	0.0	14.7	69.0
Carmans River Upper, and Tribs	1701-0102-rev+0322+0323	95964	449796	0.2	49.9	0.0	49.9	0.8
Connetquot River, Upper, and Tribs	1701-0095+0339	145762						4.8
Connetquot River, Upper, and Tribs-left		31020	72698	0.4	4.0	0.3	4.3	2.9
Connetquot River, Upper, and Tribs-main		94374	221173	0.4	33.0	0.0	33.0	1.2
Connetquot River, Upper, and Tribs-right		20367	47732	0.4	12.5	0.0	12.5	0.7
Deep Pond	1701-0270	628132	103045	6.1	0.007	0.000	0.007	36682.4
Fort Pond	1701-0122	1950948	711229	2.7	0.2	0.0	0.2	5145.4
Fresh Pond Creek and Tribs	1702-0244	7473	12020	0.6	2.2	0.0	2.2	1.4
Green Creek, Upper, and Tribs	1701-0096+0333	674	3160	0.2	1.74	0.0	1.7	0.2
Hook Pond	1701-0131	302741	331098	0.9	5.9	0.0	5.9	21.1
Kellis Pond	1701-0290	142939	156328	0.9	2.3	0.0	2.3	25.5
Lake Panamoka (Long Pond)	1701-0134	225014	184567	1.2	0.003	0.000	0.003	27054.2
Lake Ronkonkoma	1701-0020	5616213	921340	6.1	0.2	0.0	0.2	14349.2
Laurel Pond	1701-0128	841267	120009	7.0	0.015	0.000	0.015	22927.0
Ligonee Brook and Tribs	1701-0352+0353	67990						4931.1
Ligonee Brook and Tribs-main		44699	293318	0.2	3.0	0.0	3.0	6.1
Ligonee Brook and Tribs-side		11391	74747	0.2	0.1	0.0	0.1	60.5
Ligonee Brook and Tribs-upper		11900	78086	0.2	0.001	0.000	0.001	4864.5
Little Long, Long, and Shorts Pond	1701-0291	120582						12.0
Shorts		22855	37494	0.6	1.66	0.0	1.7	5.6
Long		66045	108347	0.6	17.46	0.0	17.5	1.5
Goldfish		9082	14899	0.6	5.85	0.0	5.9	0.6
Haines		6915	11344	0.6	7.32	0.0	7.3	0.4
Little Long		15685	25731	0.6	1.68	0.0	1.7	3.8
Mattituck (Marratooka) Pond	1701-0129	281939	92504	3.0	0.3	0.0	0.3	428.5
Mill Pond and Sevens Ponds	1701-0113+0289	263048	431530	0.6	5.9	0.0	5.9	18.3
Nissequogue River Upper, and Tribs	1702-0235 +0013+0238+0237+0236	366103	750739	0.5	30.3	0.0	30.3	4.9
Old Town Pond	1701-0118	21053	34538	0.6	0.4	0.0	0.4	21.2
Peconic River Middle, and Tribs	1701-0261+0262+0269	170975	801384	0.2	12.2	0.0	12.2	5.7
Peconic River Upper, and Tribs	1701-0108+0265+0266+0269	10234	111923	0.1	0.2	0.0	0.2	20.8
Sans Souci Lakes	1701-0336+0335	102484	168126	0.6	5.6	0.0	5.6	7.4
Wainscott Pond/Fairfield Pond	1701-0144	44063	144570	0.3	9.68	0.0	9.7	1.9
Wickapogue Pond	1701-0119	25993	42642	0.6	0.8	0.0	0.8	13.6
Wildwood Lake (Great Pond)	1701-0264	1352073	260950	5.2	1.8	0.0	1.8	315.8
Amityville Creek	1701-0087+0372	7697			1.1	0.0	1.1	2.9

Table 2-26 Residence Times for Fresh Water Bodies

Freshwater Flushing Time Results - Suffolk County, LI for SCDHS SWP

PWL Name (Freshwater)	PWL ID (Freshwater)	PWL Volume (m3)	PWL Surface Area (m2)	PWL Depth (m)	GW total (cfs)	SW flow (cfs)	Total Flow (cfs)	Hydraulic Flushing Time (days)
Brightwaters Canal, Nosreka, Mirror, and Cascade Lakes	1701-0338-BC+0342	15009			2.5	0.2	2.7	2.3
Carlls River	1701-0089+0346+0345+0344+0372	215294			17.0	0.0	17.0	5.2
Champlin Creek	1701-0019+0338+0340	42765			6.1	0.0	6.1	2.9
Dunton Lake, Upper, and Tribs and Hedges Creek	1701-0330-HC+0327	19895			0.5	0.2	0.7	12.3
Lawrence Creek, O-co-nee and Lawrence Lakes	1701-0338-LC	10368			0.9	0.1	1.0	4.4
Mud Creek, Robinson Pond, and Tidal Tribs	1701-0101+0331+0327	10499			2.5	0.0	2.5	1.7
Pardees, Orowoc Lakes, Creek, and Tidal Tribs	1701-0094+0341+0338	22210			7.3	0.0	7.3	1.2
Patchogue River	1701-0099+0018+0055+0327	292443			13.5	0.0	13.5	8.9
Sampawams Creek	1701-0090+0372+0343	29763			6.6	0.0	6.6	1.8
SI Sound Trib/Moores Drain, Upper, Tribs-Lower (S)	1701-0232+0233	10818			0.6	0.2	0.8	5.5
SI Sound Trib/Moores Drain, Upper, Tribs-Moores (N)		621			0.7	0.1	0.8	0.3
Swan River, Swan Lake, and Tidal Tribs	1701-0100+0332+0329+0327	29099			6.7	0.0	6.7	1.8
Terrell River	1701-0103+0313+0314	19969			1.1	0.0	1.1	7.6
Tuthills Creek	1701-0098+0327+0329+0334	26747			3.7	0.0	3.7	2.9
Willets Creek	1701-0091+0175+0372	11802			2.0	0.0	2.0	2.4
*Georgica Pond	1701-0145	1300361	1182146	1.1	11.3	0.0	11.3	47.2
*Goldsmith Inlet	1702-0026	194293	98073	2.0	0.6	0.0	0.6	132.4
*Halsey Neck Pond	1701-0355	33492	33492	1.0	0.4	0.0	0.4	34.0
*Mecox Bay	1701-0034+0289+0292	6593100	4643900	1.4	32.0	0.0	32.0	84.2
*Sagaponack Pond and Poxabogue Pond	1701-0146+0286	606508	606508	1.0	7.7	0.0	7.7	32.4

* Hydraulic flushing time for coastal ponds are for the closed condition.

Table 2-27 Subwatershed Groupings for Priority Ranking

Note: Light blue shaded subwatersheds were evaluated in both the marine/mixed and fresh/mixed subwatershed categories.

Marine/Mixed Subwatersheds	Fresh/Mixed Subwatersheds
Abets Creek	Abets Creek
Acabonack Harbor	Agawam Lake
Agawam Lake	Amityville Creek
Amityville Creek	Aspatuck Creek and River
Aspatuck Creek and River	Awixa Creek
Awixa Creek	Beaverdam Pond
Beaverdam Pond	Beaverdam Creek
Beaverdam Creek	Belmont Lake
Bellport Bay	Big/Little Fresh Ponds
Brightwaters Canal, Nosreka, Mirror, and Cascade Lakes	Big Reed Pond
Brown Creek	Brightwaters Canal, Nosreka, Mirror, and Cascade Lakes
Brushes Creek	Brown Creek
Carlls River	Brushes Creek
Carmans River Lower, and Tribs	Carlls River
Cedar Beach Creek and Tidal Tribs	Carmans River Upper, and Tribs
Centerport Harbor	Champlin Creek
Champlin Creek	Connetquot River, Upper, and Tribs
Coecles Harbor	Corey Lake and Creek, and Tribs
Cold Spring Harbor, and Tidal Tribs	Crab Meadow Creek
Cold Spring Pond and Tribs	Deep Pond
Connetquot River, Lower, and Tribs	Dunton Lake, Upper, and Tribs and Hedges Creek
Conscience Bay and Tidal Tribs	Fort Pond
Corey Creek and Tidal Tribs	Fresh Pond Creek and Tribs
Corey Lake and Creek, and Tribs	Georgica Pond
Crab Meadow Creek	Green Creek, Upper, and Tribs
Cutchogue Harbor	Halsey Neck Pond
Cutchogue Harbor - East Creek	Hook Pond
Cutchogue Harbor - Mud Creek	Kellis Pond
Cutchogue Harbor - Wickham Creek	Lake Panamoka (Long Pond)
Dam Pond	Lake Ronkonkoma
Deep Hole Creek	Laurel Pond
Dering Harbor	Lawrence Creek, O-co-nee and Lawrence Lakes
Dickerson Creek	Ligonee Brook and Tribs
Duck Island Harbor	Little Long, Long, and Shorts Pond
Dunton Lake, Upper, and Tribs and Hedges Creek	Marion Lake
Far Pond	Mattituck (Marratooka) Pond
Fish Cove	Mecox Bay and Tribs

Table 2-27 Subwatershed Groupings for Priority Ranking

Marine/Mixed Subwatersheds	Fresh/Mixed Subwatersheds
Flanders Bay, East/Center, and Tribs	Mill Pond and Sevens Ponds
Flanders Bay, West/Lower Sawmill Creek	Mud Creek, Robinson Pond, and Tidal Tribs
Flax Pond	Neguntatogue Creek
Forge River and Tidal Tribs	Nissequogue River Upper, and Tribs
Forge River Cove and Tidal Tribs	Old Town Pond
Fort Pond Bay	Oyster Pond/Lake Munchogue
Fresh Pond	Pardees, Orowoc Lakes, Creek, and Tidal Tribs
Gardiners Bay and minor Tidal Tribs	Patchogue River
Georgica Pond	Peconic River, Lower, and Tidal Tribs
Goldsmith Inlet	Peconic River Middle, and Tribs
Goose Creek	Peconic River Upper, and Tribs
Goose Neck Creek	Penataquit Creek
Grand Canal	Quantuck Creek and Old Ice Pond
Great Cove	Sagaponack Pond and Poxabogue Pond
Great Peconic Bay and minor coves	Sampawams Creek
Great South Bay, East	Sans Souci Lakes
Great South Bay, Middle	Santapogue Creek
Great South Bay, West	SI Sound Trib/Moores Drain, Lower, Tribs
Green Creek, Upper, and Tribs	Speonk River
Gull Pond	Stillman Creek
Hallock/Long Beach Bay and Tidal Tribs	Swan River, Swan Lake, and Tidal Tribs
Halsey Neck Pond	Terrell River
Harts Cove	Tuthills Creek
Hashamomuck Pond/Long Creek and Budd's Pond	Wading River
Heady and Taylor Creeks and Tribs	Wainscott Pond/Fairfield Pond
Hog Creek and Tidal Tribs	Wickapogue Pond
Hook Pond	Wildwood Lake (Great Pond)
Howell's Creek	Willets Creek
Huntington Bay	
Huntington Harbor	
James Creek	
Lake Montauk	
Lawrence Creek, O-co-nee and Lawrence Lakes	
Little Peconic Bay	
Little Sebonac Creek	
Lloyd Harbor	
Long Island Sound, Suffolk Co, Central	
Long Island Sound, Suffolk County, East	
Long Island Sound, Suffolk County, West	
Marion Lake	
Mattituck Inlet/Cr, Low, and Tidal Tribs	

Table 2-27 Subwatershed Groupings for Priority Ranking

Marine/Mixed Subwatersheds	Fresh/Mixed Subwatersheds
Mecox Bay and Tribs	
Meetinghouse Creek and Tribs	
Menantic Creek	
Middle Pond	
Mill Creek and Tidal Tribs	
Mill Pond	
Moriches Bay East	
Moriches Bay West	
Mt Sinai Harbor and Tidal Tribs	
Mud and Senix Creeks	
Mud Creek, Robinson Pond, and Tidal Tribs	
Napeague Bay	
Napeague Harbor and Tidal Tribs	
Narrow Bay	
Neguntatogue Creek	
Nicoll Bay	
Nissequogue River Lower/Sunken Meadow Creek	
North Sea Harbor and Tribs	
Northport Bay	
Northport Harbor	
Northwest Creek and Tidal Tribs	
Northwest Harbor	
Noyack Bay	
Noyack Creek and Tidal Tribs	
Ogden Pond	
Old Fort Pond	
Old Town Pond	
Orchard Neck Creek	
Orient Harbor and minor Tidal Tribs	
Oyster Pond/Lake Munchogue	
Pardees, Orowoc Lakes, Creek, and Tidal Tribs	
Patchogue Bay	
Patchogue River	
Pattersquash Creek	
Peconic River, Lower, and Tidal Tribs	
Penataquit Creek	
Penniman Creek and Tidal Tribs	
Penny Pond, Wells, Smith, and Gilbert Creeks	
Phillips Creek, Lower, and Tidal Tribs	
Pipes Cove	
Port Jefferson Harbor, North, and Tribs	

Table 2-27 Subwatershed Groupings for Priority Ranking

Marine/Mixed Subwatersheds	Fresh/Mixed Subwatersheds
Port Jefferson Harbor, South, and Tribs	
Quantuck Bay	
Quantuck Canal/Moneybogue Bay	
Quantuck Creek and Old Ice Pond	
Quogue Canal	
Red Creek Pond and Tidal Tribs	
Reeves Bay and Tidal Tribs	
Richmond Creek and Tidal Tribs	
Sag Harbor	
Sag Harbor Cove and Tribs	
Sagaponack Pond and Poxabogue Pond	
Sampawams Creek	
Santapogue Creek	
Scallop Pond	
Seatuck Cove and Tidal Tribs	
Sebonac Cr/Bullhead Bay and Tidal Tribs	
Setauket Harbor	
Sheepen Creek	
Shelter Island Sound, North, and Tribs	
Shelter Island Sound, South, and Tribs	
Shinnecock Bay - Bennet Cove (Cormorant Cove)	
Shinnecock Bay Central	
Shinnecock Bay East	
Shinnecock Bay West	
SI Sound Trib/Moores Drain, Lower, Tribs	
Smithtown Bay	
Southold Bay	
Speonk River	
Spring Pond	
Stillman Creek	
Stirling Creek and Basin	
Stony Brook Harbor and West Meadow Creek	
Swan River, Swan Lake, and Tidal Tribs	
Terrell River	
Terry's Creek and Tribs	
Three Mile Harbor	
Tiana Bay and Tidal Tribs	
Town/Jockey Creeks and Tidal Tribs	
Tuthill Cove	
Tuthills Creek	
Unchachogue/Johns Neck Creeks	

Table 2-27 Subwatershed Groupings for Priority Ranking

Marine/Mixed Subwatersheds	Fresh/Mixed Subwatersheds
Wading River	
Wainscott Pond/Fairfield Pond	
Weesuck Creek and Tidal Tribs	
West Creek and Tidal Tribs	
West Neck Bay and Creek	
West Neck Harbor	
Wickapogue Pond	
Willets Creek	
Wooley Pond	

Table 2-29 Marine/Mixed Subwatershed Characterizations

Marine Evamix Matrix	Predicted N Load (#/volume/yr)	Residence Time (days)	Total Nitrogen Concentration 90th Percentile of Last 10 Years (mg/L)	Total Phosphorus Concentration 90th Percentile Last 10 Years (mg/L)	Dissolved Oxygen 10th percentile for last ten years	HAB - Environmental # of Blooms in Last 10 Years	HAB - Human Health # of Blooms in Last 10 Years	Chl-a 90th Percentile for Last 10 Years (ug/L)	Clarity Average secchi depth for Last 10 Years (ft)
Q,+N,-N	-N	-N	-N	-N	+N	-N	-N	-N	+N
0<wt<1	15%	25%	10%	2%	15%	10%	13%	5%	5%
Abets Creek	0.209	4.1	1.86	0.05	7.02	0	0	18.4	2.5
Acabonack Harbor	0.017	11.8	0.35	0.05	6.70	1	0	4.2	6.1
Agawam Lake	0.072	10.1	3.15	0.05	7.22	0	4	40.8	1.3
Amityville Creek **	0.004	6.9	1.38	0.10	0.53	0	0	15.3	5.4
Aspatuck Creek and River	0.051	7.3	1.31	0.06	4.78	0	0	24.2	1.5
Awixa Creek	0.060	3.5	1.08	0.05	11.60	0	0	2.8	4.0
Beaverdam Pond	0.068	8.3	0.68	0.10	6.59	1	0	36.4	3.0
Beaverdam Creek	0.092	8.6	3.65	0.05	3.98	0	0	28.3	3.3
Bellport Bay **	0.019	31.2	0.72	0.06	3.70	5	0	19.3	4.0
Brightwaters Canal, Nosreka, Mirror, and Cascade Lakes **	0.022	4.8	1.07	0.05	12.80	0	0	3.5	3.0
Brown Creek	0.510	3.6	1.93	0.05	4.99	0	0	7.0	3.3
Brushes Creek	0.109	2.0	6.93	0.06	7.16	0	0	28.3	5.4
Carlls River **	0.154	8.6	1.40	0.13	3.12	2	0	30.7	3.9
Carmans River Lower, and Tribs	0.182	7.1	2.47	0.05	3.84	1	0	19.5	3.0
Cedar Beach Creek and Tidal Tribs	0.009	5.2	0.47	0.05	4.96	0	0	2.1	5.4
Centerport Harbor	0.014	3.3	1.36	0.08	6.17	2	2	20.9	5.5
Champlin Creek **	0.034	11.4	3.43	0.10	6.90	0	0	9.3	3.3
Coecles Harbor	0.001	39.6	0.33	0.05	6.40	0	0	5.5	7.0
Cold Spring Harbor, and Tidal Tribs	0.002	10.0	0.61	0.07	2.94	0	5	19.9	5.9
Cold Spring Pond and Tribs	0.010	11.4	0.36	0.06	6.30	0	0	3.9	5.9
Connetquot River, Lower, and Tribs	0.139	6.7	1.01	0.08	2.40	7	0	29.2	3.4
Conscience Bay and Tidal Tribs	0.012	12.8	0.34	0.05	6.26	0	1	8.9	4.6
Corey Creek and Tidal Tribs	0.025	7.2	0.35	0.05	7.40	0	0	2.7	5.6
Corey Lake and Creek, and Tribs	0.275	3.4	0.93	0.05	4.39	0	0	8.0	3.2
Crab Meadow Creek	0.182	1.0	1.51	0.09	5.20	0	0	3.1	5.4
Cutchogue Harbor	0.002	4.5	0.37	0.06	5.80	2	0	6.4	6.7
Cutchogue Harbor - East Creek	0.017	9.3	0.46	0.06	5.70	0	0	7.3	5.6
Cutchogue Harbor - Mud Creek	0.016	11.3	3.93	0.05	4.60	0	0	28.3	5.4
Cutchogue Harbor - Wickham Creek	0.028	5.6	3.86	0.22	5.26	0	0	28.3	5.4
Dam Pond	0.001	13.3	0.50	0.05	6.60	0	0	4.7	5.2
Deep Hole Creek	0.063	7.3	4.90	0.05	4.90	0	2	12.5	5.2
Dering Harbor	0.002	2.3	0.35	0.05	6.54	0	0	3.7	4.5
Dickerson Creek	0.017	4.1	0.28	0.05	6.51	0	0	4.4	5.4
Duck Island Harbor	0.002	2.5	0.51	0.08	6.33	2	0	14.0	5.7
Dunton Lake, Upper, and Tribs and Hedges Creek **	0.307	16.6	0.87	0.08	6.60	0	0	25.0	5.4
Far Pond	0.035	2.4	0.73	0.09	6.57	0	0	10.9	1.0
Fish Cove	0.016	5.0	1.19	0.05	4.86	0	0	9.2	4.0
Flanders Bay, East/Center, and Tribs	0.005	22.3	0.39	0.07	5.90	4	1	8.9	6.5
Flanders Bay, West/Lower Sawmill Creek	0.017	4.6	0.95	0.15	5.00	10	0	20.6	5.0
Flax Pond	0.017	3.0	0.48	0.07	3.90	0	0	9.8	5.4

Table 2-29 Marine/Mixed Subwatershed Characterizations

Marine Evamix Matrix	Predicted N Load (#/volume/yr)	Residence Time (days)	Total Nitrogen Concentration 90th Percentile of Last 10 Years (mg/L)	Total Phosphorus Concentration 90th Percentile Last 10 Years (mg/L)	Dissolved Oxygen 10th percentile for last ten years	HAB - Environmental # of Blooms in Last 10 Years	HAB - Human Health # of Blooms in Last 10 Years	Chl-a 90th Percentile for Last 10 Years (ug/L)	Clarity Average secchi depth for Last 10 Years (ft)
Q,+N,-N	-N	-N	-N	-N	+N	-N	-N	-N	+N
0<wt<1	15%	25%	10%	2%	15%	10%	13%	5%	5%
Forge River and Tidal Tribs	0.053	19.9	4.98	0.24	4.60	5	4	132.0	3.1
Forge River Cove and Tidal Tribs	0.028	8.6	0.56	0.05	6.25	5	0	16.7	4.7
Fort Pond Bay	0.000	2.8	0.36	0.05	10.26	0	0	6.6	5.4
Fresh Pond	0.044	1.3	0.57	0.05	6.63	0	0	11.4	5.4
Gardiners Bay and minor Tidal Tribs	0.000	5.3	0.30	0.05	6.50	0	0	5.5	11.0
Georgica Pond **	0.019	47.2	0.92	0.05	6.41	0	4	27.0	5.4
Goldsmith Inlet	0.006	1.9	1.03	0.10	4.80	1	0	17.2	3.9
Goose Creek	0.014	10.8	0.40	0.05	5.90	0	0	6.3	7.1
Goose Neck Creek	0.057	4.1	0.72	0.05	6.51	0	0	3.9	8.0
Grand Canal	0.149	3.5	1.40	0.12	1.70	0	0	17.3	1.5
Great Cove **	0.003	19.2	0.69	0.07	6.30	8	0	28.3	3.5
Great Peconic Bay and minor coves	0.001	221.9	0.35	0.06	6.30	2	1	5.7	7.9
Great South Bay, East *	0.006	244.0	0.63	0.05	2.80	9	0	28.2	3.7
Great South Bay, Middle **	0.001	190.0	0.57	0.06	4.37	9	0	18.6	4.7
Great South Bay, West **	0.003	27.0	0.53	0.06	6.00	9	0	18.2	5.0
Green Creek, Upper, and Tribs	0.426	3.2	3.75	0.05	4.73	0	0	11.5	4.0
Gull Pond	0.018	4.5	1.02	0.06	5.40	0	0	7.5	3.8
Hallock/Long Beach Bay and Tidal Tribs	0.001	39.3	0.35	0.05	6.70	0	0	4.6	6.4
Halsey Neck Pond **	0.027	34.0	2.20	0.05	1.23	0	0	2.2	5.4
Harts Cove	0.009	6.4	0.41	0.05	6.50	4	0	10.9	4.9
Hashamomuck Pond/Long Creek and Budd's Pond	0.006	9.3	0.34	0.05	6.20	0	1	5.8	6.3
Heady and Taylor Creeks and Tribs	0.019	25.1	0.45	0.05	4.11	0	0	6.5	5.0
Hog Creek and Tidal Tribs	0.042	7.5	0.42	0.05	7.60	0	0	6.9	5.4
Hook Pond	0.134	21.1	1.60	0.05	9.39	0	2	126.5	1.0
Howell's Creek	0.265	2.2	2.66	0.05	7.53	1	0	33.4	5.4
Huntington Bay	0.003	3.3	0.51	0.09	6.10	2	2	12.3	7.7
Huntington Harbor	0.020	11.3	0.82	0.09	4.80	2	4	24.5	6.5
James Creek	0.157	4.6	1.03	0.06	5.40	0	3	7.7	3.7
Lake Montauk	0.002	13.8	0.33	0.05	6.78	0	0	4.8	7.9
Lawrence Creek, O-co-nee and Lawrence Lakes **	0.006	11.0	0.82	0.10	1.81	1	0	24.3	1.9
Little Peconic Bay	0.000	80.8	0.34	0.06	6.10	1	0	5.8	8.1
Little Sebonac Creek	0.002	7.5	0.36	0.06	6.00	0	0	4.9	4.4
Lloyd Harbor	0.001	16.0	0.55	0.08	6.29	1	0	11.9	5.9
Long Island Sound, Suffolk Co, Central	0.000	36.8	0.37	0.06	6.40	3	0	8.3	9.4
Long Island Sound, Suffolk County, East	0.000	45.5	0.38	0.05	7.00	0	0	6.8	10.7
Long Island Sound, Suffolk County, West	0.000	45.8	0.43	0.08	7.02	0	0	8.6	8.8
Marion Lake	0.025	7.1	0.89	0.05	5.62	0	1	15.9	5.4
Mattituck Inlet/Cr, Low, and Tidal Tribs	0.023	6.8	0.63	0.06	5.40	1	4	13.8	8.1
Mecox Bay and Tribs **	0.007	84.2	1.14	0.10	5.77	0	1	28.3	5.4
Meetinghouse Creek and Tribs	0.012	9.2	5.04	0.82	2.16	1	8	47.9	4.8

Table 2-29 Marine/Mixed Subwatershed Characterizations

Marine Evamix Matrix	Predicted N Load (#/volume/yr)	Residence Time (days)	Total Nitrogen Concentration 90th Percentile of Last 10 Years (mg/L)	Total Phosphorus Concentration 90th Percentile Last 10 Years (mg/L)	Dissolved Oxygen 10th percentile for last ten years	HAB - Environmental # of Blooms in Last 10 Years	HAB - Human Health # of Blooms in Last 10 Years	Chl-a 90th Percentile for Last 10 Years (ug/L)	Clarity Average secchi depth for Last 10 Years (ft)
Q,+N,-N	-N	-N	-N	-N	+N	-N	-N	-N	+N
0<wt<1	15%	25%	10%	2%	15%	10%	13%	5%	5%
Menantic Creek	0.016	14.9	0.43	0.06	5.40	0	0	10.6	8.1
Middle Pond	0.025	6.0	0.42	0.05	5.32	0	0	15.8	1.5
Mill Creek and Tidal Tribs	0.015	9.3	0.36	0.06	5.96	0	0	5.9	7.1
Mill Pond	0.603	1.3	1.98	0.11	6.40	0	0	28.3	5.4
Moriches Bay East	0.006	45.0	0.61	0.10	6.20	10	0	29.9	3.9
Moriches Bay West	0.011	10.4	0.40	0.05	6.50	7	0	14.8	5.8
Mt Sinai Harbor and Tidal Tribs	0.015	4.5	0.49	0.07	6.59	1	0	12.0	7.3
Mud and Senix Creeks	0.055	13.2	0.70	0.09	7.14	1	0	93.7	4.0
Mud Creek, Robinson Pond, and Tidal Tribs **	0.087	7.9	1.40	0.58	3.40	0	0	28.3	5.4
Napeague Bay	0.000	4.3	0.32	0.12	6.98	0	0	5.0	9.2
Napeague Harbor and Tidal Tribs	0.001	19.1	0.30	0.05	6.80	1	0	4.2	7.1
Narrow Bay	0.019	13.5	0.55	0.06	5.83	3	0	20.2	4.3
Neguntatogue Creek	0.004	4.1	1.14	0.10	5.77	0	0	28.3	5.4
Nicoll Bay **	0.040	21.8	0.80	0.07	3.00	7	0	28.0	3.4
Nissequogue River Lower/Sunken Meadow Creek	0.062	5.0	0.48	0.07	5.80	2	0	19.4	7.3
North Sea Harbor and Tribs	0.009	5.7	0.35	0.05	6.06	0	0	5.1	6.4
Northport Bay	0.005	15.0	0.52	0.09	6.21	0	8	14.0	6.9
Northport Harbor	0.018	14.9	0.73	0.10	3.73	0	11	20.7	5.0
Northwest Creek and Tidal Tribs	0.010	7.1	0.32	0.05	6.38	1	0	4.3	8.0
Northwest Harbor	0.001	8.0	0.29	0.05	6.50	0	0	4.8	11.3
Noyack Bay	0.000	28.3	0.30	0.05	6.50	0	0	5.2	9.6
Noyack Creek and Tidal Tribs	0.012	13.4	0.37	0.05	6.36	2	0	5.4	7.2
Ogden Pond	0.020	4.1	0.65	0.07	4.88	1	0	33.1	2.0
Old Fort Pond	0.018	9.2	0.92	0.07	7.36	1	1	28.3	5.4
Old Town Pond	0.154	21.2	1.44	0.14	7.90	0	3	321.4	5.4
Orchard Neck Creek	0.121	7.5	1.76	0.11	6.54	0	0	50.7	3.0
Orient Harbor and minor Tidal Tribs	0.000	11.1	0.31	0.05	6.10	2	0	6.5	9.4
Oyster Pond/Lake Munchogue	0.000	6.1	1.14	0.10	5.77	0	0	28.3	5.2
Pardees, Orowoc Lakes, Creek, and Tidal Tribs **	0.091	5.2	2.56	0.11	4.70	1	0	22.0	3.3
Patchogue Bay **	0.031	24.7	0.79	0.08	6.20	10	0	34.8	3.4
Patchogue River **	0.293	12.5	4.01	0.12	5.05	0	0	22.0	5.4
Pattersquash Creek	0.107	4.4	1.05	0.07	4.70	1	0	35.3	3.5
Peconic River, Lower, and Tidal Tribs	0.017	16.0	0.90	0.19	1.90	1	1	303.8	3.2
Penataquit Creek	0.032	9.4	4.44	0.04	7.60	0	0	28.3	5.4
Penniman Creek and Tidal Tribs	0.018	4.6	0.64	0.12	2.80	10	0	32.9	3.7
Penny Pond, Wells, Smith, and Gilbert Creeks	0.014	4.5	1.23	0.14	8.60	0	0	28.3	1.5
Phillips Creek, Lower, and Tidal Tribs	0.073	4.4	1.01	0.09	4.82	1	0	63.2	1.5
Pipes Cove	0.001	1.0	1.21	0.12	1.45	0	0	28.3	5.4
Port Jefferson Harbor, North, and Tribs	0.004	4.3	0.39	0.07	6.42	3	0	9.6	8.5
Port Jefferson Harbor, South, and Tribs	0.015	2.6	1.11	0.08	6.37	2	0	10.5	6.3

Table 2-29 Marine/Mixed Subwatershed Characterizations

Marine Evamix Matrix	Predicted N Load (#/volume/yr)	Residence Time (days)	Total Nitrogen Concentration 90th Percentile of Last 10 Years (mg/L)	Total Phosphorus Concentration 90th Percentile Last 10 Years (mg/L)	Dissolved Oxygen 10th percentile for last ten years	HAB - Environmental # of Blooms in Last 10 Years	HAB - Human Health # of Blooms in Last 10 Years	Chl-a 90th Percentile for Last 10 Years (ug/L)	Clarity Average secchi depth for Last 10 Years (ft)
Q,+N,-N	-N	-N	-N	-N	+N	-N	-N	-N	+N
0<wt<1	15%	25%	10%	2%	15%	10%	13%	5%	5%
Quantuck Bay	0.015	60.9	0.76	0.14	2.00	8	2	49.5	3.3
Quantuck Canal/Moneybogue Bay	0.014	60.9	1.24	0.15	0.70	4	0	43.1	3.4
Quantuck Creek and Old Ice Pond	0.024	12.2	0.56	0.08	5.74	1	0	35.9	1.8
Quogue Canal	0.015	60.9	0.65	0.07	4.82	1	0	21.3	1.5
Red Creek Pond and Tidal Tribs	0.009	6.7	0.45	0.05	6.22	0	0	9.1	6.3
Reeves Bay and Tidal Tribs	0.012	17.0	0.46	0.09	5.84	2	1	14.5	5.5
Richmond Creek and Tidal Tribs	0.007	11.8	2.98	0.06	5.85	0	0	28.3	5.4
Sag Harbor	0.004	6.5	0.32	0.05	6.33	0	0	5.6	8.4
Sag Harbor Cove and Tribs	0.009	35.5	0.36	0.06	6.20	0	1	5.9	6.4
Sagaponack Pond and Poxabogue Pond **	0.045	32.4	1.14	0.10	8.26	0	3	28.3	5.4
Sampawams Creek **	0.090	5.3	2.07	0.10	3.40	0	0	22.5	5.4
Santapogue Creek	0.004	3.3	1.80	0.18	3.70	0	0	54.1	5.4
Scallop Pond	0.000	72.1	0.48	0.05	5.66	0	0	8.1	3.2
Seatuck Cove and Tidal Tribs	0.026	14.8	0.55	0.08	2.20	5	1	19.1	4.5
Sebonac Cr/Bullhead Bay and Tidal Tribs	0.010	5.0	0.33	0.06	6.00	0	0	4.9	4.3
Setauket Harbor	0.023	7.7	0.58	0.07	6.30	4	0	19.1	5.6
Sheepen Creek	0.053	3.4	0.72	0.07	7.72	1	0	21.4	1.9
Shelter Island Sound, North, and Tribs	0.000	35.9	0.32	0.05	6.30	1	0	5.1	8.8
Shelter Island Sound, South, and Tribs	0.000	41.0	0.30	0.05	6.40	0	0	5.1	10.7
Shinnecock Bay - Bennet Cove (Cormorant Cove)	0.008	17.3	0.33	0.06	6.05	1	0	5.6	7.3
Shinnecock Bay Central	0.005	14.0	0.32	0.05	4.20	6	0	8.8	6.8
Shinnecock Bay East	0.002	18.6	0.32	0.05	6.90	1	0	5.7	7.5
Shinnecock Bay West	0.010	21.0	0.57	0.08	6.50	8	0	23.9	4.0
SI Sound Trib/Moores Drain, Lower, Tribs **	0.029	8.2	1.23	0.08	2.79	0	0	28.3	5.4
Smithtown Bay	0.000	2.9	0.41	0.06	4.57	1	0	9.8	9.0
Southold Bay	0.002	1.2	0.38	0.05	6.00	0	0	6.7	7.4
Speonk River	0.067	8.3	0.76	0.17	5.00	0	0	63.3	2.0
Spring Pond	0.027	3.9	0.52	0.05	5.52	0	0	4.6	2.8
Stillman Creek	1.000	2.6	2.41	0.08	5.59	0	0	16.9	5.4
Stirling Creek and Basin	0.007	14.9	0.33	0.05	6.30	1	0	5.2	9.7
Stony Brook Harbor and West Meadow Creek	0.014	12.4	1.11	0.07	7.00	1	1	10.4	6.6
Swan River, Swan Lake, and Tidal Tribs **	0.316	7.9	2.78	0.15	5.10	0	0	34.2	5.4
Terrell River **	0.025	15.8	0.92	0.28	6.10	0	0	250.0	3.0
Terry's Creek and Tribs	0.476	1.0	3.19	0.14	5.06	3	0	25.3	5.6
Three Mile Harbor	0.006	14.5	0.32	0.05	7.11	1	1	4.7	9.5
Tiana Bay and Tidal Tribs	0.012	19.0	0.32	0.05	8.20	8	0	28.3	4.8
Town/Jockey Creeks and Tidal Tribs	0.016	12.3	0.37	0.05	6.11	0	0	7.1	7.8
Tuthill Cove	0.012	9.3	0.39	0.05	5.52	0	0	11.1	3.5
Tuthills Creek **	0.349	6.3	1.25	0.06	6.64	0	0	28.3	2.8
Unchachogue/Johns Neck Creeks	0.073	1.4	1.05	0.07	4.70	0	0	35.3	3.5

Table 2-29 Marine/Mixed Subwatershed Characterizations

Marine Evamix Matrix	**Predicted N Load** (#/volume/yr)	**Residence Time** (days)	**Total Nitrogen Concentration** 90th Percentile of Last 10 Years (mg/L)	**Total Phosphorus Concentration** 90th Percentile Last 10 Years (mg/L)	**Dissolved Oxygen** 10th percentile for last ten years	**HAB - Environmental** # of Blooms in Last 10 Years	**HAB - Human Health** # of Blooms in Last 10 Years	**Chl-a** 90th Percentile for Last 10 Years (ug/L)	**Clarity** Average secchi depth for Last 10 Years (ft)
Q,+N,-N	-N	-N	-N	-N	+N	-N	-N	-N	+N
0<wt<1	15%	25%	10%	2%	15%	10%	13%	5%	5%
Wading River	0.995	0.5	0.84	0.05	4.60	0	0	2.1	5.4
Wainscott Pond/Fairfield Pond	0.059	1.9	1.14	0.18	7.25	0	3	473.7	5.4
Weesuck Creek and Tidal Tribs	0.044	4.5	0.83	0.11	6.52	1	2	78.1	3.1
West Creek and Tidal Tribs	0.021	3.6	3.86	0.22	5.26	0	0	28.3	5.4
West Neck Bay and Creek	0.002	73.1	0.43	0.06	5.40	4	0	10.6	8.1
West Neck Harbor	0.002	8.9	0.32	0.05	6.40	0	0	4.7	7.8
Wickapogue Pond	0.084	13.6	0.74	0.12	3.72	2	2	128.6	1.0
Willets Creek **	0.004	3.8	1.05	0.09	5.60	1	0	26.0	4.0
Wooley Pond	0.022	4.7	0.39	0.05	6.30	0	0	7.0	6.9

Note: Unit nitrogen Loads shown are the 25/50 Year nitrogen loads from sanitary wastewater.

* Residence time set to a maximum value of 244 days to correspond to the typical/average duration of the algal blooming season in our region.

** Residence time used in EVAMIX was subsequently refined by HDR, Inc. (see final residence times in Tables 2-25 and 2-26). However, updated residence times had no impact on final ecological sensitivity rank for the waterbody.

Table 2-30 Fresh/Mixed Subwatershed Characterizations

Fresh Evamix Matrix	**Predicted N Load** (#/volume/yr)	**Residence Time** (days)	**Total Nitrogen Concentration** 90th Percentile of Last 10 Years (mg/L)	**Total Phosphorus Concentration** 90th Percentile Last 10 Years (mg/L)	**Dissolved Oxygen** 10th percentile for last ten years	**HAB - Environmental** # of Blooms in Last 10 Years	**HAB - Human Health** # of Blooms in Last 10 Years	**Plant and/or Macroalgae Overgrowth**	**Chl-a** 90th Percentile for Last 10 Years (ug/L)	**Clarity** Average secchi depth for Last 10 Years (ft)
Q,+N,-N	-N	-N	-N	-N	+N	-N	-N	Q	-N	+N
0<wt<1	35%	5%	10%	10%	5%	5%	15%	5%	5%	5%
Abets Creek	0.209	4.1	1.86	0.05	7.02	0	0	1	18.4	2.5
Agawam Lake	0.072	10.1	3.15	0.05	7.22	0	4	1	40.8	1.3
Amityville Creek	0.004	2.9	1.38	0.10	0.53	0	0	0	15.3	5.4
Aspatuck Creek and River	0.051	7.3	1.31	0.06	4.78	0	0	1	24.2	1.5
Awixa Creek	0.060	3.5	1.08	0.05	11.60	0	0	1	2.8	4.0
Beaverdam Pond	0.068	8.3	0.68	0.10	6.59	1	0	1	36.4	3.0
Beaverdam Creek	0.092	8.6	3.65	0.05	3.98	0	0	1	28.3	3.3
Belmont Lake	0.420	18.4	0.46	0.10	5.77	0	0	0	28.3	5.4
Big/Little Fresh Ponds **	0.004	40.8	0.76	0.05	5.77	7	0	1	26.6	8.6
Big Reed Pond *	0.000	244.0	0.78	0.05	6.70	0	3	1	7.2	4.6
Brightwaters Canal, Nosreka, Mirror, and Cascade Lakes	0.022	2.3	1.07	0.05	12.80	0	0	1	3.5	3.0
Brown Creek	0.510	3.6	1.93	0.05	4.99	0	0	1	7.0	3.3
Brushes Creek	0.109	2.0	6.93	0.06	7.16	0	0	1	28.3	5.4
Carlls River	0.154	5.2	1.40	0.13	3.12	2	0	0	30.7	3.9
Carmans River Upper, and Tribs	1.022	0.8	1.91	0.06	8.75	0	0	0	14.0	6.2
Champlin Creek	0.034	2.9	3.43	0.10	6.90	0	0	1	9.3	3.3
Connetquot River, Upper, and Tribs **	2.053	3.0	2.88	0.01	9.70	0	0	0	28.3	5.4
Corey Lake and Creek, and Tribs	0.275	3.4	0.93	0.05	4.39	0	0	1	8.0	3.2
Crab Meadow Creek	0.182	1.0	1.51	0.09	5.20	0	0	1	3.1	5.4
Deep Pond *	0.002	244.0	0.66	0.05	6.43	0	0	1	5.6	9.5
Dunton Lake, Upper, and Tribs and Hedges Creek	0.307	12.3	0.87	0.08	6.60	0	0	1	25.0	5.4
Fort Pond *	0.003	244.0	0.79	0.05	7.78	0	2	1	46.8	5.4
Fresh Pond Creek and Tribs	0.056	1.4	0.67	0.06	14.30	0	0	1	2.4	5.4
Georgica Pond	0.019	47.2	0.92	0.05	6.41	0	4	0	27.0	5.4
Green Creek, Upper, and Tribs	0.426	0.2	3.75	0.05	4.73	0	0	1	11.5	4.0
Halsey Neck Pond	0.027	34.0	2.20	0.05	1.23	0	0	1	2.2	5.4
Hook Pond	0.134	21.1	1.60	0.05	9.39	0	2	1	126.5	1.0
Kellis Pond	0.014	25.5	1.44	0.05	5.23	0	3	1	136.6	5.4
Lake Panamoka (Long Pond) *	0.009	244.0	0.46	0.05	4.60	0	0	1	0.7	7.9
Lake Ronkonkoma *	0.001	244.0	0.77	0.05	6.48	0	4	0	16.9	3.9
Laurel Pond *	0.001	244.0	0.80	0.05	5.81	0	1	1	30.9	9.2
Lawrence Creek, O-co-nee and Lawrence Lakes	0.006	4.4	0.82	0.10	1.81	1	0	1	24.3	1.9
Ligonee Brook and Tribs *	0.083	66.6	2.16	0.03	3.86	0	0	1	3.1	8.6
Little Long, Long, and Shorts Pond **	0.008	11.0	0.57	0.04	5.77	0	0	1	4.6	4.6
Marion Lake	0.025	7.1	0.89	0.05	5.62	0	1	1	15.9	5.4
Mattituck (Marratooka) Pond *	0.001	244.0	9.54	2.86	4.80	0	4	1	212.0	2.7
Mecox Bay and Tribs	0.007	84.2	1.14	0.10	5.77	0	1	1	28.3	5.4
Mill Pond and Sevens Ponds	0.046	18.3	2.10	0.19	7.04	0	4	1	60.3	5.4
Mud Creek, Robinson Pond, and Tidal Tribs	0.087	1.7	1.40	0.58	3.40	0	0	1	28.3	5.4
Neguntatogue Creek	0.004	4.1	1.14	0.10	5.77	0	0	1	28.3	5.4
Nissequogue River Upper, and Tribs	0.347	4.9	3.25	0.13	4.12	1	1	0	20.4	3.0

Table 2-30 Fresh/Mixed Subwatershed Characterizations

Fresh Evamix Matrix	Predicted N Load (#/volume/yr)	Residence Time (days)	Total Nitrogen Concentration 90th Percentile of Last 10 Years (mg/L)	Total Phosphorus Concentration 90th Percentile Last 10 Years (mg/L)	Dissolved Oxygen 10th percentile for last ten years	HAB - Environmental # of Blooms in Last 10 Years	HAB - Human Health # of Blooms in Last 10 Years	Plant and/or Macroalgae Overgrowth	Chl-a 90th Percentile for Last 10 Years (ug/L)	Clarity Average secchi depth for Last 10 Years (ft)
Q,+N,-N	-N	-N	-N	-N	+N	-N	-N	Q	-N	+N
0<wt<1	35%	5%	10%	10%	5%	5%	15%	5%	5%	5%
Old Town Pond	0.154	21.2	1.44	0.14	7.90	0	3	1	321.4	5.4
Oyster Pond/Lake Munchogue	0.000	6.1	1.14	0.10	5.77	0	0	1	28.3	5.2
Pardees, Orowoc Lakes, Creek, and Tidal Tribs	0.091	1.2	2.56	0.11	4.70	1	0	1	22.0	3.3
Patchogue River	0.293	8.9	4.01	0.12	5.05	0	0	0	22.0	5.4
Peconic River, Lower, and Tidal Tribs	0.017	16.0	0.90	0.19	1.90	1	1	1	303.8	3.2
Peconic River Middle, and Tribs	0.031	5.7	1.01	0.42	8.40	0	1	0	28.3	1.8
Peconic River Upper, and Tribs	0.039	20.8	0.31	0.05	6.77	0	2	0	28.3	5.4
Penataquit Creek	0.032	9.4	4.44	0.04	7.60	0	0	1	28.3	5.4
Quantuck Creek and Old Ice Pond	0.024	12.2	0.56	0.08	5.74	1	0	1	35.9	1.8
Sagaponack Pond and Poxabogue Pond	0.045	32.4	1.14	0.10	8.26	0	3	1	28.3	5.4
Sampawams Creek	0.090	1.8	2.07	0.10	3.40	0	0	1	22.5	5.4
Sans Souci Lakes	0.146	7.4	3.19	0.05	3.76	1	0	0	24.8	1.0
Santapogue Creek	0.004	3.3	1.80	0.18	3.70	0	0	1	54.1	5.4
SI Sound Trib/Moores Drain, Lower, Tribs **	0.029	5.8	1.23	0.08	2.79	0	0	1	28.3	5.4
Speonk River	0.067	8.3	0.76	0.17	5.00	0	0	1	63.3	2.0
Stillman Creek	1.000	2.6	2.41	0.08	5.59	0	0	1	16.9	5.4
Swan River, Swan Lake, and Tidal Tribs	0.316	1.8	2.78	0.15	5.10	0	0	1	34.2	5.4
Terrell River	0.025	7.6	0.92	0.28	6.10	0	0	1	250.0	3.0
Tuthills Creek	0.349	2.9	1.25	0.06	6.64	0	0	0	28.3	2.8
Wading River	0.995	0.5	0.84	0.05	4.60	0	0	1	2.1	5.4
Wainscott Pond/Fairfield Pond	0.059	1.9	1.14	0.18	7.25	0	3	1	473.7	5.4
Wickapogue Pond	0.084	13.6	0.74	0.12	3.72	2	2	1	128.6	1.0
Wildwood Lake (Great Pond) *	0.002	244.0	0.42	0.05	5.54	0	0	1	6.1	12.8
Willets Creek	0.004	2.4	1.05	0.09	5.60	1	0	1	26.0	4.0

* Residence time set to a maximum value of 244 days to correspond to the typical/average duration of the algal blooming season in our region.

** Residence time used in EVAMIX was subsequently refined by HDR, Inc. (see final residence times in Tables 2-25 and 2-26). However, updated residence times had no impact on final ecological sensitivity rank for the waterbody.

Table 2-32 Poorly Characterized Water Bodies

Subwatershed	SWP PWL Number	Final Rank
Abets Creek	1701-0327-AC	1
Agawam Lake	1701-0117	1
Amityville Creek	1701-0087+0372	1
Aspatuck Creek and River	1701-0303-AC	1
Awixa Creek	1701-0093+0338	1
Beaverdam Creek	1701-0324+0104	1
Beaverdam Pond	1701-0307+0306	1
Belmont Lake	1701-0021+0089	1
Big Reed Pond	1701-0281	2
Big/Little Fresh Ponds	1701-0125	3
Brightwaters Canal	1701-0338-BC+0342	1
Brown Creek	1701-0097+0333	1
Brushes Creek	1701-0247-BC+0249	1
Carmans River Upper, and Tribs	1701-0102-rev+0322+0323	1
Cedar Beach Creek and Tidal Tribs	1701-0243	3
Champlin Creek	1701-0019+0338+0340	1
Cold Spring Harbor, and Tidal Tribs	1702-0018+0156	3
Connetquot River, Upper, and Tribs	1701-0095+0339	1
Conscience Bay and Tidal Tribs	1702-0091	3
Corey Creek and Tidal Tribs	1701-0244	3
Corey Lake and Creek, and Tribs	1701-0329+0327-CL	1
Crab Meadow Creek	1702-0232-CMC+0234	2
Cutchogue Harbor - Mud Creek	1701-0045-MC	3
Cutchogue Harbor - Wickham Creek	1701-0045-WC	3
Dam Pond	1701-0228	3
Deep Pond	1701-0270	4
Dering Harbor	1701-0050+	4
Dickerson Creek	1701-0242-DC	4
Dunton Lake, Upper, and Tribs	1701-0330-HC+0327	1
Far Pond	1701-0295-FP	4
Fish Cove	1701-0037-FC	4
Flax Pond	1702-0240	3
Fort Pond	1701-0122	2
Fort Pond Bay	1701-0370	4
Fresh Pond	1701-0279	4
Fresh Pond Creek and Tribs	1702-0244	3
Georgica Pond	1701-0145	1
Goose Creek	1701-0236	3
Goose Neck Creek	1701-0272-GNC	2

Table 2-32 Poorly Characterized Water Bodies

Subwatershed	SWP PWL Number	Final Rank
Grand Canal	1701-0337-GC	1
Green Creek, Upper, and Tribs	1701-0096+0333	3
Gull Pond	1701-0231	3
Halsey Neck Pond	1701-0355	1
Heady and Taylor Creeks and Tribs	1701-0294	1
Hog Creek and Tidal Tribs	1701-0277	3
Hook Pond	1701-0131	2
Howell's Creek	1701-0327-HC	1
James Creek	1701-0247-JC+0249	1
Kellis Pond	1701-0290	1
Lake Panamoka (Long Pond)	1701-0134	4
Laurel Pond	1701-0128	2
Lawrence Creek/Lakes, O-co-nee	1701-0338-LC	1
Ligonee Brook and Tribs	1701-0352+0353	2
Little Long, and Shorts Pond	1701-0291	3
Marion Lake	1701-0229	3
Mattituck (Marratooka) Pond	1701-0129	1
Mecox Bay and Tribs	1701-0034+0289+0292	1
Menantic Creek	1701-0242-MC	2
Middle Pond	1701-0295-MP	3
Mill Pond	1702-0261	1
Mill Pond and Sevens Ponds	1701-0113+0289	1
Mud and Senix Creeks	1701-0312-MSC	2
Mud Creek, Robinson Pond, and Tribs	1701-0101+0331+0327	1
Napeague Bay	1701-0369	4
Neguntatogue Creek	1701-0088+0372	1
Nissequogue River Upper	1702-0235+0013+0238+0237+0236	1
Ogden Pond	1701-0302	1
Old Fort Pond	1701-0295-OFP	3
Old Town Pond	1701-0118	1
Orchard Neck Creek	1701-0312-ONC	2
Oyster Pond/Lake Munchogue	1701-0169	4
Pardees, Orowoc Lakes, Creek, & Tribs	1701-0094+0341+0338	1
Patchogue River	1701-0099+0018+0055+0327	1
Pattersquash Creek	1701-0319-PC	2
Peconic River Middle, and Tribs	1701-0261+0262+0269	1
Peconic River Upper, and Tribs	1701-0108+0265+0266+0269	1
Penataquit Creek	1701-0092+0338	1
Penny Pond and Creeks	1701-0298-rev+0033	2

Table 2-32 Poorly Characterized Water Bodies

Subwatershed	SWP PWL Number	Final Rank
Phillips Creek, Lower, and Tidal Tribs	1701-0299	1
Pipes Cove	1701-0366	3
Quantuck Creek and Old Ice Pond	1701-0303-QC+0304	1
Quogue Canal	1701-0301	1
1 Creek Pond and Tidal Tribs	1701-0250	1
Richmond Creek and Tidal Tribs	1701-0245	2
Sagaponack Pond	1701-0146+0286	1
Sampawams Creek	1701-0090+0372+0343	1
Sans Souci Lakes	1701-0336+0335	1
Santapogue Creek	1701-0016+0372	1
Scallop Pond	1701-0354	1
Sheepen Creek	1701-0319-SC	2
SI Sound Trib/Moores Drain, Lower, Tribs	1701-0232+0233	3
Speonk River	1701-0306-SR	1
Spring Pond	1701-0230	3
Stillman Creek	1701-0329-SC	1
Stirling Creek and Basin	1701-0049	2
Swan River, Swan Lake, and Tidal Tribs	1701-0100+0332+0329+0327	1
Terrell River	1701-0103+0313+0314	2
Tiana Bay and Tidal Tribs	1701-0112	2
Town/Jockey Creek and Tidal Tribs	1701-0235	3
Tuthill Cove	1701-0309-TC	2
Tuthills Creek	1701-0098+0327+0329+0334	1
Unchachogue/Johns Neck Creeks	1701-0319-UC	2
Wading River	1702-0099+0243	1
Wainscott Pond/Fairfield Pond	1701-0144	1
Weesuck Creek and Tidal Tribs	1701-0111-rev	1
West Creek and Tidal Tribs	1701-0246	1
Wickapogue Pond	1701-0119	1
Wildwood Lake (Great Pond)	1701-0264	4
Willets Creek	1701-0091+0175+0372	1

Table 2-34 Subwatershed Priority Rankings (page 1 of 6)

Subwatershed Name	SWP PWL Number	Rank
Block Island Sound	1701-0278	
Priority Rank 1		
Abets Creek	1701-0327-AC	1
Agawam Lake	1701-0117	1
Amityville Creek	1701-0087+0372	1
Aspatuck Creek and River	1701-0303-AC	1
Awixa Creek	1701-0093+0338	1
Beaverdam Creek	1701-0324+0104	1
Beaverdam Pond	1701-0307+0306	1
Bellport Bay	1701-0320+0325	1
Belmont Lake	1701-0021+0089	1
Brightwaters Canal	1701-0338-BC+0342	1
Brown Creek	1701-0097+0333	1
Brushes Creek	1701-0247-BC+0249	1
Carlls River	1701-0089+0346+0345+0344+0372	1
Carmans River Lower, and Tribs	1701-0321-rev	1
Carmans River Upper, and Tribs	1701-0102-rev+0322+0323	1
Champlin Creek	1701-0019+0338+0340	1
Connetquot River, Lower, and Tribs	1701-0337	1
Connetquot River, Upper, and Tribs	1701-0095+0339	1
Corey Lake and Creek, and Tribs	1701-0329+0327-CL	1
Deep Hole Creek	1701-0247-DHC+0249	1
Dunton Lake, Upper, and Tribs	1701-0330-HC+0327	1
Flanders Bay, West/Lower Sawmill Creek	1701-0254+0257	1
Forge River and Tidal Tribs	1701-0316-FR+0312+0026	1
Georgica Pond	1701-0145	1
Goldsmith Inlet (inlet closed)	1702-0026	1
Grand Canal	1701-0337-GC	1
Great Cove	1701-0376+0338	1
Great Peconic Bay and minor coves	1701-0165+0247+0249+0251	1
Great South Bay, East	1701-0039-rev+0333	1
Great South Bay, Middle	1701-0040-rev	1
Great South Bay, West	1701-0173+0372	1
Green Creek, Upper, and Tribs	1701-0096+0333	1
Halsey Neck Pond	1701-0355	1
Heady and Taylor Creeks and Tribs	1701-0294	1
Howell's Creek	1701-0327-HC	1
James Creek	1701-0247-JC+0249	1
Kellis Pond	1701-0290	1

Table 2-34 Subwatershed Priority Rankings

Subwatershed Name	SWP PWL Number	Rank
Lake Ronkonkoma	1701-0020	1
Lawrence Creek/Lakes, O-co-nee	1701-0338-LC	1
Mattituck (Marratooka) Pond	1701-0129	1
Mecox Bay and Tribs	1701-0034+0289+0292	1
Meetinghouse Creek and Tribs	1701-0256-MC	1
Mill Pond	1702-0261	1
Mill Pond and Sevens Ponds	1701-0113+0289	1
Moriches Bay East	1701-0305-rev+0306	1
Mud Creek, Robinson Pond, and Tribs	1701-0101+0331+0327	1
Neguntatogue Creek	1701-0088+0372	1
Nicoll Bay	1701-0375+0333	1
Nissequogue River Upper	1702-0235+0013+0238+0237+0236	1
Northport Bay	1702-0256	1
Northport Harbor	1702-0230	1
Ogden Pond	1701-0302	1
Old Town Pond	1701-0118	1
Pardees, Orowoc Lakes, Creek, & Tribs	1701-0094+0341+0338	1
Patchogue Bay	1701-0326	1
Patchogue River	1701-0099+0018+0055+0327	1
Peconic River Middle, and Tribs	1701-0261+0262+0269	1
Peconic River Upper, and Tribs	1701-0108+0265+0266+0269	1
Peconic River, Lower, and Tidal Tribs	1701-0259+0263	1
Penataquit Creek	1701-0092+0338	1
Penniman Creek and Tidal Tribs	1701-0300	1
Phillips Creek, Lower, and Tidal Tribs	1701-0299	1
Quantuck Bay	1701-0042+0303	1
Quantuck Canal/Moneybogue Bay	1701-0371	1
Quantuck Creek and Old Ice Pond	1701-0303-QC+0304	1
Quogue Canal	1701-0301	1
Red Creek Pond and Tidal Tribs	1701-0250	1
Sagaponack Pond	1701-0146+0286	1
Sampawams Creek	1701-0090+0372+0343	1
Sans Souci Lakes	1701-0336+0335	1
Santapogue Creek	1701-0016+0372	1
Scallop Pond	1701-0354	1
Seatuck Cove and Tidal Tribs	1701-0309-SC+0306+0311	1
Shinnecock Bay West	1701-0033-W	1
Speonk River	1701-0306-SR	1
Stillman Creek	1701-0329-SC	1
Swan River, Swan Lake, and Tidal Tribs	1701-0100+0332+0329+0327	1

Table 2-34 Subwatershed Priority Rankings

Subwatershed Name	SWP PWL Number	Rank
Terry's Creek and Tribs	1701-0256-TC	1
Tuthills Creek	1701-0098+0327+0329+0334	1
Wading River	1702-0099+0243	1
Wainscott Pond/Fairfield Pond	1701-0144	1
Weesuck Creek and Tidal Tribs	1701-0111-rev	1
West Creek and Tidal Tribs	1701-0246	1
West Neck Bay and Creek	1701-0242-WB	1
Wickapogue Pond	1701-0119	1
Willets Creek	1701-0091+0175+0372	1
Priority Rank 2		
Big Reed Pond	1701-0281	2
Centerport Harbor	1702-0229	2
Crab Meadow Creek	1702-0232-CMC+0234	2
Flanders Bay, East/Center, and Tribs	1701-0030+0255+0273	2
Forge River Cove and Tidal Tribs	1701-0316-FRC+0312	2
Fort Pond	1701-0122	2
Goose Neck Creek	1701-0272-GNC	2
Hook Pond	1701-0131	2
Huntington Bay	1702-0014	2
Huntington Harbor	1702-0228+0231	2
Laurel Pond	1701-0128	2
Ligonee Brook and Tribs	1701-0352+0353	2
Little Peconic Bay	1701-0126+0172	2
Mattituck Inlet/Cr, Low, and Tidal Tribs	1702-0020+0245	2
Menantic Creek	1701-0242-MC	2
Moriches Bay West	1701-0038-rev	2
Mud and Senix Creeks	1701-0312-MSC	2
Narrow Bay	1701-0318+0319	2
Orchard Neck Creek	1701-0312-ONC	2
Pattersquash Creek	1701-0319-PC	2
Penny Pond, Wells, Smith, and Gilbert Creeks	1701-0298-rev+0033	2
Richmond Creek and Tidal Tribs	1701-0245	2
Sheepen Creek	1701-0319-SC	2
Shinnecock Bay Central	1701-0033-C	2
Stirling Creek and Basin	1701-0049	2
Terrell River	1701-0103+0313+0314	2
Tiana Bay and Tidal Tribs	1701-0112	2
Tuthill Cove	1701-0309-TC	2
Unchachogue/Johns Neck Creeks	1701-0319-UC	2
Priority Rank 3		
Big/Little Fresh Ponds	1701-0125	3

Table 2-34 Subwatershed Priority Rankings

Subwatershed Name	SWP PWL Number	Rank
Cedar Beach Creek and Tidal Tribs	1701-0243	3
Coecles Harbor	1701-0163	3
Cold Spring Harbor, and Tidal Tribs	1702-0018+0156	3
Conscience Bay and Tidal Tribs	1702-0091	3
Corey Creek and Tidal Tribs	1701-0244	3
Cutchogue Harbor	1701-0045-CH	3
Cutchogue Harbor - East Creek	1701-0045-EC	3
Cutchogue Harbor - Mud Creek	1701-0045-MC	3
Cutchogue Harbor - Wickham Creek	1701-0045-WC	3
Dam Pond	1701-0228	3
Duck Island Harbor	1702-0262	3
Flax Pond	1702-0240	3
Fresh Pond Creek and Tribs	1702-0244	3
Goldsmith Inlet (inlet open)	1702-0026	3
Goose Creek	1701-0236	3
Gull Pond	1701-0231	3
Hallock/Long Beach Bay and Tidal Tribs	1701-0227	3
Harts Cove	1701-0309-HC	3
Hog Creek and Tidal Tribs	1701-0277	3
Little Long, and Shorts Pond	1701-0291	3
Lloyd Harbor	1702-0227	3
Long Island Sound, Suffolk Co, Central	1702-0265	3
Long Island Sound, Suffolk County, West	1702-0098+0232	3
Marion Lake	1701-0229	3
Middle Pond	1701-0295-MP	3
Nissequogue River Lower/Sunken Meadow Creek	1702-0025+0234+0232	3
Noyack Creek and Tidal Tribs	1701-0237	3
Old Fort Pond	1701-0295-OFP	3
Pipes Cove	1701-0366	3
Port Jefferson Harbor, South, and Tribs	1702-0241	3
Reeves Bay and Tidal Tribs	1701-0272-RB	3
Sag Harbor Cove and Tribs	1701-0035-SHC	3
Setauket Harbor	1702-0242	3
Shelter Island Sound, North, and Tribs	1701-0170	3
SI Sound Trib/Moores Drain, Lower, Tribs	1701-0232+0233	3
Smithtown Bay	1702-0023+0233+0234	3
Spring Pond	1701-0230	3
Stony Brook Harbor and West Meadow Creek	1702-0047+0239	3
Town/Jockey Creeks and Tidal Tribs	1701-0235	3
Priority Rank 4		

Table 2-34 Subwatershed Priority Rankings

Subwatershed Name	SWP PWL Number	Rank
Acabonack Harbor	1701-0047	4
Cold Spring Pond and Tribs	1701-0127	4
Deep Pond	1701-0270	4
Dering Harbor	1701-0050+	4
Dickerson Creek	1701-0242-DC	4
Far Pond	1701-0295-FP	4
Fish Cove	1701-0037-FC	4
Fort Pond Bay	1701-0370	4
Fresh Pond	1701-0279	4
Gardiners Bay and minor Tidal Tribs	1701-0164	4
Hashamomuck Pond/Long Creek and Budd's Pond	1701-0162+0234	4
Lake Montauk	1701-0031	4
Lake Panamoka (Long Pond)	1701-0134	4
Little Sebonac Creek	1701-0253	4
Long Island Sound, Suffolk County, East	1702-0266	4
Mill Creek and Tidal Tribs	1701-0238+	4
Mt Sinai Harbor and Tidal Tribs	1702-0019	4
Napeague Bay	1701-0369	4
Napeague Harbor and Tidal Tribs	1701-0166	4
North Sea Harbor and Tribs	1701-0037	4
Northwest Creek and Tidal Tribs	1701-0046	4
Northwest Harbor	1701-0368+0275+0276	4
Noyack Bay	1701-0167-rev	4
Orient Harbor and minor Tidal Tribs	1701-0168	4
Oyster Pond/Lake Munchogue	1701-0169	4
Port Jefferson Harbor, North, and Tribs	1702-0015	4
Sag Harbor	1701-0035-SH+0239	4
Sebonac Cr/Bullhead Bay and Tidal Tribs	1701-0051	4
Shelter Island Sound, South, and Tribs	1701-0365-rev+0240	4
Shinnecock Bay - Bennet Cove (Cormorant Cove)	1701-0033-BC+0252+0296	4
Shinnecock Bay East	1701-0033-E	4
Southold Bay	1701-0044	4
Three Mile Harbor	1701-0036	4
West Neck Harbor	1701-0132-rev	4
Wildwood Lake (Great Pond)	1701-0264	4
Wooley Pond	1701-0048+	4

Table 2-48 Range of Nitrogen Load Reduction Goals Based on Alternative Approaches

Notes:
Bold – Well characterized water body
- Poorly characterized water body. Goals should be used with caution.
N/A – Goal calculation approach was not applicable.

Subwatershed	Reference Water Body Overall Water Quality Improvement Goal	Reference Water Body HAB/DO Improvement Goal	Probability-based Chl-*a* Goal (based on high unit N load and 80% Percentile)	Nitrogen Reduction Goal for Protection of Downgradient Water Bodies		Achievable Reduction through On-Site Wastewater Management
Abets Creek	91%	83%	90%	95%		48%
Acabonack Harbor	**70%**	**41%**	**0%**	**0%**		**39%**
Agawam Lake	72%	N/A	86%	N/A		56%
Amityville Creek	0%	0%	12%	39%		13%
Aspatuck Creek and River	80%	61%	76%	93%		47%
Atlantic Ocean	N/A	N/A	N/A	N/A		N/A
Awixa Creek	79%	57%	74%	53%		29%
Beaverdam Creek	91%	82%	89%	95%		46%
Beaverdam Pond	89%	77%	86%	79%		42%
Bellport Bay	**89%**	**79%**	**87%**	**95%**		**40%**
Belmont Lake	N/A	N/A	N/A	86%		55%
Big Reed Pond	N/A	N/A	84%	0%		0%
Big/Little Fresh Ponds	33%	N/A	N/A	0%		40%
Block Island Sound	N/A	N/A	N/A	0%		1%
Brightwaters Canal, Nosreka, Mirror, and Cascade Lakes	59%	18%	74%	53%		15%
Brown Creek	96%	91%	95%	95%		52%
Brushes Creek	90%	81%	88%	73%		13%
Carlls River	86%	72%	93%	39%		48%
Carmans River Lower, and Tribs	**95%**	**90%**	**94%**	**95%**		**36%**
Carmans River Upper, and Tribs	55%	N/A	N/A	95%		36%
Cedar Beach Creek and tidal tribs	0%	0%	0%	0%		34%
Cedar Beach Creek and tidal tribs	**0%**	**0%**	**0%**	**0%**		**34%**
Centerport Harbor	**0%**	**0%**	**0%**	**0%**		**48%**

Table 2-48 Range of Nitrogen Load Reduction Goals Based on Alternative Approaches

Subwatershed	Reference Water Body Overall Water Quality Improvement Goal	Reference Water Body HAB/DO Improvement Goal	Probability-based Chl-*a* Goal (based on high unit N load and 80% Percentile)	Nitrogen Reduction Goal for Protection of Downgradient Water Bodies		Achievable Reduction through On-Site Wastewater Management
Champlin Creek	86%	72%	87%	53%		26%
Coecles Harbor	**0%**	**0%**	**0%**	**0%**		**27%**
Cold Spring Harbor	0%	0%	0%	N/A		41%
Cold Spring Pond and Tribs	**50%**	**0%**	**0%**	**73%**		**38%**
Connetquot River, Lower, and Tribs	**92%**	**84%**	**91%**	**95%**		**42%**
Connetquot River, Upper, and Tribs	78%	N/A	N/A	95%		49%
Conscience Bay and Tidal Tribs	58%	16%	49%	0%		42%
Corey Creek and Tidal Tribs	64%	28%	56%	0%		42%
Corey Lake and Creek, and Tribs	92%	84%	90%	95%		48%
Crab Meadow Creek	60%	19%	51%	0%		46%
Cutchogue Harbor	**0%**	**0%**	**0%**	**0%**		**30%**
Cutchogue Harbor - East Creek	**62%**	**24%**	**54%**	**0%**		**38%**
Cutchogue Harbor - Mud Creek	69%	38%	63%	0%		37%
Cutchogue Harbor - Wickham Creek	74%	49%	69%	0%		26%
Dam Pond	0%	0%	0%	0%		14%
Deep Hole Creek	**90%**	**79%**	**88%**	**73%**		**32%**
Deep Pond	N/A	N/A	N/A	0%		20%
Dering Harbor	0%	0%	0%	0%		35%
Dickerson Creek	22%	0%	6%	0%		35%
Duck Island Harbor	**0%**	**0%**	**0%**	**0%**		**39%**
Dunton Lake, Upper, and Tribs and Hedges Creek	94%	88%	98%	95%		52%
Far Pond	19%	0%	3%	0%		44%
Fish Cove	31%	0%	17%	0%		35%
Flanders Bay, East/Center, and Tribs (North)	**71%**	**43%**	**62%**	**73%**		**17%**

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Table 2-48 Range of Nitrogen Load Reduction Goals Based on Alternative Approaches

Subwatershed	Reference Water Body Overall Water Quality Improvement Goal	Reference Water Body HAB/DO Improvement Goal	Probability-based Chl-*a* Goal (based on high unit N load and 80% Percentile)	Nitrogen Reduction Goal for Protection of Downgradient Water Bodies		Achievable Reduction through On-Site Wastewater Management
Flanders Bay, East/Center, and Tribs (South)	**71%**	**43%**	**62%**	**73%**		**17%**
Flanders Bay, West/Lower Sawmill Creek	**56%**	**11%**	**46%**	**73%**		**14%**
Flax Pond	25%	0%	10%	0%		25%
Forge River and Tidal Tribs	**93%**	**86%**		**69%**		**49%**
Forge River Cove and Tidal Tribs	**69%**	**38%**	**62%**	**37%**		**39%**
Fort Pond	N/A	N/A	89%	N/A		44%
Fort Pond Bay	0%	0%	0%	0%		20%
Fresh Pond	30%	0%	16%	0%		27%
Fresh Pond Creek and Tribs	N/A	N/A	N/A	0%		9%
Gardiners Bay	**0%**	**0%**	**0%**	**N/A**		**9%**
Georgica Pond	58%	N/A	93%	N/A		34%
Goldsmith Inlet	**79%**	**58%**	**75%**	**0%**		**35%**
Goose Creek	59%	18%	0%	0%		41%
Goose Neck Creek	76%	51%	71%	73%		37%
Grand Canal	86%	71%	83%	95%		50%
Great Cove	**42%**	**0%**	**30%**	**53%**		**7%**
Great Peconic Bay and minor coves	**73%**	**47%**	**66%**	**N/A**		**16%**
Great South Bay, East	**95%**	**91%**	**94%**	**N/A**		**28%**
Great South Bay, Middle	**53%**	**6%**	**66%**	**N/A**		**6%**
Great South Bay, West	**39%**	**0%**	**27%**	**N/A**		**5%**
Green Creek, Upper, and Tribs	94%	88%	93%	95%		52%
Gull Pond	40%	0%	27%	0%		31%
Hallock/Long Beach Bay and Tidal Tribs	**67%**	**34%**	**61%**	**0%**		**6%**
Halsey Neck Pond	N/A	N/A	94%	N/A		30%
Harts Cove	0%	0%	0%	37%		41%

Table 2-48 Range of Nitrogen Load Reduction Goals Based on Alternative Approaches

Subwatershed	Reference Water Body Overall Water Quality Improvement Goal	Reference Water Body HAB/DO Improvement Goal	Probability-based Chl-*a* Goal (based on high unit N load and 80% Percentile)	Nitrogen Reduction Goal for Protection of Downgradient Water Bodies		Achievable Reduction through On-Site Wastewater Management
Hashamomuck Pond/Long Creek and Budd's Pond	12%	0%	0%	0%		32%
Heady and Taylor Creeks	87%	74%	84%	0%		41%
Hog Creek and Tidal Tribs	78%	56%	74%	0%		45%
Hook Pond	N/A	N/A	97%	N/A		48%
Howell's Creek	87%	74%	85%	95%		48%
Huntington Bay	**0%**	**0%**	**0%**	**0%**		**33%**
Huntington Harbor	**72%**	**44%**	**66%**	**0%**		**41%**
James Creek	90%	80%	88%	73%		48%
Kellis Pond	N/A	N/A	N/A	N/A		36%
Lake Montauk	**0%**	**0%**	**0%**	**N/A**		**37%**
Lake Panamoka	N/A	N/A	N/A	0%		44%
Lake Ronkonkoma	**52%**	**N/A**	**N/A**	**N/A**		**44%**
Laurel Pond	N/A	N/A	N/A	73%		14%
Lawrence Creek, O-co-nee and Lawrence Lakes	51%	3%	65%	53%		14%
Ligonee Brook and Tribs	31%	N/A	N/A	81%		28%
Little Peconic Bay	**0%**	**0%**	**0%**	**0%**		**17%**
Little Sebonac Creek	**0%**	**0%**	**0%**	**73%**		**16%**
Little, Long, and Short Ponds	N/A	N/A	N/A	N/A		14%
Lloyd Harbor	**0%**	**0%**	**0%**	**0%**		**19%**
Long Island Sound Central	**0%**	**0%**	**0%**	**N/A**		**16%**
Long Island Sound East	**0%**	**0%**	**0%**	**N/A**		**4%**
Long Island Sound West	**0%**	**0%**	**0%**	**N/A**		**3%**
Marion Lake	N/A	N/A	57%	0%		41%
Mattituck (Marratooka) Pond	N/A	N/A	N/A	90%		14%
Mattituck Inlet/Creek	**66%**	**32%**	**59%**	**0%**		**34%**

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Table 2-48 Range of Nitrogen Load Reduction Goals Based on Alternative Approaches

Subwatershed	Reference Water Body Overall Water Quality Improvement Goal	Reference Water Body HAB/DO Improvement Goal	Probability-based Chl-*a* Goal (based on high unit N load and 80% Percentile)	Nitrogen Reduction Goal for Protection of Downgradient Water Bodies		Achievable Reduction through On-Site Wastewater Management
Mecox Bay	N/A	N/A	N/A	N/A		23%
Meetinghouse Creek and Tribs	**57%**	**14%**	**48%**	**73%**		**32%**
Menantic Creek	72%	45%	67%	0%		42%
Middle Pond	52%	3%	42%	0%		48%
Mill and Seven Ponds	N/A	N/A	N/A	N/A		22%
Mill Creek and Tidal Tribs	**52%**	**4%**	**0%**	**0%**		**42%**
Mill Pond	90%	80%	88%	0%		51%
Moriches Bay East	**79%**	**57%**	**74%**	**N/A**		**39%**
Moriches Bay West	**37%**	**0%**	**24%**	**N/A**		**8%**
Mount Sinai Harbor	**0%**	**0%**	**0%**	**0%**		**45%**
Mud and Senix Creeks	89%	79%	87%	69%		50%
Mud Creek, Robinson Pond, and Tidal Tribs	87%	75%	88%	95%		44%
Napeague Bay	0%	0%	0%	N/A		3%
Napeague Harbor	**0%**	**0%**	**0%**	**0%**		**16%**
Narrow Bay	**69%**	**38%**	**63%**	**37%**		**45%**
Neguntatogue Creek	19%	0%	2%	39%		10%
Nicoll Bay	**92%**	**83%**	**90%**	**95%**		**45%**

Table 2-48 Range of Nitrogen Load Reduction Goals Based on Alternative Approaches

Subwatershed	Reference Water Body Overall Water Quality Improvement Goal	Reference Water Body HAB/DO Improvement Goal	Probability-based Chl-*a* Goal (based on high unit N load and 80% Percentile)	Nitrogen Reduction Goal for Protection of Downgradient Water Bodies		Achievable Reduction through On-Site Wastewater Management
Nissequogue River Lower/Sunken Meadow Creek	**78%**	**57%**	**74%**	**0%**		**44%**
Nissequogue River Upper, and Tribs	67%	N/A	N/A	78%		44%
North Sea Harbor and Tribs	**0%**	**0%**	**0%**	**0%**		**40%**
Northport Bay	**0%**	**0%**	**0%**	**0%**		**42%**
Northport Harbor	**72%**	**44%**	**66%**	**0%**		**49%**
Northwest Creek and Tidal Tribs	**45%**	**0%**	**0%**	**0%**		**25%**
Northwest Harbor	**0%**	**0%**	**0%**	**0%**		**15%**
Noyack Bay (P/O)	**0%**	**0%**	**0%**	**0%**		**25%**
Noyack Creek and Tidal Tribs	**73%**	**45%**	**0%**	**0%**		**28%**
Ogden Pond	31%	0%	16%	93%		37%
Old Fort Pond	56%	12%	47%	0%		47%
Old Town Pond	N/A	N/A	98%	N/A		44%
Orchard Neck Creek	92%	83%	90%	69%		49%
Orient Harbor and minor tidal tribs	**0%**	**0%**	**0%**	**0%**		**19%**
Oyster Pond / Lake Munchogue	N/A	N/A	0%	N/A		0%
Pardees, Orowoc Lakes, Creek, and Tidal Tribs	83%	67%	85%	53%		39%
Patchogue Bay	**91%**	**81%**	**89%**	**95%**		**39%**

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Table 2-48 Range of Nitrogen Load Reduction Goals Based on Alternative Approaches

Subwatershed	Reference Water Body Overall Water Quality Improvement Goal	Reference Water Body HAB/DO Improvement Goal	Probability-based Chl-*a* Goal (based on high unit N load and 80% Percentile)	Nitrogen Reduction Goal for Protection of Downgradient Water Bodies		Achievable Reduction through On-Site Wastewater Management
Patchogue River	93%	86%	98%	95%		49%
Pattersquash Creek	82%	65%	79%	69%		54%
Peconic River Middle, and Tribs	N/A	N/A	N/A	86%		10%
Peconic River Upper, and Tribs	N/A	N/A	N/A	86%		7%
Peconic River, Lower, and Tidal Tribs	**86%**	**71%**	**83%**	**86%**		**32%**
Penataquit Creek	83%	67%	80%	53%		33%
Penniman Creek and Tidal Tribs	**30%**	**0%**	**16%**	**71%**		**37%**
Penny Pond, Wells, Smith, and Gilberts Creeks	0%	0%	0%	3%		47%
Phillips Creek, Lower, and Tidal Tribs	80%	60%	76%	71%		42%
Pipes Cove	0%	0%	0%	0%		40%
Port Jefferson Harbor, North, and Tribs	**0%**	**0%**	**0%**	**0%**		**39%**
Port Jefferson Harbor, South, and Tribs	**0%**	**0%**	**0%**	**0%**		**31%**
Quantuck Bay	**93%**	**85%**	**91%**	**93%**		**39%**
Quantuck Canal/Moneybogue Bay	**91%**	**82%**	**89%**	**93%**		**47%**
Quantuck Creek and Old Ice Pond	80%	61%	76%	93%		37%
Quogue Canal	93%	86%	91%	37%		40%

Table 2-48 Range of Nitrogen Load Reduction Goals Based on Alternative Approaches

Subwatershed	Reference Water Body Overall Water Quality Improvement Goal	Reference Water Body HAB/DO Improvement Goal	Probability-based Chl-*a* Goal (based on high unit N load and 80% Percentile)	Nitrogen Reduction Goal for Protection of Downgradient Water Bodies		Achievable Reduction through On-Site Wastewater Management
Red Creek Pond and Tidal Tribs	10%	0%	0%	73%		35%
Reeves Bay and Tidal Tribs	**67%**	**35%**	**61%**	**73%**		**45%**
Richmond Creek and Tidal Tribs	66%	31%	59%	0%		19%
Sag Harbor	**0%**	**0%**	**0%**	**0%**		**33%**
Sag Harbor Cove and Tribs	**81%**	**62%**	**0%**	**0%**		**44%**
Sagaponack Pond / Poxabogue Pond	N/A	N/A	96%	N/A		29%
Sampawams Creek	80%	59%	84%	39%		40%
Sans Souci Lakes	N/A	N/A	N/A	96%		49%
Santapogue Creek	56%	0%	0%	39%		10%
Scallop Pond	11%	0%	0%	73%		10%
Seatuck Cove and Tidal Tribs	**86%**	**71%**	**83%**	**37%**		**36%**
Sebonac Cr/Bullhead Bay and Tidal Tribs	**11%**	**0%**	**0%**	**73%**		**29%**
Setauket Harbor	**61%**	**22%**	**53%**	**0%**		**46%**
Sheepen Creek	54%	7%	44%	69%		54%
Shelter Island Sound, North, and tribs	**0%**	**0%**	**0%**	**0%**		**20%**
Shelter Island Sound, South, and tribs	**0%**	**0%**	**0%**	**0%**		**16%**
Shinnecock Bay - Bennet Cove (Cormorant Cove)	**50%**	**0%**	**0%**	**0%**		**47%**

Table 2-48 Range of Nitrogen Load Reduction Goals Based on Alternative Approaches

Subwatershed	Reference Water Body Overall Water Quality Improvement Goal	Reference Water Body HAB/DO Improvement Goal	Probability-based Chl-*a* Goal (based on high unit N load and 80% Percentile)	Nitrogen Reduction Goal for Protection of Downgradient Water Bodies		Achievable Reduction through On-Site Wastewater Management
Shinnecock Bay Central	**3%**	**0%**	**0%**	**0%**		**10%**
Shinnecock Bay East	**0%**	**0%**	**0%**	**N/A**		**28%**
Shinnecock Bay West	**71%**	**42%**	**65%**	**3%**		**38%**
SI Sound Trib/Moores Drain, Lower, Tribs	63%	26%	87%	0%		16%
Smithtown Bay	**0%**	**0%**	**0%**	**0%**		**19%**
Southold Bay	**0%**	**0%**	**0%**	**0%**		**32%**
Speonk River	88%	76%	85%	79%		44%
Spring Pond	34%	0%	20%	0%		46%
Stillman Creek	97%	94%	96%	95%		51%
Stirling Creek and Basin	43%	0%	0%	0%		40%
Stony Brook Harbor and West Meadow Creek	**60%**	**19%**	**52%**	**0%**		**43%**
Swan River, Swan Lake, and Tidal Tribs	96%	92%	96%	73%		50%
Terrell River	72%	44%	83%	37%		37%
Terry's Creek and Tribs	**91%**	**82%**	**89%**	**73%**		**27%**
Three Mile Harbor	**31%**	**0%**	**0%**	**0%**		**42%**
Tiana Bay and Tidal Tribs	68%	36%	62%	3%		46%
Town/Jockey Creek	**63%**	**26%**	**55%**	**0%**		**49%**

Table 2-48 Range of Nitrogen Load Reduction Goals Based on Alternative Approaches

Subwatershed	Reference Water Body Overall Water Quality Improvement Goal	Reference Water Body HAB/DO Improvement Goal	Probability-based Chl-*a* Goal (based on high unit N load and 80% Percentile)	Nitrogen Reduction Goal for Protection of Downgradient Water Bodies		Achievable Reduction through On-Site Wastewater Management
Tuthill Cove	40%	0%	28%	37%		42%
Tuthills Creek	94%	88%	96%	95%		48%
Unchachogue/Johns Neck Creeks	18%	0%	1%	69%		55%
Wading River	88%	76%	86%	0%		38%
Wainscott Pond	N/A	N/A	75%	N/A		15%
Weesuck Creek and Tidal tribs	72%	44%	66%	71%		36%
West Creek and Tidal Tribs	46%	0%	35%	73%		27%
West Neck Bay and Creek	**68%**	**37%**	**62%**	**0%**		**35%**
West Neck Harbor	**0%**	**0%**	**0%**	**0%**		**24%**
Wickapogue Pond	N/A	N/A	94%	N/A		38%
Wildwood Lake (Great Pond)	N/A	N/A	N/A	86%		22%
Willets Creek	0%	0%	28%	39%		6%
Wooley Pond	**42%**	**0%**	**0%**	**0%**		**40%**

Table 2-49 Subwatersheds where Additional Nitrogen Load Reductions are Required

Subwatershed	Reference Water Body Overall Water Quality Improvement Goal	Reference Water Body HAB/DO Improvement Goal	Probability-based Chl-*a* Goal (based on high unit N load and 80% Percentile)	Achievable Reduction through On-Site Wastewater Management)
Abets Creek	91%	83%	90%	48%
Acabonack Harbor	70%	41%	0%	39%
Agawam Lake	72%	N/A	86%	56%
Aspatuck Creek and River	80%	61%	76%	47%
Awixa Creek	79%	57%	74%	29%
Beaverdam Creek	91%	82%	89%	46%
Beaverdam Pond	89%	77%	86%	42%
Bellport Bay	89%	79%	87%	40%
Big Reed Pond	N/A	N/A	84%	0%
Brightwaters Canal, Nosreka, Mirror, and Cascade Lakes	59%	18%	74%	15%
Brown Creek	96%	91%	95%	52%
Brushes Creek	90%	81%	88%	13%
Carlls River	86%	72%	93%	48%
Carmans River Lower, and Tribs	95%	90%	94%	36%
Carmans River Upper, and Tribs	55%	N/A	N/A	36%
Champlin Creek	86%	72%	87%	26%
Cold Spring Pond and Tribs	50%	0%	0%	38%
Connetquot River, Lower, and Tribs	92%	84%	91%	42%
Connetquot River, Upper, and Tribs	78%	N/A	N/A	49%
Conscience Bay and Tidal Tribs	58%	16%	49%	42%
Corey Creek and Tidal Tribs	64%	28%	56%	42%
Corey Lake and Creek, and Tribs	92%	84%	90%	48%
Crab Meadow Creek	60%	19%	51%	46%
Cutchogue Harbor - East Creek	62%	24%	0%	38%
Cutchogue Harbor - Mud Creek	69%	38%	63%	37%
Cutchogue Harbor - Wickham Creek	74%	49%	69%	26%

Table 2-49 Subwatersheds where Additional Nitrogen Load Reductions are Required

Subwatershed	Reference Water Body Overall Water Quality Improvement Goal	Reference Water Body HAB/DO Improvement Goal	Probability-based Chl-*a* Goal (based on high unit N load and 80% Percentile)	Achievable Reduction through On-Site Wastewater Management)
Deep Hole Creek	90%	79%	88%	32%
Dunton Lake, Upper, and Tribs and Hedges Creek	94%	88%	98%	52%
Flanders Bay, East/Center, and Tribs (North)	71%	43%	62%	17%
Flanders Bay, East/Center, and Tribs (South)	71%	43%	62%	17%
Flanders Bay, West/Lower Sawmill Creek	56%	11%	46%	14%
Forge River and Tidal Tribs	93%	86%		49%
Forge River Cove and Tidal Tribs	69%	38%	62%	39%
Fort Pond	N/A	N/A	89%	44%
Georgica Pond	58%	N/A	93%	34%
Goldsmith Inlet	79%	58%	75%	35%
Goose Creek	59%	18%	0%	41%
Goose Neck Creek	76%	51%	71%	37%
Grand Canal	86%	71%	83%	50%
Great Cove	42%	0%	30%	7%
Great Peconic Bay and minor coves (north)	73%	47%	0%	16%
Great South Bay, East	95%	91%	94%	28%
Great South Bay, Middle	53%	6%	66%	6%
Great South Bay, West	39%	0%	27%	5%
Great Peconic Bay (South)	73%	47%	0%	16%
Green Creek, Upper, and Tribs	94%	88%	93%	52%
Gull Pond	40%	0%	27%	31%
Hallock/Long Beach Bay and Tidal Tribs	67%	34%	0%	6%
Halsey Neck Pond	N/A	N/A	94%	30%
Heady and Taylor Creeks	87%	74%	84%	41%
Hog Creek and Tidal Tribs	78%	56%	74%	45%
Hook Pond	N/A	N/A	97%	48%
Howell's Creek	87%	74%	85%	48%

Table 2-49 Subwatersheds where Additional Nitrogen Load Reductions are Required

Subwatershed	Reference Water Body Overall Water Quality Improvement Goal	Reference Water Body HAB/DO Improvement Goal	Probability-based Chl-*a* Goal (based on high unit N load and 80% Percentile)	Achievable Reduction through On-Site Wastewater Management)
Huntington Harbor	72%	44%	66%	41%
James Creek	90%	80%	88%	48%
Laurel Pond	N/A	N/A	N/A	14%
Lawrence Creek, O-co-nee and Lawrence Lakes	51%	3%	65%	14%
Marion Lake	N/A	N/A	57%	41%
Mattituck Inlet/Creek	66%	32%	59%	34%
Meetinghouse Creek and Tribs	57%	14%	48%	32%
Menantic Creek	72%	45%	67%	42%
Mill Creek and Tidal Tribs	52%	4%	0%	42%
Mill Pond	90%	80%	88%	51%
Moriches Bay East	79%	57%	74%	39%
Moriches Bay West	37%	0%	24%	8%
Mud and Senix Creeks	89%	79%	87%	50%
Mud Creek, Robinson Pond, and Tidal Tribs	87%	75%	88%	44%
Narrow Bay	69%	38%	63%	45%
Neguntatogue Creek	19%	0%	2%	10%
Nicoll Bay	92%	83%	90%	45%
Nissequogue River Lower/Sunken Meadow Creek	78%	57%	0%	44%
Nissequogue River Upper, and Tribs	67%	N/A	N/A	44%
Northport Harbor	72%	44%	66%	49%

Table 2-49 Subwatersheds where Additional Nitrogen Load Reductions are Required

Subwatershed	Reference Water Body Overall Water Quality Improvement Goal	Reference Water Body HAB/DO Improvement Goal	Probability-based Chl-*a* Goal (based on high unit N load and 80% Percentile)	Achievable Reduction through On-Site Wastewater Management)
Northwest Creek and Tidal Tribs	45%	0%	0%	25%
Noyack Creek and Tidal Tribs	73%	45%	0%	28%
Old Fort Pond	56%	12%	47%	47%
Old Town Pond	N/A	N/A	98%	44%
Orchard Neck Creek	92%	83%	90%	49%
Pardees, Orowoc Lakes, Creek, and Tidal Tribs	83%	67%	85%	39%
Patchogue Bay	91%	81%	89%	39%
Patchogue River	93%	86%	98%	49%
Pattersquash Creek	82%	65%	79%	54%
Peconic River, Lower, and Tidal Tribs	86%	71%	83%	32%
Penataquit Creek	83%	67%	80%	33%
Phillips Creek, Lower, and Tidal Tribs	80%	60%	76%	42%
Quantuck Bay	93%	85%	91%	39%
Quantuck Canal/Moneybogue Bay	91%	82%	89%	47%
Quantuck Creek and Old Ice Pond	80%	61%	76%	37%
Quogue Canal	93%	86%	91%	40%
Reeves Bay and Tidal Tribs	67%	35%	61%	45%
Richmond Creek and Tidal Tribs	66%	31%	59%	19%
Sag Harbor Cove and Tribs	81%	62%	0%	44%

Table 2-49 Subwatersheds where Additional Nitrogen Load Reductions are Required

Subwatershed	Reference Water Body Overall Water Quality Improvement Goal	Reference Water Body HAB/DO Improvement Goal	Probability-based Chl-*a* Goal (based on high unit N load and 80% Percentile)	Achievable Reduction through On-Site Wastewater Management)
Sagaponack Pond / Poxabogue Pond	N/A	N/A	96%	29%
Sampawams Creek	80%	59%	84%	40%
Santapogue Creek	56%	0%	0%	10%
Seatuck Cove and Tidal Tribs	86%	71%	83%	36%
Setauket Harbor	61%	22%	53%	46%
Shinnecock Bay West	71%	42%	65%	38%
SI Sound Trib/Moores Drain, Lower, Tribs	63%	26%	87%	16%
Speonk River	88%	76%	85%	44%
Stillman Creek	97%	94%	96%	51%
Stony Brook Harbor and West Meadow Creek	60%	19%	52%	43%
Swan River, Swan Lake, and Tidal Tribs	96%	92%	96%	50%
Terrell River	72%	44%	83%	37%
Terry's Creek and Tribs	91%	82%	89%	27%
Tiana Bay and Tidal Tribs	68%	36%	62%	46%
Town/Jockey Creek	63%	26%	0%	49%
Tuthills Creek	94%	88%	96%	48%
Wading River	88%	76%	86%	38%
Wainscott Pond	N/A	N/A	75%	15%

Table 2-49 Subwatersheds where Additional Nitrogen Load Reductions are Required

Subwatershed	Reference Water Body Overall Water Quality Improvement Goal	Reference Water Body HAB/DO Improvement Goal	Probability-based Chl-*a* Goal (based on high unit N load and 80% Percentile)	Achievable Reduction through On-Site Wastewater Management)
Weesuck Creek and Tidal tribs	72%	44%	66%	36%
West Creek and Tidal Tribs	46%	0%	35%	27%
West Neck Bay and Creek	68%	37%	62%	35%
Wickapogue Pond	N/A	N/A	94%	38%
Willets Creek	0%	0%	28%	6%

Table 2-50
Alternative Wastewater Treatment Technology Summary

Technology	Description	System Name	Provisionally Approved	Effectiveness: Achievable Nitrogen Levels: Demonstration Results	% Nitrate Removal[1]	Probability: 19 mg/L Nitrogen	Source	Implementability Criteria: Footprint (square feet)	Source	Depth to Groundwater Needed (feet below ground surface)	Source	Lot Size <5,000 sf	Source	Lot Size <10,000 sf	Source	Visibility / Aesthetics	Source	Retrofit existing septic tank	Source
Innovative/Alternative Onsite Wastewater Treatment Systems																			
Trickling filter/fixed film/packed bed	Filter incorporating an engineered textile treatment medium	Orenco Advantex AX20-RT	Yes	18.8	71%	High	SCDHS	44	a.	N/AP		Yes	SCDHS	Yes	a.	High	SCDHS	Yes	SCDHS
Trickling filter/fixed film/packed bed		Orenco Advantex AX20	No	21	68%	Med	SCDHS	20	a.	N/AP		Yes	SCDHS	Yes	a.	High	SCDHS	Yes	a.
Extended aeration/fixed film/suspended growth/activated sludge	Utilizes both the fixed film and suspended growth technology	Fuji Clean CEN Series Systems	Yes	16.6	74%	High	SCDHS	33	a.	N/AP		Yes	SCDHS	Yes	a.	Med	SCDHS	No	a.
Extended aeration/fixed film/suspended growth/activated sludge	Employs innovative Hydro-Kinetic filtration technology	Norweco Hydro-Kinetic	Yes	17.4	73%	High	SCDHS	120	a.	N/AP		No	a.	Yes	a.	High	SCDHS	Yes	SCDHS
Extended aeration/activated sludge	Extended aeration and attached growth processes with anoxic tank	Norweco Singulair TNT	Yes	18.3	72%	High	SCDHS	56	a.	N/AP		Yes	SCDHS	Yes	a.	Med	SCDHS	No	a.
Extended aeration/activated sludge		Hydro-Action AN Series	Yes	11.6	82%	High	SCDHS	55	a.	N/AP		Yes	SCDHS	Yes	a.	Med	SCDHS	No	a.
Trickling filter/fixed film/packed bed	Absorbent trickle filter made of polystyrene beads (SeptiTech) or foam cubes (Waterloo) that retain water and host microbes.	Bio Microbics SeptiTech/STAAR	Yes	13.6	79%	High	SCDHS	51	a.	N/AP		No	a.	Yes	a.	High	SCDHS	Yes	SCDHS
Trickling filter/fixed film/packed bed		Waterloo Biofilter	No	63.1	3%	Low	SCDHS	25-75	a.	N/AP		No	a.	Yes	a.	High	SCDHS	No	a.
Membrane Bioreactor (MBR) with activated sludge	Combination of a membrane process like microfiltration or ultrafiltration with a suspended growth bioreactor	BUSSE MF-B-400	No	83.4	0%	Low	SCDHS	40	a.	N/AP		No	a.	Yes	a.	High	SCDHS	No	a.
Membrane Bioreactor (MBR) with activated sludge		Bio-Microbics BioBarrier MBR Series	No	50.5	22%	Low	SCDHS	50	a.	N/AP		No	a.	Yes	a.	High	SCDHS	Yes	SCDHS
Extended aeration/fixed film/suspended growth/activated sludge	Biologically Active Filter operating as a Sequencing Batch Reactor	Amphidrome	No	22.7	65%	Med	SCDHS	120	a.	N/AP		No	a.	Yes	a.	High	SCDHS	Yes	SCDHS
Extended aeration/fixed film/suspended growth/activated sludge		Pugo Systems	No	27.9	57%	Med	SCDHS	40	a.	N/AP		Yes	SCDHS	Yes	a.	Med	SCDHS	No	a.
Filtration	Organic filter media made from renewable natural material that retains water and hosts microbes A denite polishing unit is tested with this technology	PremierTech Aqua Ecoflo Coco Filter + Denite	No	18.8	71%	High	SCDHS	96	m.	N/AP		No	m.	Yes	m.	High	SCDHS	Yes	m.
I/A Denitrification Polishing Units																			
Filtration	Sulfur / Limestone Filter	--	No	--	84%	--	SCDHS	<25	--	N/AP		Yes	--	Yes	--	Low	--	Yes	--
Filtration	Woodchip filter / Box nitrogen removing biofilter	--	No	--	88%		SCDHS	N/AV		--		No	--	Yes	--	Low	--	Yes	--
Filtration	Recirculating gravel filter and vegetated bed	--	No	3.2	95%	High	e. / h.	>700	h.	~2-3	h.	No	g.	Yes	g.	High	g.	Yes	e.

Table 2-50
Alternative Wastewater Treatment Technology Summary

Technology	Description	System Name	Provisionally Approved	Effectiveness – Achievable Nitrogen Levels: Demonstration Results	% Nitrate Removal[1]	Probability: 19 mg/L Nitrogen	Source	Implementability Criteria: Footprint (square feet)	Source	Depth to Groundwater Needed (feet below ground surface)	Source	Lot Size <5,000 sf	Source	Lot Size <10,000 sf	Source	Visibility / Aesthetics	Source	Retrofit existing septic tank	Source
Leaching Technologies																			
Gravity Leaching	Subsurface wastewater disposal facilities used to remove contaminants and impurities from the liquid that emerges from a septic tank by force of gravity	Retaining wall systems	--	--	Min	Low		See note 3.		2	SCDHS	Yes	--	Yes	--	Low	--	Yes	--
		Leaching pools and galleys	--	--	Min	Low		See note 3.		5	SCDHS	Yes	--	Yes	--	Low	--	Yes	--
		Gravelless trenches and geotextile sand filters	--	--	25%	N/AV	SCDHS	See note 3.		4	SCDHS	No	--	Yes	--	Low	--	Yes	--
Pressurized shallow drainfields	Used to distribute wastewater following pretreatment from an I/A system		--	--	N/AV	N/AV		See note 3.		3	SCDHS	Yes	--	Yes	--	Low	--	Yes	--
Appendix A Systems																			
Modified subsurface sewage disposal systems	Sewer systems for a small community also known as denitrification systems that are not to exceed 15,000 gpd design flow		--	5.9	--	High	l.	High	f.	High	f.	Yes	f.	Yes	f.	--	--	N/A	
Experimental/Other[4]																			
Constructed Wetlands	An engineered system design to simulate a natural wetland for waste treatment	--	--	--	up to 50%	Med	c.	Varies	--	N/AP	--	No	c.	No	c.	High	--	N/AP	--
Nitrogen removing biofilter (NYS CCWT) / Layered soil treatment	Passive wastewater treatment comprised of a sand-	Lined NRB	--	7.9	88%	High	h.	>700	h.	~3-4	h.	No	g.	Yes	g.	High	h.	Yes	h.
	based "nitrification layer" underlain by a	Unlined NRB	--	10	85%	High	h.	>700	h.	~3-4	h.	No	g.	Yes	g.	High	h.	Yes	h.
Composting Toilets	Type of dry toilet or micro-flush toilet that uses a predominantly aerobic process to treat waste by managed aerobic decomposition; urine would need to be reclaimed for re-use elsewhere	--	--	--	N/AV	High	--	N/A		N/A		Yes	--	Yes	--		--	N/AP	
Source separation	Separate collection and treatment of wastewater streams/ Urine would need to be reclaimed for re-use elsewhere.	--	--	--	75% - 80% reduction	High	j.	N/A		N/A		Yes	--	Yes	--	Low	--	N/AP	

Table 2-50
Alternative Wastewater Treatment Technology Summary

Technology	Description	System Name	Implementability Criteria													
			Ability to handle seasonal variations	Source	O&M Frequency	Source	Time until replacement of a key component	Source	Capital Cost Range	Source	O&M Contract Cost	Source	Annual Electric @ $0.22/kwh	Source	Power outage	Source
Innovative/Alternative Onsite Wastewater Treatment Systems																
Trickling filter/fixed film/packed bed	Filter incorporating an engineered textile treatment medium	Orenco Advantex AX20-RT	High	SCDHS	See note 2.		5-10 years	a.	High to Very High	b.	$270	b.	$74	b.	Reverts to conventional septic or one day storage	SCDHS
Trickling filter/fixed film/packed bed		Orenco Advantex AX20	High	a.	See note 2.		5-10 years	a.	N/AV		N/AV		N/AV		Reverts to conventional septic or one day storage	SCDHS
Extended aeration/fixed film/suspended growth/activated sludge	Utilizes both the fixed film and suspended growth technology	Fuji Clean CEN Series Systems	High	SCDHS	See note 2.		5-6 years	a.	Low to High	b.	$250	b.	$102	b.	Reverts to conventional septic	SCDHS
Extended aeration/fixed film/suspended growth/activated sludge	Employs innovative Hydro-Kinetic filtration technology	Norweco Hydro-Kinetic	Med	SCDHS	See note 2.		5-7 years	a.	Medium to Very High	b.	$300	b.	$231	b.	Reverts to conventional septic	SCDHS
Extended aeration/activated sludge	Extended aeration and attached growth processes with anoxic tank	Norweco Singulair TNT	High	SCDHS	See note 2.		7-10 years	a.	Low to Medium	b.	$315	b.	$216	b.	Reverts to conventional septic	SCDHS
Extended aeration/activated sludge		Hydro-Action AN Series	High	SCDHS	See note 2.		5-7 years	a.	Medium to High	b.	$250	b.	$162	b.	Reverts to conventional septic	SCDHS
Trickling filter/fixed film/packed bed	Absorbent trickle filter made of polystyrene beads (SeptiTech) or foam cubes (Waterloo) that retain water and host microbes.	Bio Microbics SeptiTech/STAAR	High	a.	See note 2.		5 years	a.	Medium to High	b.	N/AV		$201	b.	Reverts to conventional septic	SCDHS
Trickling filter/fixed film/packed bed		Waterloo Biofilter	High	a.	See note 2.		7-10 years	a.	High to Very High	SCDHS	N/AV		$209		Reverts to conventional septic or one day storage	SCDHS
Membrane Bioreactor (MBR) with activated sludge	Combination of a membrane process like microfiltration or ultrafiltration with a suspended growth bioreactor	BUSSE MF-B-400	High	a.	See note 2.		5-10 years	a.	Very High	SCDHS	N/AV		$241		Reverts to conventional septic	SCDHS
Membrane Bioreactor (MBR) with activated sludge		Bio-Microbics BioBarrier MBR Series	Med	a.	See note 2.		2-5 years	a.	High to Very High	SCDHS	N/AV		$402		Reverts to conventional septic	SCDHS
Extended aeration/fixed film/suspended growth/activated sludge	Biologically Active Filter operating as a Sequencing Batch Reactor	Amphidrome	Med	a.	See note 2.		2-5 years	a.	N/AV		N/AV		$291		Reverts to conventional septic	SCDHS
Extended aeration/fixed film/suspended growth/activated sludge		Pugo Systems	Med	a.	See note 2.		N/AV		Low	SCDHS	N/AV		$112		Reverts to conventional septic	SCDHS
Filtration	Organic filter media made from renewable natural material that retains water and hosts microbes A denite polishing unit is tested with this technology	PremierTech Aqua Ecoflo Coco Filter + Denite	High	m.	See note 2.		5-15 years	m.	Medium to Very High	SCDHS	N/A		$40		Reverts to conventional septic	m.
I/A Denitrification Polishing Units																
Filtration	Sulfur / Limestone Filter	--	N/AV		See note 1.		N/AV		N/AV		N/AV		N/AV		Functions	--
Filtration	Woodchip filter / Box nitrogen removing biofilter	--	N/AV		N/AV		N/AV		N/AV		N/AV		N/AV		Functions	--
Filtration	Recirculating gravel filter and vegetated bed	--	Yes	e.	Low	e.	N/AV		Very High	h.	N/A		$240	e.	Reverts to conventional septic	e.

Table 2-50
Alternative Wastewater Treatment Technology Summary

Technology	Description	System Name	Implementability Criteria: Ability to handle seasonal variations	Source	O&M Frequency	Source	Time until replacement of a key component	Source	Capital Cost Range	Source	O&M Contract Cost	Source	Annual Electric @ $0.22/kwh	Source	Power outage	Source
Leaching Technologies																
Gravity Leaching	Subsurface wastewater disposal facilities used to remove contaminants and impurities from the liquid that emerges from a septic tank by force of gravity	Retaining wall systems	High	--	Low	--	N/AV		Low to High	--	N/AP		$0	--	Functions	--
		Leaching pools and galleys	High	--	Low	--	N/AV		Low to High	--	N/AP		$0	--	Functions	--
		Gravelless trenches and geotextile sand filters	High	--	Low	--	N/AV		N/AV		N/AP		$0	--	Functions	--
Pressurized shallow drainfields	Used to distribute wastewater following pretreatment from an I/A system		High	--	Low	--	N/AV		N/AV		N/AP		N/AV		Does not function	--
Appendix A Systems																
Modified subsurface sewage disposal systems	Sewer systems for a small community also known as denitrification systems that are not to exceed 15,000 gpd design flow		High	f.	High	-		-	High	-	N/A		High	--	Odor control still operates	f.
Experimental/Other[4]																
Constructed Wetlands	An engineered system design to simulate a natural wetland for waste treatment	--	Med	c.	Low	c.	N/AP	-	Very High	c.	N/AV	--	Low	c.	Functions	--
Nitrogen removing biofilter (NYS CCWT) / Layered soil treatment	Passive wastewater treatment comprised of a sand-based "nitrification layer" underlain by a	Lined NRB	N/AV	-	Low	g.	N/AV	-	Very High	h.	N/AV	--	Low	g.	Does not function	g.
		Unlined NRB	N/AV	-	Low	g.	N/AV	-	Very High	h.	N/AV	--	Low	g.	Does not function	g.
Composting Toilets	Type of dry toilet or micro-flush toilet that uses a predominantly aerobic process to treat waste by managed aerobic decomposition; urine would need to be reclaimed for re-use elsewhere	--	N/AP		High	i.	N/AV		Low	i.	N/AP		N/AP		Functions	i.
Source separation	Separate collection and treatment of wastewater streams/ Urine would need to be reclaimed for re-use elsewhere.	--	High	-	Low	j.	N/AV		Low	j.	N/AP		N/AP		Functions	j.

Table 2-50
Alternative Wastewater Treatment Technology Summary

KEY

* Cost assumes using existing leaching pools.

Capital Cost		**O&M Service Frequency**	
Low	<$15,000	Low	Annually
Medium	$15,000 - $18,000	Medium	Every 6 months
High	$18,000 - $21,000	High	Quarterly
Very High	>$21,000	Very High	Monthly or greater

Lot Size		**Visibility / Aesthetics**	
Small	< 5,000 square feet	Low	2 access lids or less
Medium	< 10,000 square feet	Medium	3 access lids
		High	3 access lids or more, a large access hatch, or above grade

Notes

N/AV - Information is not available.
N/AP - Criteria is not applicable.
SCDHS - Suffolk County Department of Health Services
O&M - operatic I/A Denitrification Polishing Units
MBR - membrane biological reactor
SBR - sequencing batch reactor N/AV
VI - vendor information
High groundwater is defined as less than 10 feet bgs.
A-F - anti-flotation

1. Where demonstration results are available, the precent nitrate removal is calculated using an influent concentration of 65 mg/L, per SCDHS.
2. All I/A OWTS need to be maintained once per year at a minimum. Most manufacturers maintain every 6 months. All I/A systems come with a 3-year warranty.
3. Leaching systems' footprint varies based on application and percolation rate, which is field tested. Relatively, the pressurized shallow drainfield will have the smallest footprint, followed by the geotextile sand filter.
4. Installation and data from experimental systems are limited.

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Table 2-57 Summary of Subwatersheds in Groundwater Management Zone IV

Subwatershed Name	SWP PWL ID	Number of Vacant/Ag Parcels for Potential Development	SCDEDP Projected Number of New Residences at Build-out	Estimated Number of New Residential Parcels at 1 Acre Minimum with Grandfathering	Estimated Number of New Residential Parcels at 1 Acre Minimum and no Grandfathering	Reduced Number of Residences from Build-out Projection
Acabonack Harbor	1701-0047	145	152	151	44	108
Agawam Lake	1701-0117	9	9	9	4	5
Aspatuck Creek and River	1701-0303-AC	39	52	51	21	31
Big/Little Fresh Ponds	1701-0125	6	6	6	0	6
Block Island Sound	1701-0278	21	21	21	0	21
Brushes Creek	1701-0247-BC+0249	27	122	122	116	6
Cedar Beach Creek and Tidal Tribs	1701-0243	17	27	27	18	9
Cold Spring Pond and Tribs	1701-0127	51	85	85	49	36
Corey Creek and Tidal Tribs	1701-0244	54	73	73	34	39
Cutchogue Harbor	1701-0045-CH	32	37	37	11	26
Cutchogue Harbor - East Creek	1701-0045-EC	27	30	30	9	21
Cutchogue Harbor - Mud Creek	1701-0045-MC	42	108	108	90	18
Cutchogue Harbor - Wickham Creek	1701-0045-WC	20	35	35	21	14
Dam Pond	1701-0228	7	20	20	19	1
Deep Hole Creek	1701-0247-DHC+0249	34	63	63	41	22

Table 2-57 Summary of Subwatersheds in Groundwater Management Zone IV

Subwatershed Name	SWP PWL ID	Number of Vacant/Ag Parcels for Potential Development	SCDEDP Projected Number of New Residences at Build-out	Estimated Number of New Residential Parcels at 1 Acre Minimum with Grandfathering	Estimated Number of New Residential Parcels at 1 Acre Minimum and no Grandfathering	Reduced Number of Residences from Build-out Projection
Far Pond	1701-0295-FP	12	19	19	11	8
Fish Cove	1701-0037-FC	9	14	14	8	6
Flanders Bay, East/Center, and Tribs	1701-0030+0255+0273	96	212	212	163	49
Flanders Bay, West/Lower Sawmill Creek	1701-0254+0257	12	37	37	29	8
Fort Pond	1701-0122	31	32	32	7	25
Fort Pond Bay	1701-0370	38	39	38	22	17
Fresh Pond	1701-0279	44	47	47	39	8
Gardiners Bay and minor Tidal Tribs	1701-0164	99	101	100	19	82
Georgica Pond	1701-0145	43	43	43	28	15
Goldsmith Inlet	1702-0026	19	91	91	82	9
Goose Creek	1701-0236	59	77	77	28	49
Goose Neck Creek	1701-0272-GNC	17	17	17	0	17
Great Peconic Bay and minor coves	1701-0165+0247+0249+0251	162	366	366	261	105
Great South Bay, Middle	1701-0040-rev	37	38	38	2	36
Gull Pond	1701-0231	26	29	29	6	23
Hallock/Long Beach Bay and Tidal Tribs	1701-0227	85	116	116	80	36

Table 2-57 Summary of Subwatersheds in Groundwater Management Zone IV

Subwatershed Name	SWP PWL ID	Number of Vacant/Ag Parcels for Potential Development	SCDEDP Projected Number of New Residences at Build-out	Estimated Number of New Residential Parcels at 1 Acre Minimum with Grandfathering	Estimated Number of New Residential Parcels at 1 Acre Minimum and no Grandfathering	Reduced Number of Residences from Build-out Projection
Halsey Neck Pond	1701-0355	6	9	9	8	1
Hashamomuck Pond/Long Creek and Budd's Pond	1701-0162+0234	68	129	129	86	43
Heady and Taylor Creeks and Tribs	1701-0294	67	77	77	31	46
Hog Creek and Tidal Tribs	1701-0277	61	61	61	5	56
Hook Pond	1701-0131	29	38	38	23	15
James Creek	1701-0247-JC+0249	31	58	58	41	17
Kellis Pond	1701-0290	6	6	6	6	0
Lake Montauk	1701-0031	114	121	119	34	87
Laurel Pond	1701-0128	3	9	9	8	1
Little Peconic Bay	1701-0126+0172	84	134	132	68	66
Little Sebonac Creek	1701-0253	20	27	27	23	4
Long Island Sound, Suffolk Co, Central	1702-0265	175	803	803	739	64
Long Island Sound, Suffolk County, East	1702-0266	426	999	999	765	234
Marion Lake	1701-0229	31	36	36	14	22
Mattituck (Marratooka) Pond	1701-0129	2	10	10	9	1

Table 2-57 Summary of Subwatersheds in Groundwater Management Zone IV

Subwatershed Name	SWP PWL ID	Number of Vacant/Ag Parcels for Potential Development	SCDEDP Projected Number of New Residences at Build-out	Estimated Number of New Residential Parcels at 1 Acre Minimum with Grandfathering	Estimated Number of New Residential Parcels at 1 Acre Minimum and no Grandfathering	Reduced Number of Residences from Build-out Projection
Mattituck Inlet/Cr, Low, and Tidal Tribs	1702-0020+0245	96	230	230	186	44
Mecox Bay and Tribs	1701-0034+0289+0292	155	357	357	318	39
Meetinghouse Creek and Tribs	1701-0256-MC	42	88	88	73	15
Middle Pond	1701-0295-MP	16	18	18	5	13
Mill Creek and Tidal Tribs	1701-0238+	5	8	8	5	3
Mill Pond and Sevens Ponds	1701-0113+0289	1	1	1	1	0
Moriches Bay East	1701-0305-rev+0306	19	19	19	4	15
Moriches Bay West	1701-0038-rev	2	2	2	0	2
Napeague Bay	1701-0369	65	66	66	39	27
Napeague Harbor and Tidal Tribs	1701-0166	10	13	13	6	7
North Sea Harbor and Tribs	1701-0037	51	60	60	25	35
Northwest Creek and Tidal Tribs	1701-0046	5	5	5	3	2
Northwest Harbor	1701-0368+0275+0276	22	22	22	20	2
Noyack Bay	1701-0167-rev	35	42	42	29	13

Table 2-57 Summary of Subwatersheds in Groundwater Management Zone IV

Subwatershed Name	SWP PWL ID	Number of Vacant/Ag Parcels for Potential Development	SCDEDP Projected Number of New Residences at Build-out	Estimated Number of New Residential Parcels at 1 Acre Minimum with Grandfathering	Estimated Number of New Residential Parcels at 1 Acre Minimum and no Grandfathering	Reduced Number of Residences from Build-out Projection
Noyack Creek and Tidal Tribs	1701-0237	12	13	13	6	7
Ogden Pond	1701-0302	11	12	12	8	4
Old Fort Pond	1701-0295-OFP	13	13	13	6	7
Old Town Pond	1701-0118	6	6	6	6	0
Orient Harbor and minor Tidal Tribs	1701-0168	29	45	45	27	18
Peconic River, Lower, and Tidal Tribs	1701-0259+0263	21	29	29	14	15
Penniman Creek and Tidal Tribs	1701-0300	21	21	21	17	4
Penny Pond, Wells, Smith, and Gilbert Creeks	1701-0298-rev+0033	32	36	36	7	29
Phillips Creek, Lower, and Tidal Tribs	1701-0299	43	43	43	19	24
Pipes Cove	1701-0366	18	21	21	7	14
Quantuck Bay	1701-0042+0303	26	26	26	8	18
Quantuck Canal/Moneybogue Bay	1701-0371	15	16	16	5	11
Quantuck Creek and Old Ice Pond	1701-0303-QC+0304	57	70	70	31	39
Quogue Canal	1701-0301	16	17	17	11	6

Table 2-57 Summary of Subwatersheds in Groundwater Management Zone IV

Subwatershed Name	SWP PWL ID	Number of Vacant/Ag Parcels for Potential Development	SCDEDP Projected Number of New Residences at Build-out	Estimated Number of New Residential Parcels at 1 Acre Minimum with Grandfathering	Estimated Number of New Residential Parcels at 1 Acre Minimum and no Grandfathering	Reduced Number of Residences from Build-out Projection
Red Creek Pond and Tidal Tribs	1701-0250	9	10	10	5	5
Reeves Bay and Tidal Tribs	1701-0272-RB	47	51	51	10	41
Richmond Creek and Tidal Tribs	1701-0245	44	126	126	119	7
Sag Harbor	1701-0035-SH+0239	64	68	68	13	55
Sag Harbor Cove and Tribs	1701-0035-SHC	51	56	55	11	45
Sagaponack Pond and Poxabogue Pond	1701-0146+0286	48	94	94	89	5
Sebonac Cr/Bullhead Bay and Tidal Tribs	1701-0051	46	55	55	42	13
Shelter Island Sound, North, and Tribs	1701-0170	27	35	35	18	17
Shelter Island Sound, South, and Tribs	1701-0365-rev+0240	36	37	37	25	12
Shinnecock Bay - Bennet Cove (Cormorant Cove)	1701-0033-BC+0252+0296	57	68	67	27	41
Shinnecock Bay Central	1701-0033-C	8	8	8	1	7

Table 2-57 Summary of Subwatersheds in Groundwater Management Zone IV

Subwatershed Name	SWP PWL ID	Number of Vacant/Ag Parcels for Potential Development	SCDEDP Projected Number of New Residences at Build-out	Estimated Number of New Residential Parcels at 1 Acre Minimum with Grandfathering	Estimated Number of New Residential Parcels at 1 Acre Minimum and no Grandfathering	Reduced Number of Residences from Build-out Projection
Shinnecock Bay East	1701-0033-E	74	78	78	23	55
Shinnecock Bay West	1701-0033-W	45	51	51	30	21
SI Sound Trib/Moores Drain, Lower, Tribs	1701-0232+0233	10	15	15	8	7
Southold Bay	1701-0044	83	104	104	35	69
Spring Pond	1701-0230	11	11	11	0	11
Stirling Creek and Basin	1701-0049	20	23	23	7	16
Terry's Creek and Tribs	1701-0256-TC	59	116	116	76	40
Three Mile Harbor	1701-0036	271	289	287	66	223
Tiana Bay and Tidal Tribs	1701-0112	86	108	107	34	74
Town/Jockey Creeks and Tidal Tribs	1701-0235	26	34	34	14	20
Wainscott Pond/Fairfield Pond	1701-0144	7	12	12	11	1
Weesuck Creek and Tidal Tribs	1701-0111-rev	28	60	59	39	21
West Creek and Tidal Tribs	1701-0246	27	30	30	13	17
Wickapogue Pond	1701-0119	5	5	5	4	1

Table 2-57 Summary of Subwatersheds in Groundwater Management Zone IV

Subwatershed Name	SWP PWL ID	Number of Vacant/Ag Parcels for Potential Development	SCDEDP Projected Number of New Residences at Build-out	Estimated Number of New Residential Parcels at 1 Acre Minimum with Grandfathering	Estimated Number of New Residential Parcels at 1 Acre Minimum and no Grandfathering	Reduced Number of Residences from Build-out Projection
Wooley Pond	1701-0048+	12	12	12	1	11

Table 2-58 Comparison of Reduced Nitrogen Load and Nitrogen Load Reduction Target

Subwatershed Name	SWP PWL ID	Aggregated Nitrogen Load Reduction Target based on Wastewater Management Area (lb/year)	Nitrogen Load Reduction from Future Build-out Conditions Establishing 1 Acre Minimum (lb/year), Assuming No Grandfathering	Nitrogen Load Reduction from Existing Conditions Based on I/A OWTS Implementation
Acabonack Harbor	1701-0047	27,320	2,741	21,824
Agawam Lake	1701-0117	22,878	127	15,389
Aspatuck Creek and River	1701-0303-AC	20,924	787	13,958
Big/Little Fresh Ponds	1701-0125	11,151	152	3,803
Block Island Sound	1701-0278	10,971	533	8,147
Brushes Creek	1701-0247-BC+0249	3,454	152	2,351
Cedar Beach Creek and Tidal Tribs	1701-0243	2,898	228	1,961
Cold Spring Pond and Tribs	1701-0127	11,132	914	7,377
Corey Creek and Tidal Tribs	1701-0244	8,357	990	5,487
Cutchogue Harbor	1701-0045-CH	28,907	660	4,448
Cutchogue Harbor - East Creek	1701-0045-EC	6,432	533	4,289
Cutchogue Harbor - Mud Creek	1701-0045-MC	11,909	457	8,031
Cutchogue Harbor - Wickham Creek	1701-0045-WC	4,032	355	2,694
Dam Pond	1701-0228	304	25	207
Deep Hole Creek	1701-0247-DHC+0249	7,739	558	5,136
Far Pond	1701-0295-FP	2,663	203	1,638
Fish Cove	1701-0037-FC	6,040	152	4,005
Flanders Bay, East/Center, and Tribs	1701-0030+0255+0273	133,173	1,244	12,170
Flanders Bay, West/Lower Sawmill Creek	1701-0254+0257	66,468	203	6,866
Fort Pond	1701-0122	5,916	635	4,503
Fort Pond Bay	1701-0370	8,185	431	4,166
Fresh Pond	1701-0279	4,891	203	3,871
Gardiners Bay and minor Tidal Tribs	1701-0164	711,147	2,081	17,636
Georgica Pond	1701-0145	25,078	381	16,853

Table 2-58 Comparison of Reduced Nitrogen Load and Nitrogen Load Reduction Target

Subwatershed Name	SWP PWL ID	Aggregated Nitrogen Load Reduction Target based on Wastewater Management Area (lb/year)	Nitrogen Load Reduction from Future Build-out Conditions Establishing 1 Acre Minimum (lb/year), Assuming No Grandfathering	Nitrogen Load Reduction from Existing Conditions Based on I/A OWTS Implementation
Goldsmith Inlet	1702-0026	2,192	228	1,492
Goose Creek	1701-0236	10,575	1,244	7,123
Goose Neck Creek	1701-0272-GNC	5,675	431	3,814
Great Peconic Bay and minor coves	1701-0165+0247+0249+0251	232,236	2,665	30,537
Great South Bay, Middle	1701-0040-rev	8,879	914	5,834
Gull Pond	1701-0231	3,067	584	2,088
Hallock/Long Beach Bay and Tidal Tribs	1701-0227	3,444	914	2,334
Halsey Neck Pond	1701-0355	902	25	452
Hashamomuck Pond/Long Creek and Budd's Pond	1701-0162+0234	8,505	1,091	5,765
Heady and Taylor Creeks and Tribs	1701-0294	25,284	1,167	13,853
Hog Creek and Tidal Tribs	1701-0277	11,794	1,421	9,059
Hook Pond	1701-0131	40,466	381	27,541
James Creek	1701-0247-JC+0249	13,341	431	8,741
Kellis Pond	1701-0290	2,064	-	1,405
Lake Montauk	1701-0031	23,389	2,208	16,096
Laurel Pond	1701-0128	493	25	336
Little Peconic Bay	1701-0126+0172	348,534	1,675	20,232
Little Sebonac Creek	1701-0253	1,875	102	1,102
Long Island Sound, Suffolk Co, Central	1702-0265	519,445	1,624	238,872
Long Island Sound, Suffolk County, East	1702-0266	64,267	5,939	25,501
Marion Lake	1701-0229	4,140	558	2,819
Mattituck (Marratooka) Pond	1701-0129	392	25	267
Mattituck Inlet/Cr, Low, and Tidal Tribs	1702-0020+0245	24,178	1,117	16,475
Mecox Bay and Tribs	1701-0034+0289+0292	49,779	990	23,229

Table 2-58 Comparison of Reduced Nitrogen Load and Nitrogen Load Reduction Target

Subwatershed Name	SWP PWL ID	Aggregated Nitrogen Load Reduction Target based on Wastewater Management Area (lb/year)	Nitrogen Load Reduction from Future Build-out Conditions Establishing 1 Acre Minimum (lb/year), Assuming No Grandfathering	Nitrogen Load Reduction from Existing Conditions Based on I/A OWTS Implementation
Meetinghouse Creek and Tribs	1701-0256-MC	9,007	381	5,895
Middle Pond	1701-0295-MP	5,005	330	3,065
Mill Creek and Tidal Tribs	1701-0238+	3,955	76	3,003
Mill Pond and Sevens Ponds	1701-0113+0289	12,193	-	8,240
Moriches Bay East	1701-0305-rev+0306	85,459	381	37,767
Moriches Bay West	1701-0038-rev	517,405	51	2,153
Napeague Bay	1701-0369	379,103	685	3,667
Napeague Harbor and Tidal Tribs	1701-0166	5,209	178	2,539
North Sea Harbor and Tribs	1701-0037	36,050	888	12,881
Northwest Creek and Tidal Tribs	1701-0046	8,717	51	6,916
Northwest Harbor	1701-0368+0275+0276	15,241	51	4,353
Noyack Bay	1701-0167-rev	23,329	330	10,666
Noyack Creek and Tidal Tribs	1701-0237	5,659	178	4,383
Ogden Pond	1701-0302	1,966	102	1,563
Old Fort Pond	1701-0295-OFP	9,336	178	4,326
Old Town Pond	1701-0118	3,244	-	2,080
Orient Harbor and minor Tidal Tribs	1701-0168	88,579	457	5,080
Peconic River, Lower, and Tidal Tribs	1701-0259+0263	54,425	381	29,434
Penniman Creek and Tidal Tribs	1701-0300	5,379	102	3,571
Penny Pond, Wells, Smith, and Gilbert Creeks	1701-0298-rev+0033	26,184	736	18,295
Phillips Creek, Lower, and Tidal Tribs	1701-0299	15,431	609	10,315
Pipes Cove	1701-0366	6,846	355	3,535
Quantuck Bay	1701-0042+0303	56,467	457	4,008

Table 2-58 Comparison of Reduced Nitrogen Load and Nitrogen Load Reduction Target

Subwatershed Name	SWP PWL ID	Aggregated Nitrogen Load Reduction Target based on Wastewater Management Area (lb/year)	Nitrogen Load Reduction from Future Build-out Conditions Establishing 1 Acre Minimum (lb/year), Assuming No Grandfathering	Nitrogen Load Reduction from Existing Conditions Based on I/A OWTS Implementation
Quantuck Canal/Moneybogue Bay	1701-0371	14,433	279	7,896
Quantuck Creek and Old Ice Pond	1701-0303-QC+0304	15,134	990	9,914
Quogue Canal	1701-0301	62,988	152	3,310
Red Creek Pond and Tidal Tribs	1701-0250	2,973	127	1,787
Reeves Bay and Tidal Tribs	1701-0272-RB	24,205	1,041	16,249
Richmond Creek and Tidal Tribs	1701-0245	5,197	178	3,525
Sag Harbor	1701-0035-SH+0239	66,127	1,396	18,289
Sag Harbor Cove and Tribs	1701-0035-SHC	42,113	1,142	28,904
Sagaponack Pond and Poxabogue Pond	1701-0146+0286	27,244	127	18,458
Sebonac Cr/Bullhead Bay and Tidal Tribs	1701-0051	9,480	330	6,378
Shelter Island Sound, North, and Tribs	1701-0170	281,916	431	6,071
Shelter Island Sound, South, and Tribs	1701-0365-rev+0240	274,385	305	9,610
Shinnecock Bay - Bennet Cove (Cormorant Cove)	1701-0033-BC+0252+0296	26,005	1,041	17,422
Shinnecock Bay Central	1701-0033-C	74,002	178	1,132
Shinnecock Bay East	1701-0033-E	91,577	1,396	21,028
Shinnecock Bay West	1701-0033-W	121,378	533	16,091
SI Sound Trib/Moores Drain, Lower, Tribs	1701-0232+0233	1,653	178	1,076
Southold Bay	1701-0044	35,204	1,751	5,227
Spring Pond	1701-0230	1,555	279	1,047
Stirling Creek and Basin	1701-0049	3,221	406	2,193
Terry's Creek and Tribs	1701-0256-TC	9,897	1,015	6,738

Table 2-58 Comparison of Reduced Nitrogen Load and Nitrogen Load Reduction Target

Subwatershed Name	SWP PWL ID	Aggregated Nitrogen Load Reduction Target based on Wastewater Management Area (lb/year)	Nitrogen Load Reduction from Future Build-out Conditions Establishing 1 Acre Minimum (lb/year), Assuming No Grandfathering	Nitrogen Load Reduction from Existing Conditions Based on I/A OWTS Implementation
Three Mile Harbor	1701-0036	60,534	5,660	47,103
Tiana Bay and Tidal Tribs	1701-0112	45,952	1,878	31,610
Town/Jockey Creeks and Tidal Tribs	1701-0235	16,952	508	11,516
Wainscott Pond/Fairfield Pond	1701-0144	2,593	25	1,719
Weesuck Creek and Tidal Tribs	1701-0111-rev	13,075	533	8,916
West Creek and Tidal Tribs	1701-0246	4,936	431	3,211
Wickapogue Pond	1701-0119	2,172	25	1,398
Wooley Pond	1701-0048+	7,813	279	6,062

Table 2-63 Subwatersheds with Potential Pathogen Impacts from Sanitary Wastewater

Note: Orange highlighted cells indicate potential pathogenic impacts from on-site sanitary wastewater disposal.

Subwatershed Name	SWP PWL ID	Number of Unsewered Parcels in <10ft DTGW	Documented Pathogenic Impact	Percent of Shallow DTGW Parcels that are Unsewered Residential	Percent of Shallow DTGW Acreage that is Unsewered Residential
Abets Creek	1701-0327-AC	394	Y	80%	70%
Acabonack Harbor	1701-0047	540	Y	69%	43%
Agawam Lake	1701-0117	73	Y	37%	64%
Amityville Creek	1701-0087+0372	0	Y	0%	0%
Aspatuck Creek and River	1701-0303-AC	116	Y	78%	69%
Awixa Creek	1701-0093+0338	0	Y	0%	0%
Beaverdam Pond	1701-0307+0306	92	Y	58%	57%
Beaverdam Creek	1701-0324+0104	311	Y	82%	47%
Bellport Bay	1701-0320+0325	518	Y	85%	41%
Belmont Lake	1701-0021+0089	353	N	97%	83%
Big Reed Pond	1701-0281	0	N	0%	0%
Big/Little Fresh Ponds	1701-0125	150	Y	62%	47%
Block Island Sound	1701-0278	110	Y	75%	28%
Brightwaters Canal, Nosreka, Mirror, and Cascade Lakes	1701-0338-BC+0342	0	Y	0%	0%
Brown Creek	1701-0097+0333	787	Y	91%	47%
Brushes Creek	1701-0247-BC+0249	43	Y	79%	36%
Carlls River	1701-0089+0346+0345+0344+0372	828	Y	98%	76%
Carmans River Lower, and Tribs	1701-0321-rev	509	Y	42%	7%
Carmans River Upper, and Tribs	1701-0102-rev+0322+0323	92	Y	55%	12%
Cedar Beach Creek and Tidal Tribs	1701-0243	103	Y	81%	67%
Centerport Harbor	1702-0229	76	Y	59%	38%
Champlin Creek	1701-0019+0338+0340	88	Y	94%	39%
Coecles Harbor	1701-0163	175	N	61%	9%
Cold Spring Harbor, and Tidal Tribs	1702-0018+0156	41	Y	29%	9%
Cold Spring Pond and Tribs	1701-0127	159	Y	86%	41%
Connetquot River, Lower, and Tribs	1701-0337	620	Y	78%	67%

Table 2-63 Subwatersheds with Potential Pathogen Impacts from Sanitary Wastewater

Subwatershed Name	SWP PWL ID	Number of Unsewered Parcels in <10ft DTGW	Documented Pathogenic Impact	Percent of Shallow DTGW Parcels that are Unsewered Residential	Percent of Shallow DTGW Acreage that is Unsewered Residential
Connetquot River, Upper, and Tribs	1701-0095+0339	569	Y	89%	14%
Conscience Bay and Tidal Tribs	1702-0091	74	Y	68%	71%
Corey Creek and Tidal Tribs	1701-0244	219	Y	81%	43%
Corey Lake and Creek, and Tribs	1701-0329+0327-CL	180	Y	89%	77%
Crab Meadow Creek	1702-0232-CMC+0234	53	Y	68%	29%
Cutchogue Harbor	1701-0045-CH	136	Y	74%	71%
Cutchogue Harbor - East Creek	1701-0045-EC	194	Y	70%	67%
Cutchogue Harbor - Mud Creek	1701-0045-MC	174	Y	80%	60%
Cutchogue Harbor - Wickham Creek	1701-0045-WC	19	Y	68%	38%
Dam Pond	1701-0228	26	N	38%	22%
Deep Hole Creek	1701-0247-DHC+0249	152	Y	80%	79%
Deep Pond	1701-0270	0	N	0%	0%
Dering Harbor	1701-0050+	62	Y	45%	40%
Dickerson Creek	1701-0242-DC	26	Y	46%	30%
Duck Island Harbor	1702-0262	136	Y	33%	40%
Dunton Lake, Upper, and Tribs and Hedges Creek	1701-0330-HC+0327	434	Y	61%	61%
Far Pond	1701-0295-FP	34	N	74%	80%
Fish Cove	1701-0037-FC	65	Y	77%	62%
Flanders Bay, East/Center, and Tribs	1701-0030+0255+0273	718	Y	81%	19%
Flanders Bay, West/Lower Sawmill Creek	1701-0254+0257	51	Y	65%	8%
Flax Pond	1702-0240	14	Y	36%	46%
Forge River and Tidal Tribs	1701-0316-FR+0312+0026	775	Y	76%	55%
Forge River Cove and Tidal Tribs	1701-0316-FRC+0312	259	Y	89%	78%
Fort Pond	1701-0122	20	N	70%	44%
Fort Pond Bay	1701-0370	55	N	35%	12%
Fresh Pond	1701-0279	51	Y	75%	12%

CDM Smith

Table 2-63 Subwatersheds with Potential Pathogen Impacts from Sanitary Wastewater

Subwatershed Name	SWP PWL ID	Number of Unsewered Parcels in <10ft DTGW	Documented Pathogenic Impact	Percent of Shallow DTGW Parcels that are Unsewered Residential	Percent of Shallow DTGW Acreage that is Unsewered Residential
Fresh Pond Creek and Tribs	1702-0244	0	Y	0%	0%
Gardiners Bay and minor Tidal Tribs	1701-0164	289	Y	70%	6%
Georgica Pond	1701-0145	150	Y	68%	74%
Goldsmith Inlet	1702-0026	53	Y	62%	58%
Goose Creek	1701-0236	300	Y	87%	84%
Goose Neck Creek	1701-0272-GNC	140	Y	85%	73%
Grand Canal	1701-0337-GC	450	Y	83%	55%
Great Cove	1701-0376+0338	2	Y	100%	100%
Great Peconic Bay and minor coves	1701-0165+0247+0249+0251	843	Y	82%	56%
Great South Bay, East	1701-0039-rev+0333	2156	Y	88%	31%
Great South Bay, Middle	1701-0040-rev	1619	Y	74%	7%
Great South Bay, West	1701-0173+0372	160	Y	46%	2%
Green Creek, Upper, and Tribs	1701-0096+0333	368	Y	87%	65%
Gull Pond	1701-0231	112	Y	74%	71%
Hallock/Long Beach Bay and Tidal Tribs	1701-0227	233	Y	47%	15%
Halsey Neck Pond	1701-0355	26	Y	77%	65%
Harts Cove	1701-0309-HC	183	Y	68%	33%
Hashamomuck Pond/Long Creek and Budd's Pond	1701-0162+0234	255	Y	60%	24%
Heady and Taylor Creeks and Tribs	1701-0294	152	N	91%	83%
Hog Creek and Tidal Tribs	1701-0277	76	Y	88%	85%
Hook Pond	1701-0131	162	N	67%	34%
Howell's Creek	1701-0327-HC	78	Y	92%	27%
Huntington Bay	1702-0014	31	Y	74%	51%
Huntington Harbor	1702-0228+0231	100	Y	60%	22%
James Creek	1701-0247-JC+0249	265	Y	78%	67%
Kellis Pond	1701-0290	4	Y	25%	19%
Lake Montauk	1701-0031	314	Y	61%	39%
Lake Panamoka (Long Pond)	1701-0134	2	Y	0%	0%
Lake Ronkonkoma	1701-0020	36	Y	42%	6%

Table 2-63 Subwatersheds with Potential Pathogen Impacts from Sanitary Wastewater

Subwatershed Name	SWP PWL ID	Number of Unsewered Parcels in <10ft DTGW	Documented Pathogenic Impact	Percent of Shallow DTGW Parcels that are Unsewered Residential	Percent of Shallow DTGW Acreage that is Unsewered Residential
Laurel Pond	1701-0128	2	N	100%	100%
Lawrence Creek, O-co-nee and Lawrence Lakes	1701-0338-LC	0	Y	0%	0%
Ligonee Brook and Tribs	1701-0352+0353	83	Y	42%	29%
Little Long, Long, and Shorts Pond	1701-0291	2	N	0%	0%
Little Peconic Bay	1701-0126+0172	393	Y	81%	58%
Little Sebonac Creek	1701-0253	78	Y	55%	5%
Lloyd Harbor	1702-0227	40	Y	45%	19%
Long Island Sound, Suffolk Co, Central	1702-0265	174	Y	76%	29%
Long Island Sound, Suffolk County, East	1702-0266	420	Y	75%	37%
Long Island Sound, Suffolk County, West	1702-0098+0232	48	Y	35%	38%
Marion Lake	1701-0229	25	Y	76%	57%
Mattituck (Marratooka) Pond	1701-0129	0	N	0%	0%
Mattituck Inlet/Cr, Low, and Tidal Tribs	1702-0020+0245	205	Y	71%	55%
Mecox Bay and Tribs	1701-0034+0289+0292	655	Y	76%	61%
Meetinghouse Creek and Tribs	1701-0256-MC	104	Y	80%	74%
Menantic Creek	1701-0242-MC	77	N	88%	75%
Middle Pond	1701-0295-MP	115	N	90%	92%
Mill Creek and Tidal Tribs	1701-0238+	76	Y	87%	29%
Mill Pond	1702-0261	33	Y	73%	76%
Mill Pond and Sevens Ponds	1701-0113+0289	118	N	86%	65%
Moriches Bay East	1701-0305-rev+0306	1305	Y	87%	74%
Moriches Bay West	1701-0038-rev	170	Y	73%	11%
Mt Sinai Harbor and Tidal Tribs	1702-0019	64	Y	41%	27%
Mud and Senix Creeks	1701-0312-MSC	306	Y	86%	86%
Mud Creek, Robinson Pond, and Tidal Tribs	1701-0101+0331+0327	256	Y	79%	50%
Napeague Bay	1701-0369	178	Y	62%	31%

Table 2-63 Subwatersheds with Potential Pathogen Impacts from Sanitary Wastewater

Subwatershed Name	SWP PWL ID	Number of Unsewered Parcels in <10ft DTGW	Documented Pathogenic Impact	Percent of Shallow DTGW Parcels that are Unsewered Residential	Percent of Shallow DTGW Acreage that is Unsewered Residential
Napeague Harbor and Tidal Tribs	1701-0166	212	N	47%	5%
Narrow Bay	1701-0318+0319	1489	Y	61%	13%
Neguntatogue Creek	1701-0088+0372	0	Y	0%	0%
Nicoll Bay	1701-0375+0333	489	Y	79%	22%
Nissequogue River Lower/Sunken Meadow Creek	1702-0025+0234+0232	259	Y	54%	25%
Nissequogue River Upper, and Tribs	1702-0235+0013+0238+0237+0236	486	Y	76%	25%
North Sea Harbor and Tribs	1701-0037	475	Y	84%	63%
Northport Bay	1702-0256	108	Y	81%	81%
Northport Harbor	1702-0230	48	Y	77%	45%
Northwest Creek and Tidal Tribs	1701-0046	115	Y	63%	26%
Northwest Harbor	1701-0368+0275+0276	43	Y	51%	22%
Noyack Bay	1701-0167-rev	220	N	93%	71%
Noyack Creek and Tidal Tribs	1701-0237	69	Y	88%	64%
Ogden Pond	1701-0302	101	Y	84%	77%
Old Fort Pond	1701-0295-OFP	99	Y	85%	80%
Old Town Pond	1701-0118	18	Y	89%	88%
Orchard Neck Creek	1701-0312-ONC	279	Y	88%	76%
Orient Harbor and minor Tidal Tribs	1701-0168	184	Y	85%	47%
Oyster Pond/Lake Munchogue	1701-0169	0	Y	0%	0%
Pardees, Orowoc Lakes, Creek, and Tidal Tribs	1701-0094+0341+0338	127	Y	94%	36%
Patchogue Bay	1701-0326	1128	Y	82%	69%
Patchogue River	1701-0099+0018+0055+0327	799	Y	73%	50%
Pattersquash Creek	1701-0319-PC	1302	Y	76%	71%
Peconic River Middle, and Tribs	1701-0261+0262+0269	153	N	37%	8%
Peconic River Upper, and Tribs	1701-0108+0265+0266+0269	93	Y	39%	6%
Peconic River, Lower, and Tidal Tribs	1701-0259+0263	661	Y	58%	18%
Penataquit Creek	1701-0092+0338	13	Y	100%	100%

Table 2-63 Subwatersheds with Potential Pathogen Impacts from Sanitary Wastewater

Subwatershed Name	SWP PWL ID	Number of Unsewered Parcels in <10ft DTGW	Documented Pathogenic Impact	Percent of Shallow DTGW Parcels that are Unsewered Residential	Percent of Shallow DTGW Acreage that is Unsewered Residential
Penniman Creek and Tidal Tribs	1701-0300	77	Y	78%	73%
Penny Pond, Wells, Smith, and Gilbert Creeks	1701-0298-rev+0033	430	Y	84%	70%
Phillips Creek, Lower, and Tidal Tribs	1701-0299	125	Y	71%	81%
Pipes Cove	1701-0366	192	Y	77%	37%
Port Jefferson Harbor, North, and Tribs	1702-0015	20	Y	40%	9%
Port Jefferson Harbor, South, and Tribs	1702-0241	21	Y	52%	18%
Quantuck Bay	1701-0042+0303	219	Y	78%	45%
Quantuck Canal/Moneybogue Bay	1701-0371	293	Y	82%	64%
Quantuck Creek and Old Ice Pond	1701-0303-QC+0304	227	Y	74%	57%
Quogue Canal	1701-0301	185	Y	89%	87%
Red Creek Pond and Tidal Tribs	1701-0250	60	N	52%	52%
Reeves Bay and Tidal Tribs	1701-0272-RB	527	Y	81%	41%
Richmond Creek and Tidal Tribs	1701-0245	130	Y	77%	54%
Sag Harbor	1701-0035-SH+0239	238	Y	64%	34%
Sag Harbor Cove and Tribs	1701-0035-SHC	814	Y	89%	38%
Sagaponack Pond and Poxabogue Pond	1701-0146+0286	318	Y	64%	41%
Sampawams Creek	1701-0090+0372+0343	35	Y	77%	85%
Sans Souci Lakes	1701-0336+0335	13	Y	69%	8%
Santapogue Creek	1701-0016+0372	0	Y	0%	0%
Scallop Pond	1701-0354	5	N	100%	100%
Seatuck Cove and Tidal Tribs	1701-0309-SC+0306+0311	188	Y	71%	48%
Sebonac Cr/Bullhead Bay and Tidal Tribs	1701-0051	107	Y	76%	27%
Setauket Harbor	1702-0242	98	Y	61%	64%
Sheepen Creek	1701-0319-SC	483	Y	55%	52%

Table 2-63 Subwatersheds with Potential Pathogen Impacts from Sanitary Wastewater

Subwatershed Name	SWP PWL ID	Number of Unsewered Parcels in <10ft DTGW	Documented Pathogenic Impact	Percent of Shallow DTGW Parcels that are Unsewered Residential	Percent of Shallow DTGW Acreage that is Unsewered Residential
Shelter Island Sound, North, and Tribs	1701-0170	246	Y	77%	63%
Shelter Island Sound, South, and Tribs	1701-0365-rev+0240	348	N	74%	41%
Shinnecock Bay - Bennet Cove (Cormorant Cove)	1701-0033-BC+0252+0296	154	Y	77%	45%
Shinnecock Bay Central	1701-0033-C	56	N	63%	9%
Shinnecock Bay East	1701-0033-E	98	Y	45%	4%
Shinnecock Bay West	1701-0033-W	672	Y	85%	31%
SI Sound Trib/Moores Drain, Lower, Tribs	1701-0232+0233	95	Y	45%	5%
Smithtown Bay	1702-0023+0233+0234	436	Y	40%	32%
Southold Bay	1701-0044	132	Y	74%	61%
Speonk River	1701-0306-SR	77	Y	62%	59%
Spring Pond	1701-0230	51	Y	75%	73%
Stillman Creek	1701-0329-SC	91	Y	85%	51%
Stirling Creek and Basin	1701-0049	100	Y	71%	21%
Stony Brook Harbor and West Meadow Creek	1702-0047+0239	176	Y	38%	5%
Swan River, Swan Lake, and Tidal Tribs	1701-0100+0332+0329+0327	710	Y	81%	52%
Terrell River	1701-0103+0313+0314	57	Y	51%	8%
Terry's Creek and Tribs	1701-0256-TC	109	Y	66%	24%
Three Mile Harbor	1701-0036	364	Y	61%	29%
Tiana Bay and Tidal Tribs	1701-0112	255	Y	83%	69%
Town/Jockey Creeks and Tidal Tribs	1701-0235	141	Y	85%	77%
Tuthill Cove	1701-0309-TC	208	Y	49%	42%
Tuthills Creek	1701-0098+0327+0329+0334	399	Y	79%	52%
Unchachogue/Johns Neck Creeks	1701-0319-UC	1444	Y	89%	2%
Wading River	1702-0099+0243	61	Y	28%	11%
Wainscott Pond/Fairfield Pond	1701-0144	14	Y	43%	16%
Weesuck Creek and Tidal Tribs	1701-0111-rev	168	Y	77%	38%
West Creek and Tidal Tribs	1701-0246	135	Y	59%	26%

Table 2-63 Subwatersheds with Potential Pathogen Impacts from Sanitary Wastewater

Subwatershed Name	SWP PWL ID	Number of Unsewered Parcels in <10ft DTGW	Documented Pathogenic Impact	Percent of Shallow DTGW Parcels that are Unsewered Residential	Percent of Shallow DTGW Acreage that is Unsewered Residential
West Neck Bay and Creek	1701-0242-WB	125	N	72%	13%
West Neck Harbor	1701-0132-rev	44	N	82%	56%
Wickapogue Pond	1701-0119	19	N	74%	70%
Wildwood Lake (Great Pond)	1701-0264	32	N	38%	30%
Willets Creek	1701-0091+0175+0372	0	Y	0%	0%
Wooley Pond	1701-0048+	86	Y	80%	85%

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Section 3

Drinking Water and Aquifer Protection

The SWP has been prepared to provide wastewater management recommendations for all water resources in Suffolk County. While the previous sections have focused primarily on the evaluation of our local surface water resources, it is our sole source aquifer that provides our drinking water and baseflow that discharges into our surface waters. In order to establish wastewater management priority areas for the protection of groundwater and drinking water, model-simulated nitrogen concentrations have been predicted in the shallow Upper Glacial aquifer and community supply wells within Suffolk County. The following section describes:

- Use of groundwater flow and contaminant transport models to simulate nitrate concentrations in the shallow upper glacial aquifer resulting from 2016 land use and current conditions of wastewater management after 50 years (the methodology used to estimate the parcel-specific nitrogen loads within Suffolk County was described previously in Section 2 of this SWP);
- Use of groundwater flow and contaminant transport models to simulate nitrate concentrations in untreated water withdrawn by community supply wells resulting from 2016 land use and current conditions of wastewater management after 50 years;
- Use of groundwater flow and contaminant transport models to simulate nitrate concentrations in the shallow upper glacial aquifer resulting from projected future build-out land use and current conditions of wastewater management after 50 years;
- Use of groundwater flow and contaminant transport models to simulate nitrate concentrations in untreated water withdrawn by community supply wells resulting from projected future build-out land use and current conditions of wastewater management after 50 years;
- Identification of priority areas for nitrogen load reduction and
- Identification and evaluation of alternative approaches to reduce nitrogen in groundwater, community supply wells and private wells.

3.1 Predicted Nitrogen Concentrations in Groundwater

Using the three-dimensional solute transport model, the parcel-specific nitrogen loads comprised of nitrogen loads from sanitary wastewater, nitrogen loads from fertilizer, nitrogen loads from pets and nitrogen loads from atmospheric deposition described in Section 2.1.5 were introduced to the centroid of each parcel in Suffolk County. Using the Suffolk County groundwater models (Main Body, North Fork, Shelter Island and South Fork) to simulate the recent average groundwater flow field resulting from 2012-2013 annual average water supply pumping and long-term average annual recharge from precipitation, the models were used to track the migration of the nitrogen loads through the aquifer system for a period of 200 years.

3.1.1 Existing Land Use

The simulated concentrations of nitrogen in the shallow upper glacial aquifer that would result after 200 years of continued nitrogen loading under existing conditions (2016) of land use and wastewater management are shown by **Figure 3-1**. Areas where the simulated nitrogen concentration in the shallow upper glacial aquifer is less than 1 mg/L are shown in dark blue. Comparison of these areas with land use mappings illustrates the effectiveness of land preservation on water quality, as illustrated by very low simulated nitrogen concentrations in preserved areas with no nitrogen loading from sanitary wastewater, fertilizer or pets. These include areas such as Mashomack Preserve and the central Pine Barrens. Areas where the simulated nitrogen concentration is between 1 and 2 mg/L are shown in light blue. These include areas where low density development exists and more densely populated sewered areas such as the Southwest Sewer District (SWSD) in southwestern Suffolk County, where most of the sanitary wastewater is collected, treated at the County's Bergen Point Wastewater Treatment Plant (WWTP) and discharged to the Atlantic Ocean, south of the barrier island. Areas where the simulated concentration of nitrogen is between 2 and 4 mg/L are shown in green. Areas where the simulated nitrogen concentrations are less than 4 mg/L are, in general, areas where residential development is less dense. Areas where the simulated concentrations of nitrogen are between 4 and 10 mg/L are shown in yellow and orange. The simulated results show that although the SWSD is sewered, elevated nitrogen concentrations from the unsewered high density residential area north of the SWSD continue to migrate downgradient towards the coast, hence areas of elevated nitrogen concentrations remain within some areas of the SWSD.

Modeling and empirical evaluations of nitrogen loading and groundwater quality documented in the **Long Island Comprehensive Waste Treatment Management Plan** (208 Study, 1978) concluded that average nitrate concentrations in groundwater would have to be less than 6 mg/L to result in compliance with the 10 mg/L drinking water maximum contaminant level (MCL) 90 percent of the time, and that this correlated to approximately 6.7 people per acre, or ½ acre zoning. To protect human health, Article 6 of the Suffolk County Sanitary Code established Groundwater Management Zones (GMZs) in 1980. Article 6 permits residential development in unsewered areas within GMZ III, V and VI on parcels of 1-acre (40,000 square feet) or larger to limit groundwater nitrogen concentrations within those GMZs to 4 mg/L. Residential development in the I, II, IV and VIII is limited to parcels of ½-acre (20,000 square feet) or larger to limit groundwater nitrogen concentrations within those GMZs to 6 mg/L. For other than residential developments, Article 6 of the Suffolk County Sanitary Code (760-607) allows individual sewerage systems on parcels where the population density equivalent is < 40,000 square feet within Groundwater Management Zones III, V or VI, and the population density equivalent is < 20,000 square feet outside of Groundwater Management Zones III, V or VI.

The 208 assessment and Article 6 density restrictions were corroborated by the groundwater modeling evaluation completed as part of the **Suffolk County Comprehensive Water Resources Management Plan** (2015). A series of model simulations was used to evaluate projected nitrogen concentrations in the shallow upper glacial aquifer and in a shallow supply well that would result from hypothetical residential developments of uniform residential parcel sizes. The evaluation showed that uniform development of one-acre parcels would result in nitrogen concentrations in

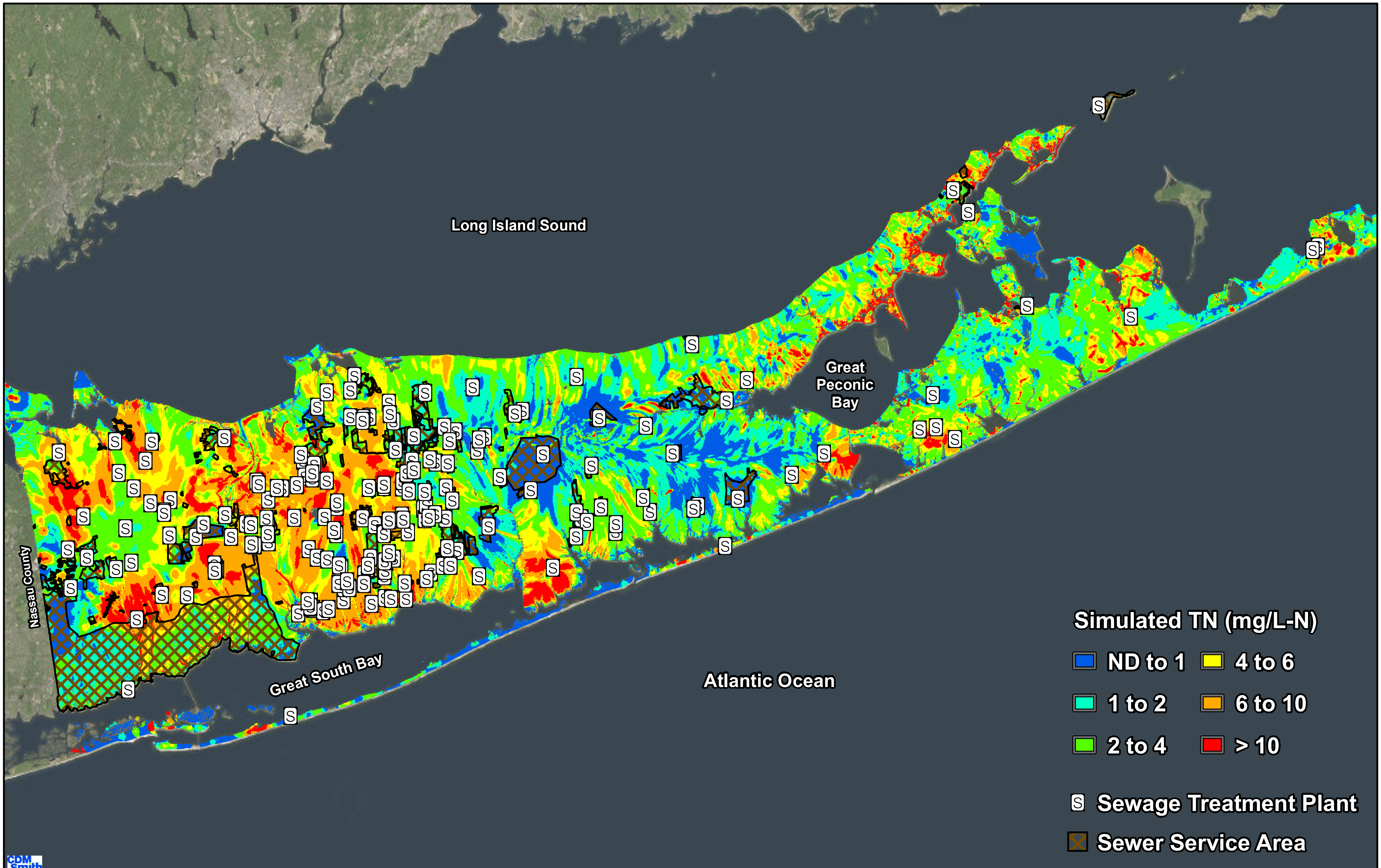


Figure 3-1
Simulated Nitrogen Concentration within the Upper Glacial Aquifer
Existing Conditions (2016)
Suffolk County Subwatersheds Wastewater Plan

Date: 5/29/2019

shallow groundwater that approached 4 mg/L, development comprised of ½ acre parcels would result in nitrogen concentrations just over 6 mg/L and groundwater downgradient of a uniform development of ¼ acre parcels would result in upper glacial nitrogen concentrations in excess of 10 mg/L. As shown by **Figure 3-2**, areas where simulated nitrogen concentrations greater than 6 mg/L, shown in orange, typically coincide with areas where residential parcel sizes are less than or equal to ½ acre. Areas where the simulated nitrogen concentration is greater than 10 mg/L are shown in red. These areas are also typically located where residential parcels less than ½ acre, or even ¼ acre (e.g., pre-Sanitary Code Article 6) exist.

3.1.2 Build-Out Land Use

The simulated concentrations of nitrogen in the shallow upper glacial aquifer that would result after 200 years of continued nitrogen loading under projected future build-out conditions of land use and wastewater management are shown by **Figure 3-3**. In general, the simulated nitrogen concentrations resulting from build-out depict a similar pattern to existing conditions; although a comparison of **Figures 3-2** and **3-3** shows that increases in simulated concentrations resulting from changes in land use types after full build-out may be observed more often within the East End towns where more development potential exists. In some areas, nitrogen concentrations in shallow groundwater are predicted to decrease under build out conditions. These areas are generally limited to parcels where the nitrogen loading rate from the existing land use is higher than the converted land use. For example, the model projects that nitrogen loads would decrease upon conversion of an existing agricultural crop that receives high fertilizer applications to maintain crop yield and health (e.g. row crops, sod farms, etc.) to a residential land use that complies with Article 6 of the Suffolk County sanitary code minimum lot size. It should be noted that this is not to suggest that these parcels should be converted to residential parcels as a means to reduce nitrogen loading but it does underscore the importance of continuing to pursue and implement the existing agricultural Best Management Practices (BMPs) described in Section 8.4.12.1.

3.2 Predicted Nitrogen Concentrations in Community Supply Wells

The model was also used to simulate the nitrogen concentrations that would occur in community supply wellfields assuming that nitrogen loading from existing land uses, wastewater management and current annual average precipitation, recharge and water supply pumping rates continued unchanged for 200 years. Simulated nitrogen concentration is represented as a wellfield averaged concentration at each location. Many community water supply locations throughout the County include more than one supply well and those locations are referred to as wellfields. Wellfields may have several wells on the property and the operation of individual wells can vary. In some instances, only a single well is pumped whereas during other times wells are cycled or all wells are pumped.

The groundwater model simulates water withdrawals at model nodes and model levels. Model nodes represent areal points where the equations for groundwater flow are solved. Model levels extend vertically, defining individual aquifer units or subdivided within different aquifer units. A well is simulated by assigning the areal location to a node and pumping is assigned at the model level(s) that the well screen is closest to vertically. While the groundwater model discretization has

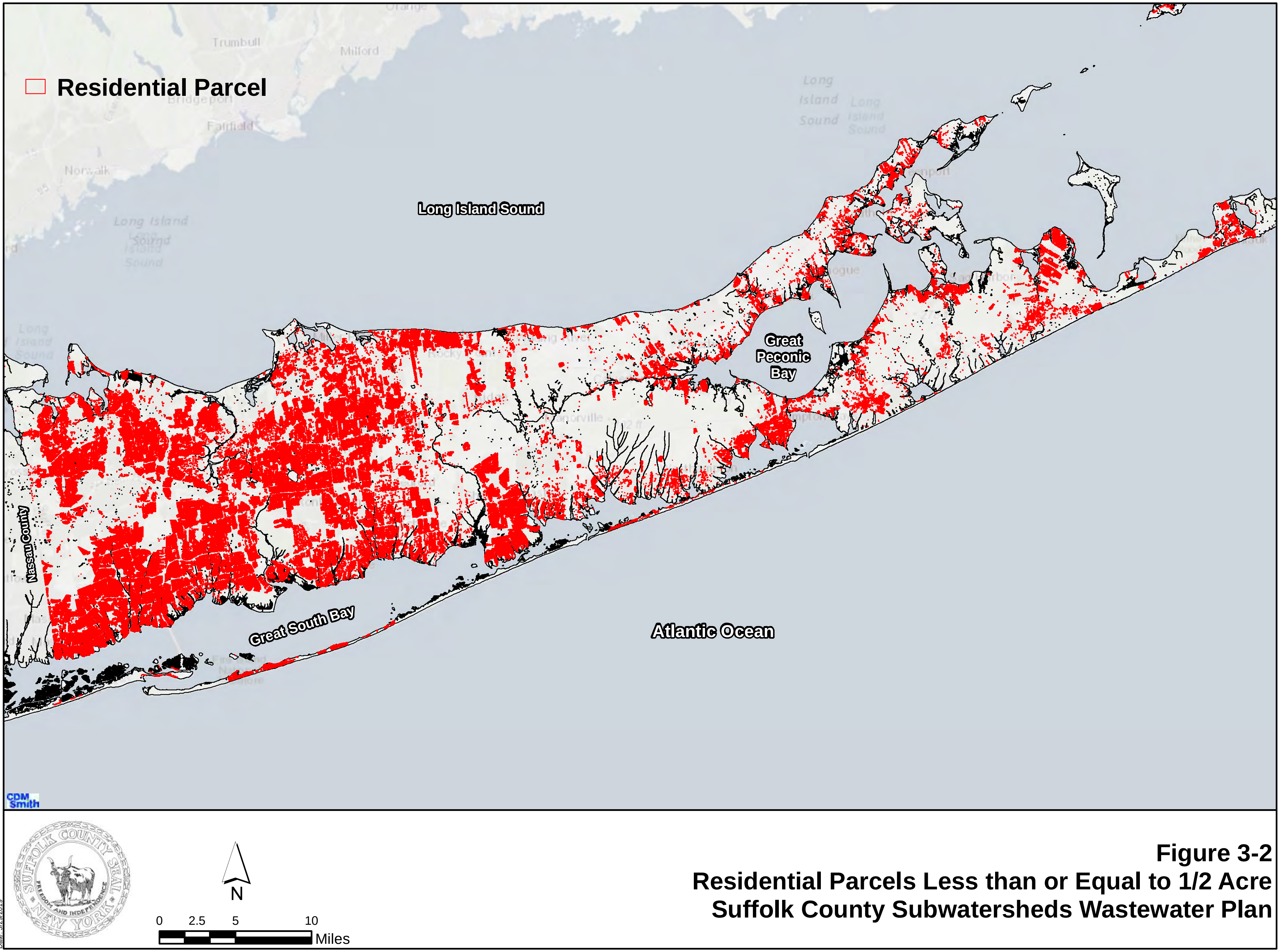


Figure 3-2
Residential Parcels Less than or Equal to 1/2 Acre
Suffolk County Subwatersheds Wastewater Plan

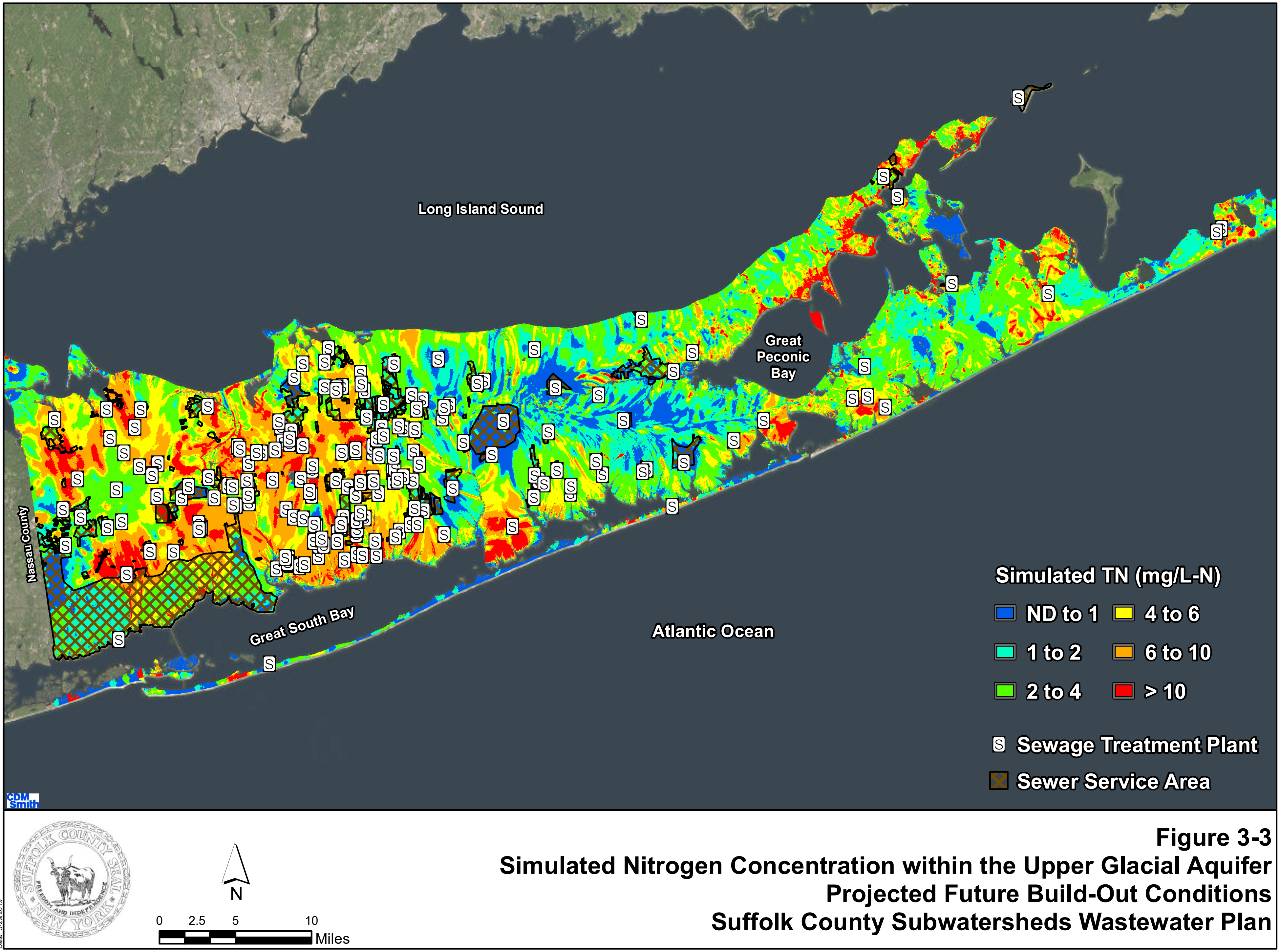


Figure 3-3
Simulated Nitrogen Concentration within the Upper Glacial Aquifer
Projected Future Build-Out Conditions
Suffolk County Subwatersheds Wastewater Plan

Date: 5/29/2019

been greatly enhanced for the SWP simulations, there are many instances where wells within a wellfield are close to one another and are assigned to the same model node and model level. Because of this, and due to the variation in daily operations at any given wellfield, model-simulated nitrogen concentrations at each wellfield are shown as flow-weighted averages based on the well-specific pumping rates and simulated concentrations.

3.2.1 Existing Land Use

The time that it takes recharging precipitation to travel from the water table to a water supply well depends on a variety of factors including the depth of the well, the water supply pumping rate and hydrogeologic properties of the aquifer. It may take less than a year for recharging precipitation to reach a shallow upper glacial well, while it can take decades, a century, or even longer for recharging precipitation to travel from the deep recharge area in the center of the County to a well screened in the deep Magothy aquifer near the coast.

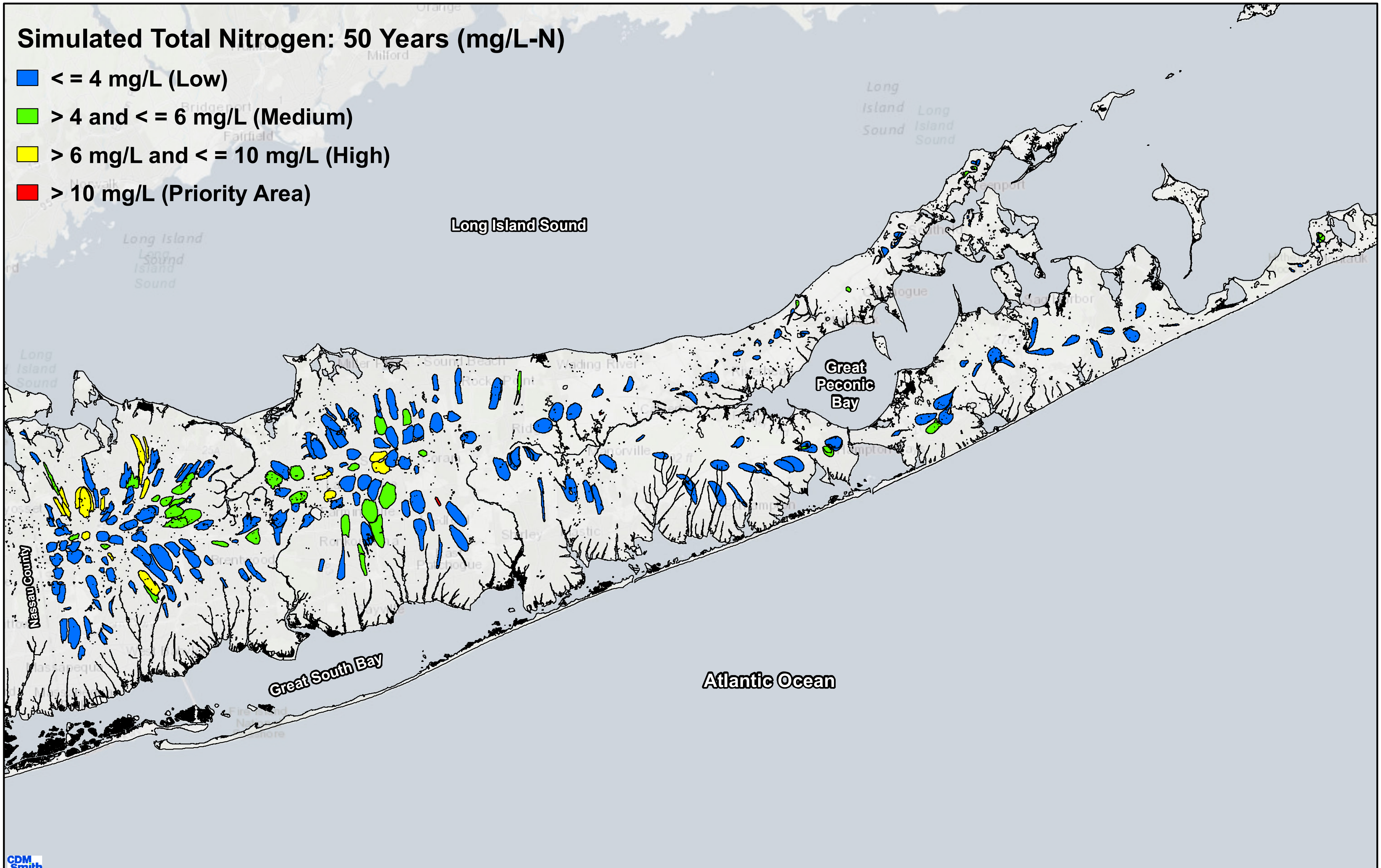
Suffolk County identified 50 years as the planning horizon for wastewater upgrades in community supply well contributing areas. The simulated 50-year contributing areas to Suffolk County community supply wells are shown on **Figure 3-4**. The contributing areas are color-coded based upon the simulated equilibrium nitrogen concentrations in the wells after 50 years.

Simulated nitrogen concentrations within wells represented by their corresponding fifty-year contributing areas for wells are depicted based on their simulated nitrogen concentrations as follows:

- > 10 mg/L are shown in red,
- < 10 mg/L and > 6 mg/L are shown in yellow,
- < 6 mg/L and > 4 mg/L are shown in green, and
- < 4 mg/L are shown in blue.

As previously described, 10 mg/L is the drinking water criteria or MCL for nitrate and the **Long Island Comprehensive Waste Treatment Management Plan** (208 Study, 1978) concluded that average nitrate concentrations in groundwater would have to be less than 6 mg/L to result in compliance with the 10 mg/L MCL 90 percent of the time. Similarly, average nitrate concentrations in groundwater would have to be less than 4 mg/L to result in 99 percent compliance with the 10 mg/L MCL. In many cases, the simulated equilibrium concentrations will not match currently observed nitrogen concentrations, because land use and nitrogen loading have not remained constant for the past 50 years. In addition, some community supply wells that were simulated have not been actively pumping for the entire 50-year period.

Figure 3-5 summarizes the distribution of simulated nitrogen concentrations resulting from existing land uses in public supply wells after 50 years (wells having a minimum time of travel greater than 50 years are not included). The figure shows that nitrogen concentrations in almost 77 percent of the community supply wells are simulated to be less than 4 mg/L after 50 years, 14.5 percent are simulated to be between 4 and 6 mg/L, over six percent are simulated to be between 6 and 10 mg/L and two percent are simulated to exceed 10 mg/L.



Date: 5/29/2019

N

0 2.5 5 10 Miles

Figure 3-4
Simulated Nitrogen Concentration within Community Supply Wells after 50 Years
2016 Land Use Conditions as per Division of Planning & Environment
Suffolk County Subwatersheds Wastewater Plan

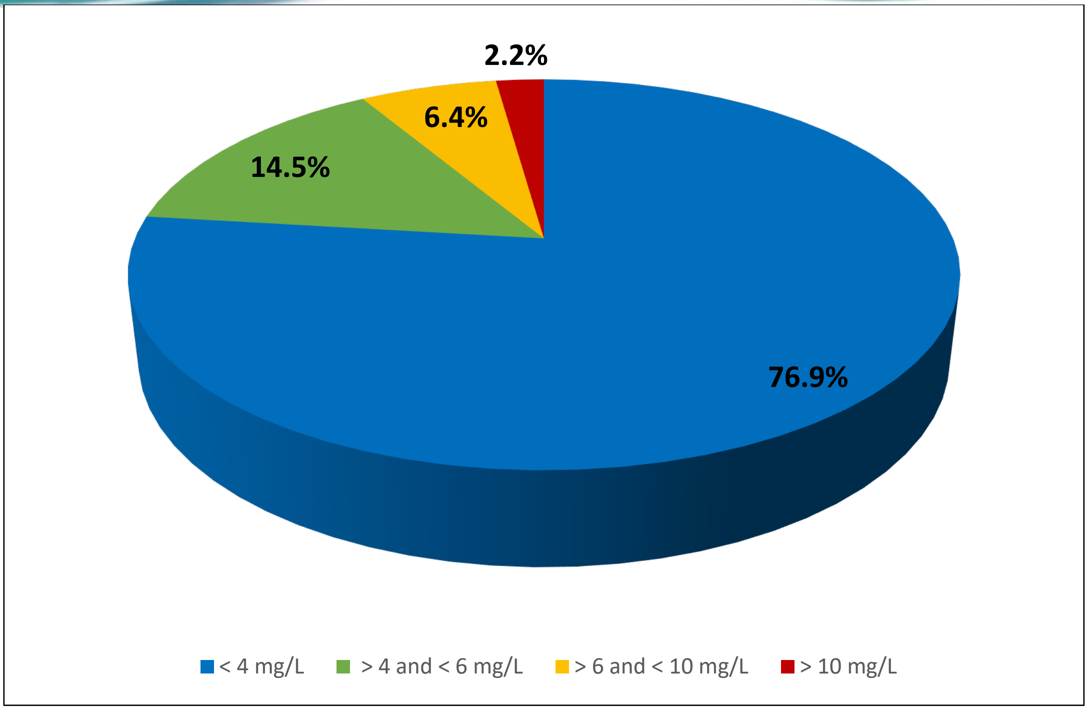


Figure 3-5 Simulated Nitrogen Concentrations in Community Supply Wells after 50 Years

3.2.2 Build-Out Land Use

The nitrogen loading simulations were repeated, using current (2012-2013) average annual water supply pumping rates and updated parcel-specific nitrogen loads associated with Suffolk County Department of Economic Development and Planning's listing of the parcel-specific land uses projected to result from full build-out in the future. The simulated 50-year contributing areas to Suffolk County community supply wells based on build-out nitrogen loads are shown in **Figure 3-6,** using the same color coding used for the existing conditons simulation. Consistent with the contributing area depictions for existing land use and nitrogen loading, the calculated concentrations in wells screened within the same wellfield are shown as flow-weighted averages based on the assigned pumping rates.

Figure 3-7 summarizes the distribution of simulated nitrogen concentrations in public supply wells resulting from future predicted build-out land uses after 50 years (as with existing conditions, wells having a minimum time of travel greater than 50 years are not included). The figure shows that nitrogen concentrations in 74 percent of the community supply wells are projected to be less than 4 mg/L, 15.5 percent are projected to be between 4 and 6 mg/L, over seven percent are projected to be between 6 and 10 mg/L and 2.7 percent are projected to exceed 10 mg/L 50 years after potential full build-out conditions are realized.

Comparison of **Figures 3-5** and **3-7** shows that nitrogen concentrations in the 50-year contributing areas to public supply wells are predicted to increase slightly if the projected full build-out conditions occur without any changes to wastewater management. The percentage of community supply wells with a nitrogen concentration of less than 4 mg/L in the untreated water source is predicted to decline by 2.7 percent, from 76.9 percent based on the 50-year contributing area and

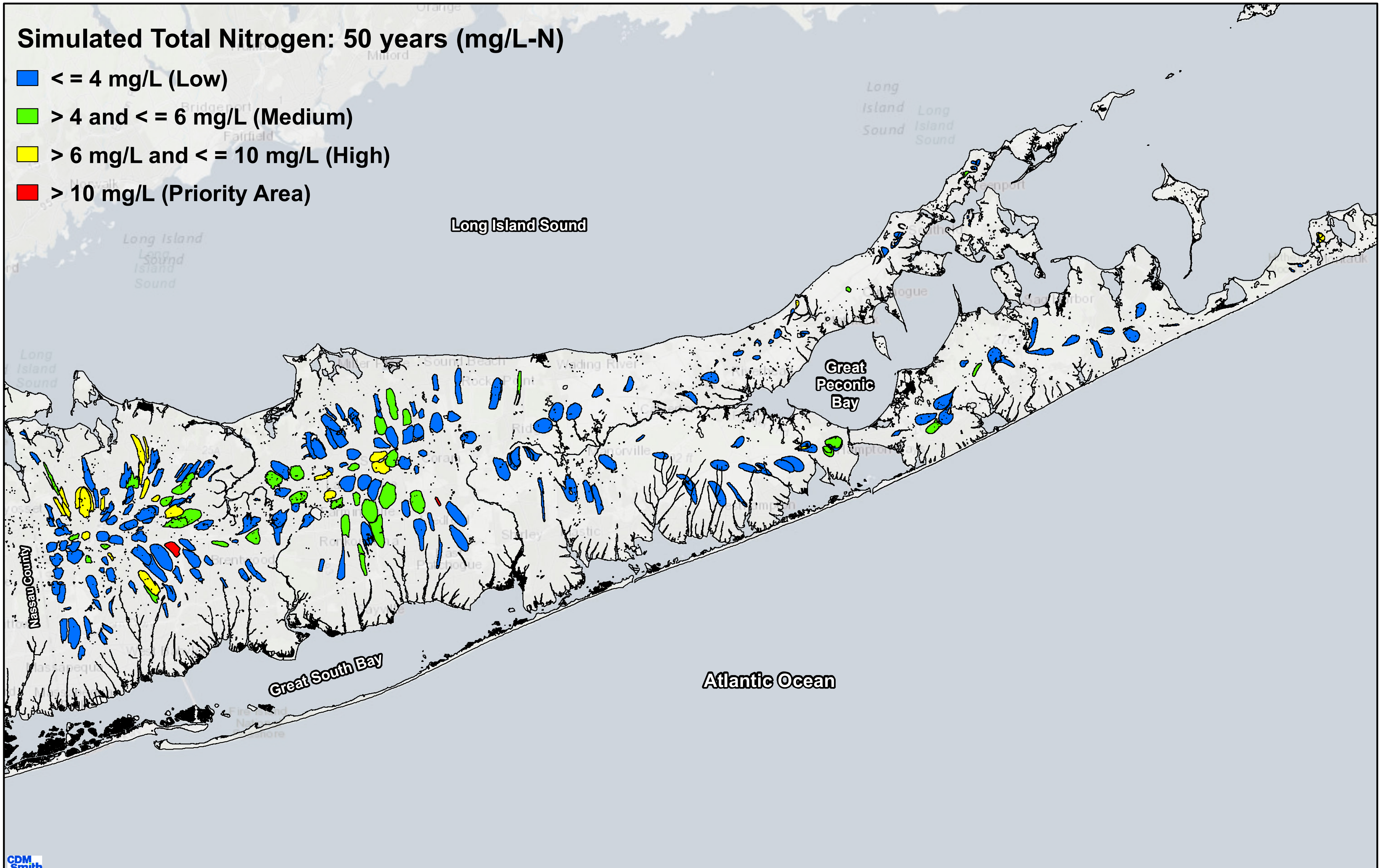


Figure 3-6
Simulated Nitrogen Concentration within Community Supply Wells after 50 Years
Projected Build-Out Land Use Conditions as per Division of Planning & Environment
Suffolk County Subwatersheds Wastewater Plan

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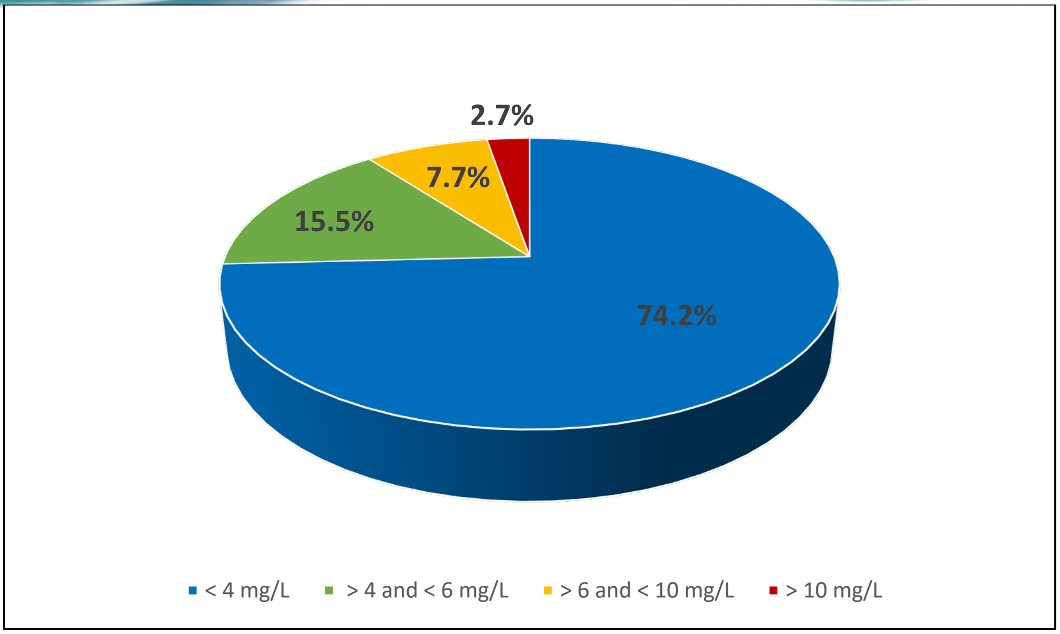

Figure 3-7 Projected Nitrogen Concentrations in Community Supply Wells after 50 Years of Build-out Land Uses

existing conditions to 74.2 percent based on future projected build-out conditions. The percentage of community supply wells with nitrogen concentrations between 4 and 6 mg/L in untreated source water is predicted to increase by 1 percent, from 14.5 to 15.5 percent, the percentage of community supply wells with nitrogen concentrations between 6 and 10 mg/L is predicted to increase by 1.3 percent from 6.4 percent to 7.7 percent, and the percentage of community supply wells with untreated source water greater than the 10 mg/L MCL is predicted to increase by 0.5 percent from 2.2 percent to 2.7 percent.

It is also important to note, that the build-out condition does not account for existing concentrations during present day (e.g., nitrogen from “legacy” land use). The model simulation starts with a nitrogen concentration of zero throughout the aquifer and runs for a period of 50 years.

3.3 Priority Areas for Nitrogen Reduction for Groundwater Protection and Nitrogen Reduction Requirements

3.3.1 Priority Area Mapping

Suffolk County has responded to the need to protect the sole source aquifer from nitrogen contamination for current and future generations through the years. Historical studies and plans have documented the need to either limit development density or provide increased levels of sanitary wastewater treatment to protect the aquifer from constituents such as nitrogen that are found in wastewater. As described in Section 3.1, in 1980, Suffolk County codified these recommendations in Article 6 of the Sanitary Code. **Figure 3-8** provides an overview of the Groundwater Management Zones, overlain onto simulated nitrogen concentrations based on 2016 land use conditions after 200 years. As shown on the figure, areas of lower nitrogen concentrations

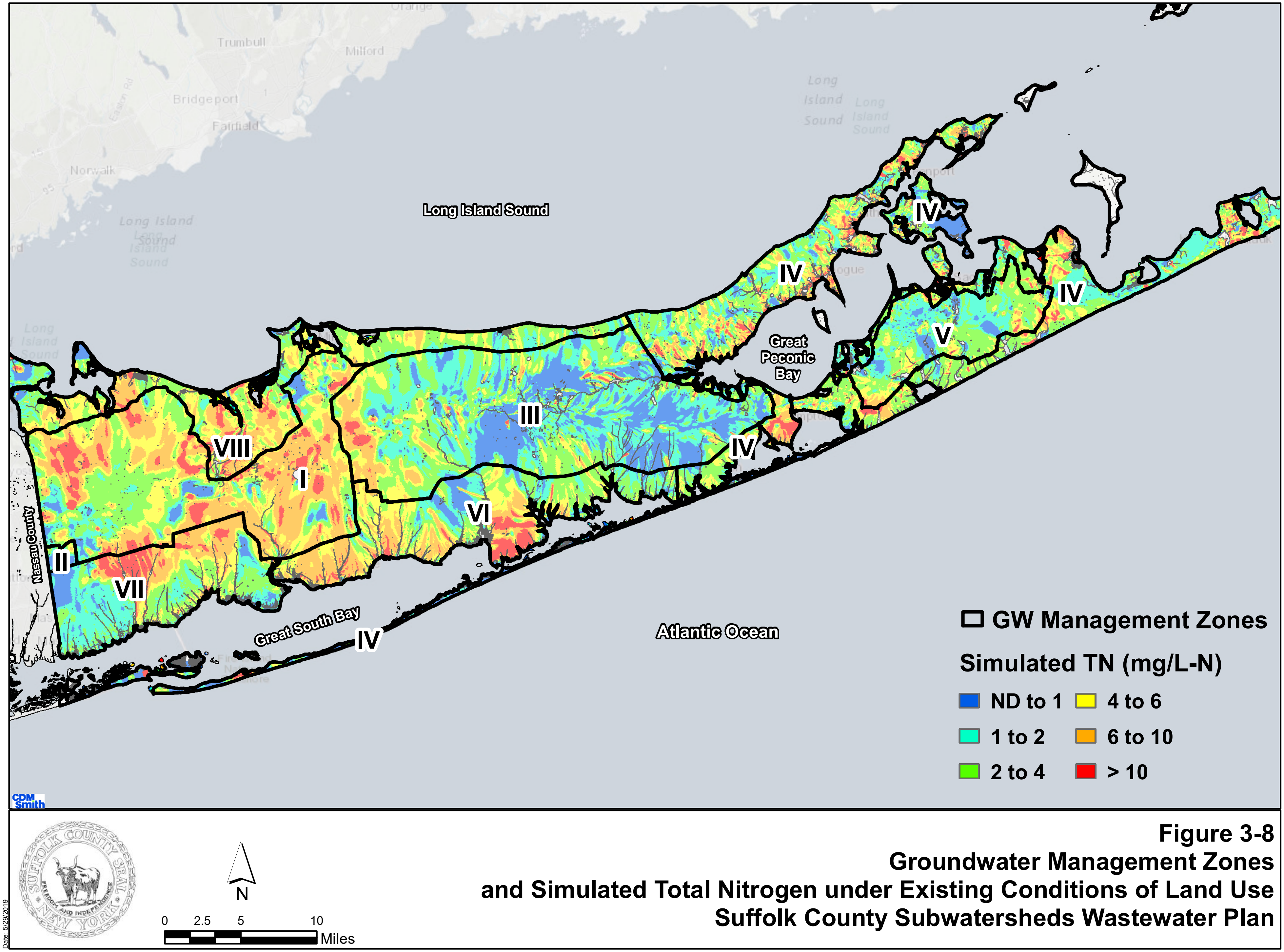

Figure 3-8
Groundwater Management Zones and Simulated Total Nitrogen under Existing Conditions of Land Use
Suffolk County Subwatersheds Wastewater Plan

are found in Groundwater Management Zones III and V, highlighting the effectiveness of Article 6, the Long Island Pine Barrens Protection Act and other open space preservation programs. Areas of higher nitrogen concentrations are often found where development had occurred prior to establishment of Article 6; unsewered residential parcels that are smaller than one acre are shown on **Figure 3-9**.

The priority areas for groundwater and drinking water restoration and protection established through this SWP are shown on **Figure 3-10**. The groundwater and drinking water priority areas on **Figure 3-10** combine both aquifer restoration and protection objectives. Priority area identification considered:

- Simulated upper glacial nitrogen concentrations resulting from both existing and projected future build-out land use (and existing wastewater management),
- Model-predicted nitrogen concentrations at community supply wellfields and
- Actual observed nitrogen concentrations in individual community supply wells.

Current residential development density was also considered as the priority areas were delineated. Priority areas in the five East End towns (East Hampton, Riverhead, Shelter Island, Southampton, Southold) were identified using a slightly different approach than for the five West End Towns (Babylon, Brookhaven, Islip, Huntington, Smithtown), based upon consideration of the 10 mg/L MCL for nitrogen and the type of potable supply available.

Areas shown in light red on **Figure 3-10** are Priority Rank 1 for groundwater restoration. The areas shown in light red in the five West End towns are the contributing areas to public supply wells where nitrogen concentrations in raw (untreated) water either currently exceed the drinking water MCL of 10 mg/L or are projected to exceed 10 mg/L based on current conditions of land use and wastewater management (Task 11a memorandum, **Equilibrium Simulations, Existing Conditions**, 2018). Community supply wells where raw water from individual wells has recently exceeded 10 mg/L are listed on **Table 3-1**.

As summarized by **Table 3-2**, SCDHS estimates that over 90 percent of the County's approximately 30,000 private potable supply wells are located within the five East End towns. Because these private wells are primarily screened within the upper glacial aquifer, the areas where groundwater modeling simulated shallow upper glacial nitrogen concentrations to exceed 10 mg/L and the contributing areas where simulated or actual nitrate concentrations in community supply wells exceed 10 mg/L are identified as Priority Rank 1 for wastewater management for groundwater protection. As the East End Priority Rank 1 areas were delineated, the existing residential development density was also used to help to identify the area requiring protection of potable supply.

In a similar fashion, contributing areas to existing community supply wellfields where nitrogen concentrations are simulated to be between 6 and 10 mg/L in raw water withdrawn from the wells are shown in yellow for the five West End towns; these areas are Priority Rank 2 for groundwater restoration and protection. In the five East End towns, the areas where the model-simulated nitrate concentrations are between 6 and 10 mg/L that are shown in yellow are Priority Rank 2 for groundwater restoration and protection. The remainder of the County, shown in light blue, is

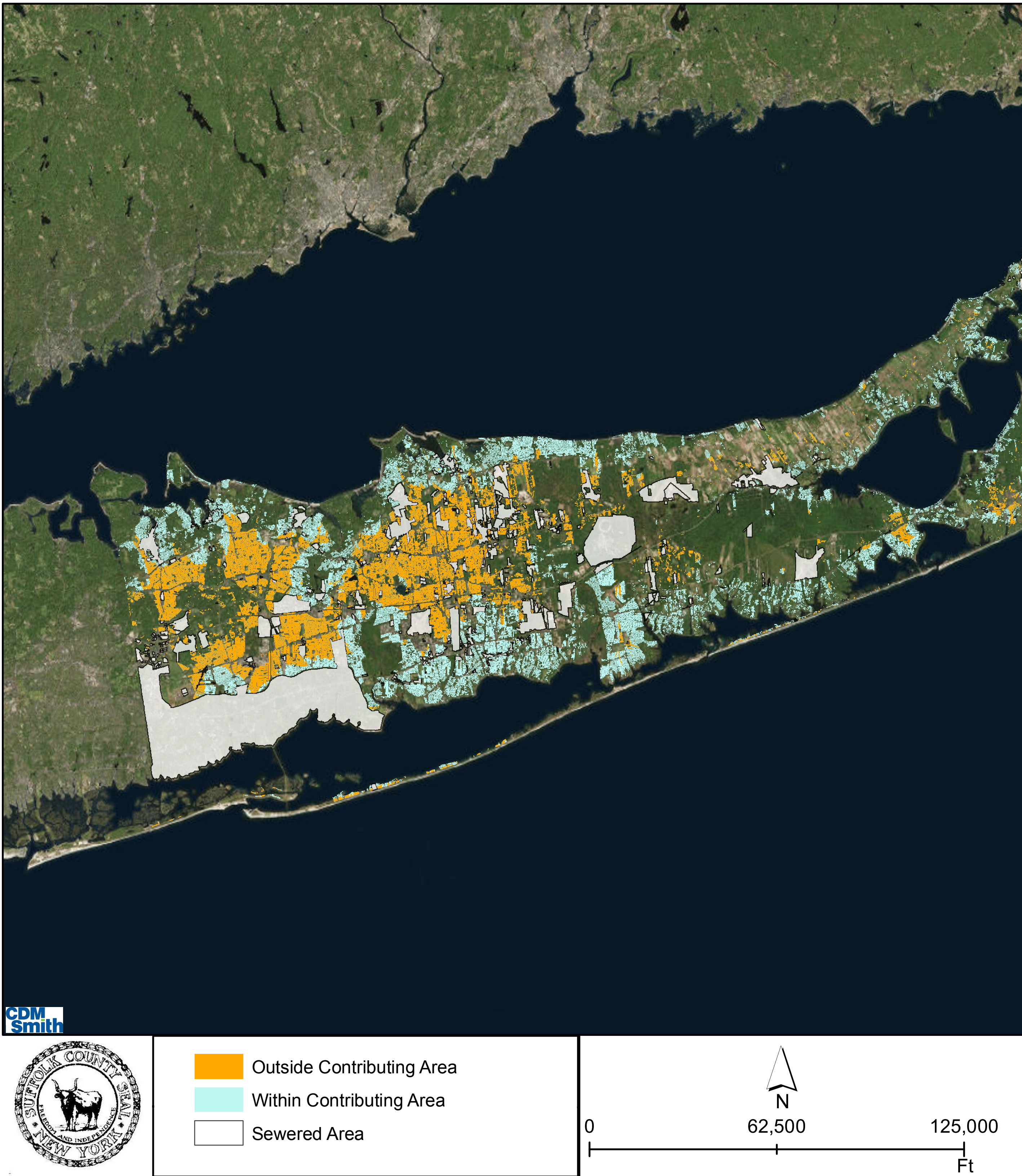

Figure 3-9
Unsewered Residential Parcels
Less than 40,000 SF

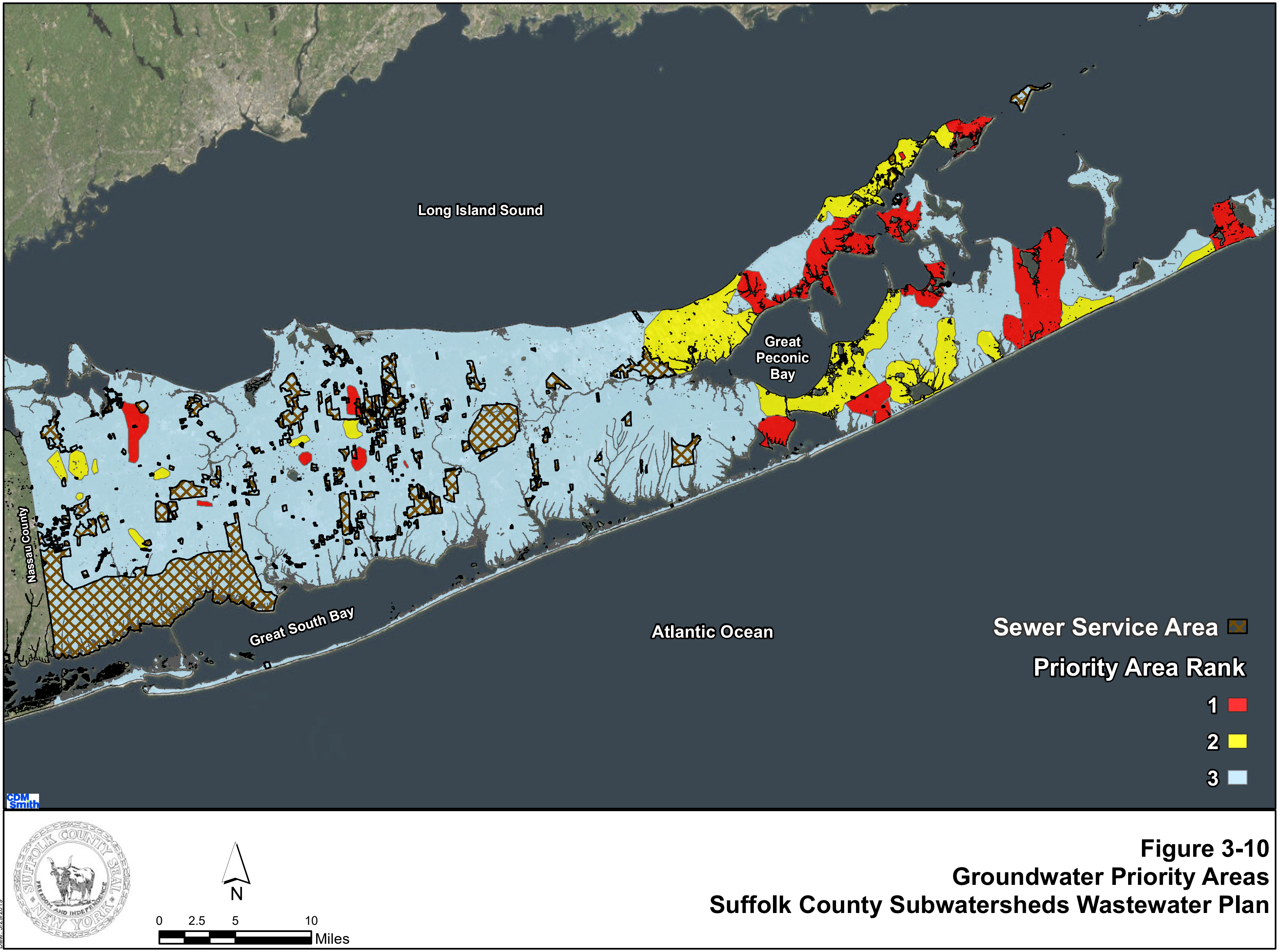

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Figure 3-10
Groundwater Priority Areas
Suffolk County Subwatersheds Wastewater Plan

Table 3-1 SCWA Community Supply Wells with Nitrogen Concentrations > 10 mg/L in Raw Water

Well Name	Well Number
Broadway #1A	S-134006
Browns Hills Road #2A	S-117863
Church St. (Northport) #1	S-23371
Church St. (Northport) #2	S-30762
Commercial Blvd. #2	S-31624
Horseblock Rd. #1	S-46400
Islands End #6A	S-124937
Islands End #7A	S-125174
Jayne Blvd. #1	S-14792
Long Springs Rd. #3B	S-122603
Middleville Road #1	S-54162
Reservoir Ave. #1A	S-133193
South Spur Dr. #1	S-35939
South Spur Dr. #2	S-37351
Spinney Rd. #2	S-53593
Spinney Rd. #3	S-123249
Virginia Ave. #1	S-72300

Table 3-2 SCDHS Office of Wastewater Management Approvals with Private Supply Wells by Town

Town	Percentage of Private Wells
Babylon	0%
Brookhaven	6%
East Hampton	33%
Huntington	1%
Islip	0%
Riverhead	1%
Shelter Island	9%
Smithtown	1%
Southold	37%
Southampton	13%

groundwater protection Priority Rank 3. It should be noted that areas shaded blue include areas where parcel sizes typically exceed 1 acre as well as protected/preserved areas (e.g., Central Pine Barrens) where nitrogen loading is low and/or where the majority of existing parcels are connected to public water supply. Finally, the Priority Rank 3 areas located in central Suffolk County have extremely long travel times, on the order of centuries, to potential receptors.

3.3.2 Aggregation with Surface Water Priority Areas

The groundwater and drinking water protection areas shown on **Figure 3-9** combine both aquifer restoration and protection objectives. As noted above, residential parcels falling within the contributing area to a surface water subwatershed have been addressed separately as described in Section 2 of this SWP. Priority areas for groundwater restoration/protection were considered together with the areas identified for surface water protection. In some cases, groundwater with a high nitrogen concentration discharges to a large, well flushed surface water body with a low priority for nitrogen load reduction. Because the approximately 30,000 private wells that withdraw water for household potable supply and recharge the water at the same parcel are not incorporated into the groundwater modeling evaluation, the East End town groundwater protection areas can overlap with the surface water protection areas. In areas of overlap, the higher priority rank (e.g., surface water or groundwater and drinking water) was selected for wastewater management planning purposes. For much of the East End, the groundwater priority rank is higher than the surface water priority rank, and the highest priority ranking has been selected for the overall SWP.

These areas are described further in Section 4.

3.3.3 Nitrogen Load Reductions in Community Supply Well Contributing Areas

3.3.3.1 Existing Land Use

Sanitary nitrogen load reductions required to reduce raw water nitrogen concentrations to 4 mg/L (e.g., the concentration target to achieve 99 percent compliance with the 10 mg/L MCL) in Suffolk County community supply wells with travel times of less than or equal to 50 years are summarized in **Table 3-3** (please see tables at the end of this section). The wellfield-specific reductions are calculated based on the Countywide subwatershed average that 68.5 percent of the total nitrogen loading originates from sanitary wastewater. Based on the 50-year contributing area, 233 wellfields have simulated nitrogen concentrations of less than 4 mg/L, therefore no nitrogen load reduction in the contributing areas would be required to achieve the 4 mg/L target. Nitrogen reductions for these wellfields are identified as N/A.

The four wellfields for which nitrogen load reductions from implementation of I/A systems would not be sufficient to achieve 4 mg/L are shaded in light blue [(1)]. Based on the Countywide average contribution of sanitary nitrogen loading of 68.5 percent, nitrogen from wastewater would have to be reduced by 75 to 87 percent to achieve the 4 mg/L target nitrogen concentration in untreated source water from these wellfields. The average 70 percent nitrogen reduction provided by an I/A system would significantly reduce nitrogen concentrations in each wellfield; nitrogen concentrations in two of the wellfields would be reduced to less than 6 mg/L, and nitrogen concentrations in two of the wellfields would be reduced to less than 10 mg/L. An in-depth evaluation of the land use within each of the wellfield's contributing areas would be required to identify the sanitary load component of the total load, to confirm that the reduced nitrogen concentrations would be achieved by I/A implementation.

(1) It should be noted that the simulated nitrogen concentrations for the Camp Quinipet wellfield are likely an artifact of the process. For the nitrogen load simulations, a parcel-specific sanitary load is applied to the centroid of the parcel. In the case of Camp Quinipet, it so happens that the well is located at a model node near the centroid of the parcel, resulting in a simulated high nitrogen concentration. Similarly, the simulated nitrogen concentration at the Riverhead well is also likely due to a similar issue.

3.3.3.2 Future Build-out Land Use

Sanitary nitrogen load reductions required to reduce untreated nitrogen concentrations in Suffolk County community supply wells with travel times of less than or equal to 50 years to 4 mg/L based on future projected build-out land uses are summarized in **Table 3-4** (please see tables at the end of this section). Based on the 50-year travel time alone, no nitrogen load reduction would be required in the contributing areas for 224 wellfields with simulated nitrogen concentrations of less than 4 mg/L; nitrogen reductions for those wellfields are identified as N/A.

The four wellfields for which nitrogen load reductions from implementation of I/A systems would not be sufficient to achieve 4 mg/L are shaded in light blue. Based on the Countywide average contribution of sanitary nitrogen loading of 68.5 percent, nitrogen from wastewater would have to be reduced by 74 to 93 percent to achieve the 4 mg/L target nitrogen concentration in untreated source water from these wellfields. The average 70 percent nitrogen reduction provided by an I/A system would significantly reduce nitrogen concentrations in each wellfield.

3.4 Wastewater Planning

Suffolk County has nine major water purveyors with Suffolk County Water Authority (SCWA) being by far the largest system (**Figure 3-11**). In 2018, SCWA had 590 active wells within their system which withdrew 73 billion gallons (billing 62 billion gallons) serving 384,256 customers (**SCWA 2018 Water Quality Report**). As shown on **Figure 3-11**, the majority of the western portion of the County is already served by community supply. Areas that rely on private wells are primarily located in the eastern portion of the County, particularly on the Forks and Shelter Island.

Due to the differences in water supply and aquifer characteristics between the five West End Towns (Babylon, Brookhaven, Islip, Huntington and Smithtown) and the five East End Towns (East Hampton, Riverhead, Shelter Island, Southampton and Southold) two separate evaluations of alternatives for the protection of groundwater and drinking water were completed as summarized below:

> **West End Towns** – Options for groundwater and drinking water protection include I/A OWTS in priority areas and well replacement. Because many wells in the West End Towns are hundreds of feet deep with long travel times from the water table to the well screen, it may take decades for the improved water quality resulting from the reduced nitrogen loading provided by I/A OWTS installation to be realized. Replacement wells installed to deeper depths could temporarily alleviate elevated nitrogen concentrations. However, this would be a temporary fix as ultimately nitrogen will continue to migrate deeper into the aquifer system and increasing withdrawals at depth will only cause nitrogen concentrations to increase over time. Replacement of shallow community supply wells with deeper wells could be a viable option to alleviate elevated nitrogen concentrations until the benefits of I/A OWTS are realized.
>
> **East End Towns** – As noted above, the SCDHS database of private wells shows that over 90 percent of private wells in the County are located in the five East End Towns. Private supply wells are typically shallow and are not monitored as frequently as community supply wells. The elevated nitrogen concentrations observed on the East End result from both unsewered

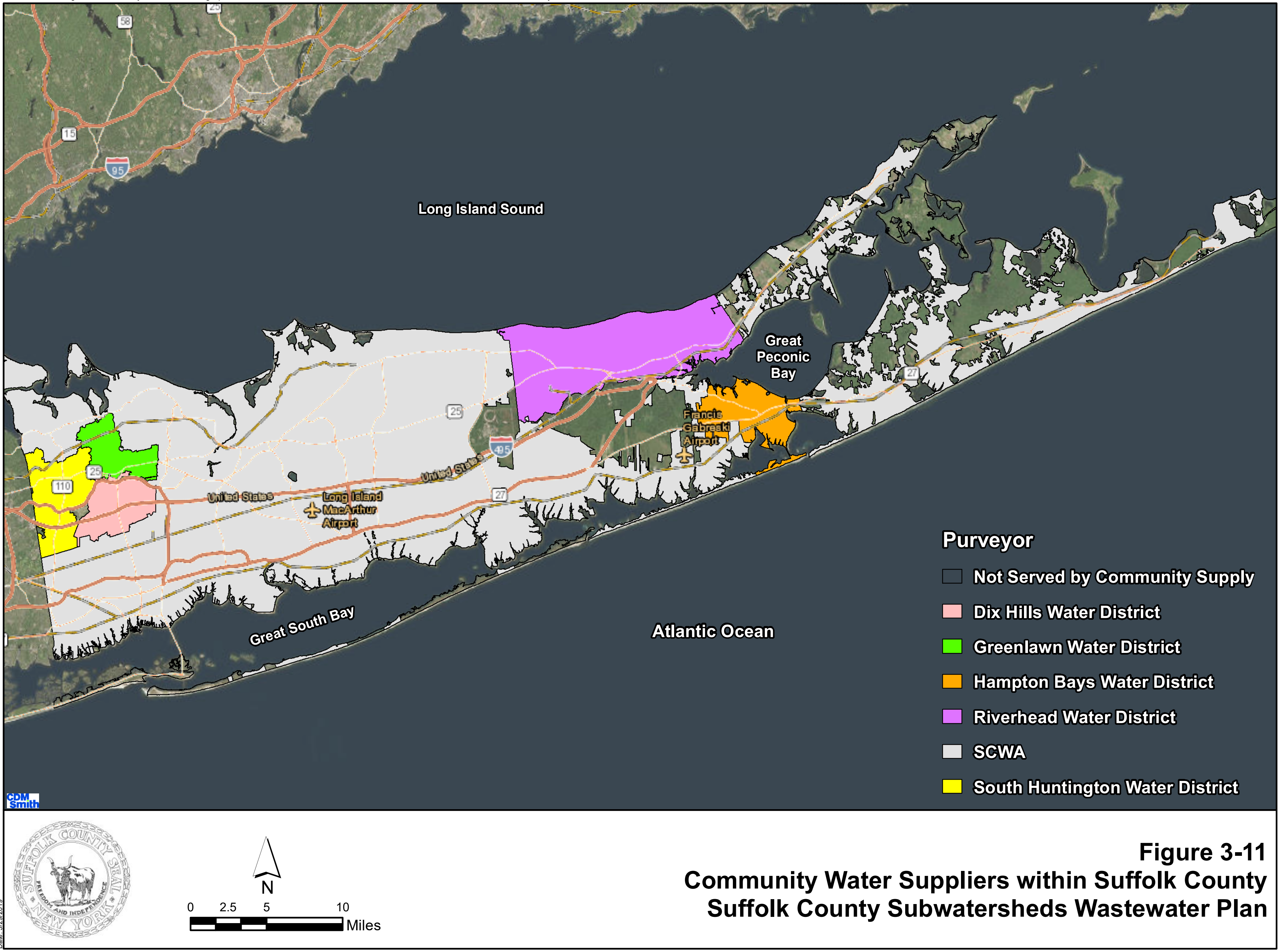

Figure 3-11
Community Water Suppliers within Suffolk County
Suffolk County Subwatersheds Wastewater Plan

Date: 5/29/2019

development and agricultural activities, particularly on the North Fork. In areas where nitrogen loading is primarily from fertilization, wastewater management will not be sufficient to achieve targeted nitrogen load reductions. The limited fresh water yield of the aquifers on the East End, particularly on the North Fork and Shelter Island, further complicates the response to observed nitrogen contamination. The Magothy Aquifer is comprised entirely of salt water on the North Fork and Shelter Island and increased pumping in the upper glacial aquifer will exacerbate the potential for salt-water intrusion.

3.4.1 Nitrogen Reduction for Restoration/Protection of Community Water Supply Wells

As described in Section 3.3.3, implementation of I/A OWTS in community supply well contributing areas are anticipated to provide sufficient nitrogen load reduction to reduce nitrogen concentrations to 4 mg/L in all wells that were simulated to exceed 10 mg/L except for SCWA's Race Avenue and Brown Hills Road wellfields. This conclusion was based on a Countywide estimate that 68.5 percent of nitrogen loading within the subwatersheds originates from on-site disposal of sanitary wastewater.

This was further considered for community water supply wells that have been observed to have nitrogen concentrations exceeding 10 mg/L in raw water or that are simulated to exceed 10 mg/L. Alternative nitrogen reduction approaches are also identified. The wells evaluated are listed in **Table 3-5**. As anticipated, inconsistencies exist between simulated and observed concentrations at some community supply wells because the simulations represent the nitrogen concentrations that would result from 50 years of continuous nitrogen loading under 2016 land use conditions. The simulations do not account for ancestral land use such as agriculture that may cause observed concentrations in some wells to exceed 10 mg/L-N, so simulated concentrations may not reach that level. Conversely, a well that has been simulated to exceed 10 mg/L-N, may not show concentrations above 10 mg/L due to changing pumping conditions, impacts not being fully realized (if the well has been in operation for a short period of time) or other localized conditions. Several of the individual wells listed in **Table 3-5** are located in wellfields that when considered as a whole do not exceed 10 mg/ L (Forty-First Street, for example). In general, model simulations agree with observed conditions as noted on the table. It is important to note that this analysis was based on raw water quality samples, prior to treatment. All water distributed as potable supply in Suffolk County meets or exceeds New York State drinking water standards.

There are few options available for community supply wells that exceed or are close to exceeding 10 mg/L nitrogen. Enhanced treatment can be installed, the wells can be replaced by deeper wells, wells can be relocated or decommissioned (with water supply being imported to replace the well's production) or the source of contamination can be removed or significantly reduced through sewering, implementation of I/A OWTS, or fertilizer management (if agricultural land use is suspected to be the primary cause of impairment).

In some instances, new wells have been installed to deeper depths in Suffolk County to achieve better water quality either through blending with an existing shallow well or to completely replace the shallow well. While this has its merits, simply deepening a community supply well ultimately can draw the contamination (nitrogen or other) that exists in the shallow aquifer to deeper depths,

Table 3-5
Community Water Supply Wells with High Nitrogen Concentrations (close to or exceeding 10 mg/L)

Purveyor	Wellfield	Well	Depth (ft)	Aquifer	Conditions of Elevated Nitrogen
SCWA[1]	Boyle Road (Port Jefferson)	S-68880 (#2)	597	Magothy	Simulated & Observed
	Broadway	S-134006 (#1A)	560	Upper Glacial	Simulated & Observed
	Brook Avenue	S-36714 (#3)	358	Magothy	Simulated
	Browns Hills Road	S-117863 (#2A)	50	Upper Glacial	Simulated & Observed
	Church Street (Northport)[3]	S-23371 (#1)	475	Upper Glacial	Simulated & Observed
		S-30762 (#2)	478	Upper Glacial	Simulated & Observed
	Commercial Boulevard	S-31624 (#2)	439	Magothy	Observed
	Forty-First Street	S-117665 (#6)	229	Magothy	Simulated
	Head of the Neck Rd	S-14710 (#2)	115	Upper Glacial	Simulated (no longer active)
	Horseblock Road	S-46400 (#1)	266	Upper Glacial	Simulated & Observed
	Islands End	S-124937 (#6A)	83	Upper Glacial	Observed
		S-125174 (#7A)	83	Upper Glacial	Observed
	Jayne Boulevard	S-14792 (#1)	455	Magothy	Simulated & Observed
	Long Springs Road	S-122603 (#3B)	99	Upper Glacial	Observed
	Middleville Road	S-54162 (#1)	548	Magothy	Observed
	Race Avenue	S-17037 (#1)	155	Upper Glacial	Simulated (Observed exceeded 8 mg/L in 2001)
	Reservoir Avenue	S-133193 (#1A)	517	Upper Glacial	Observed
	Schuyler Drive	S-23715 (#2)	315	Upper Glacial	Simulated & Observed (2008)
	South Spur Drive	S-35939 (#1)	616	Magothy	Observed
		S-37351 (#2)	663	Magothy	Observed
	Spinney Road	S-53593 (#2)	162	Upper Glacial	Observed
		S-123249 (#3)	533	Magothy	Observed
	Virginia Avenue	S-72300 (#1)	274	Upper Glacial	Simulated & Observed
Riverhead Water District[4]	River Road (Grumman), Plant 12-1	S-49605 (#12-1)	142	Upper Glacial	Simulated

1.Data from SCWA: 2018 raw water samples which exceeded 10 mg/L-N for nitrate.
2.Latest (2017-2018) water quality reports from Dix Hills, Greenlawn, South Huntington, Hampton Bays and Riverhead Water Districts indicate that there were no exceedances of 10 mg/L-N for nitrate.
3. Simulated concentrations do not exceed 10 mg/L, but at 8 or 9 mg/L they approach 10 mg/L.
4. Likely due to modeling artifact at single node assigned to well.

particularly if there are deep wells in adjacent areas that will ultimately result in larger drawdowns at depth (and hence accelerate the downward migration of the shallow contamination). However, this solution is effective at reducing nitrogen, particularly if the deeper well pumps at a lower capacity and is simply used to blend with raw water from shallow wells.

Installing community water supply wells into the Lloyd Aquifer is currently forbidden in most areas of Long Island as per the Lloyd Aquifer Moratorium. The New York State Department of Environmental Conservation (NYSDEC) will allow installation of supply wells in the Lloyd, but only under a very restricted set of circumstances; e.g., for coastal communities where the Magothy aquifer is absent. In 2006, the SCWA submitted an application to install a 300 gallon per minute (gpm) well into the Lloyd at Middleville Road to alleviate nitrogen concentrations from the wellfield. This application was ultimately denied. For the purposes of this analysis, it is assumed that installing new water supply wells into the Lloyd Aquifer is not a feasible option for reducing nitrogen in drinking water supplies.

Each community supply well that has either been observed or simulated to exceed 10 mg/L is briefly described below. In each case, I/A OWTS implementation is a viable alternative to reduce nitrogen concentrations to 4 mg/L unless specifically noted. Wellfield-specific alternatives to I/A OWTS implementation are identified.

3.4.1.1 Western Suffolk County Towns

It would be a challenge to replace or relocate community supply wells in the five western Towns to achieve improved water quality. Available land to site a new wellfield is limited and a high density of supply wells already exists.

3.4.1.1.1 Boyle Road (Port Jefferson) & Jayne Boulevard

The SCWA has indicated that Boyle Road (Port Jefferson) Well #2 and Jayne Boulevard Well #1 have exceeded 10 mg/L of nitrate as nitrogen in raw water samples collected in 2018. A cross-section of the well fields is shown on **Figure 3-12**. Both wells are very deep and installed within the basal portion of the Magothy Aquifer. Boyle Road (Port Jefferson) Well #1 is approximately 125 feet deeper than Well #2 and although it has not exceeded 10 mg/L-N, concentrations have increased over time (**Figure 3-12**). Jayne Boulevard already has two deep wells installed, approximately 200 feet deeper than Well #1. While these wells currently exhibit good water quality and adding a third well is possible, adding a third well at depth will increase drawdown and downward nitrogen migration at this wellfield and is not recommended at this time. Model simulations agree with observed conditions. Although nitrogen levels in each wellfield average less than 10 mg/L, the two individual wells are simulated at concentrations greater than 10 mg/L.

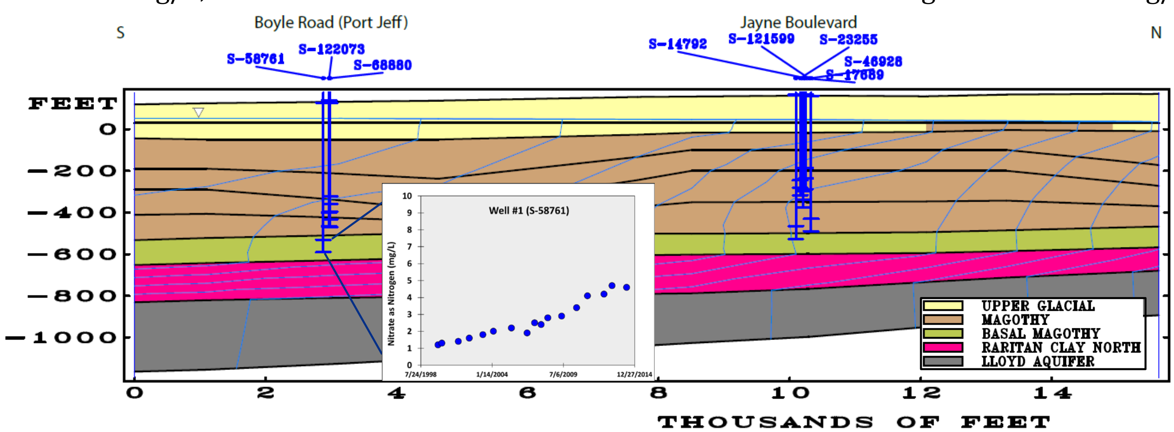

Figure 3-12 North-South Cross Section through SCWA Boyle Road (Port Jefferson) and Jayne Boulevard Wellfields

3.4.1.1.2 Broadway

Similar to Boyle Road and Jayne Boulevard, Broadway Well #1A is installed within the basal Magothy Aquifer (**Figure 3-13**). Wells #2 (S-27070) and #3 (S-38735) are also screened into the basal Magothy Aquifer and Well #3 is actually screened into a sandy portion of the upper Raritan Clay. Due to the limited remaining depth, deepening or replacing these wells with deeper wells is not feasible and I/A OWTS installation is the recommended nitrogen reduction approach.

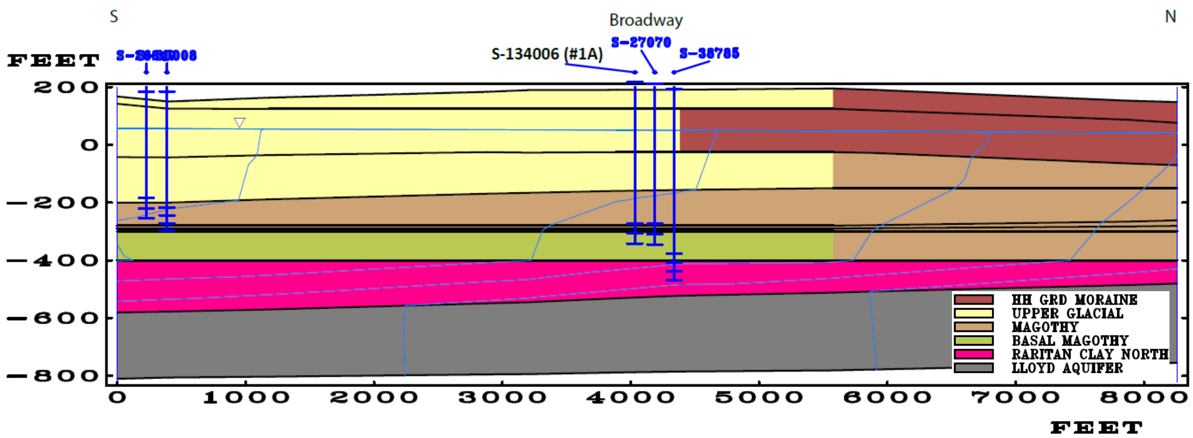

Figure 3-13 Cross Section through the SCWA Broadway Wellfield

3.4.1.1.3 Church Street (Northport) & Reservoir Avenue

Both supply wells for the Church Street (Northport) wellfield have exceeded 10 mg/L of nitrate in raw water samples throughout 2018 as has Reservoir Avenue Well #1A (**Figure 3-14**). While there is approximately 100 feet of aquifer below the Church Street wells, deepening or replacing these wells with deeper wells is not recommended. The Reservoir Avenue well is downgradient and deeper than the Church Street wells and since that is also impacted, deepening the Church Street wells is not anticipated to provide a benefit. The model simulated concentration from the Church Street (Northport) wellfield is approximately 9 mg/L, which is close to the observed concentration. However, the model simulated concentration at Reservoir Avenue Well #1A is approximately 4 mg/L, much lower than observed data. Observed data could reflect legacy land uses that loaded more nitrogen to the aquifer than existing conditions or the wellfield may have been pumping at a much higher rate historically.

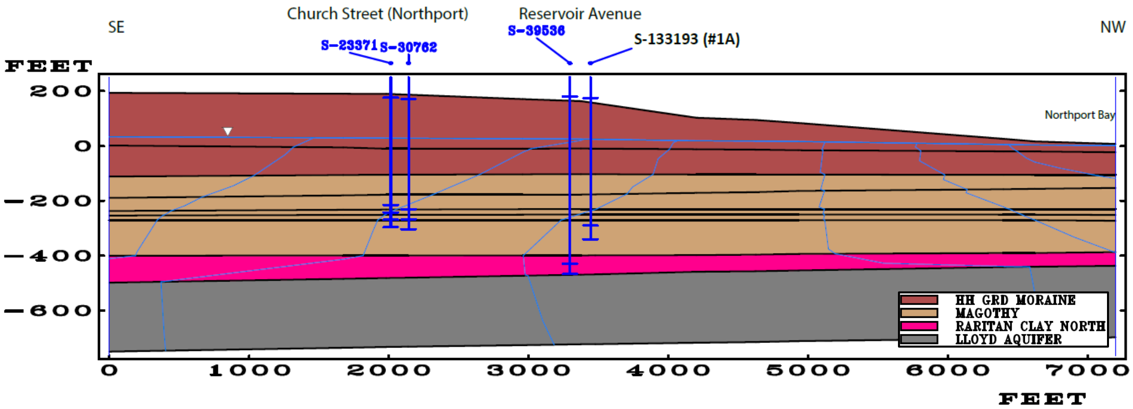

Figure 3-14 Cross Section through the SCWA Church Street (Northport) and Reservoir Avenue Wellfields

3.4.1.1.4 Commercial Boulevard

There are two wells screened within the middle portion of the Magothy Aquifer at SCWA's Commercial Boulevard wellfield (**Figure 3-15**). Although both wells are screened over a similar interval of the aquifer, only Well #2 was reported as exceeding the MCL of 10 mg/L. However, Well #3 is a seasonal well and operates at a fraction of the pumping rate of Well #2. Furthermore, the only sample that has exceeded nitrate is from the November 2018 sampling event. So, it seems as though nitrate is slowly increasing in this well and has only recently breached the 10 mg/L MCL threshold. It would be expected that Well #3 will soon follow suit. The wellfield has a simulated concentration of 5.36 mg/L at 50 years, much lower than 10 mg/L. However, simulated concentrations after 200 years approach 7 mg/L. It is likely that legacy land use is impacting water quality at this wellfield or a significant percentage of the homes within the contributing area are on cesspools (as opposed to septic systems).

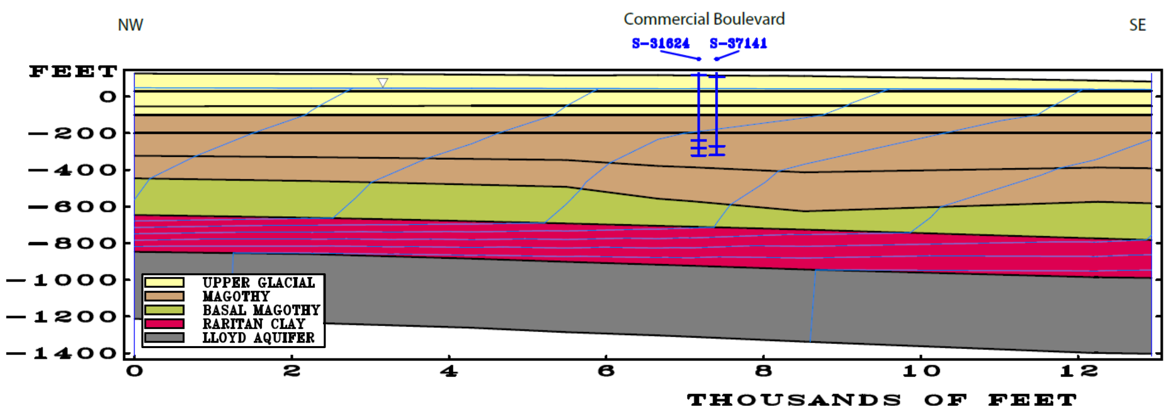

Figure 3-15 Cross Section through the SCWA Commercial Boulevard Wellfield

Although there are nearly 400 feet of Magothy Aquifer below these wells, there is a downward gradient in the aquifer so deepening these wells may only provide better water quality for a limited period of time. Deepening these wells is an option to I/A OWTS at this site. Prior to this being implemented however, additional hydrogeologic and water quality data are required.

3.4.1.1.5 Horseblock Road & Virginia Avenue

Supply wells installed at the Virginia and Horseblock Road wellfields are relatively shallow compared to other wells included in this analysis (**Figure 3-16**). Two of the three wells at the Horseblock Road wellfield have elevated nitrate levels, with Well #1 (S-46400) consistently exceeding 10 mg/L nitrate as nitrogen. There is significant (500-600+ feet) thickness of Magothy Aquifer beneath both wellfields and if the geology and water quality are conducive, deepening the wells or adding new wells is an option at these sites. Replacing Well #1 with a deeper well will likely shift the excessive nitrate to the other two shallow wells, although blending with deeper water may still provide a worthwhile benefit. Similarly, the two wells at the Virginia Avenue wellfield are screened at similar intervals, with Well #2 historically exceeding 6 mg/L nitrate as nitrogen. If well replacement is chosen, it is recommended that both wells be deepened into the Magothy Aquifer. Prior to this being implemented however, additional hydrogeologic and water quality data are required.

As these wells are shallow, should I/A OWTS be implemented within the well contributing areas (and Groundwater Priority Area), it is anticipated that nitrogen concentrations will decline, particularly for Horseblock Road as there is no confining unit present.

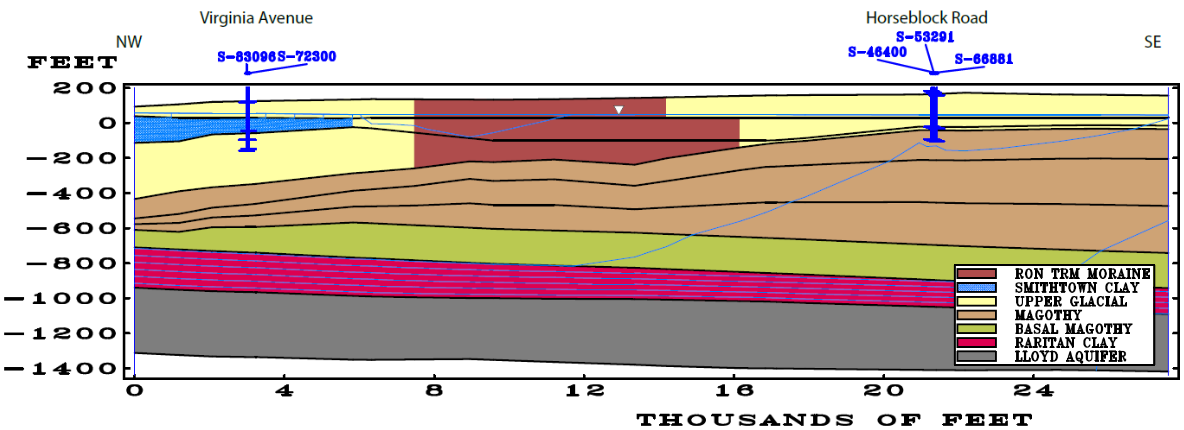

Figure 3-16 Cross Section through the SCWA Virginia Avenue and Horseblock Road Wellfields

3.4.1.1.6 Schuyler Drive

Although the most recent raw water concentrations (2018) have indicated that water quality at the Schuyler Drive wellfield does not exceed 10 mg/L of nitrate as nitrogen, model simulations indicate that Well #2 (S-23715) is at risk. SCWA data indicate that it has previously exceeded 10 mg/L (**Figure 3-17**), so this wellfield should be closely monitored. As shown on **Figure 3-17**, there are two wells within the upper glacial aquifer. There is significant thickness (approximately 400 feet) of Magothy Aquifer below these wells so replacing these wells with Magothy wells is an option, assuming the water quality is improved.

Replacing only Well #2, will likely leave Well #1 at risk, which historically has had much lower concentrations of nitrate. Assuming that the current treatment is to blend the raw water from the two wells, ultimately replacing only Well #2 may result in similar to current wellfield concentrations. As these wells are shallow, the best alternative may be to implement I/A OWTS within the Priority Area.

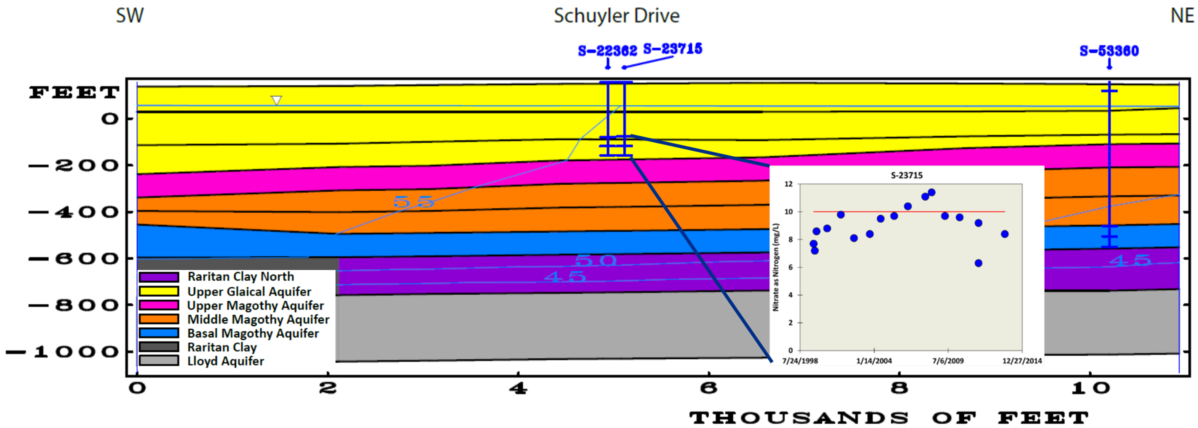

Figure 3-17 Cross Section through the SCWA Schuyler Drive Wellfield. Water quality data from SCWA

3.4.1.1.7 South Spur Drive and Middleville Road

Despite their depths, the South Spur Drive and Middleville Road wellfields have had elevated nitrogen concentrations for many years. The wells are screened just above or within a sandy portion of the Raritan Clay (**Figure 3-18**), so deepening these wells is not a viable nitrogen reduction option. Currently, SCWA operates a nitrate removal plant at South Spur Drive. The plant capacity is 1200 gallons per minute (gpm), or one third of the total wellfield capacity. While the plant removes all nitrate from the raw water (which is then blended with the untreated water to reduce nitrate), the waste brine is significant and challenging to dispose of cost effectively. This wellfield is discussed further in the Comprehensive Water Resources Management Plan (SCDHS, 2015; Task 8.3).

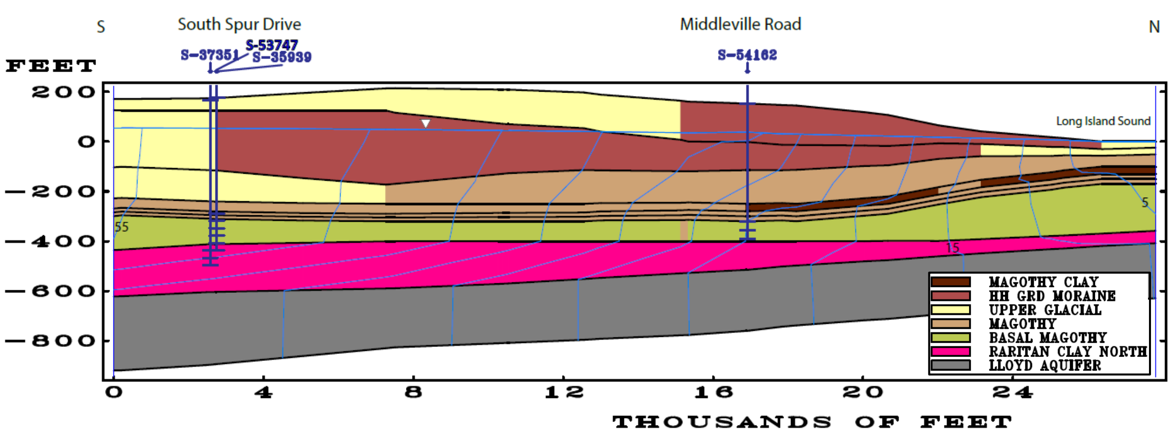

Figure 3-18 Cross Section through the SCWA South Spur Drive and Middleville Road Wellfields

The model simulates a concentration of 4.5 mg/L for Middleville Road #1. However, this wellfield is adjacent to the Middleville Road wellfield for North Shore VA Hospital where the model simulates elevated nitrogen (one well is simulated to exceed 10 mg/L and simulated concentrations in the other Magothy wells approach 10 mg/L).

Model simulations indicate that the two South Spur Drive wells do not exceed 3 mg/L, although the model simulation indicates that Well #3 exceeds 10 mg/L. It is likely that the discrepancy between the model output and observed conditions at South Spur Drive may be due to the differences in actual vs. simulated operational schemes at this wellfield.

As discussed in the Comprehensive Water Resources Management Plan (Comp Plan), the SCWA has evaluated various options to reduce the nitrogen at these wellfields including installing a major transmission main originating from a new wellfield located in Dix Hills to the south or potentially from the Wayne Court wellfield (**Figure 3-19**). However, as discussed in the Comp Plan, the Wayne Court alternative would be a short-term solution as nitrate concentrations at that location are also increasing over time. The capital cost of this new water main was estimated to be on the order of $1.4 million.

According to SCWA (as summarized in the Comp Plan), the longer water main that would run from Dix Hills would cost approximately $20.5 million for the water main alone (capital). Incorporating booster stations and additional wells would significantly increase that cost estimate. Another alternative evaluated by SCWA as part of the Comp Plan was pumping groundwater from the Pine Barrens. That project would involve installing nine wells within the Pine Barrens and installing a new 28-mile transmission main with three new booster pumping stations, primarily along the Long Island Expressway (**Figure 3-20**). The capital cost of the project was estimated at $51.5 million. In addition, the main from Dix Hills would also be required (as a connection point at the Long Island Expressway), so the cost would increase to at least $70 million. As this estimate is nearly 10 years old and additional booster pumps will likely be required, $70 million is considered a low-end estimate for this project. In addition, as discussed in the Comp Plan, pumping groundwater from the Pine Barrens has associated environmental (wetland) impacts and water quality (iron) issues that would need to be addressed.

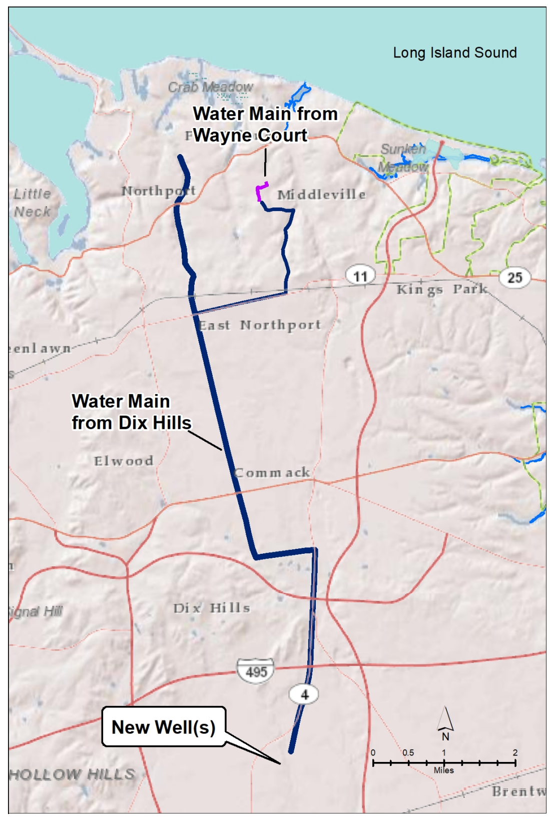

Figure 3-19 Potential New Water Mains Evaluated by SCWA for the Comprehensive Water Resources Management Plan (SCDHS, 2015).

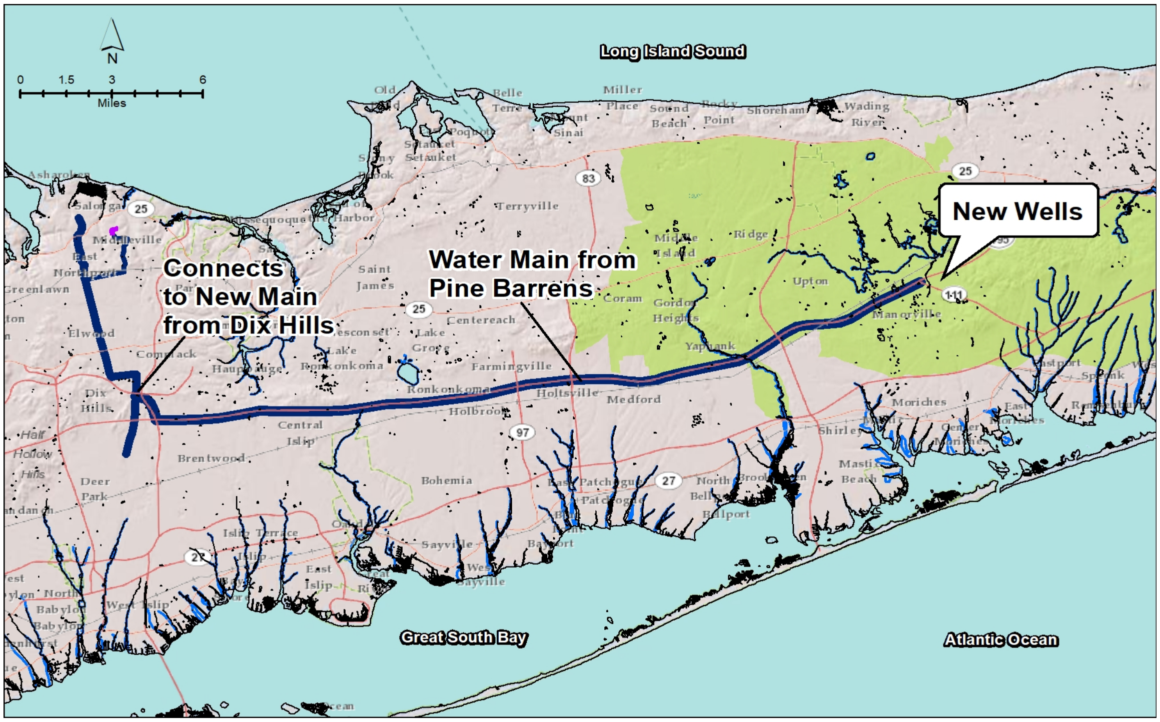

Figure 3-20 Potential New Water Mains for the Northport Area from the Pine Barrens Evaluated by SCWA for the Comprehensive Water Resources Management Plan (SCDHS, 2015).

3.4.1.2 Eastern Suffolk County Towns

Wells at three community water supply wellfields have exceeded 10 mg/L of nitrate as nitrogen in the eastern portion of the County: the Spinney Road wellfield in Southampton and the Browns Hills Road and Islands End wellfields in Southold.

3.4.1.2.1 Spinney Road

The Spinney Road wellfield is located in Southampton, north of Shinnecock Bay. There are four wells within the wellfield and well numbers 2 and 3 have exceeded 10 mg/L of nitrate in 2018. The cause of the nitrate exceedance is most likely related to agriculture as there is very little residential development within the contributing area to the wellfield and agricultural land use is prevalent (**Figure 3-21**).

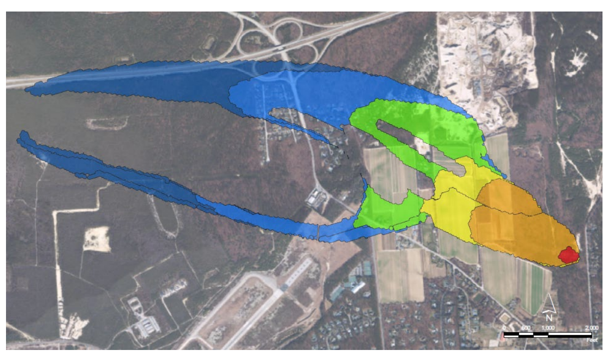

Figure 3-21 Simulated Water Table Contributing Area to the SCWA Spinney Road Wellfield

As the model simulated nitrogen concentration is less than 10 mg/L (the highest simulated concentration at this wellfield is 6.86 mg/L from Well 1; 6.05 mg/L from Well 2), it is likely that the agricultural fertilizer loading rate applied in the model is lower than historical fertilizer applications that are now being realized at the well.

Because there is little residential development within the wells' contributing area, implementing I/A OWTS would not significantly reduce nitrogen concentrations for the wellfield. While two of the wells (#3 and 4 or S-123249 and S-133227, respectively) are already screened into the Magothy, there is significant thickness (> 400 feet) of Magothy Aquifer beneath the wells (**Figure 3-22**). Replacing these wells with deeper wells could temporarily alleviate the nitrogen problem at this wellfield. However, the nitrogen sources should also be reduced.

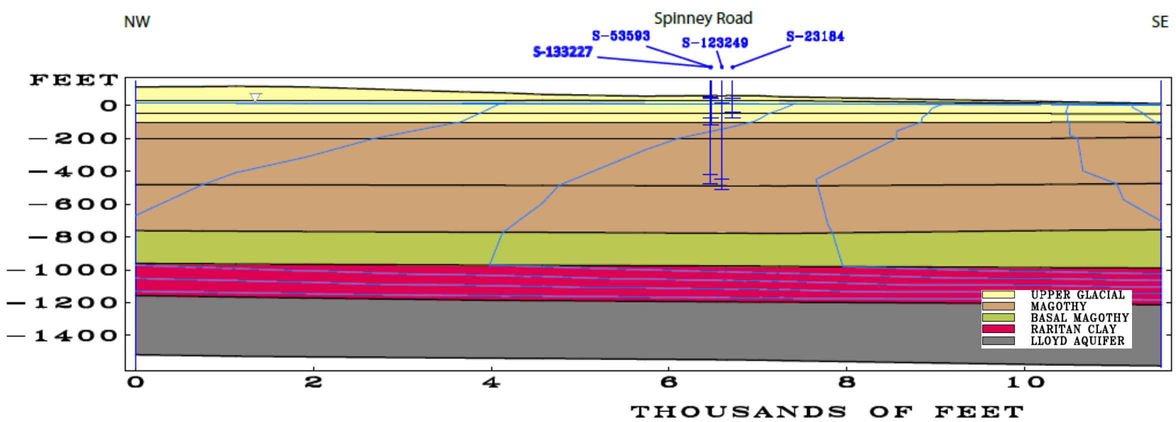

Figure 3-22 Cross Section through the SCWA Spinney Road Wellfield

3.4.1.2.2 Islands End & Browns Hills Road

The Islands End and Brown Hills Road wellfields are located on the North Fork, where the fresh aquifer is of limited thickness. There is little, if any, Magothy Aquifer with fresh groundwater. Therefore, deepening these wells is not a viable option. The wells have relatively low capacities compared to community supply wells to the west. For example, the Browns Hills Road wellfield has three wells, each having an authorized capacity of only 50 gpm.

The Browns Hills Road wellfield in Orient has had documented nitrogen problems for many years and residents served by that system currently utilize point of use (POU) treatment systems to remove nitrogen at a single tap within each residence. These systems are maintained and replaced by the SCWA when appropriate. The Browns Hills wellfield is surrounded by agricultural land. Therefore, installing I/A OWTS in this area will not completely resolve the nitrogen issue in this wellfield.

Similarly, the Island End wellfield is screened into the upper glacial aquifer and surrounded by agricultural (and golf) land uses. As shown on **Figure 3-23**, the wells are screened as deep as they can be, limited vertically by salt water and a lower clay unit at the base of the freshwater portion of the aquifer. As with the Browns Hills Road wellfield, installing I/A OWTS within the area will not completely resolve the elevated nitrogen concentrations in the Islands End wellfield.

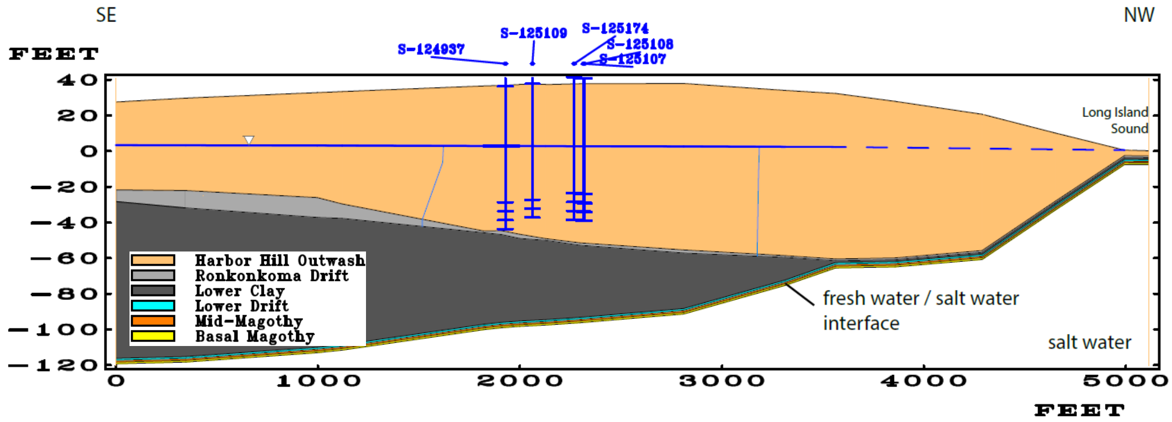

Figure 3-23 Cross Section through the SCWA Islands End Wellfield

Model simulated nitrogen concentrations at the Islands End wellfield range from 0.6 to 5.14 mg/L based on the nitrogen loading from fertilizer assigned in the model. It is likely that the actual historical fertilization of the surrounding agricultural parcels was higher, resulting in the higher observed nitrogen concentrations.

Wellfields that are impacted from agricultural activities and are limited by relatively thin freshwater thickness have limited options. While implementation of I/A OWTS will certainly reduce nitrogen to the aquifer and benefit private drinking water wells, they will be of little benefit to these two community water supply wellfields on the North Fork where elevated nitrogen concentrations have been observed.

The SCWA has indicated that the existing wells on the North Fork are capable of supplying potable water to the total existing population (SCDHS, 2009). However, thousands of residents would need to connect to the distribution system. In addition, because the Browns Hills Road wellfield has been impacted by nitrogen, a water main would need to be extended to the existing Browns Hills Road distribution system from East Marion (**Figure 3-24**). This project was evaluated by SCWA in 2009 and involves the installation of a 12-inch water main between East Marion the Browns Hills area in Orient. The main would transmit up to 500 gpm at an estimated cost of nearly $4 million.

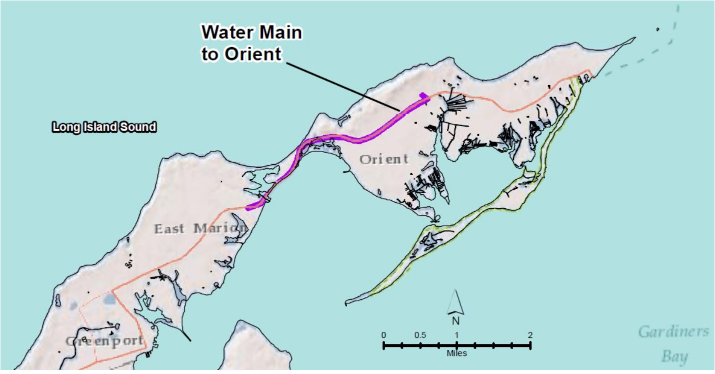

Figure 3-24 Potential Water Main Investigated by SCWA in 2009

The SCWA also investigated supplying the North Fork with groundwater from the Pine Barrens to supplement future population growth. This project would involve the installation of additional wells within the Pine Barrens to be pumped to the North Fork. The resulting transmission main is shown on **Figure 3-25** (modified from SCWA, 2009). The estimated cost of the project was $50 million.

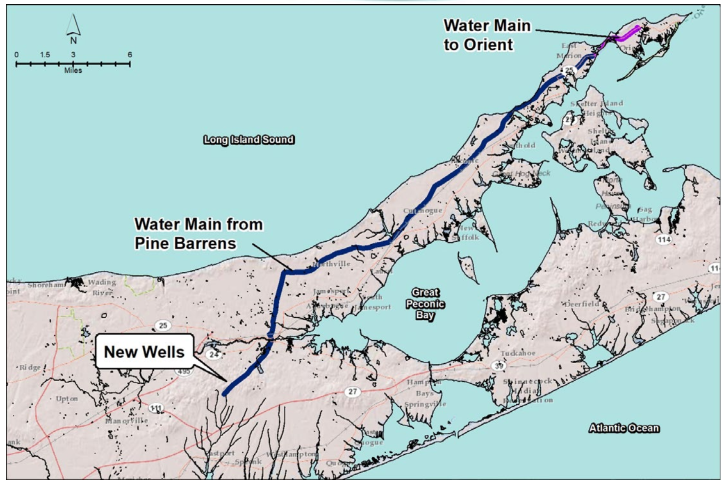

Figure 3-25 Potential Water Main to Orient Investigated by SCWA in 2009

Community water supply wells on the South Fork have not exceeded 10 mg/L of nitrogen as of 2018. Although more limited than the main body aquifer, the South Fork aquifer is thicker and there is less agriculture than on the North Fork so that installation of new wells is possible. Groundwater priority areas are primarily associated with private wells.

3.4.2 Nitrogen Reduction for Restoration/Protection of Private Water Supply Wells

Nitrogen management options for private supply wells include three options:

- Connection to community supply;
- Wellhead treatment, or
- Nitrogen reduction through wastewater management and fertilizer management.

SCDHS estimates that there are approximately 30,000 private wells in the eastern five towns. Although this represents the latest estimate based on SCDHS data, an analysis of actual locations of private wells on the East End has not recently been conducted. Assuming that the wells continue to be distributed among the five East End Towns as they were when last mapped in 2009 for the Comprehensive Water Resources Management Plan, the approximate number of private wells by Town is summarized in **Table 3-6**.

Table 3-6
Estimated Number of Private Wells within the Five East End Towns (2019)

Town	Private Residential Wells (Households): 2019
East Hampton	12,778
Riverhead	819
Shelter Island	2,366
Southampton	7,469
Southold	6,568
Total	**30,000**

A water demand analysis was also conducted for the Comp Plan, based on reported pumpage data. Water usage per capita varied by town, with Shelter Island having the lowest usage per capita (which is consistent with the strict irrigation and swimming pool water usage regulations within the Town). A summary of water usage per capita for the East End towns is shown on **Table 3-7**. The estimate for Riverhead was updated with the published value of water usage of 180 gallons per person per day which is listed in the Riverhead Water District 2018 Water District Newsletter (accessed online at: https://www.townofriverheadny.gov/pview.aspx?id=2492). Based on the Town-specific per capita demands and population based on the average of annual average census place data utilized in the nitrogen loading simulations (based on 2010 estimates, provided by the Suffolk County Planning Department) the water demand for private wells was calculated as shown on **Table 3-7**.

Table 3-7
Private Well Water Supply Demand

Town	Average Gallons Per Day Per Capita (gpcd)	Private Residential Wells (Households)	Persons per Household	Water Demand (mgd)
East Hampton	230	12,778	2.76	8.1
Riverhead	180	819	2.62	0.4
Shelter Island	92	2,366	2.42	0.5
Southampton	117	7,469	2.91	2.5
Southold	118	6,568	2.57	2.0

Installed capacity and peak monthly pumpage (2012-2013) for community supply wells included in the SWP are listed on **Table 3-8**. The summary on **Table 3-8** only includes the major water purveyors in the area including SCWA, Riverhead Water District and Hampton Bays Water District. Smaller community supplies, such as the ones on Shelter Island are not included. It is assumed minimal excess capacity exists for those purveyors.

Table 3-8
Approximate Remaining Capacity of Existing Water Supply Wells on the East End

Town	Installed Capacity (MGD)	Max Monthly Pumpage (MGD)[1]	Remaining Capacity (MGD)[2]
East Hampton	26.5	17.4	6.9
Riverhead	33.6	21.9	8.8
Southampton	78.7	44.1	26
Southold	12.1	6.7	4.1

1. Based on total monthly pumping. Daily pumpage was not available.
2. Assuming a run time of 18 hours.
3. Does not account for safe yield or redundancy.

As shown on the table, additional capacity is required for East Hampton, but installed capacity is sufficient for other towns. It is important to note that additional wells may still be needed for Southold as safe yield and redundancy and other regulatory restrictions based on run-time or water quality (e.g., conductivity or chloride levels) are not accounted for in this analysis. It is assumed that the system can handle the additional capacity without significant modification. Average permitted capacity per well in East Hampton is 473 gpm. In order to meet the demand requirements of connecting all private wells to community supply, 1.2 MGD of additional supply would be required, or two additional supply wells having a permitted capacity of 450 gpm. Additional costs would be incurred by the purveyor for treatment and booster pumps as needed.

Connection costs to the SCWA distribution system are estimated as summarized in **Table 3-9**.

Table 3-9 Estimated Connection Costs to Community Supply

Water Service Connection Costs	Cost ($)	Notes
Tapping fee	1,350	
Home connection		
New 1-inch tap	3,000	
Stub vault	1,050	
Water main surcharge (annual)	3,600	Average – varies significantly based upon area served
Total	**$5,400 - $9,000**	

The costs of installing a new water main are considerable and may be cost prohibitive for remote, sparsely populated areas. Installing new main in very remote areas may result in significantly higher costs. Connection costs vary considerably and can exceed $20,000 per household. In those instances, utilizing a private system may be the only feasible option, provided there is sufficient water and water quality is acceptable. Recommendations for managing nitrogen in private supply wells are provided below in Section 3.5.2.

3.4.2.1 Shelter Island

Shelter Island is primarily served by private wells. Although there are three water purveyors on the island (Dering Harbor, Shelter Island Heights and West Neck Water Supply), there is very limited fresh water available for community water supply. Stringent water use restrictions exist and water use for irrigation and swimming pools is very restricted. Expansion of the SCWA distribution to Shelter Island has been evaluated for years. SCWA recently acquired the Dering Harbor system and intends to install two new 50 gpm wells, but the island primarily remains on private wells.

For the purposes of this evaluation, it is assumed that most of Shelter Island will remain on private wells. There is little agriculture on Shelter Island, so groundwater nitrogen issues are due to on-site wastewater systems. Implementing I/A OWTS is the most viable alternative for water quality improvement to groundwater and private wells on Shelter Island.

3.5 Cost and Recommendations

3.5.1 Western Suffolk County Towns

Groundwater Priority Areas in the five western Suffolk County towns are based on community water supply wells that have exceeded 10 mg/L of nitrate as nitrogen or wells that should be closely monitored as they are at risk of doing so based upon model projections. While replacing shallow wells with deeper wells at three of the impacted wellfields is an option, it does not remedy the source of the problem. However, it is less expensive than implementing I/A OWTS throughout the contributing area and would provide a potential temporary solution that could reduce nitrogen levels while I/A OWTS are installed. It should be noted that while well replacement may be the less expensive option, source control is always the preferred long-term strategy for addressing groundwater contamination.

It is important to note that historic land uses are not evaluated in the SWP. Therefore, although replacing shallow wells with deeper wells has shown to be effective, water quality at depth has not been evaluated as part of this study and additional investigations would be required before well replacements are implemented.

Installation of deeper wells is not an option at several wellfields where wells are already deep such as the wellfields in Northport. Since installing a well(s) into the Lloyd Aquifer is not an option, SCWA would have to reconfigure pressure zones to bring water in from adjacent zones or transfer water from the Pine Barrens in order to provide an alternate water source. Because travel time from the water table to these wells is on the order of decades it will take decades before the benefits of implementing I/A OWTS are realized.

Alternatives and associated costs for nitrogen reduction at wells were nitrate in raw water samples has exceeded 10 mg/L are summarized in **Table 3-10**. Recommendations are marked with an asterisk. Recommendations for all areas included installation of I/A OWTS as a means to reduce the source of the nitrogen contamination. However, since it may take decades to realize the benefit of these systems at some of the wellfields, deepening the wells (after proper water quality investigations have been conducted) is identified as a temporary solution.

For the Northport area, drilling a well into the Lloyd Aquifer would be the most cost- effective remedy to reduce nitrogen concentrations. However, as that option has been explored and rejected by the NYSDEC, it remains infeasible at this time. In the meantime, the transmission main from the Wayne Court wellfield is recommended, assuming that the water quality from Wayne Court is suitable. Should that not be an option, the Dix Hills main should be further evaluated. While construction of the Pine Barrens main is technically feasible, it is the most costly and should be implemented as a last resort.

Table 3-10
Summary of Alternatives for Groundwater Priority Areas in Western Suffolk County

Study Area	GW Priority Area	Number of Parcels	Alternative	Cost ($M)
Jayne Boulevard	1	2,041	I/A OWTS*	40
Boyle Road (Port Jefferson)	2	2,017	I/A OWTS*	41
Broadway / South Huntington (Whitson)	2	3,091	I/A OWTS*	62
Horseblock	2	1,252	I/A OWTS*	25
			Well Replacement*	2
Northport (South Spur Dr, Middleville Rd., Church St, Reservoir Ave)	1	5,461	I/A Systems*	111
			Wayne Court Main*	2
			Dix Hills*	20+

CDM Smith

Study Area	GW Priority Area	Number of Parcels	Alternative	Cost ($M)
			Pine Barrens	70+
Commercial	1	398	I/A OWTS*	8
			Well Replacement*	2
Virginia Ave	1	877	I/A OWTS*	17
			Well Replacement*	2
Schuyler Drive	2	533	I/A OWTS*	11

Note: It is recommended that I/A OWTS be installed in all areas as the long-term solution for nitrogen reduction in community supply wells in the West End Towns.

3.5.2 Eastern Suffolk County

Although recent estimates indicate that there are 30,000 private wells in the eastern portion of the County, determining specific locations of private wells is beyond the scope of this study. Alternatives that have been evaluated for the East End private well areas are as follows:

- Convert existing septic systems on 30,000 private well sites to I/A OWTS;
- Connect the 30,000 private wells to public supply systems; or
- Provide wellhead treatment.

3.5.2.1 I/A OWTS

I/A OWTS implementation in the East End towns is planned in the Surface Water Priority Areas. These areas include a significant number of residential parcels with private wells and as these areas are slated for I/A OWTS implementation, they are excluded from the cost estimates for Groundwater Priority Areas. For example, of the approximate 52,800 developed parcels included within the Groundwater Priority Areas:

- 14,600 are included in Surface Water Priority Rank Area 1;
- 1,400 are included in Surface Water Priority Rank Area 2; and
- 14,400 are included in Surface Water Priority Rank Area 3.

Approximately 57 percent of the parcels within Groundwater Priority Rank Areas 1 and 2 are also included within Surface Water Priority Rank Areas 1, 2 and 3.

As the costs for I/A OWTS systems are based on lot size and depth to water, knowing which parcels utilize private wells would be helpful and would reduce some of the cost uncertainty with this analysis. In absence of these data, assumptions were made regarding lot size and depth to water for cost estimation purposes. Within Groundwater Priority Areas 1 and 2, there are approximately 50,000 residential parcels. Approximately 78 percent of those parcels have a depth to water of greater than 10 feet and only approximately 2 percent have an area less than or equal to 5,000 square feet. So, for I/A OWTS system costs, it is assumed that 78 percent of the parcels with private wells have a depth to water of greater than 10 feet and 2 percent are assumed to have an area of less than 5,000 square feet. Assumptions are shown on **Table 3-11**.

Table 3-11
Assumed Private Well Residential Wells on the East End

Town	Private Residential Wells (Households)	Depth to Water > 10 feet		Depth to Water < 10 feet	
		Area < 5000 sf	Area > 5000 sf	Area < 5000 sf	Area > 5000 sf
East Hampton	12,778	199	9,768	56	2,755
Riverhead	819	13	626	4	177
Shelter Island	2,366	37	1,809	10	510
Southampton	7,469	117	5,708	33	1,610
Southold	6,568	102	5,021	29	1,416

A summary of I/A OWTS installation costs is shown on **Table 3-12**. Due to the overlap with Surface Water Protection Areas, an approximate cost for Groundwater Priority Areas only would be 43 percent of the costs.

Table 3-12
Approximate Cost to Install I/A Systems within Residential Parcels on the East End in Groundwater Priority Areas 1 and 2

Town	Private Residential Wells (Households)	Depth to Water > 10 feet		Depth to Water < 10 feet		Total Cost ($M)
		Area < 5000 sf	Area > 5000 sf	Area < 5000 sf	Area > 5000 sf	
		Cost ($M)				
East Hampton	12,778	4.43	190.23	2.26	72.69	**269.61**
Riverhead	819	0.29	12.19	0.16	4.67	**17.31**
Shelter Island	2,366	0.82	35.23	0.40	13.46	**49.91**
Southampton	7,469	2.61	111.18	1.33	42.48	**157.6**
Southold	6,568	2.27	97.78	1.17	37.36	**138.58**
Total	**30,000**	**10.42**	**446.61**	**5.32**	**170.66**	**633.01**

There are approximately 2,700 non-residential, but developed, parcels within Groundwater Priority Rank Areas 1 and 2 (commercial, industrial, institutional). Installing I/A OWTS systems at non-residential parcels will improve water quality, but it is not clear which non-residential parcels are connected to potable supply. Regardless of the source of potable water, the cost of converting existing septic systems or cesspools to I/A OWTS is shown on **Table 3-13**. Although these conversions may not be needed to protect the water supply of a particular establishment, conversions to I/A OWTS will improve water quality downgradient of the parcel and provide benefit for downgradient private supply wells.

Table 3-13
Approximate Cost to Install I/A OWTS for Developed, Non-Residential Parcels on the East End within Groundwater Priority Areas 1 and 2

Town	Groundwater Priority Area		Total Cost ($M)
	1 ($M)	2 ($M)	
East Hampton	20.80	4.88	**25.68**
Riverhead	0.00	6.32	**6.32**
Shelter Island	2.62	0.00	**2.62**
Southampton	16.01	14.11	**30.12**
Southold	8.58	13.12	**21.7**
Total	**48.01**	**38.43**	**86.44**

Note: Costs shown are capital costs and do not include operation and maintenance.

3.5.2.2 Connection to Community Water Supply

Connecting to public supply is one alternative to I/A OWTS installation. In many instances, the water main is in place and a connection to the water main is simple and only involves a tap at a particular residence. In other instances, if a parcel is outside of the existing water supply distribution zone, new water mains would be required, which would significantly increase the cost and effort of connection. Furthermore, additional wells may be required, as in East Hampton.

Connecting Shelter Island to the SCWA system would require installing a transmission main across Shelter Island Sound and modification of the SCWA distribution system. As this option has been previously evaluated by others and has not moved forward, it is assumed that Shelter Island will remain on private wells along with the limited community supply that already exists on the island.

To develop a cost estimate for this alternative, the number of sites within the distribution area need to be determined. It is assumed that if a parcel is within a distribution area, a simple connection to the distribution system can be established and the cost would be approximately $5,900 per connection (see connection fees in Section 3.4.2). However, for parcels that are outside the service area, new mains are required. For those parcels, it is assumed that an average connection cost of $9,500 would be applied plus a 5-year main surcharge of $3,600 per year. A GIS exercise was conducted to approximate parcels within and outside of existing community distribution systems as follows:

- The number of developed (County land uses 1-6) parcels within Groundwater Priority Rank Areas 1 and 2 was determined;
- The parcels were then filtered to those within community water supply distribution areas;
- The remaining parcels outside of community water supply distribution areas were all assumed to use private wells (summarized on **Table 3-14**);
- The remaining private wells were considered as private wells within community water supply distribution areas (e.g., for costing purposes, a connection was assumed, no water main extension would be required); this is shown on **Table 3-15**.

Table 3-14
Developed Parcels with Private Wells by Town within Groundwater Priority Areas 1 and 2 and Outside of Community Supply Distribution Areas

Land Use	East Hampton		Riverhead		Southampton		Southold	
	1	2	1	2	1	2	1	2
Low Density Residential	495	207	0	0	65	704	261	299
Medium Density Residential	2729	523	0	0	137	952	590	728
High Density Residential	192	82	0	0	19	55	26	588

Table 3-15
Developed Parcels with Private Wells within Existing Distribution Areas by Town within Groundwater Priority Areas 1 and 2

Land Use	East Hampton		Riverhead		Southampton		Southold	
	1	2	1	2	1	2	1	2
Low Density Residential	1132	349	0	0	234	374	398	67
Medium Density Residential	5021	1154	0	0	2500	1763	2270	1168
High Density Residential	717	177	0	0	425	241	175	0

Installing I/A OWTS systems on non-residential parcels will improve water quality, but it is not clear which non-residential parcels are connected to public supply. These other land uses may require more costly connections larger than 1-inch. For the purposes of this evaluation, it was assumed that non-residential land uses are connected to community supply. Capital costs to connect residential users on private wells to public supply are summarized below in **Table 3-16.**

Table 3-16
Estimated Capital Costs to Connect Residential Parcels to Public Supply by Town within Groundwater Priority Areas 1 and 2

Land Use	East Hampton		Riverhead		Southampton		Southold		Total	
	1	2	1	2	1	2	1	2	1	2
Low Density Residential ($M)	11.40	4.04	0.02	1.08	2.01	8.91	4.84	3.25	**18.27**	**17.29**
Medium Density Residential ($M)	55.57	11.80	0.02	5.96	16.07	19.46	19.02	13.82	**90.67**	**51.04**
High Density Residential ($M)	6.07	1.84	0.02	0.79	2.71	1.96	1.30	5.59	**10.09**	**10.19**
Total Residential Cost ($M)	**75.04***	**17.68**	**0.05**	**7.83**	**20.79**	**30.34**	**29.15***	**22.67**	**123.04**	**78.52**

*An additional $2 million was added for two new water supply wells in East Hampton and $4 million for a new water main between East Marion and Orient.

3.5.2.3 Treatment for Private Wells

Households that utilize private wells may have treatment systems installed to remove contamination. Household treatment systems are either point of use (POU) systems, in which treatment systems are localized to particular taps, or point of entry (POE) systems in which all water entering the home is treated (also referred to as "whole house" treatment systems). An example of a point of use system would be a system installed on a kitchen sink (water filters on faucets, for example) so that water used for drinking and cooking is treated. Point of entry systems are typically installed after the storage tank.

Suffolk County Standards for Private Wells require POE systems for removal of most contaminants including iron, manganese, chloride, VOCs, and aldicarb residues. Treatment for nitrate can be accomplished using a POU system, but the system must be capable of providing a minimum of 10 gpm of treated water. Household systems typically use granular activated carbon (GAC) for VOC removal and reverse osmosis (RO) systems for nitrate and/or chloride removal, although ion exchange systems are also utilized. Treatment technologies approved by SCDHS are listed in **Table 3-17**.

Household treatment systems are not regulated or maintained by any particular agency or other institution and operation and maintenance of the household treatment units are the sole responsibility of the home owner. Without routine inspection and maintenance, these systems may not perform as designed and may not provide effective treatment.

Table 3-17
Approved Water Treatment Technologies for Various Contaminants (from SCDHS, 1992)

Water Quality Issue	Concentration (mg/L)	Approved Treatment Technology
Iron	0.3 to 0.99	1,2,3,4
	1.0 – 5.0	2,3,4
Manganese	0.3 to 0.99	1,2,3
	1.0 – 5.0	2,3
Iron + Manganese	0.3 to 0.99	1,2,3
	1.0 – 5.0	2,3
Nitrate	10 – 20	5,6
Chloride	>250	6
VOCs or aldicarb	Exceeding MCL	7

Treatment Technology Key:

1. Polyphosphate feeder
2. Ion exchange
3. Potassium permanganate/filtration
4. Oxidation/filtration
5. Distillation
6. Reverse osmosis
7. Granular activated carbon

Costs of POE or POU treatment can vary widely. A summary of various costs can be found online at waterfiltercomparisons.com. For the purposes of this analysis, an approximate cost estimate was obtained online from a vendor and assumes the following:

- Whole House Treatment System (4-6 bathrooms): $2,300
- Nitrate Water Filter (POE; 4-6 bathrooms): $2,100

It is assumed that a system has a capital cost of $4,400.

Typical operation and maintenance of these systems requires media replacement and ultraviolet (UV) bulb replacement (if the POE system includes UV). Maintenance costs can vary greatly depending on if the homeowner conducts the maintenance or has a professional service the system. If a homeowner conducts the maintenance, it is anticipated that the annual cost would be approximately $1,000. However, costs can be more than $6,000 if a professional conducts routine maintenance (as quoted by SCWA in the Suffolk County Water Resources Management Plan, based on the Browns Hills System). Costs are presented on **Table 3-18**.

Table 3-18
Estimated Costs for POE/POU Systems on all Private Wells on the East End

Town	Private Residential Wells (Households)	POE/POU Treatment Cost ($M)	20 Year O&M Cost ($M)	Total Cost ($M)
East Hampton	12,778	56.22	255.56	**314.34**
Riverhead	819	3.60	16.38	**20.15**
Shelter Island	2,366	10.41	47.32	**58.20**
Southampton	7,469	32.86	149.38	**183.74**
Southold	6,568	28.90	131.36	**161.57**
Total	**30,000**	132	600	**738**

Overall, the capital costs between I/A OWTS implementation and provision of public supply to address nitrogen contamination are similar. Assuming I/A OWTS are installed as part of the Surface Water Priority Area implementation, costs to complete the Groundwater Priority Areas would approximately be 43 percent of the total cost, or $272 million. A very preliminary estimate of the cost to connect homes currently served by private wells to public supply would be approximately $223 million. Installing POE/POU systems may initially be the least expensive alternative, although operation and maintenance of these systems is costly and without proper maintenance (filter replacements, etc.) they will not function as intended.

Connecting private wells to public supply has other benefits (protection against pesticides and other contaminants in addition to nitrogen), but there may be some adverse impacts. Due to the limited freshwater availability on the North Fork, pumping an additional two mgd from the aquifer should be spread out and focused in western portions of the Fork where the aquifer is thicker. Salt-water intrusion is a potential, particularly if the additional pumpage is centralized to wells on the east end of the Fork. Wells would need to be located where nitrogen levels in the aquifer are low. Installing wells and pumping from the Pine Barrens is a viable alternative that would reduce risk to salt-water intrusion. The cost of this alternative is high, however, particularly if treatment for iron and manganese is required.

It is recommended that the I/A OWTS be implemented in the Groundwater Protection Areas as the best long-term option. Without source reduction, treatment for nitrogen removal may be required at the community supply wells. One of the goals identified in the Comp Water Plan is that community water supply should be available to all Suffolk County residents. Homes currently using private wells that are within the SCWA, Hampton Bays and Riverhead Water Districts should be encouraged to connect to the community supply systems. Residents with private wells are strongly encouraged to have their water tested by the SCDHS to support the decision- making process. If community water supply is not readily available, installation of POE/POU systems is recommended for any private well that currently exceeds New York State drinking water standards. Residents who do not wish to connect to public supply should utilize POE/POU treatment as necessary.

3.6 Contaminants of Emerging Concern

As documented in the Comp Water Plan and Section 1.1.4 of this SWP, more advanced and sensitive analytical techniques have been developed that allow the detection of increasingly lower concentrations of contaminants in the environment. As these methods have evolved, additional contaminants, previously not known to exist in the environment, are being found every day. These contaminants of concern that can be found in wastewater are often referred to as Contaminants of Emerging Concern (CECs) and include compounds such as pharmaceuticals and personal care products (PPCPs), 1,4-Dixoane, and perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA), also known as PFAS (per- and polyfluoroalkyl substances). PPCPs include a broad range of products such as prescription and over the counter drugs, including antibiotics, veterinary and illicit drugs, fragrances, sun-screen products, cosmetics, some detergents, some food and drink additives, trace plasticizers that contaminate the consumer products and all of their respective metabolites and transformation products. Many are used and released to the environment in large enough quantities such that low levels are detected in wastewaters and receiving waters. As most pharmaceuticals are designed to be water soluble, and to be persistent long enough to serve their designated therapeutic purposes, they can be continuously introduced into the environment by sewage treatment plants and by on-site wastewater disposal systems in unsewered areas.

To protect the aquifer system and drinking water from CECs, Suffolk County is working together with SBU CCWT, SCWA, USGS, NYSDEC, and the Long Island Commission for Aquifer Protection to evaluate CEC occurrence, CEC removal by existing technologies and to identify needs for the development of new technologies. Recommendations to address CECs may be found in Section 8.4.4 of this SWP.

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Section 3 Tables

Table 3-3 Required Sanitary Nitrogen Load Reductions – Existing Land Use

Water Supplier	Wellfield	Normalized Equilibrium Nitrogen Concentration after 50 Years (1) (mg/L)	Sanitary Nitrogen Load Reduction Required to Achieve 4 mg/L (2) (%)
SCWA	Wicks Rd	4.02	0%
Hampton Bays Water District	Well 4-2	4.05	1%
SCWA	Harvest Ln	4.10	3%
South Huntington Water District	Amityville Road	4.11	3%
Hampton Bays Water District	Ponguogue Ave	4.14	3%
SCWA	Morris Ave	4.19	5%
SCWA	Meehan Ln	4.21	5%
SCWA	Blue Spruce Ln	4.23	6%
SCWA	Blue Point Rd	4.24	6%
SCWA	Islands End	4.26	6%
SCWA	Laurel Hill Rd	4.36	8%
SCWA	Astor Ave	4.38	9%
SCWA	Eastwood Blvd	4.44	10%
SCWA	Capitol Ct	4.46	10%
SCWA	Oval Dr	4.56	12%
SCWA	West Prospect St	4.63	14%
SCWA	Church St Hol	4.70	15%
SCWA	Ruth Blvd	4.79	16%
SCWA	Jayne Blvd	4.92	19%
SCWA	Brecknock Hall	4.95	19%
SCWA	Fairmont Ave	4.95	19%
SCWA	Horseblock Rd	4.96	19%
SCWA	Kings Park Rd	4.97	20%
SCWA	Evergreen Dr	5.02	20%
SCWA	Evergreen Dr	5.02	20%
SCWA	Inlet Dr	5.04	21%
SCWA	Inlet Dr	5.04	21%
SCWA	Pierson St	5.08	21%
SCWA	Flanders Rd	5.09	21%
SCWA	Mayfair Dr	5.14	22%
SCWA	Knight St	5.15	22%
Dix Hills Water District	Vanderbilt Pkwy	5.22	23%
SCWA	Wheat Path	5.32	25%

Table 3-3 Required Sanitary Nitrogen Load Reductions – Existing Land Use

Water Supplier	Wellfield	Normalized Equilibrium Nitrogen Concentration after 50 Years [1] (mg/L)	Sanitary Nitrogen Load Reduction Required to Achieve 4 mg/L [2] (%)
SCWA	Commercial Blvd	5.36	25%
SCWA	Hurtin Blvd	5.49	27%
Hampton Bays Water District	Ponquogue Ave	5.51	27%
SCWA	Farrington Rd	5.55	28%
SCWA	Schuyler Dr	5.74	30%
SCWA	Lincoln Ave	5.92	32%
Greenlawn Water District	Burr Rd	5.95	33%
SCWA	Sy Ct	6.02	34%
Dix Hills Water District	Ryder Ave	6.14	35%
South Huntington Water District	Whitson Rd	6.16	35%
South Huntington Water District	Wolf Hill Rd	6.46	38%
SCWA	Mckay Rd	6.52	39%
SCWA	Boyle Rd South	6.56	39%
SCWA	Douglas Ave	6.60	39%
Greenlawn Water District	Pulaski Rd	6.63	40%
SCWA	Virginia Ave	6.90	42%
SCWA	Brook Ave	6.91	42%
SCWA	South Spur Dr	7.18	44%
SCWA	Woodchuck Hollow Rd	7.31	45%
SCWA	Hollywood Pl	7.52	47%
SCWA	Boyle Rd North	8.47	53%
SCWA	Waterside Rd	8.81	55%
McCarren Water Supply	Oakbeach Rd (Edward McCarren)	8.87	55%
SCWA	Broadway	8.90	55%
SCWA	Church St Npt	8.98	55%
SCWA	Race Ave	15.77	75%
Riverhead Water District	Well 12-1	17.83	78%
Camp Quinipet	Camp Quinipet	26.49	85%
SCWA	Browns Hills Rd	31.69	87%
SCWA	Stem Ln	3.98	N/A
SCWA	Kayron Dr	3.97	N/A
Greenlawn Water District	Huntsman La	3.95	N/A
Hampton Bays Water District	Old Riverhead Road	3.83	N/A
SCWA	Third Ave	3.78	N/A
SCWA	Plymouth St	3.68	N/A

Table 3-3 Required Sanitary Nitrogen Load Reductions – Existing Land Use

Water Supplier	Wellfield	Normalized Equilibrium Nitrogen Concentration after 50 Years (1) (mg/L)	Sanitary Nitrogen Load Reduction Required to Achieve 4 mg/L (2) (%)
SCWA	Flower Hill Rd	3.65	N/A
SCWA	Belle Terre Rd	3.65	N/A
Dix Hills Water District	Caledonia Rd	3.64	N/A
SCWA	Samuel St	3.62	N/A
SCWA	Crystal Brook Hollow Rd	3.60	N/A
SCWA	Middleville Rd	3.60	N/A
SCWA	Liberty St	3.60	N/A
SCWA	Bay Shore Rd	3.59	N/A
SCWA	Middle Rd Southold	3.58	N/A
SCWA	Meade Dr	3.48	N/A
SCWA	Edgewood Ave St. James	3.45	N/A
Greenlawn Water District	Wicks Road	3.43	N/A
SCWA	Bicycle Path	3.43	N/A
SCWA	Oak St	3.42	N/A
SCWA	Peconic St	3.37	N/A
SCWA	Gun Club Rd	3.36	N/A
SCWA	Harbor Rd	3.35	N/A
SCWA	Bridgehampton Rd	3.35	N/A
SCWA	Hawkins Rd	3.33	N/A
Riverhead Water District	Middle Road	3.30	N/A
SCWA	Flamingo Ave	3.28	N/A
SCWA	Blank Ln	3.26	N/A
SCWA	Church St Boh	3.20	N/A
Riverhead Water District	RWD Boy Scout Camp- WR Manorville Rd (Hi-zone)	3.18	N/A
Hampton Bays Water District	Jones Rd/Montauk	3.16	N/A
SCWA	Boyle Rd Port Jeff	3.14	N/A
SCWA	Dare Rd	3.10	N/A
SCWA	South Howell Ave	3.09	N/A
SCWA	Fairmount Ave	3.09	N/A
SCWA	Barton Ave	3.07	N/A
SCWA	Old Dock Rd	3.07	N/A
Greenlawn Water District	Buttercup La	3.06	N/A
SCWA	Long Springs Rd	3.05	N/A
SCWA	South Fulton St	3.05	N/A
SCWA	Bob Dassler Wellfield	2.94	N/A
SCWA	Harbor Walk	2.92	N/A

Table 3-3 Required Sanitary Nitrogen Load Reductions – Existing Land Use

Water Supplier	Wellfield	Normalized Equilibrium Nitrogen Concentration after 50 Years (1) (mg/L)	Sanitary Nitrogen Load Reduction Required to Achieve 4 mg/L (2) (%)
Greenlawn Water District	Manor Road	2.87	N/A
SCWA	Jennings Rd	2.85	N/A
SCWA	New York Ave	2.83	N/A
SCWA	Railroad Ave	2.83	N/A
SCWA	Pleasant Ave	2.81	N/A
South Huntington Water District	Oakwood Rd	2.81	N/A
SCWA	Carlson Ave	2.81	N/A
SCWA	Peconic Ave Medford	2.81	N/A
SCWA	Pier Ave	2.80	N/A
SCWA	College Rd	2.77	N/A
SCWA	Henry Clay Dr	2.74	N/A
SCWA	Washington St	2.73	N/A
SCWA	Nicolls Rd	2.68	N/A
SCWA	Hallock Ave	2.66	N/A
Greenlawn Water District	Elmo Pl	2.61	N/A
SCWA	Maple Ave	2.61	N/A
SCWA	Spring Close Hwy	2.57	N/A
SCWA	Wheeler Rd	2.56	N/A
SCWA	Reservoir Ave	2.55	N/A
SCWA	Locust Dr	2.55	N/A
SCWA	North Magee St	2.49	N/A
SCWA	Industry Ct	2.48	N/A
SCWA	Malloy Dr	2.48	N/A
SCWA	August Rd	2.48	N/A
SCWA	Walter Ct	2.42	N/A
SCWA	Lawrence Rd	2.42	N/A
SCWA	Foxcroft Ln	2.41	N/A
SCWA	Water Rd	2.40	N/A
South Huntington Water District	Downs Rd	2.38	N/A
SCWA	Bay Dr	2.37	N/A
South Huntington Water District	Walt Whitman Rd	2.36	N/A
Greenlawn Water District	Clay Pitts Rd	2.34	N/A
Dix Hills Water District	Carlls Strt Path	2.31	N/A
SCWA	East Forks Rd	2.26	N/A
SCWA	Daniel Webster Dr	2.25	N/A

Table 3-3 Required Sanitary Nitrogen Load Reductions – Existing Land Use

Water Supplier	Wellfield	Normalized Equilibrium Nitrogen Concentration after 50 Years (1) (mg/L)	Sanitary Nitrogen Load Reduction Required to Achieve 4 mg/L (2) (%)
South Huntington Water District	Gwynne Rd	2.19	N/A
SCWA	Patchogue-Yaphank Rd	2.18	N/A
South Huntington Water District	Rivendale Court	2.08	N/A
SCWA	Development Dr.	2.06	N/A
South Huntington Water District	W Rogues Path	2.04	N/A
SCWA	Spinney Rd	1.98	N/A
SCWA	Lafayette Rd	1.98	N/A
SCWA	Fisher Ave	1.97	N/A
SCWA	Fish Rd	1.94	N/A
SCWA	Ackerly Pond Ln	1.93	N/A
SCWA	American Blvd	1.93	N/A
SCWA	St Johnsland Rd	1.92	N/A
SCWA	Old North Rd	1.91	N/A
SCWA	Scuttlehole Rd	1.91	N/A
SCWA	Sunrise Hwy	1.90	N/A
SCWA	Flint Ln	1.90	N/A
SCWA	Mill Ln Peconic	1.90	N/A
SCWA	Bellmore Ave	1.90	N/A
SCWA	Town Line Rd Nesconset	1.84	N/A
SCWA	Broadhollow Rd	1.83	N/A
SCWA	Kennys Rd	1.83	N/A
SCWA	Accabonac Rd	1.80	N/A
SCWA	Laurel Hill Rd	1.80	N/A
SCWA	Shady Ln	1.77	N/A
SCWA	Rocky Point Rd	1.76	N/A
SCWA	Herricks Ln	1.73	N/A
SCWA	Elwood Rd	1.70	N/A
SCWA	Cross Hwy	1.70	N/A
SCWA	Greenbelt Pkwy	1.69	N/A
SCWA	Division St	1.67	N/A
Calverton Hills Owners Assn	Toppings Path	1.66	N/A
SCWA	Middle Rd Peconic	1.61	N/A
SCWA	Falcon Dr	1.61	N/A
SCWA	Wyandanch Ave	1.60	N/A
SCWA	Bailey Rd	1.60	N/A
SCWA	Middle Country Rd	1.58	N/A

Table 3-3 Required Sanitary Nitrogen Load Reductions – Existing Land Use

Water Supplier	Wellfield	Normalized Equilibrium Nitrogen Concentration after 50 Years [(1)] (mg/L)	Sanitary Nitrogen Load Reduction Required to Achieve 4 mg/L [(2)] (%)
SCWA	Edgemere Road	1.58	N/A
SCWA	Sag Harbor Tpke	1.57	N/A
SCWA	Gordon Ave	1.56	N/A
SCWA	Chestnut St	1.52	N/A
Greenlawn Water District	Park Ave	1.52	N/A
SCWA	Oakview Hwy	1.51	N/A
SCWA	Forty-First St	1.50	N/A
SCWA	Tenety Ave	1.48	N/A
SCWA	County Rd 31	1.47	N/A
SCWA	Gus Guerrera	1.47	N/A
SCWA	Quogue-Riverhead Rd	1.47	N/A
SCWA	Strathmore Ct Dr	1.45	N/A
SCWA	Tuckahoe Rd	1.44	N/A
SCWA	William Floyd Pkwy	1.40	N/A
SCWA	County Rd 111	1.39	N/A
SCWA	West Neck Rd	1.35	N/A
SCWA	West Neck Rd	1.35	N/A
Hampton Bays Water District	Well 4-1	1.34	N/A
SCWA	Sunken Meadow State Park	1.34	N/A
Brookhaven National Labs	Well #10	1.34	N/A
Greenlawn Water District	Jericho Tpke	1.33	N/A
South Huntington Water District	Cottontail Rd.	1.30	N/A
SCWA	Roses Grove Rd	1.29	N/A
SCWA	Sound Ave	1.28	N/A
Hampton Bays Water District	Not Specified	1.25	N/A
SCWA	Country Club Dr	1.25	N/A
SCWA	Cornell Dr	1.23	N/A
Dix Hills Water District	Deer Park Ave	1.23	N/A
SCWA	North Rd	1.22	N/A
SCWA	Central Walk (Fhbr)	1.19	N/A
SCWA	Bellrose Ave	1.19	N/A
Shelter Island Heights Association	North Ferry Wellfield	1.14	N/A
SCWA	Mud Rd	1.13	N/A
SCWA	Town Line Rd East Hampton	1.13	N/A

Table 3-3 Required Sanitary Nitrogen Load Reductions – Existing Land Use

Water Supplier	Wellfield	Normalized Equilibrium Nitrogen Concentration after 50 Years [1] (mg/L)	Sanitary Nitrogen Load Reduction Required to Achieve 4 mg/L [2] (%)
SCWA	Station Rd	1.12	N/A
SCWA	The Long Way	1.12	N/A
SCWA	Adams Ave	1.11	N/A
SCWA	North Washington Ave	1.08	N/A
SCWA	Helme Ave	1.08	N/A
SCWA	Mt Sinai-Coram Rd	1.04	N/A
SCWA	Sunset Dr	1.02	N/A
SCWA	Sunset Dr	1.02	N/A
SCWA	Tower St	1.01	N/A
SCWA	North Country Rd	1.00	N/A
SCWA	Sherry Dr	0.98	N/A
Shelter Island Chalets	Shelter Island Chalets	0.98	N/A
SCWA	Carrol St	0.94	N/A
SCWA	Center Walk	0.91	N/A
SCWA	Mt Sinai-Coram Rd South	0.90	N/A
SCWA	Edison Dr	0.90	N/A
Seaview Water Company	Seaview	0.87	N/A
Shelter Island Heights Association	New York Avenue Wellfield	0.86	N/A
SCWA	Mill Ln Huntington	0.84	N/A
SCWA	Edge Of Woods Rd	0.84	N/A
Dix Hills Water District	Dix Hills Park/ Vanderbilt Pkwy	0.83	N/A
SCWA	Moriches-Riverhead Rd	0.80	N/A
SCWA	Wayne Ct	0.79	N/A
SCWA	Old Country Rd	0.77	N/A
SCWA	Tower Hill Rd	0.77	N/A
SCWA	Oak Ave	0.76	N/A
SCWA	Daly Rd	0.76	N/A
SCWA	Lambert Ave Mastic	0.75	N/A
SCWA	Lumber Ln	0.75	N/A
Dix Hills Water District	Elkland Rd	0.75	N/A
SCWA	Circle Dr	0.74	N/A
Brookhaven National Labs	Well #7	0.73	N/A
SCWA	Gazza Blvd	0.73	N/A
Riverhead Water District	Northville Turnpike, Plant 17	0.72	N/A
Riverhead Water District	Sound Ave and Phillips	0.71	N/A
SCWA	Albany Ave	0.71	N/A

Table 3-3 Required Sanitary Nitrogen Load Reductions – Existing Land Use

Water Supplier	Wellfield	Normalized Equilibrium Nitrogen Concentration after 50 Years [1] (mg/L)	Sanitary Nitrogen Load Reduction Required to Achieve 4 mg/L [2] (%)
SCWA	South Davis Ave	0.69	N/A
Kings Cabins	Kings Cabins	0.68	N/A
Riverhead Water District	Well 7-2, 7-3	0.67	N/A
SCWA	Montauk State Bl	0.65	N/A
Dix Hills Water District	Thorngrove La.	0.58	N/A
SCWA	Dolores Pl	0.58	N/A
SCWA	Locust Ave	0.56	N/A
SCWA	Old Country Rd North	0.56	N/A
Hampton Bays Water District	Bellows Rd	0.54	N/A
SCWA	Landscape Dr	0.52	N/A
SCWA	Meeting House Rd	0.51	N/A
SCWA	Laurel Lake	0.47	N/A
SCWA	Laurel Lake	0.47	N/A
SCWA	Union Bl	0.45	N/A
SCWA	Sawyer Ave	0.44	N/A
Peconic View Mobile Home Park	Peconic View Mobile Home Park	0.43	N/A
SCWA	Dune Rd	0.43	N/A
Shelter Island Heights Association	St. John's Road Wellfield	0.42	N/A
South Huntington Water District	Mount MiseryWell	0.41	N/A
Riverhead Water District	Osborne Ave Wellfield, Plant 4	0.40	N/A
SCWA	Emjay Blvd	0.37	N/A
SCWA	Radio Ave	0.35	N/A
Brookhaven National Labs	Well #6	0.35	N/A
Brookhaven National Labs	Well #11	0.34	N/A
Dering Harbor Village	Yoco Rd, Well #1	0.32	N/A
Shelter Island Heights Association	Icepond Wellfield	0.29	N/A
SCWA	Albin Ave	0.28	N/A
SCWA	Oxhead Rd	0.26	N/A
SCWA	China Rd	0.26	N/A
SCWA	New Highway	0.23	N/A
Riverhead Water District	Pulaski Street-Stotzky Park, Plant 2	0.21	N/A
SCWA	Lambert Ave Copiague	0.20	N/A
Brookhaven National Labs	Pulaski St Wellfield, Main Plant	0.17	N/A

Table 3-3 Required Sanitary Nitrogen Load Reductions – Existing Land Use

Water Supplier	Wellfield	Normalized Equilibrium Nitrogen Concentration after 50 Years [1] (mg/L)	Sanitary Nitrogen Load Reduction Required to Achieve 4 mg/L [2] (%)
Dix Hills Water District	Colby Drive	0.15	N/A
Riverhead Water District	Middle Country Road, Plant 11	0.15	N/A
SCWA	Twelfth St	0.13	N/A
SCWA	Smith St EF	0.11	N/A
Greenlawn Water District	Cuba Hill Rd	0.09	N/A
Brookhaven National Labs	Well #12	0.08	N/A
Riverhead Water District	S130317	0.08	N/A
SCWA	Great Neck Rd	0.08	N/A
SCWA	Fifth Ave	0.08	N/A
Riverhead Water District	Tuthills Road, Plant 15-2	0.07	N/A
SCWA	Lakeview Ave	0.06	N/A
SCWA	Smith St	0.04	N/A
SCWA	Montauk Hwy	0.03	N/A
SCWA	Thomas Ave	0.00	N/A
Dougherty Water Supply	Lawrence Dougherty	0.00	N/A
Ocean Beach Water District	OceanWalk #1	0.00	N/A
Dix Hills Water District	Seneca Ave	0.00	N/A
SCWA	Raleigh Ln	N/A	N/A
SCWA	Moffit Blvd	N/A	N/A
SCWA	Carleton Ave	N/A	N/A
SCWA	Easton St	N/A	N/A
SCWA	Greene Ave	N/A	N/A
SCWA	Head Of The Neck Rd	N/A	N/A
SCWA	Main St Mastic	N/A	N/A
SCWA	New Mill Rd	N/A	N/A
SCWA	Old Neck Rd	N/A	N/A
SCWA	Seatuck Ave	N/A	N/A
SCWA	Waterworks Rd	N/A	N/A
SCWA	West Yaphank Rd	N/A	N/A

Notes: (1) Simulated well-specific nitrogen concentrations were normalized based on flow-weighted concentrations to develop representative wellfield concentrations for wells located in close proximity and at similar screen intervals

(2) Required sanitary load reductions are developed based on the Countywide average of 68.5% of the nitrogen load generated by on-site sanitary wastewater.

(3) Simulated concentrations result from the assumed location of the septic system at the centroid of the parcel. As the well location is also near the centroid, simulated concentrations are artificially high as a result of the load-assignment approach.

Table 3-4 Required Sanitary Nitrogen Load Reductions – Future Build-out Land Use

Water Supplier	Wellfield	Normalized Equilibrium Nitrogen Concentration after 50 Years (1) (mg/L)	Sanitary Nitrogen Load Reduction Required to Achieve 4 mg/L (2) (%)
SCWA	Harvest Ln	4.00	0%
SCWA	Wicks Rd	4.06	2%
SCWA	Blank Ln	4.13	3%
SCWA	Crystal Brook Hollow Rd	4.19	4%
SCWA	Astor Ave	4.26	6%
SCWA	Morris Ave	4.26	6%
SCWA	Eastwood Blvd	4.26	6%
South Huntington Water District	Amityville Road	4.36	8%
Hampton Bays Water District	Ponguogue Ave	4.38	9%
Hampton Bays Water District	Old Riverhead Road	4.38	9%
SCWA	Samuel St	4.44	10%
SCWA	Kayron Dr	4.45	10%
Dougherty Water Supply	Lawrence Dougherty	4.50	11%
SCWA	Capitol Ct	4.51	11%
SCWA	South Fulton St	4.52	12%
SCWA	Church St Hol	4.74	16%
SCWA	Knight St	4.75	16%
SCWA	Kings Park Rd	4.77	16%
SCWA	Fairmount Ave	4.77	16%
SCWA	Laurel Hill Rd	4.79	16%
Dix Hills Water District	Vanderbilt Pkwy	4.80	17%
SCWA	Blue Point Rd	4.87	18%
SCWA	Edgemere Road	4.88	18%
SCWA	Jayne Blvd	4.93	19%
SCWA	Brecknock Hall	5.03	20%
SCWA	Ruth Blvd	5.06	21%
SCWA	Wheat Path	5.07	21%
Dix Hills Water District	Elkland Rd	5.07	21%
SCWA	Mayfair Dr	5.17	23%
SCWA	Horseblock Rd	5.18	23%
SCWA	Commercial Blvd	5.22	23%
SCWA	West Prospect St	5.40	26%
SCWA	Pierson St	5.43	26%
SCWA	Oval Dr	5.59	28%

Table 3-4 Required Sanitary Nitrogen Load Reductions – Future Build-out Land Use

Water Supplier	Wellfield	Normalized Equilibrium Nitrogen Concentration after 50 Years [1] (mg/L)	Sanitary Nitrogen Load Reduction Required to Achieve 4 mg/L [2] (%)
SCWA	Dare Rd	5.69	30%
SCWA	Hurtin Blvd	5.78	31%
Hampton Bays Water District	Ponquogue Ave	5.82	31%
SCWA	Lincoln Ave	5.93	33%
SCWA	Evergreen Dr	5.93	33%
SCWA	Evergreen Dr	5.93	33%
SCWA	Fairmont Ave	6.05	34%
SCWA	Farrington Rd	6.16	35%
South Huntington Water District	Whitson Rd	6.28	36%
Hampton Bays Water District	Well 4-2	6.32	37%
SCWA	Schuyler Dr	6.33	37%
South Huntington Water District	Wolf Hill Rd	6.35	37%
Greenlawn Water District	Burr Rd	6.38	37%
SCWA	Sy Ct	6.41	38%
SCWA	Flanders Rd	6.47	38%
SCWA	Mckay Rd	6.49	38%
SCWA	Boyle Rd South	6.60	39%
SCWA	Brook Ave	6.72	40%
SCWA	Douglas Ave	6.77	41%
SCWA	Inlet Dr	6.90	42%
SCWA	Inlet Dr	6.90	42%
Greenlawn Water District	Pulaski Rd	7.01	43%
SCWA	Virginia Ave	7.08	44%
SCWA	South Spur Dr	7.11	44%
SCWA	Hollywood Pl	7.16	44%
Dix Hills Water District	Ryder Ave	7.51	47%
SCWA	Woodchuck Hollow Rd	7.71	48%
SCWA	Boyle Rd North	8.27	52%
SCWA	Waterside Rd	8.66	54%
SCWA	Broadway	9.21	57%
McCarren Water Supply	Oakbeach Rd (Edward McCarren)	9.27	57%
SCWA	Church St Npt	9.39	57%
SCWA	Emjay Blvd	11.98	67%
SCWA	Race Ave	15.21	74%

Table 3-4 Required Sanitary Nitrogen Load Reductions – Future Build-out Land Use

Water Supplier	Wellfield	Normalized Equilibrium Nitrogen Concentration after 50 Years (1) (mg/L)	Sanitary Nitrogen Load Reduction Required to Achieve 4 mg/L (2) (%)
Camp Quinipet	Camp Quinipet	29.67	87%
SCWA	Browns Hills Rd	56.28	93%
SCWA	Blue Spruce Ln	3.99	N/A
SCWA	Liberty St	3.95	N/A
SCWA	Oak St	3.90	N/A
SCWA	Stem Ln	3.82	N/A
SCWA	Meehan Ln	3.81	N/A
SCWA	Flamingo Ave	3.77	N/A
Greenlawn Water District	Huntsman La	3.76	N/A
SCWA	Bay Shore Rd	3.69	N/A
SCWA	Plymouth St	3.68	N/A
SCWA	Bridgehampton Rd	3.67	N/A
SCWA	Flower Hill Rd	3.61	N/A
SCWA	Third Ave	3.60	N/A
Hampton Bays Water District	Jones Rd/Montauk	3.59	N/A
SCWA	Middleville Rd	3.57	N/A
Greenlawn Water District	Wicks Road	3.52	N/A
SCWA	Edgewood Ave St. James	3.49	N/A
SCWA	Belle Terre Rd	3.47	N/A
SCWA	Gun Club Rd	3.45	N/A
SCWA	Railroad Ave	3.42	N/A
SCWA	Bicycle Path	3.40	N/A
SCWA	Pier Ave	3.40	N/A
SCWA	Peconic St	3.40	N/A
SCWA	Harbor Rd	3.38	N/A
Riverhead Water District	RWD Boy Scout Camp- WR Manorville Rd (Hi-zone)	3.33	N/A
Dix Hills Water District	Caledonia Rd	3.31	N/A
SCWA	Meade Dr	3.30	N/A
SCWA	Boyle Rd Port Jeff	3.29	N/A
Greenlawn Water District	Buttercup La	3.29	N/A
SCWA	Wheeler Rd	3.29	N/A
SCWA	Barton Ave	3.28	N/A
South Huntington Water District	Oakwood Rd	3.24	N/A
Greenlawn Water District	Manor Road	3.20	N/A
SCWA	Old Dock Rd	3.18	N/A
SCWA	Hawkins Rd	3.17	N/A

Table 3-4 Required Sanitary Nitrogen Load Reductions – Future Build-out Land Use

Water Supplier	Wellfield	Normalized Equilibrium Nitrogen Concentration after 50 Years (1) (mg/L)	Sanitary Nitrogen Load Reduction Required to Achieve 4 mg/L (2) (%)
SCWA	South Howell Ave	3.06	N/A
SCWA	Carlson Ave	3.00	N/A
SCWA	Bob Dassler Wellfield	3.00	N/A
SCWA	Hallock Ave	3.00	N/A
SCWA	New York Ave	2.97	N/A
SCWA	Pleasant Ave	2.95	N/A
SCWA	Peconic Ave Medford	2.94	N/A
SCWA	Long Springs Rd	2.90	N/A
SCWA	Nicolls Rd	2.86	N/A
SCWA	Shady Ln	2.86	N/A
SCWA	North Magee St	2.80	N/A
SCWA	Reservoir Ave	2.80	N/A
SCWA	Jennings Rd	2.78	N/A
SCWA	Washington St	2.78	N/A
SCWA	College Rd	2.77	N/A
SCWA	Patchogue-Yaphank Rd	2.71	N/A
SCWA	Lawrence Rd	2.69	N/A
SCWA	Foxcroft Ln	2.66	N/A
SCWA	Maple Ave	2.66	N/A
SCWA	Spring Close Hwy	2.65	N/A
SCWA	Henry Clay Dr	2.64	N/A
SCWA	Bay Dr	2.62	N/A
SCWA	Industry Ct	2.59	N/A
Greenlawn Water District	Elmo Pl	2.58	N/A
SCWA	Locust Dr	2.54	N/A
SCWA	Church St Boh	2.54	N/A
South Huntington Water District	Gwynne Rd	2.53	N/A
SCWA	August Rd	2.46	N/A
South Huntington Water District	Downs Rd	2.46	N/A
Riverhead Water District	Middle Road	2.46	N/A
SCWA	Water Rd	2.42	N/A
SCWA	Walter Ct	2.39	N/A
SCWA	Daniel Webster Dr	2.37	N/A
SCWA	Middle Rd Southold	2.36	N/A
Greenlawn Water District	Clay Pitts Rd	2.32	N/A
Dix Hills Water District	Carlls Strt Path	2.30	N/A

Table 3-4 Required Sanitary Nitrogen Load Reductions – Future Build-out Land Use

Water Supplier	Wellfield	Normalized Equilibrium Nitrogen Concentration after 50 Years (1) (mg/L)	Sanitary Nitrogen Load Reduction Required to Achieve 4 mg/L (2) (%)
SCWA	Lafayette Rd	2.30	N/A
SCWA	Flint Ln	2.29	N/A
SCWA	East Forks Rd	2.29	N/A
SCWA	Kennys Rd	2.28	N/A
South Huntington Water District	Rivendale Court	2.25	N/A
SCWA	Sunset Dr	2.25	N/A
SCWA	Sunset Dr	2.25	N/A
South Huntington Water District	WaltWhitman Rd	2.23	N/A
SCWA	Development Dr.	2.21	N/A
SCWA	Malloy Dr	2.19	N/A
SCWA	Town Line Rd Nesconset	2.11	N/A
SCWA	Mill Ln Peconic	2.10	N/A
SCWA	Sound Ave	2.09	N/A
SCWA	Strathmore Ct Dr	2.08	N/A
SCWA	Old North Rd	2.05	N/A
SCWA	Laurel Hill Rd	2.04	N/A
SCWA	Cross Hwy	1.98	N/A
SCWA	Sunrise Hwy	1.97	N/A
SCWA	Rocky Point Rd	1.93	N/A
SCWA	Fisher Ave	1.91	N/A
SCWA	Bellmore Ave	1.91	N/A
SCWA	American Blvd	1.90	N/A
SCWA	Division St	1.89	N/A
SCWA	Islands End	1.89	N/A
SCWA	Spinney Rd	1.88	N/A
SCWA	Middle Country Rd	1.83	N/A
SCWA	Wyandanch Ave	1.83	N/A
SCWA	Middle Rd Peconic	1.83	N/A
SCWA	Oxhead Rd	1.83	N/A
SCWA	St Johnsland Rd	1.81	N/A
SCWA	Fish Rd	1.80	N/A
SCWA	Elwood Rd	1.80	N/A
SCWA	Chestnut St	1.77	N/A
SCWA	Harbor Walk	1.74	N/A
Brookhaven National Labs	Well #10	1.70	N/A
SCWA	Accabonac Rd	1.69	N/A
SCWA	Oakview Hwy	1.69	N/A

Table 3-4 Required Sanitary Nitrogen Load Reductions – Future Build-out Land Use

Water Supplier	Wellfield	Normalized Equilibrium Nitrogen Concentration after 50 Years (1) (mg/L)	Sanitary Nitrogen Load Reduction Required to Achieve 4 mg/L (2) (%)
SCWA	Greenbelt Pkwy	1.67	N/A
SCWA	Scuttlehole Rd	1.65	N/A
SCWA	Bailey Rd	1.64	N/A
SCWA	Sag Harbor Tpke	1.63	N/A
SCWA	County Rd 31	1.62	N/A
SCWA	Gordon Ave	1.61	N/A
SCWA	Broadhollow Rd	1.57	N/A
South Huntington Water District	W Rogues Path	1.54	N/A
SCWA	Forty-First St	1.49	N/A
SCWA	Ackerly Pond Ln	1.48	N/A
South Huntington Water District	Cottontail Rd.	1.48	N/A
Shelter Island Chalets	Shelter Island Chalets	1.47	N/A
SCWA	Herricks Ln	1.47	N/A
SCWA	Tenety Ave	1.45	N/A
Greenlawn Water District	Park Ave	1.45	N/A
Hampton Bays Water District	Well 4-1	1.45	N/A
SCWA	Edge Of Woods Rd	1.44	N/A
Hampton Bays Water District	Bellows Rd	1.43	N/A
SCWA	Country Club Dr	1.42	N/A
Shelter Island Heights Association	North Ferry Wellfield	1.42	N/A
SCWA	Gus Guerrera	1.42	N/A
SCWA	Quogue-Riverhead Rd	1.41	N/A
SCWA	Center Walk	1.40	N/A
Greenlawn Water District	Jericho Tpke	1.38	N/A
Calverton Hills Owners Assn	Toppings Path	1.35	N/A
Hampton Bays Water District	Not Specified	1.34	N/A
SCWA	County Rd 111	1.32	N/A
SCWA	Central Walk (Fhbr)	1.31	N/A
SCWA	North Country Rd	1.31	N/A
SCWA	Roses Grove Rd	1.30	N/A
SCWA	Tuckahoe Rd	1.28	N/A
SCWA	West Neck Rd	1.27	N/A
SCWA	West Neck Rd	1.27	N/A

Table 3-4 Required Sanitary Nitrogen Load Reductions – Future Build-out Land Use

Water Supplier	Wellfield	Normalized Equilibrium Nitrogen Concentration after 50 Years (1) (mg/L)	Sanitary Nitrogen Load Reduction Required to Achieve 4 mg/L (2) (%)
SCWA	Meeting House Rd	1.25	N/A
SCWA	Helme Ave	1.25	N/A
SCWA	Sunken Meadow State Park	1.24	N/A
SCWA	William Floyd Pkwy	1.23	N/A
SCWA	Town Line Rd East Hampton	1.23	N/A
SCWA	Mud Rd	1.21	N/A
Dix Hills Water District	Deer Park Ave	1.19	N/A
SCWA	Cornell Dr	1.18	N/A
SCWA	Mt Sinai-Coram Rd	1.17	N/A
SCWA	Adams Ave	1.14	N/A
SCWA	North Washington Ave	1.13	N/A
SCWA	Bellrose Ave	1.12	N/A
SCWA	Tower St	1.06	N/A
SCWA	The Long Way	1.06	N/A
Kings Cabins	Kings Cabins	1.05	N/A
SCWA	Mt Sinai-Coram Rd South	1.05	N/A
SCWA	Station Rd	1.00	N/A
SCWA	Old Country Rd	0.99	N/A
Shelter Island Heights Association	St. John's Road Wellfield	0.99	N/A
SCWA	Lumber Ln	0.98	N/A
SCWA	Falcon Dr	0.96	N/A
SCWA	Edison Dr	0.92	N/A
SCWA	Moriches-Riverhead Rd	0.92	N/A
SCWA	Carrol St	0.91	N/A
SCWA	Sherry Dr	0.90	N/A
Shelter Island Heights Association	New York Avenue Wellfield	0.89	N/A
Riverhead Water District	Sound Ave and Phillips	0.86	N/A
SCWA	Montauk State Bl	0.85	N/A
Seaview Water Company	Seaview	0.85	N/A
Dering Harbor Village	Yoco Rd, Well #1	0.84	N/A
SCWA	North Rd	0.84	N/A
SCWA	Gazza Blvd	0.83	N/A
SCWA	Mill Ln Huntington	0.83	N/A
Dix Hills Water District	Dix Hills Park/ Vanderbilt Pkwy	0.81	N/A

Table 3-4 Required Sanitary Nitrogen Load Reductions – Future Build-out Land Use

Water Supplier	Wellfield	Normalized Equilibrium Nitrogen Concentration after 50 Years [(1)] (mg/L)	Sanitary Nitrogen Load Reduction Required to Achieve 4 mg/L [(2)] (%)
SCWA	Wayne Ct	0.81	N/A
SCWA	Circle Dr	0.80	N/A
SCWA	Tower Hill Rd	0.80	N/A
SCWA	Oak Ave	0.80	N/A
Riverhead Water District	Northville Turnpike, Plant 17	0.80	N/A
SCWA	Lambert Ave Mastic	0.80	N/A
SCWA	Daly Rd	0.78	N/A
SCWA	Laurel Lake	0.69	N/A
SCWA	Laurel Lake	0.69	N/A
SCWA	Albany Ave	0.69	N/A
SCWA	South Davis Ave	0.68	N/A
Dix Hills Water District	Thorngrove La.	0.68	N/A
SCWA	Dolores Pl	0.65	N/A
Brookhaven National Labs	Well #7	0.59	N/A
SCWA	Locust Ave	0.59	N/A
SCWA	Old Country Rd North	0.55	N/A
SCWA	Sawyer Ave	0.50	N/A
Riverhead Water District	Well 7-2, 7-3	0.50	N/A
SCWA	Union Bl	0.47	N/A
SCWA	Radio Ave	0.43	N/A
South Huntington Water District	Mount Misery Well	0.42	N/A
SCWA	Dune Rd	0.40	N/A
SCWA	New Highway	0.33	N/A
Brookhaven National Labs	Well #11	0.31	N/A
Riverhead Water District	Osborne Ave Wellfield, Plant 4	0.31	N/A
Peconic View Mobile Home Park	Peconic View Mobile Home Park	0.30	N/A
Shelter Island Heights Association	Icepond Wellfield	0.29	N/A
SCWA	Landscape Dr	0.29	N/A
SCWA	Albin Ave	0.28	N/A
Brookhaven National Labs	Well #6	0.25	N/A
SCWA	Twelfth St	0.24	N/A
SCWA	Lambert Ave Copiague	0.20	N/A
SCWA	China Rd	0.20	N/A

Table 3-4 Required Sanitary Nitrogen Load Reductions – Future Build-out Land Use

Water Supplier	Wellfield	Normalized Equilibrium Nitrogen Concentration after 50 Years [(1)] (mg/L)	Sanitary Nitrogen Load Reduction Required to Achieve 4 mg/L [(2)] (%)
Riverhead Water District	Pulaski Street-Stotzky Park, Plant 2	0.16	N/A
Riverhead Water District	Middle Country Road, Plant 11	0.16	N/A
SCWA	Fifth Ave	0.12	N/A
Dix Hills Water District	Colby Drive	0.12	N/A
SCWA	Smith St EF	0.11	N/A
Brookhaven National Labs	Pulaski St Wellfield, Main Plant	0.11	N/A
Riverhead Water District	Tuthills Road, Plant 15-2	0.10	N/A
Greenlawn Water District	Cuba Hill Rd	0.10	N/A
Brookhaven National Labs	Well #12	0.08	N/A
SCWA	Great Neck Rd	0.07	N/A
SCWA	Lakeview Ave	0.06	N/A
Riverhead Water District	S130317	0.05	N/A
SCWA	Smith St	0.03	N/A
SCWA	Montauk Hwy	0.03	N/A
Dix Hills Water District	Seneca Ave	0.02	N/A
Riverhead Water District	Well 12-1	0.00	N/A
SCWA	Thomas Ave	0.00	N/A
Ocean Beach Water District	OceanWalk #1	0.00	N/A
SCWA	Raleigh Ln	N/A	N/A
SCWA	Moffit Blvd	N/A	N/A
SCWA	Carleton Ave	N/A	N/A
SCWA	Easton St	N/A	N/A
SCWA	Greene Ave	N/A	N/A
SCWA	Head Of The Neck Rd	N/A	N/A
SCWA	Main St Mastic	N/A	N/A
SCWA	New Mill Rd	N/A	N/A
SCWA	Old Neck Rd	N/A	N/A
SCWA	Seatuck Ave	N/A	N/A
SCWA	Waterworks Rd	N/A	N/A
SCWA	West Yaphank Rd	N/A	N/A

Notes: (1) Simulated well-specific nitrogen concentrations were normalized based on flow-weighted concentrations to develop representative wellfield concentrations for wells located in close proximity and at similar screen intervals

(2) Required sanitary load reductions are developed based on the Countywide average of 68.5% of the nitrogen load generated by on-site sanitary wastewater.

Table 3-4 Required Sanitary Nitrogen Load Reductions – Future Build-out Land Use

(3) Simulated concentrations result from the assumed location of the septic system at the centroid of the parcel. As the well location is also near the centroid, simulated concentrations are artificially high as a result of the load-assignment approach.

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Section 4

Integrated Subwatershed Wastewater Management Strategy

Sections 2 and 3 of this SWP identified the priority areas and nitrogen load reduction goals developed to restore and protect Suffolk County's surface waters, drinking water and the sole source aquifer. Sections 2 and 3 also described the wastewater management alternatives that Suffolk County could implement to provide the nitrogen load reduction goals that have been identified.

The collaborative approach that the County used to develop an integrated wastewater management framework to reduce nitrogen loading from all currently unsewered parcels in the County is described in this section, including:

- Development of aggregated surface water wastewater management areas;
- Summary of the groundwater priority areas identified in Section 3;
- Integration of surface water and groundwater priority areas;
- Identification and evaluation of wastewater management implementation alternatives;
- Recommended Wastewater Management Strategy (e.g., the Plan), and
- Description of Anticipated Environmental Benefits.

While implementation of I/A OWTS is the presumptive nitrogen load reduction alternative for most unsewered areas in the County, areas where centralized or clustered sewering would be an appropriate alternative are also identified in this section.

4.1 Surface Water

While the data generated for individual subwatersheds (e.g., existing water quality, estimated nitrogen loads, individual priority ranks, and individual load reduction goals) is valuable on many levels, implementing a Countywide wastewater management program that tracks 190 individual water bodies is not an efficient administrative structure and its oversight would cause unnecessary expense. Further, and as discussed previously, dozens of water bodies have insufficient data to properly characterize them. Aggregation into larger management areas provides a means for these water bodies to be ranked, prioritized and tracked in a manner that is consistent with regional/local well characterized water bodies with similar conditions. The following subsections describe the methodology used to establish aggregated surface water wastewater management areas, provides a description of each established area, and presents the overall priority rank and load reduction goal for each management area. It should be noted that the original individual priority ranks still have value on many levels, particularly for local and estuary-specific initiatives, and can be found in **Table 2-33** and Appendix D of the SWP.

4.1.1 Surface Water Aggregated Wastewater Management Areas

The 190 surface water subwatersheds that were ranked individually for nitrogen load reduction priority were grouped together into wastewater management areas based upon the following general guidance criteria:

- Major estuary watershed within which the water body is located;
- Similar priority rank and/or nitrogen load reduction goal (documented in the Task 6, Tiered Priority Area Services technical memorandum) and shown on **Figure 4-1**; and
- Downstream receiving water body priorities for nitrogen load reduction and downstream receiving water body target nitrogen load reductions.

Ultimately, the aggregation process involved grouping water bodies together that have similar priority rank, load reduction goals, and are situated within the same major estuary program (e.g., Long Island Sound, Peconic Estuary, South Shore Estuary Reserve). For example, water bodies within the Long Island Sound (LIS) watershed were evaluated for aggregation together, but were not considered for aggregation with water bodies in the Peconic Estuary (PE) watershed or the South Shore Estuary Reserve (SSER). In total, 21 wastewater management areas were established Countywide, as shown on **Figure 4-2** and summarized on **Table 4-1** at the end of this section. Of the 21 wastewater management areas, six management areas are located in the LIS watershed, six management areas are located within the PE watershed, six are located within the SSER, and three are located in other areas (e.g., outside of a specific estuary program boundary). Detailed description of the management areas is provided below.

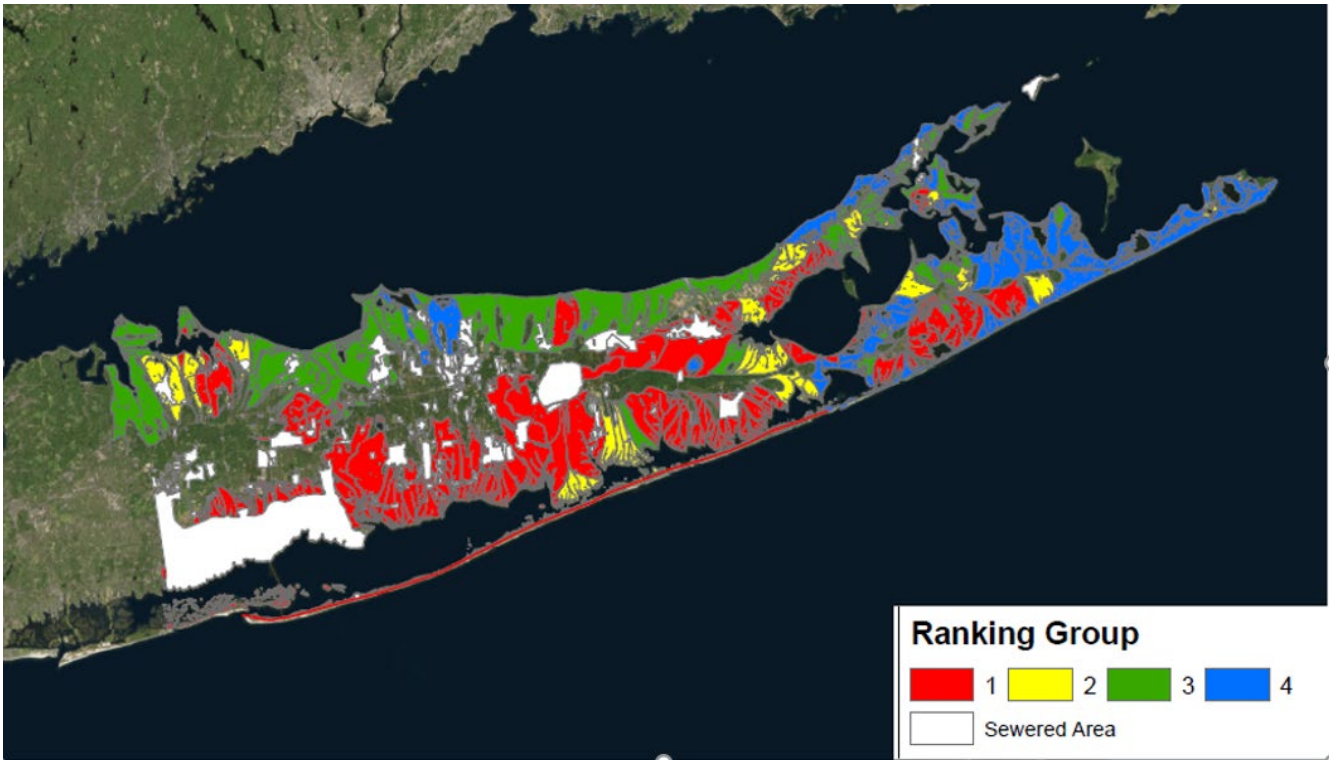


Figure 4-1 Priority Areas for Nitrogen Load Reduction

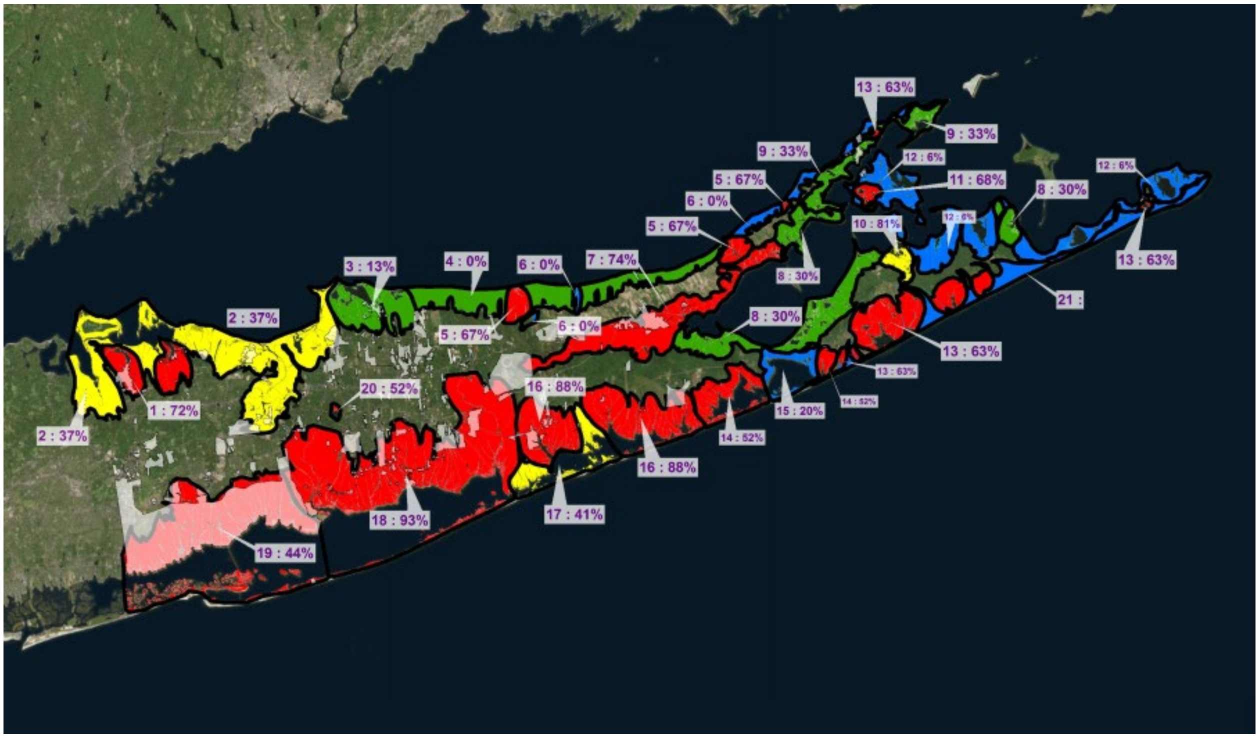


Figure 4-2 Wastewater Management Areas

4.1.1.1 Wastewater Management Area 1 – Western Long Island Sound Harbors Restoration Area

The Western LIS Harbors Restoration Area includes Huntington Harbor, Mill Pond, and Northport Harbor. Water quality in Northport Harbor and Huntington Harbor is well characterized and the Harbors received individual surface water priority ranks of Priority Rank 1 and Priority Rank 2, respectively. Huntington Harbor and Northport Harbor have experienced frequent occurrences of the red tide HAB *Alexandrium*, which can cause paralytic shellfish poisoning and has forced the closure of these areas to shellfishing. Mill Pond, which is connected to Centerport Harbor, is a unique water body in that it is manually closed and isolated from Centerport Harbor by a control valve by the community during times of high tide. Several fish kills have occurred in Mill Pond and although poorly characterized, it received an individual rank of Priority Rank 1. Load reduction goals for ideal water quality are amongst the highest in the LIS estuary ranging from 72 to 90 percent for these three water bodies.

Combined, the wastewater management priority area rank is Priority Rank 1 with an overall nitrogen reduction goal of 72 percent to achieve ideal water quality.

4.1.1.2 Wastewater Management Area 2 – Long Island Sound Harbors and Bays Restoration and Protection Area I

The LIS Harbors and Bays Restoration and Protection Area I area includes 13 western Suffolk water bodies with varying individual Priority Ranks and load reduction goals. Four of the water bodies (Cold Spring Harbor, Flax Pond, Nissequogue River Upper, and Crab Meadow Creek) are poorly characterized for water quality while the remaining nine are well characterized. Well characterized water bodies have individual surface water Priority Ranks of 2 and 3, with the exception of Northport Bay (individual Priority Rank 1). The larger bays within Wastewater Management Area 2 generally shared low nitrogen load reduction goals while the connected harbors, creeks, and streams had ideal water quality nitrogen load reduction goals ranging from 25 to 78 percent. Land use in the area is generally a mix of low, medium, and high-density residential development. Despite having an individual Priority Rank of 1, Northport Bay was included within Wastewater Management Area 2 area because its direct groundwater contributing area is very small and its load reduction goal is estimated to be 0 percent due to the large volume of the water body that dilutes delivered nitrogen enrichment. Ultimately, Northport Bay's water quality concerns should be addressed through nitrogen reductions obtained from connected Wastewater Management Area 1 water bodies. Water quality within Wastewater Management Area 2 water bodies is generally characterized by the occurrence of occasional (but not frequent) HABs, acceptable water clarity, acceptable dissolved oxygen, and low total nitrogen. Notable exceptions are frequent HABs in Northport Bay, which likely originate from its connected water bodies such as Northport Harbor, and low dissolved oxygen in Smithtown Bay. Low dissolved oxygen in Smithtown Bay has been the subject of previous study, "Physical Processes Contributing to Localized, Seasonal Hypoxic Conditions in the Bottom Waters of Smithtown Bay, Long Island Sound, New York", (Swanson et. al, 2016) and is likely due to thermally controlled stratification that inhibits vertical mixing and a hydrodynamic gyre caused by the surrounding land areas which results in weak currents, little mixing with the Sound and increased residence time in Smithtown Bay.

Combined, the wastewater management priority area rank is Priority Rank 2 with an overall ideal water quality goal of 37 percent.

4.1.1.3 Wastewater Management Area 3 –Long Island Sound Harbors and Bays Restoration and Protection Area II

The LIS Harbors and Bays Restoration and Protection Area II area includes five water bodies with individual surface water priority ranks of Priority Rank 3 and 4. Individual load reduction goals for ideal water quality range from 0 to 61 percent. There is one poorly characterized water body (Conscience Bay). Water quality within Wastewater Management Area 3 water bodies is generally characterized by the occurrence of occasional (but not frequent) HABs, acceptable water clarity, acceptable dissolved oxygen, and low total nitrogen. Of the five individual water bodies, Setauket Harbor has the poorest observed water quality and the highest load reduction goal while Mount Sinai Harbor generally has excellent water quality and a resulting load reduction goal of 0 percent. Mount Sinai Harbor was selected as a reference water body used for establishing acceptable nitrogen loads under the ideal load reduction goal methodology.

Combined, the wastewater management priority area rank is Priority Rank 3 with an overall ideal water quality goal of 13 percent.

4.1.1.4 Wastewater Management Area 4 – Central and Western Long Island Sound Open Waters Protection Area

The Central and Western Long Island Sound Open Waters Protection Area includes one water body with an individual surface water priority rank of Priority Rank 3. As denoted, this management area includes the direct groundwater contributing areas to the open waters of Suffolk County Long

Island Sound Central. Observed water quality is generally very good with occasional, but infrequent HABs, acceptable water clarity, and acceptable dissolved oxygen.

The wastewater management priority area rank is Priority Rank 3 with an overall ideal water quality goal of 0 percent.

4.1.1.5 Wastewater Management Area 5 – Long Island Sound Inlets and Creek Restoration Area

The Long Island Sound Inlets and Creek Restoration Area includes three eastern Suffolk water bodies with individual priority ranks of Priority Ranks of 1, 2 and 3. Individual water bodies within this management area include Wading River, Mattituck Inlet/Creek and Goldsmith Inlet. Observed water quality is generally poor with occasional HABs (primarily Mattituck Inlet/Creek), poor water clarity, and low dissolved oxygen. The poor water quality correlates with relatively high load reduction goals for ideal water quality ranging from 66 to 88 percent. It should be noted that Wading River is considered poorly characterized for water quality (e.g., insufficient data to properly characterize existing conditions).

Combined, the wastewater management priority area rank is Priority Rank 1 with an overall ideal water quality goal of 67 percent.

4.1.1.6 Wastewater Management Area 6 – Eastern Long Island Sound Open Waters and Long Island Sound Freshwaters Protection Area

The Eastern Long Island Sound Open Waters and Long Island Sound Freshwaters Protection Area includes four eastern Suffolk water bodies with individual surface water priority ranks of Priority Ranks 3 and 4. Three of the four individual water bodies include freshwater ponds that are poorly characterized for water quality (Deep Pond, Fresh Pond Creek and Tribs, and Lake Panamoka) while one water body is well characterized (Long Island Sound, East). Observed water quality based on the limited data for the freshwater ponds is very good. Observed water quality for Long Island Sound, East is also very good. The observation of good/acceptable water quality correlates well with adjacent land use which is typically less intensely developed when compared to land use in the contributing areas of other water bodies in Suffolk County.

Combined, the wastewater management priority area rank is Priority Rank 4 with an overall ideal water quality goal of 0 percent; however, it should be noted that insufficient data was available to develop nitrogen load reduction goals to achieve ideal water quality for the freshwater ponds.

4.1.1.7 Wastewater Management Area 7 – Peconic Estuary Restoration and Protection Area I

The Peconic Estuary Restoration and Protection Area I includes 15 individual water bodies located within the western Peconic Estuary. Eight of the water bodies are poorly characterized for water quality while the remaining seven are well characterized. Wastewater Management Area 7 generally includes water bodies with the poorest water quality and highest sensitivity to nitrogen within the Peconic Estuary and includes two water bodies with an individual rank of Priority Rank 2 (Flanders Bay East/Center, and Tribs [North] and Laurel Pond), one water body with Priority Rank 4 (Wildwood Lake), with the remaining water bodies identified as Priority Rank 1. Individual load reduction goals for ideal water quality range from 46 percent to 91 percent with the majority of the individual goals around 70 percent.

Land use around the area is diverse and includes a mix of low, medium, and high-density residential development and agricultural uses, with the majority of parcels identified as medium density residential. The land use development intensity in the estuary varies dramatically when comparing the northern estuary groundwater contributing areas to the southern estuary groundwater contributing areas. For example, the land use along the north side of Flanders Bay, East is primarily low, medium, and high density residential and agricultural whereas the land use along the south side of the Bay is predominantly open space and recreation. For this reason, the groundwater contributing areas along the north side of the estuary were included in Wastewater Management Area 7 and the groundwater contributing areas along the south side were included in Wastewater Management Area 8. Water quality within Wastewater Management Area 7 water bodies is generally poor and characterized by the occurrence of frequent HABs, elevated chlorophyll-*a*, low dissolved oxygen and poor water clarity. The most notable exception is the comparatively better water quality in Great Peconic Bay which benefits from a large water body volume, tidal exchange/flushing from water bodies with good water quality to the east, and the less intense land use along the south side of the bay. However, because of the intense land use along the north side of Great Peconic Bay and observation of poor water quality in all connected north shore estuaries, the north shore of Great Peconic Bay was included in Wastewater Management Area 7.

Combined, the wastewater management priority area rank is Priority Rank 1 with an overall ideal water quality nitrogen reduction goal of 74 percent.

4.1.1.8 Wastewater Management Area 8 – Peconic Estuary Restoration and Protection Area II

The Peconic Estuary Restoration and Protection Area II includes 27 individual water bodies located within the central Peconic Estuary and also includes groundwater contributing areas located along the south shore of the western Peconic Bays (e.g., Reeves Bay, Flanders Bay, East, and Great Peconic Bay). Eleven of the water bodies are poorly characterized for water quality while the remaining 16 are well characterized. Wastewater Management Area 8 generally includes water bodies with good water quality and moderate sensitivity to nitrogen. While surface waters within this wastewater management area currently exhibit good water quality, the individual nitrogen load reduction goals for many of the same waters are elevated, suggesting that these water bodies may be vulnerable to water quality degradation in the future. Individual surface water priority ranks vary in Wastewater Management Area 8; however, the majority of the water bodies are ranked as Priority Rank 3 or Priority Rank 4, particularly for the water bodies that are well characterized. Similarly, individual load reduction goals for ideal water quality typically fall between 30 and 78 percent; however, the overall range is from 0 percent to 73 percent. It should be noted that the large range in load reduction goals is, in part, a function of aggregating proximate individual water bodies with minimal land contributing area (e.g., water bodies with low load reduction goals include part of Noyack Bay, Little Sebonac Creek, and Sebonac Creek/Bullhead Bay). Land use around the area is diverse and includes a mix of low, medium, and high-density residential development and agricultural uses, with the majority of parcels assigned as medium density residential. However, Wastewater Management Area 8 also includes a significant number of open space and recreational parcels when compared to Wastewater Management Area 7, which results in improved water quality and lower load reduction goals. Water quality within Wastewater Management Area 8 water bodies is generally acceptable and characterized by the occurrence of infrequent HABs, and acceptable chlorophyll-*a*, dissolved oxygen, and water clarity.

There are eight reference water bodies located within Wastewater Management Area 8. Combined, the wastewater management priority area rank is Priority Rank 3 with an overall ideal water quality goal of 30 percent.

4.1.1.9 Wastewater Management Area 9 – Peconic Estuary Restoration and Protection Area III

The Peconic Estuary Restoration and Protection Area III includes 14 individual water bodies located on the North Fork of the eastern Peconic Estuary. Nine of the 14 water bodies are poorly characterized for water quality. The characteristics of Wastewater Management Area 9 are very similar to Wastewater Management Area 8, with the predominant difference being the geographic location of the aggregated water bodies. In general, water bodies within this wastewater management area exhibit good water quality and moderate sensitivity to nitrogen. While surface waters within this wastewater management area currently exhibit good water quality, the individual load reduction goals for many of the same waters are elevated, suggesting that these water bodies may be vulnerable to water quality degradation in the future. Individual surface water bodies in Wastewater Management Area 9 are ranked as Priority Rank 3 or Priority Rank 4 with the exception of Stirling Creek as Priority Rank 2. Individual nitrogen load reduction goals for ideal water quality typically fall between 12 and 67 percent; however, the overall range is from 0 percent to 67 percent. It should be noted that the large range in load reduction goals is, in part, a function of aggregating proximate individual water bodies with minimal land contributing area (e.g., water bodies with low load reduction goals include part of Orient Harbor, part of Shelter Island Sound, North, and Southold Bay). Land use around the area is diverse and includes a mix of low, medium, and high-density residential development and agricultural uses, with the majority of parcels assigned as medium density residential. Water quality within Wastewater Management Area 9 water bodies is generally acceptable and characterized by the occurrence of infrequent HABs, and acceptable chlorophyll-*a*, dissolved oxygen, and water clarity.

There are six reference water bodies located within Wastewater Management Area 9. Combined, the wastewater management priority area rank is Priority Rank 3 with an overall ideal water quality goal of 33 percent.

4.1.1.10 Wastewater Management Area 10 – Sag Harbor Cove and Connected Creeks

The Sag Harbor Cove and Connected Creeks Wastewater Management Area includes the subwatersheds of Sag Harbor Cove and Tribs and Ligonee Brook and Tribs. Sag Harbor Cove and Tribs is well characterized and received an individual surface water priority rank of Priority Rank 3 while Ligonee Brook and Tribs is poorly characterized and received Priority Rank 2. While the water quality in Sag Harbor Cove is generally acceptable, the individual load reduction goal for ideal water quality of 81 percent is elevated due to the combination of high nitrogen load coupled with long residence time, suggesting that this water body may be vulnerable to water quality degradation in the future. Ligonee Brook is hydraulically connected to Sag Harbor Cove and represents the headwaters that feed the cove. Land use in this management area is predominantly medium density residential with a significant number of open space parcels within the Ligonee Brook subwatershed.

Combined, the wastewater management priority area rank is Priority Rank 2 with an overall nitrogen load reduction goal to achieve ideal water quality of 81 percent.

4.1.1.11 Wastewater Management Area 11 – West Neck Bay and Creek and Menantic Creek

The West Neck Bay and Creek and Menantic Creek Wastewater Management Area includes the two subwatersheds with the highest sensitivity to nitrogen located in the Town of Shelter Island; West Neck Bay and Creek and Menantic Creek. Both water bodies are well characterized and West Neck Bay and Creek received an individual surface water priority rank of Priority Rank 1, while Menantic Creek received a rank of Priority Rank 2. Land use in this management area is predominantly medium density residential. The water quality of West Neck Bay and Creek is moderately degraded with recurring HABs, elevated chlorophyll-*a* and low dissolved oxygen. West Neck Bay and Creek has an ideal water quality load reduction goal of 68 percent, while Menantic Creek has an ideal water quality load reduction goal of 72 percent.

Combined, the wastewater management priority area rank is Priority Rank 1 with an overall ideal water quality goal of 68 percent.

4.1.1.12 Wastewater Management Area 12 – Peconic Estuary Restoration and Protection Area IV

The Peconic Estuary Restoration and Protection Area IV Wastewater Management Area includes 21 individual water bodies located within the eastern Peconic Estuary. The water quality in this management area relevant to nutrient-related endpoints is generally excellent with 11 water bodies serving as reference water bodies for the establishment of ideal water quality load reduction goals and most water bodies are ranked as Priority Rank 4.

Eight of the water bodies are poorly characterized for water quality, while the remaining 13 are well characterized. While surface waters within this wastewater management area currently exhibit good water quality relative to nutrient-related impacts, Big Reed Pond and Lake Montauk have pathogen-related water quality degradation. Further, Three Mile Harbor exhibits good water quality at its central monitoring stations, but recent data has documented nutrient related degradation within a hydrodynamically-isolated area at the head of the harbor. Accordingly, Three Mile Harbor has been identified for further study in the recommendations of this SWP. It should be noted that Three Mile Harbor's groundwater contributing area overlaps a Groundwater/Drinking Water Priority Rank 1 area and, as such, all parcels within the Three Mile Harbor subwatershed will receive the benefit of being prioritized as Priority Rank 1 within this SWP. Individual load reduction goals for ideal water quality typically fall between 0 and 45 percent. Land use around the area is diverse and includes a mix of low, medium, and high-density residential development and open space and recreational parcels.

Water quality within the majority of the Wastewater Management Area 12 water bodies is generally excellent and characterized by the occurrence of infrequent HABs, and acceptable chlorophyll-*a*, dissolved oxygen, and water clarity. Combined, the wastewater management priority area rank is Priority Rank 4 with an overall ideal water quality goal of 6 percent.

4.1.1.13 Wastewater Management Area 13 – Coastal Ponds Restoration and Protection Water Bodies

The Coastal Ponds Restoration and Protection Water Bodies Wastewater Management Area includes 14 individual coastal pond water bodies located within the Peconic Estuary, South Shore Estuary Reserve, and in the Towns of East Hampton and Southampton contributing areas to the Atlantic Ocean. The coastal ponds of Suffolk County represent a unique challenge and opportunity for restoration. In general, most coastal ponds within the County have experienced at least one blue-green algae HAB with many experiencing recurring HABs. Further, although select water bodies are well characterized for a handful of water quality parameters, most coastal ponds are poorly characterized for overall water quality and are not well understood with respect to water quality impacts from phosphorus and waterfowl (e.g., pathogens). Finally, most coastal ponds are close enough to an adjacent marine water body where hydromodification (e.g., creation of manmade channels to promote flushing) could be a cost-beneficial means of reducing the impacts of nitrogen loading. The land use around most coastal ponds in Suffolk County is medium and high density residential. Unfortunately, because of the lack of water quality data, load reduction goals could not be established for most coastal ponds. Preliminary load reduction goals of 58 percent and 72 percent were established for Georgica Pond and Agawam Lake; however, these goals should be used as preliminary targets and should be refined after additional monitoring data has been collected to properly characterize the freshwaters and coastal ponds of Suffolk County. Water quality within the coastal ponds is generally poor and characterized by the occurrence of frequent HABs, elevated chlorophyll-*a*, and low dissolved oxygen (in water bodies where water quality data exists).

Combined, the wastewater management priority area rank is Priority Rank 1 with an overall water quality goal of 63 percent. As mentioned above, the load reduction goal should be used with caution as a preliminary planning tool only.

4.1.1.14 Wastewater Management Area 14 – Shinnecock Bay Restoration and Protection Area I

The Shinnecock Bay Restoration and Protection Area I Wastewater Management Area includes eight individual water bodies located within Shinnecock Bay of the SSER. Five of the water bodies are poorly characterized for water quality while the remaining three are well characterized. Wastewater Management Area 14 generally includes water bodies with the poorest water quality and highest sensitivity to nitrogen within Shinnecock Bay and its connected water bodies and includes five water bodies with an individual surface water rank of Priority Rank 1 and three with a Priority Rank of 2. Individual load reduction goals for ideal water quality range from 0 percent to 87 percent. It should be noted that the large range in load reduction goals is primarily due to the incorporation of Shinnecock Bay Central and Penny Pond, Wells Smith and Gilbert Creeks, which have load reduction goals of three percent and 0 percent, respectively. Shinnecock Bay Central generally has good water quality based on the eastern sampling stations due to the proximity to the Shinnecock Inlet and poor water quality at the western sampling stations and Penny Pond, Wells Smith and Gilbert Creeks are poorly characterized for water quality. Land use around the area includes a mix of low, medium, and high density residential, with the majority of parcels identified as medium density residential. Water quality within Wastewater Management Area 14 water bodies is generally poor to fair and is characterized by the occurrence of frequent HABs, elevated chlorophyll-*a*, low dissolved oxygen and poor water clarity within the well characterized water bodies, with the exception of eastern Shinnecock Bay Central.

Combined, the wastewater management priority area rank is Priority Rank 1 with an overall ideal water quality goal of 52 percent.

4.1.1.15 Wastewater Management Area 15 – Shinnecock Bay Restoration and Protection Area II

The Shinnecock Bay Restoration and Protection Area II Wastewater Management Area includes five individual water bodies located within Eastern Shinnecock Bay. Three of the water bodies are poorly characterized for water quality while the remaining two are well characterized. Wastewater Management Area 15 generally receives the benefit of enhanced flushing through the close proximity to Shinnecock Inlet, which results in good water quality and moderate sensitivity to nitrogen. While the well characterized surface waters within this wastewater management area currently exhibit good water quality, select individual load reduction goals for many of the same waters are elevated, suggesting that these water bodies may be vulnerable to water quality degradation in the future. Three of the water bodies in this management area have an individual surface water priority rank of Priority Rank 4 and the remaining two are Priority Rank 3. Individual load reduction goals for ideal water quality range between 0 and 56 percent. Land use around the area is diverse and primarily includes a mix of low, medium, and high density residential with the majority of parcels assigned as medium density residential.

Combined, the wastewater management priority area rank is Priority Rank 4 with an overall ideal water quality goal of 20 percent.

4.1.1.16 Wastewater Management Area 16 - Moriches Bay Restoration and Protection Area I

The Moriches Bay Restoration and Protection Area I Wastewater Management Area includes 15 individual water bodies located within Moriches Bay, Quantuck Bay, the Forge River, and their connecting water bodies of the SSER. Nine of the water bodies are poorly characterized for water quality while the remaining six are well characterized. Wastewater Management Area 16 generally includes water bodies with the poorest water quality and highest sensitivity to nitrogen within the Moriches Bay region and its connected water bodies and includes 11 water bodies with an individual surface water rank of Priority Rank 1 and four with an individual rank of Priority Rank 2. Individual load reduction goals for overall water quality range from 31 percent to 93 percent with the majority of the water bodies having a load reduction goal of greater than 80 percent. Land use around the area is intense and includes a mix of low, medium, and high density residential, along with agricultural use in select subwatersheds, with the majority of parcels assigned as medium density residential. With high predicted nitrogen loads combined with poor flushing due to the presence of the barrier beaches, water quality within Wastewater Management Area 16 water bodies is poor and is characterized by the occurrence of frequent HABs, elevated chlorophyll-*a*, low dissolved oxygen and poor water clarity within the well characterized water bodies.

Combined, the wastewater management priority area rank is Priority Rank 1 with an overall ideal water quality goal of 88 percent.

4.1.1.17 Wastewater Management Area 17 – Moriches Bay Restoration and Protection Area II

The Moriches Bay Restoration and Protection Area II Wastewater Management Area includes seven individual water bodies located within western Moriches Bay, Narrow Bay, and their connecting water bodies. Four of the water bodies are poorly characterized for water quality, while the remaining three are well characterized. Wastewater Management Area 17 generally receives the benefit of enhanced flushing through the close proximity to Moriches Inlet, which results in good water quality and moderate sensitivity to nitrogen. Because of the geometry associated with the contributing areas of subwatersheds adjacent to Narrow Bay, Narrow Bay's subwatershed generally receives a lower overall nitrogen load per unit volume than nearby water bodies resulting in a lower priority rank and nitrogen load reduction goal (e.g., when compared to the unsewered areas of Great South Bay and Moriches Bay East). The majority of the water bodies in this management area have an individual surface water priority rank of Priority Rank 2 with one water body receiving Priority Rank 3 (Hart's Cove). Individual load reduction goals for ideal water quality range between 0 and 86 percent; however, the majority of the load reduction goals are 69 percent or lower. Land use around the area includes primarily a mix of low, medium, and high density residential with the majority of parcels assigned as medium density residential. In addition, there are agricultural land use parcels in Harts Cove.

Combined, the wastewater management priority area rank is Priority Rank 2 with an overall ideal water quality goal of 41 percent.

4.1.1.18 Wastewater Management Area 18 – Great South Bay Restoration Area I

The Great South Bay Restoration Area I Wastewater Management Area includes 22 individual water bodies located within and connected to generally unsewered areas discharging to Great South Bay. Sixteen of the water bodies are poorly characterized for water quality while the remaining six are well characterized. The poorly characterized water bodies generally represent the freshwater/tidal stream systems that drain into Great South Bay, while the well characterized water bodies represent the larger embayments. The water bodies within Wastewater Management Area 18 represent some of the most impacted surface waters in Suffolk County due to the intense unsewered residential land use combined with extremely poor flushing due to the presence of the barrier islands. Not surprisingly, all water bodies within this management area received individual surface water priority ranks of Priority Rank 1. Individual load reduction goals for ideal water quality range from 78 percent to 97 percent. Land use around the area is intense and includes a mix of primarily medium and high density residential. Water quality in Wastewater Management Area 18 is poor and is characterized by the occurrence of frequent HABs, elevated chlorophyll-*a*, low dissolved oxygen and poor water clarity within the well characterized water bodies.

Combined, the wastewater management priority area rank is Priority Rank 1 with an overall ideal water quality goal of 93 percent, which represents the highest overall regional load reduction goal in the County.

4.1.1.19 Wastewater Management Area 19 – Great South Bay Restoration Area II

The Great South Bay Restoration Area II Wastewater Management Area includes 16 individual water bodies located within and connected to the sewered sections of Great South Bay contributing area. Twelve of the water bodies are poorly characterized for water quality, while the remaining four are well characterized. The poorly characterized water bodies generally represent the freshwater/tidal stream systems that drain into Great South Bay while the well characterized water bodies represent the larger embayments. Wastewater Management Area 19 receives the benefit of the Southwest Sewer District (SWSD), which has resulted in incremental water quality benefits when compared to the unsewered sections of Great South Bay, and comparatively lower load reduction goals. However, the combination of legacy nitrogen (e.g., nitrogen that continues to seep into the Bay from groundwater that is older than the SWSD), nitrogen contributions from unsewered areas north of the SWSD, poor flushing associated with the barrier islands, and mixing of nitrogen from the unsewered eastern Great South Bay continue to result in overall poor water quality within this management area. All water bodies in this management area have an individual priority rank of Priority Rank 1. Individual load reduction goals for overall water quality range between 0 and 86 percent; however, it should be noted that the load reduction goal range for ideal water quality for the well characterized embayments is from 39 to 53 percent. Land use around the area is intense and includes a mix of primarily medium and high density residential. While water quality in the sewered portions of Great South Bay show incremental benefit when compared to the unsewered areas, water quality in Wastewater Management Area 19 is still considered poor and is characterized by the occurrence of frequent HABs, elevated chlorophyll-*a*, low dissolved oxygen and poor water clarity within the well characterized water bodies.

Combined, the wastewater management priority area rank is Priority Rank 1 with an overall ideal water quality goal of 44 percent.

4.1.1.20 Wastewater Management Area 20 – Lake Ronkonkoma

The Lake Ronkonkoma Wastewater Management Area includes the Lake Ronkonkoma groundwater contributing area. When compared to the other fresh water bodies studied within this SWP, Lake Ronkonkoma's water quality is generally considered well characterized and is generally poor to fair with occasional HABs, elevated chlorophyll-*a*, and pathogen impacts. Based upon the observed water quality, predicted nitrogen loads, and predicted residence time, Lake Ronkonkoma received a surface water priority rank of Priority Rank 1, and a load reduction goal of 52 percent. It should be noted that the load reduction goal should be used with caution as a preliminary planning tool since insufficient fresh water quality data exists in Suffolk County to establish a local nitrogen load reference threshold.

4.1.1.21 Wastewater Management Area 21 – Atlantic Ocean

The Atlantic Ocean Wastewater Management Area includes the direct groundwater contributing area to the Atlantic Ocean along the eastern end of the South Fork of Suffolk County. As an open water body with generally excellent water quality, the open waters of the Atlantic Ocean received a priority rank of Priority Rank 4 and a load reduction goal of 0 percent. Despite this overall characterization, it should be noted that the near shore contributing area of the Atlantic Ocean (e.g., the 0 to 2-year groundwater contributing area) is still considered a high priority for wastewater upgrades in Suffolk County as these areas have a higher likelihood of contributing to pathogen impacts in nearby recreational beaches.

4.1.2 Aggregated Wastewater Management Area Priority Rank and Nitrogen Load Reduction Establishment

After individual water bodies were assigned to a specific management area, the management area's overall priority rank was established as the average priority rank of all individual water bodies within the management area. The average wastewater management area load reduction goals were established as the sum of total goal loads (e.g., total nitrogen reduction required) for the well-characterized water bodies divided by the total nitrogen loads for the well-characterized water bodies within each management area. The Wastewater Management Areas and nitrogen load reduction targets for each are shown on **Figure 4-3** and summarized on **Table 4-2**.

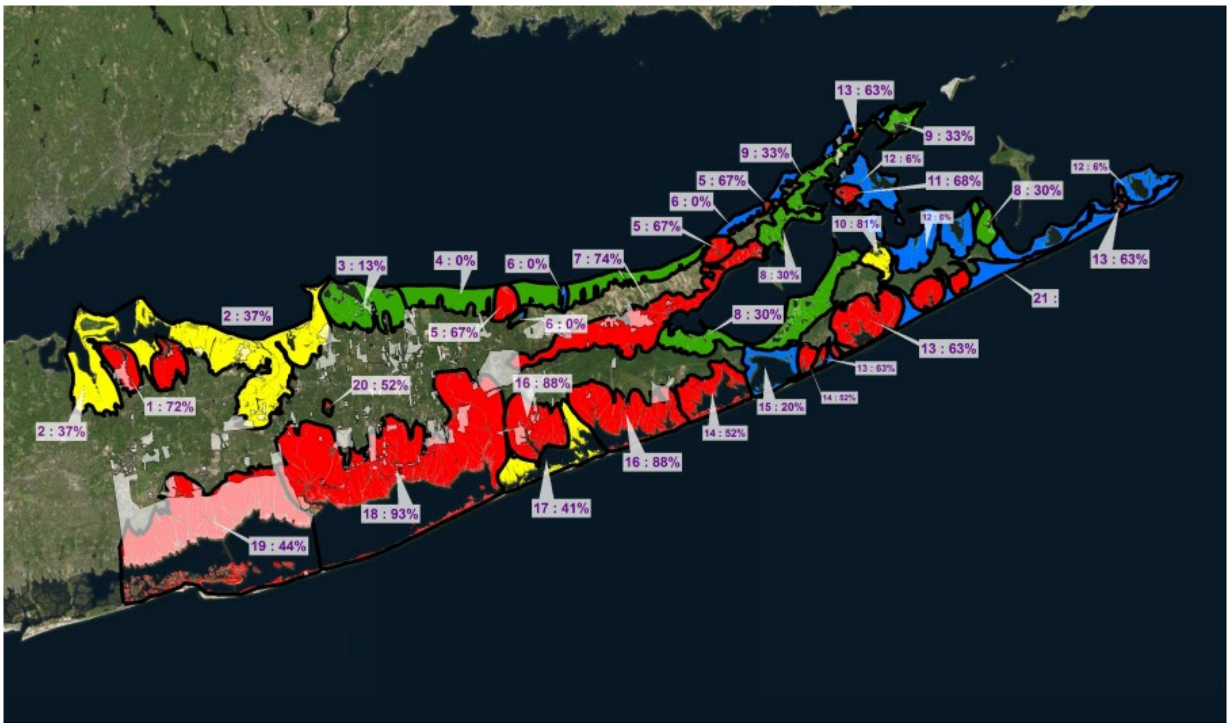


Figure 4-3 Wastewater Management Areas and Nitrogen Load Reduction Targets

In general, nitrogen load reduction goals are consistent with the priority area rankings documented in Section 2, that is, they are greatest in the most densely developed and poorly flushed subwatersheds (e.g., unsewered areas discharging to Great South Bay and the western part of the Peconic Estuary) , and lowest in the less densely developed subwatersheds and those that are well flushed (such as central and eastern Long Island Sound, eastern Peconic Estuary and the Atlantic Ocean).

Table 4-2 Nitrogen Load Reduction Management Areas and Nitrogen Load Reduction Targets

Management Area	Management Area Name	Management Area Reference Water Body HAB/DO Improvement Goal*	Management Area Reference Water body Overall Water Quality Improvement Goal*	Achievable Reduction through On-Site Wastewater Management
1	Western Long Island Sound Harbor Restoration Areas	44%	72%	50%
2	Long Island Sound Harbors and Bays Restoration and Protection Area I	23%	37%	43%
3	Long Island Sound Harbors and Bays Restoration and Protection Area II	5%	13%	45%
4	Central and Western Long Island Sound Open Waters Protection Area	0%	0%	16%
5	Long Island Sound Inlets and Creeks Restoration Area	34%	67%	39%
6	Eastern Long Island Sound Open Waters and Long Island Sound Fresh Waters Protection Area	0%	0%	5%
7	Peconic Estuary Restoration and Protection Area I	49%	74%	23%
8	Peconic Estuary Restoration and Protection Area II	14%	30%	34%
9	Peconic Estuary Restoration and Protection Area III	15%	33%	30%
10	Sag Harbor Cove and Connected Creeks	62%	81%	45%
11	West Neck Bay and Creek and Menantic Creek	37%	68%	42%
12	Peconic Estuary Restoration and Protection Area IV	0%	6%	11%
13	Coastal Ponds Restoration and Protection Water bodies	N/A	63%	36%
14	Shinnecock Bay Restoration and Protection Area I	28%	52%	44%
15	Shinnecock Bay Restoration and Protection Area II	0%	20%	42%
16	Moriches Bay Restoration Area I	76%	88%	48%
17	Moriches Bay Restoration Area II	18%	41%	48%
18	Great South Bay Restoration Area I	87%	93%	48%
19	Great South Bay Restoration Area II	2%	44%	27%
20	Lake Ronkonkoma	N/A	52%	48%
21	Atlantic Ocean	N/A	N/A	N/A

* Reduction goals of well-characterized water bodies within each management area used to calculate the weighted average management area nitrogen reduction goals shown.
The Overall Water Quality Improvement Goal is based on the reference water body approach for marine and mixed waters and EPA guidance value for freshwater.

4.1.3 Near Shore Priority Area Establishment

In addition to the individual ecologically driven priority areas discussed previously, Suffolk County, through collaboration with its stakeholders and project partners, has identified all near shore areas in Suffolk County (defined as the 0-2 year groundwater travel time to all surface water bodies in Suffolk County) as high priority areas for wastewater upgrades. The 0-2 year groundwater travel time to surface waters represents a unique opportunity to arrest and reverse increasing nitrogen trends observed in both groundwater and the receiving surface water bodies. Benefits of incorporating the 0-2 year groundwater contributing area as a top priority for wastewater upgrades include:

- The quickest return on investment relative to arresting and reversing increasing nitrogen trends in surface water bodies for most water bodies in Suffolk County;
- Addresses potential pathogen impacts from wastewater sources, if such sources are identified through further study as recommended in Section 8.4.8; and,
- Represents the most cost effective nitrogen load reduction area for nitrogen from wastewater sources as demonstrated in Section 2.2.2.

Based upon the rationale above, the 0-2 year groundwater contributing area was incorporated into the aggregated phased implementation map as a Phase II implementation (highest priority) element for wastewater upgrades.

4.2 Summary of Groundwater and Drinking Water Priority Areas

As described in Section 3 of this SWP, groundwater and drinking water priority areas for nitrogen load reduction were identified based on model-simulated groundwater concentrations in the shallow upper glacial aquifer and observed groundwater concentrations in untreated water withdrawn at community supply wells.

Figure 4-4 illustrates the Priority Areas for Groundwater and Drinking Water Protection and Restoration. As shown on **Figure 4-4**, Groundwater/Drinking Water Priority Rank 1 areas are shaded red, Priority Rank 2 areas are shown in yellow, and Priority Rank 3 areas are shown in blue.

Groundwater/Drinking Water Priority Rank 1 areas were established based on two criteria:

- Areas where groundwater model simulations identify that nitrogen concentrations greater than 10 mg/L will be observed in the shallow upper glacial aquifer in the five East End Towns where the majority of the County's estimated 30,000 private potable wells are located;
- Areas contributing recharge to community supply wellfields where measured concentrations in untreated water were observed to exceed 10 mg/L in 2018 and areas contributing recharge to community supply wellfields where groundwater model simulations estimate the nitrogen in untreated water will exceed 10 mg/L after 50 years based on existing conditions of water supply pumping and wastewater management or 50 years after projected build-out conditions are realized.

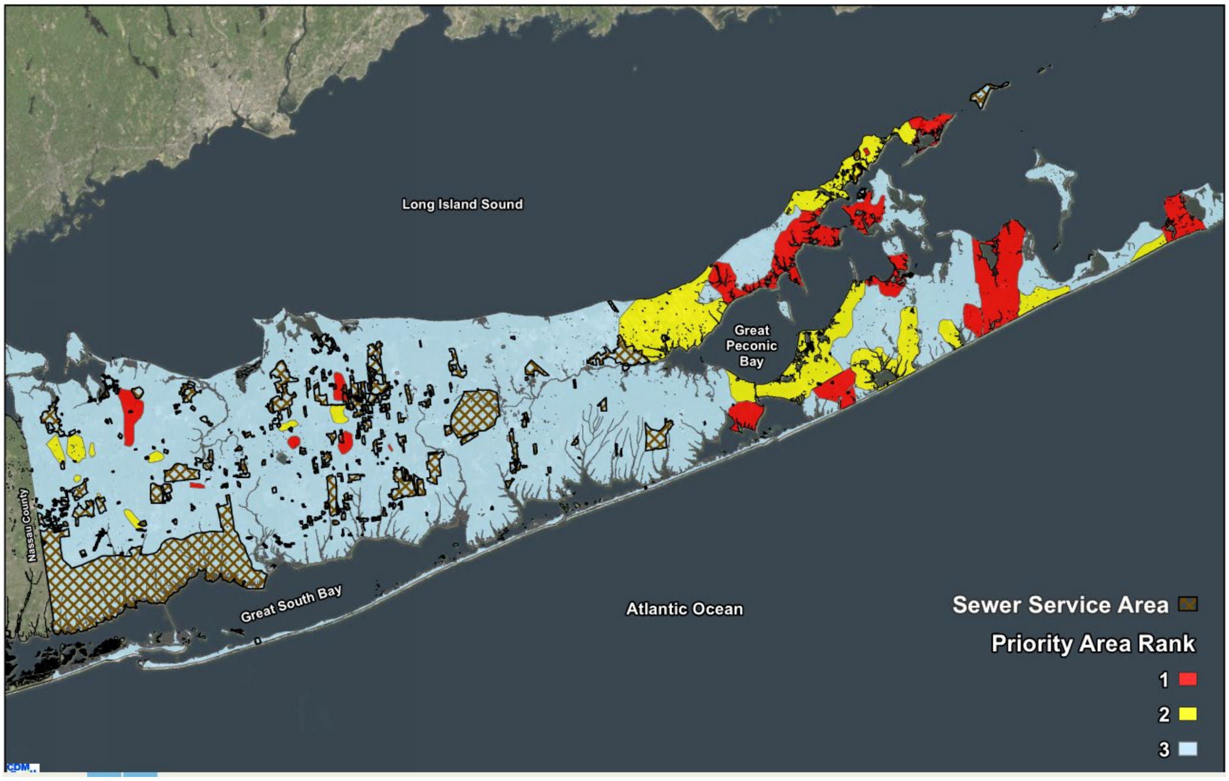


Figure 4-4 Groundwater Priority Areas for Nitrogen Load Reduction

Groundwater Priority Rank 2 areas were based on:

- Areas where the groundwater simulations identify nitrogen concentrations greater than 6 mg/L in the shallow upper glacial aquifer in the five East End Towns where the majority of the County's estimated 30,000 private potable wells are located and
- Areas contributing recharge to community supply wellfields where groundwater model simulations estimate the nitrogen in untreated water to exceed 6 mg/L after 50 years based on existing conditions of water supply pumping and wastewater management.

Recognizing the importance of groundwater and potable supply protection and that any area of the County could contribute to a community or private supply well in the future, the remaining areas in the County are identified as Priority Rank 3.

4.3 Integrated Priority Areas

The surface water priority areas identified in Section 2, groundwater/drinking water supply priority areas identified in Section 3, and near-shore areas described in Section 4.1.3 have been combined into a single Subwatersheds Wastewater Plan map for wastewater management implementation purposes.

The areas contributing groundwater to community supply wells are well defined, as the locations, depths, and pumping rates of these wells are mapped and compiled. Throughout the five western towns, the areas contributing groundwater to surface waters (e.g., subwatersheds) and the areas contributing groundwater to community supply wells are separate and distinct; e.g., recharging precipitation can only travel through the aquifer to discharge to one or the other.

Because the locations, depths and pumping rates of private wells are not defined, and because water withdrawn from these wells is largely recharged as sanitary wastewater on the same parcel from which it was withdrawn, these wells are not included in the groundwater model delineations of subwatersheds or contributing areas. Therefore, there is some overlap between the areas contributing groundwater to surface waters and the areas contributing groundwater to private potable wells, primarily in the East End Towns. Consequently, in the five East End Towns, some areas were ranked both for surface water restoration/protection and for groundwater/drinking water restoration and protection.

In each case, the higher of the two Priority Rankings (e.g., Surface Water or Groundwater/Drinking Water) is assigned to the overlapped area. For example, areas of the East End Towns receiving Groundwater Priority Rank 1 and Surface Water Priority Rank 2, 3 or 4 received an overall implementation Priority Rank of 1 and are recommended to be implemented as the highest priority area during Phase II of the overall Program discussed below.

The combined priority areas are shown on **Figure 4-5**. As shown on **Figure 4-5**, the map incorporates three aggregated implementation areas which include:

- Phase II areas: all surface water and groundwater/drinking water Priority Rank 1 areas and all near shore areas (e.g., 0-2 year groundwater contributing area);
- Phase III areas: all surface water contributing areas for Priority Ranks 2, 3, and 4 surface water bodies and all groundwater/drinking water Priority Rank 2 areas, and
- Phase IV areas defined as all other areas not included in Phases II and III.

A detailed description of the project phases is provided below in Section 4.4.

4.4 Countywide I/A OWTS Alternatives Evaluation

The following sections present an overview of the evaluation used to compare and contrast the benefits associated with a range of wastewater management implementation alternatives where the presumptive wastewater management upgrade method is the use of I/A OWTS. The alternatives were developed to provide perspective and identify implications to the program under the various policy triggers defined by the Article 6 Work Group and ultimately evaluate implications of varying degrees of implementation program aggressiveness and ramp-up rates. While this evaluation assumes that the majority of existing parcels with OSDS were upgraded to I/A OWTS, it should be noted that parcels identified as being presumptive for being sewered (see Section 4.5.2) were assumed to be connected to sewers. An evaluation of sewer expansion alternatives and preliminary identification of parcels that may benefit from sewering or clustering is provided below in Section 4.5. A Countywide Microsoft Access database was assembled to include many of the characteristics of each and every Suffolk County parcel evaluated in the SWP. Characteristics included physical parameters such as size and parcel-use and modeled parameters such as depth to groundwater and nitrogen load. This database enabled estimation of nitrogen load reductions and associated costs for specific areas. The database is described in **Appendix F**.

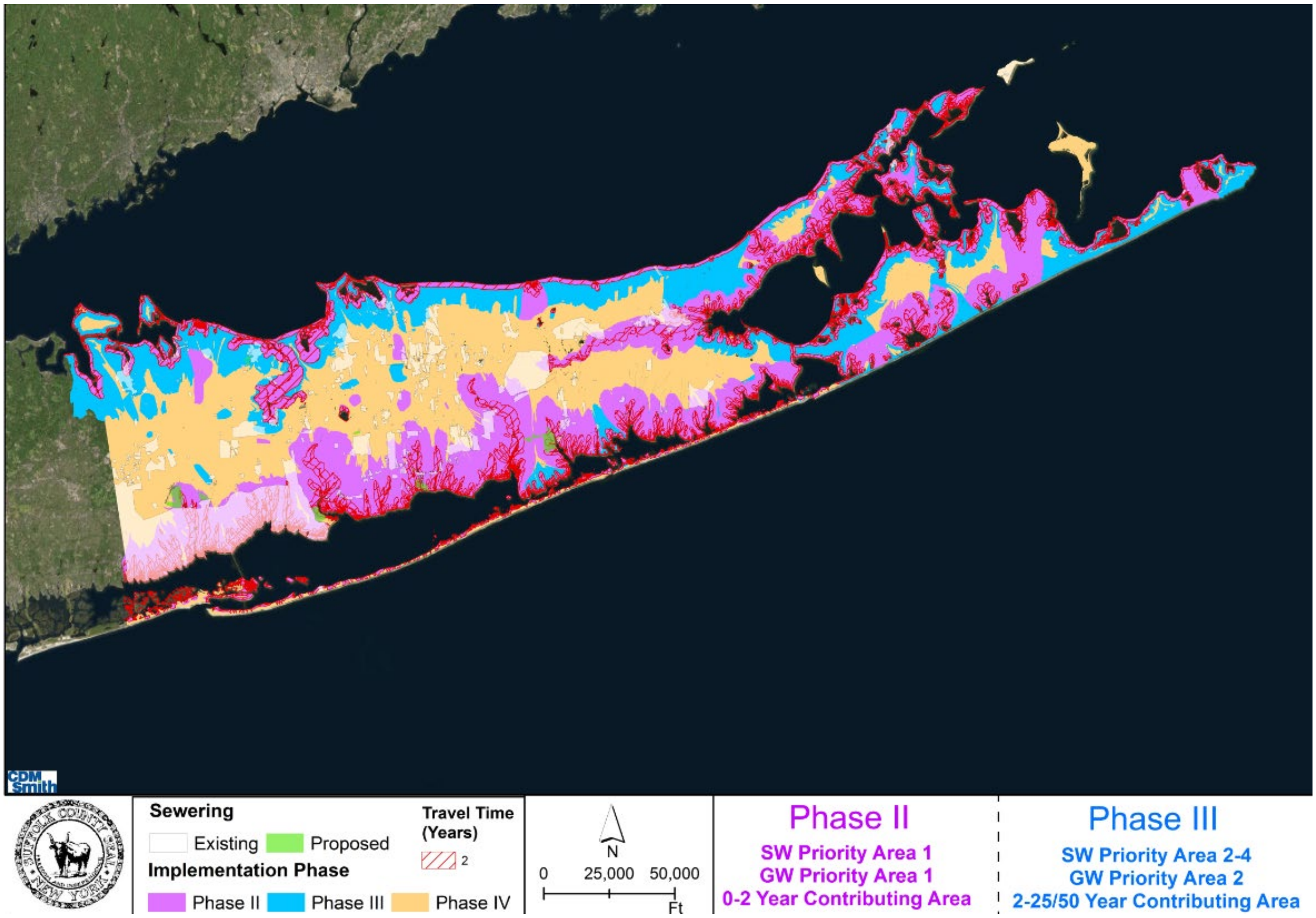


Figure 4-5 Priority Areas for Surface Water and Groundwater Protection

Using the parcel-specific Access database, a series of SWP implementation alternatives was evaluated to identify the policy options and associated schedules that could be implemented to reduce nitrogen loading to all priority surface waters and high priority groundwater areas. The evaluation of Suffolk County policy considerations and SWP implementation alternatives is described below. Suffolk County's objectives for SWP implementation guided the analysis of policy options. The County's objectives included establishment of implementation phases and associated schedules and budgets as summarized below:

- **Phase I** – The SWP program was to include a five-year Phase I "Ramp-up" period during which the County could establish a Countywide Water Quality Management District, establish a stable and recurring source of revenue to provide grant funding for the I/A OWTS upgrades, modify the County Sanitary Code and establish the Responsible Management Entity (RME) capabilities needed to manage and monitor the program and provide sufficient time for design professionals and the industry to build the requisite capacity to support full-scale implementation. During this period, I/A OWTS would be required for all new construction and the existing County, Town and Village voluntary I/A OWTS upgrades and

Town and Village I/A OWTS upgrade mandates would continue. Based on available funding and the Chesapeake Bay Restoration Fund Program example, it is assumed that up to 1,000 upgrades could be implemented each year during the five-year Phase I period.

- **Phase II** – During the Phase II period, I/A OWTS installations would continue for new construction and the existing County, Town and Village voluntary I/A OWTS upgrades and Town and Village I/A OWTS upgrade mandates would continue. In addition, I/A OWTS would be required in the 0 to 2-year groundwater contributing area for all surface waters, within all surface water Priority Rank 1 areas and within all groundwater/surface water Priority Rank 1 areas. The objective is to complete all I/A OWTS installations in this area within 30 years.
- **Phase III** - During the Phase II period, I/A OWTS installations would continue for new construction and the existing County, Town and Village voluntary I/A OWTS upgrades and Town and Village I/A OWTS upgrade mandates would continue. In addition, I/A OWTS installations would be required in the groundwater contributing areas for all surface water Priority Rank 2, 3 and 4 areas, and all groundwater/drinking water Priority Rank 2 areas. The objective is to complete all I/A OWTS installations in this area within 15 years so that all surface water Priority areas and all groundwater/drinking water Priority Rank 1 and 2 areas are completed within 45 years.
- **Phase IV** – During the Phase IV period wastewater management would be addressed at all remaining parcels in the County that were not addressed during Phases I through III. The Phase IV schedule has not yet been identified as it will be established based on the evaluations conducted during the first three phases of the program, but it would begin when Phase III is complete.
- The project schedule should maintain a steady growth rate so that incremental increase in annual l/A OWTS upgrades was approximately 2,500 year.
- Annual funding requirements should not exceed more than $50M to $75M.

Policy options triggering the need to install I/A OWTS included:

- New construction;
- OSDS failure;
- Property transfer;
- Building expansion and
- Voluntary upgrades.

The alternatives evaluation considered various funding levels for each of the I/A OWTS triggers. The main alternatives that were evaluated using the Access database to calculate the number of parcels, associated costs and funding requirements and nitrogen reductions achieved are identified on **Table 4-3** in Sections 4.4.1 and 4.4.2 below, and an overview of the recommended program is provided in Section 4.4.3.

4.4.1 Description of Alternatives

Eight Countywide wastewater management alternatives were evaluated to identify a recommended roadmap for a Countywide wastewater upgrade program assuming that all existing unsewered parcels not presumed to be connected to sewers are upgraded to I/A OWTS. The alternative numbers are generally arranged in order of least aggressive (Alternative 1) to most aggressive (Alternative 8). Whenever possible, the alternatives incorporate program models and lessons learned from wastewater upgrade programs at proximal jurisdictions. The Article 6 policy options triggering the need to install I/A OWTS were identified by the Article 6 Workgroup including:

- New construction;
- OSDS failure;
- Property transfer;
- Building expansion and
- Voluntary upgrades.

For the purpose of cost development, it was assumed that grant funding would continue to be made available for voluntary I/A OWTS installations and those triggered by OSDS failure. While proximal jurisdictions do not offer grant funding for upgrades at property transfer, the residents of Suffolk County have expressed concerns about the potential financial implications of requiring upgrades at property transfer without offering grants to offset the upgrade cost. Suffolk County acknowledges this legitimate concern as property values vary dramatically geographically. For low property values, the cost of a wastewater upgrade could be a significant fraction of the overall property sale, potentially resulting in a significant economic burden on the property owner. Ultimately, providing partial or full grant funding for qualifying property transfers may be needed to make the recommendations of the SWP affordable to the residents of Suffolk County.

To provide an initial revenue range to accommodate this potential need, an annual stable recurring revenue source range is provided for the preferred alternative (Alternative 4) below. The low end of the cost range assumes property transfer does not qualify for grant funding, a mid-range alternative assumes that property transfer qualifies for 50 percent grant funding, while the upper end of the cost range assumes that the cost of wastewater upgrades under property transfer are covered 100 percent through grant funding. Alternatives 1 through 6 were created to evaluate the advantages and disadvantages of implementing the program under various I/A OWTS upgrade triggers. Each of these alternatives share the following overarching program structure, based upon the implementation of a phased approach that targets the highest priority areas first:

- Phase I: A five-year phase with the primary objective(s) of:
    - Requiring I/A OWTS for all new construction;
    - Establishment of a stable and recurring revenue source;
    - Establishment of a Countywide Water Quality Management District; and,

Table 4-3 Summary of Wastewater Alternatives Comparative Analysis

Alternative #	Alternative Description	Total Implementation Time For Highest Priority Areas (Phase II)	Total Implementation Time (All Priority Areas, Phase II+III)	Largest Incremental Increase in Upgrades per Year	Maximum # of Annual Upgrades (no NC) (not scored)	Maximum Estimated Annual Cost Needed for Stable Recurring Revenue Source	Final Score
1	- Phased implementation to accommodate program growth - Four phases I: 5-Year RME Ramp Up II: Highest Priority Areas with inter-phases III: Secondary Priority Areas IV: Remaining Parcels Countywide - Maximum 1,000 upgrades per year; not dependent on upgrade triggers - Voluntary and system failure upgrades are funded 100% - New construction of a building addition is funded 50% - Property transfer upgrades do not qualify for funding	166 years (0 points)	239 years (0 points)	1000/year (3 points)	1000/year	$20M/year (3 points)	**6**
2	- Phased implementation to accommodate program growth - Four phases, same as alternative 1 - Upgrade triggers: New Construction, System Failure, Voluntary - Voluntary and system failure upgrades are funded 100% - New construction of a building addition is funded 50%	60 years (1 point)	87 years (0 points)	1,984/year (3 points)	3,478/year	$66M/year (2 points)	**6**
3	- Phased implemention to accommodate program growth - Four phases, same as alternative 1 - Upgrade triggers: New Construction, Property Transfer, Voluntary - Voluntary upgrades are funded 100% - New construction of a building addition is funded 50% - Property transfer upgrades do not qualify for funding	50 years (1 point)	71 years (1 point)	2,950/year (2 points)	3,950/year	$19M/year (3 points)	**7**
4 Recommended Alternative	- Phased implementation to accommodate program growth - Four phases, same as alternative 1 - Upgrade triggers: New Construction, Property Transfer, System Failure, Voluntary - Voluntary and system failure upgrades are funded 100% - New construction of a building addition is funded 50% - Property transfer upgrades do not qualify for funding (Alternative 4A), are funded 50% (Alternative 4B), or are funded 100% (Alternative 4C)	30 years (3 points)	45 years (3 points)	2,894/year (2 points)	6,998/year	Alternative 4A - $68M/year (2 points) Alternative 4B - $103M/year (0 points) Alternative 4C - $140/year (0 points)	**Alternative 4A -10 Alternatives 4B and 4C - 8**
5	- Phased implementation to accommodate program growth - Four phases, same as alternative 1, except no inter-phasing within Phase II - Upgrade triggers: New Construction, System Failure, Property Transfer, Voluntary - Voluntary and system failure upgrades are funded 100% - New construction of a building addition is funded 50% - Property transfer upgrades do not qualify for funding	17 years (3 points)	30 years (3 points)	9,592/year (0 points)	10,592/year	$99M/year (1 point)	**7**
6	- Phased implementation to accommodate program growth - Property Transfer implemented immediately - Four phases, same as alternative 1, except no inter-phasing within Phase II - Upgrade triggers: New Construction, System Failure, Property Transfer, Voluntary - Voluntary and system failure upgrades are funded 100% - New construction of a building addition is funded 50% - Property transfer upgrades do not qualify for funding	8 years (3 points)	15 years (3 points)	12,987/year (0 points)	14,758/year	$78.5M/year (1 point)	**7**
7	- Little phasing to accommodate program growth - Three phases I: 5-Year RME Ramp Up II: All Priority Areas III: Remaining Parcels Countywide - No inter-phasing within Phase II - Upgrade Triggers: New Construction, System Failure, Property Transfer, Voluntary - Voluntary and system failure upgrades are funded 100% - New construction of a building addition is funded 50% - Property transfer upgrades do not qualify for funding	12 years (3 points)	19 years (3 points)	13,336/year (0 points)	14,336/year	$131M/year (0 points)	**6**
8	- No phasing to accommodate program growth - Two phases I: 5-Year RME Ramp Up II: All Parcels Countywide - Upgrade Triggers: New Construction, System Failure, Property Transfer, Voluntary - Voluntary and system failure upgrades are funded 100% - New construction of a building addition is funded 50% - Property transfer upgrades do not qualify for funding	9 years (3 points)	9 years (3 points)	21,394/year (0 points)	22,394/year	$201M/year (0 points)	**6**

- Continuation of the existing voluntary upgrade program(s) and Town/Village mandates.

- Phase II: The timeframe of the phase varies based upon the I/A OWTS upgrade triggers selected. The kick-off for this phase is the collection of revenue from the stable recurring revenue source. This phase has the following primary objective(s):

  - Continuation of existing voluntary upgrade program(s) and Town/Village mandates;

  - Implementation of wastewater upgrades within the 0 to 2-year groundwater contributing area for all surface water bodies, within all surface water Priority Rank 1 areas, and within all groundwater/drinking water Priority Rank 1 areas (e.g., areas with existing or predicted total nitrogen of greater than 10 mg/L).

- Phase III: The timeframe of the phase varies based upon the I/A OWTS upgrade triggers selected. The kick-off for this phase is the completion of upgrades within all Phase II priority areas. This phase has the following primary objective(s):

  - Continuation of existing voluntary upgrade program(s) and Town/Village mandates;

  - Implementation of wastewater upgrades within the 2- to 25/50-year groundwater contributing area for all surface water bodies and within all groundwater/drinking water Priority Rank 2 areas (e.g., areas with predicted total nitrogen of between 6 mg/L and 10 mg/L).

- Phase IV: The timeframe of this phase is not included within the SWP and shall be determined based on future analysis during subsequent program evaluations (see Section 8.4.11 – Adaptive Management Plan). The kick-off of this phase is the completion of upgrades within all Phase III priority areas. The primary objective of this phase to upgrade all remaining parcels in Suffolk County that were not addressed during Phases I through III above.

A summary of Alternatives 1 through 6 is provided below followed by a brief description of the advantages and disadvantages of each alternative.

- **Alternative 1: Incorporates the four-phase program described previously. Assumes that the maximum I/A OWTS upgrade rate for existing properties is 1,000 upgrades per year based upon the current upgrade rate under the Chesapeake Bay Restoration Fund Program. This alternative was evaluated to provide perspective on the estimated timeframe for wastewater upgrades in Suffolk County under a scenario where Suffolk County achieves an upgrade rate consistent with the Chesapeake Bay Program, which currently leads the nation in number of upgrades per year. For the purposes of this analysis, the assumption is that all upgrades would be funded at 100 percent through the stable recurring revenue source and there are no specific upgrade triggers.**

  Since the number of I/A OWTS upgrades is limited to 1,000 per year, the amount of time to complete all upgrades is very high when compared to the goal of 30 years for upgrades within all Phase II areas and 45 years for upgrades within all Phase II and Phase III areas.

Specifically, this alternative will take 166 years to complete Phase II and a total of 239 years to upgrade all priority areas by the end of Phase III. The cost to fund the upgrades falls below the range of potential funding evaluated under the various stable and recurring revenue source models. The maximum incremental step increase in annual upgrades is within the range that is forecast to be acceptable for accommodating industry and RME ramp-up.

- **Alternative 2: Incorporates the four-phase program described previously. Assumes that the only upgrade trigger for existing properties is existing OSDS failure, and the new construction of a building addition, which occur during Phases II and III. System failure and voluntary upgrades are 100 percent funded through the stable recurring revenue source. New construction of a building addition is 50 percent funded.**

  To accommodate industry and RME ramp-up, Phase II has two sub-phases that disaggregate when new geographic priority areas are implemented. Since the property transfer trigger is not included, the amount of time to complete all upgrades is very high when compared to the goal of 30 years for upgrades within all Phase II areas and 45 years for upgrades within all Phase II and Phase III areas. Specifically, this alternative will take 60 years to complete Phase II and 87 years to upgrade all priority areas by the end of Phase III. The cost to fund the upgrades falls within the range of potential funding evaluated under the various stable and recurring revenue source models. The maximum incremental step increase in annual upgrades is within the range that is forecast to be acceptable for accommodating industry and RME ramp up.

- **Alternative 3: Incorporates the four-phase program described previously. Assumes that the only upgrade trigger for existing properties is property transfer, and the new construction of a building addition, which occur during Phases II and III. Voluntary upgrades are funded 100 percent through the stable recurring revenue source, new construction of a building addition is funded 50 percent, and upgrades at property transfer do not qualify for funding.**

  To accommodate industry and RME ramp-up, Phase II has two sub-phases that disaggregate when new geographic priority areas are implemented. Since the system failure trigger is not included, the length of time to complete all upgrades is very long when compared to the goal of 30 years for upgrades within all Phase II areas and 45 years for upgrades within all Phase II and Phase III areas. Specifically, this alternative will take 50 years to complete Phase II and 71 years to upgrade all priority areas by the end of Phase III. The cost to fund the upgrades is below the range of potential funding evaluated under the various stable and recurring revenue source models. The maximum incremental step increase in annual I/A OWTS installs is within the range that is forecast to be acceptable for accommodating industry and RME ramp-up.

- **Alternative 4 (includes sub-Alternatives 4A , 4B, and 4C):** Incorporates the four-phase program described previously. Includes upgrade triggers for existing properties at property transfer, existing OSDS failure, and the new construction of a building addition which occur during Phases II and III. Alternative 4 also includes the implementation of ramp-up sub-phases during Phase II to accommodate program ramp-up. Voluntary upgrades and system failure are 100 percent funded through the stable recurring revenue source under

Alternative 4A; Alternative 4B assumes voluntary upgrades and system failure are funded 100 percent and property transfer is funded 50 percent; while **Alternative 4C** assumes system failure, voluntary upgrades, and property transfer are 100 percent funded. New construction of a building addition is 50 percent funded under all alternatives.

To accommodate industry and RME ramp-up, Phase II has several sub-phases that geographically disaggregate when new triggers or priority areas are implemented. The amount of time to complete all upgrades is equivalent to the goals of 30 years for upgrades within Phase II areas and 45 years for upgrades within all Phase II and Phase III areas. Specifically, this alternative will take approximately 30 years to complete Phase II and 45 years to upgrade all priority areas by the end of Phase III. The cost to fund the upgrades is within the range of potential funding evaluated under the various stable and recurring revenue source models under Alternative 4A but exceeds the evaluated funding sources under Alternatives 4B and 4C. The maximum incremental step increase in annual installs is within the range that is forecast to be acceptable for accommodating industry and RME ramp up.

- **Alternative 5: The same as Alternative 4 but does not include program sub-phases to accommodate program ramp-up. Upgrade triggers for existing properties at property transfer, system failure, and the new construction of a building addition initiate at the same time in Phase II.**

  Phase II has no sub-phases for new triggers or priority areas and therefore the implementation time is faster. The amount of time to complete all upgrades is faster than the goal of 30 years for upgrades within Phase II areas and close to the goal of 45 years for upgrades within all Phase III areas. Specifically, this alternative will take approximately 17 years to complete Phase II and 30 years to upgrade all priority areas by the end of Phase III. The cost to fund the upgrades is greater than the range of potential funding evaluated under the various stable and recurring revenue source models. The maximum incremental step increase in annual installs is above the range that is forecast to be acceptable for accommodating industry and RME ramp-up.

- **Alternative 6: Similar to Alternative 4, I/A OWTS are required Countywide for property transfer immediately along with for new construction on vacant lots. Alternative 6 incorporates the four-phase program described previously and includes upgrade triggers for existing properties at property transfer (immediately), existing OSDS failure (at Phase II), and the new construction of a building addition, which occur during Phases II and III. Voluntary upgrades and OSDS failure are 100 percent funded through the stable recurring revenue source, new construction of a building addition is 50 percent funded, and upgrades at property transfer do not qualify for funding.**

  The purpose of this alternative is to determine if implementing I/A OWTS upgrades Countywide on all property transfers is feasible. Since property transfer is not phased in, the amount of time to complete all upgrades is faster than the goals of 30 years for upgrades within Phase II areas and 45 years for upgrades within all Phase II and Phase III areas. Specifically, this alternative will take approximately eight years to complete Phase II and 15 years to upgrade all priority areas by the end of Phase III. Since property transfer does not qualify for funding, the cost to fund the upgrades is still within the range of potential funding evaluated under the various stable and recurring revenue source models. However, the maximum incremental step increase in annual installs is much higher than the range that is forecast to be acceptable for accommodating industry and RME ramp- up.

Alternatives 7 and 8 were developed to compare the implications to the program if the geographic target area phases were expanded to be more aggressive, when compared to the phased geographic areas described in Alternatives 1 through 6. A summary of Alternatives 7 and 8 is provided below followed by a brief description of the advantages and disadvantages for each alternative. It should be noted that while these alternatives were evaluated, it is not believed that they are realistic given the extremely high annual cost requirement and because they do not provide for any accommodation of industry and RME ramp-up.

- **Alternative 7: Includes three program phases as follows:**
  - **Phase I: Same as Alternatives 1 through 6;**
  - **Phase II: Wastewater upgrades in ALL priority areas; and,**
  - **Phase III: Wastewater upgrades in all remaining areas.**

  As shown above, the primary difference between Alternatives 1 through 6 and Alternative 7 is that Alternative 7 initiates wastewater upgrades in ALL priority areas simultaneously, instead of breaking them down into separate phases wherein the highest priority areas are addressed first (Alternatives 1 through 6). Alternative 7 includes I/A OWTS upgrade triggers for existing properties at property transfer, existing OSDS failure, and new construction of a building addition, which are initiated during Phase II. Voluntary and system failure upgrades are funded 100 percent through the stable recurring revenue source, new construction of a building addition is funded 50 percent, and upgrades at property transfer do not qualify for funding.

  The purpose of Alternative 7 is to evaluate the implications to the program if upgrades using ALL trigger mechanisms are required in ALL priority areas simultaneously during Phase II. Under Alternative 7, the amount of time to complete all priority area upgrades is approximately 19 years. The largest incremental increase in the number of installs per year is greater than 10,000, which would not support industry and RME growth and would likely exceed their capacity. The estimated annual cost needed for the stable and recurring revenue source is $131 million/year, which exceeds the range of potential funding evaluated under the various stable and recurring revenue source models.

- **Alternative 8: Includes two program phases as follows:**
  - **Phase I: Same as Alternatives 1 through 6; and,**
  - **Phase II: Wastewater upgrades for ALL parcels, Countywide.**

  As shown above, the primary difference between Alternatives 1 through 6 and Alternative 8 is that Alternative 8 initiates wastewater upgrades for ALL parcels Countywide, with no incorporation of the priority areas. Alternative 8 includes upgrade triggers for existing properties at property transfer, existing OSDS failure, and new construction of a building addition, which are initiated during Phase I. Voluntary and system failure upgrades are funded 100 percent through the stable recurring revenue source, new construction of a building addition is funded 50 percent, and upgrades at property transfer do not qualify for funding.

The purpose of Alternative 8 is to evaluate the implications to the program if upgrades using ALL trigger mechanisms are required for all parcels Countywide during Phase II. Under Alternative 8, the amount of time to complete all priority area upgrades is approximately nine years. The largest incremental increase in the number of installs per year is greater than 20,000 which would not be supported by industry and RME growth and would likely exceed their capacity. The estimated annual cost needed for the stable and recurring revenue source is $200 million/year, which exceeds the range of potential funding evaluated under the various stable and recurring revenue source models.

4.4.2 Alternatives Scoring and Comparative Analysis

In an effort to provide unbiased selection of a recommended alternative, a scoring system was used to rank each of the alternatives evaluated. The scoring system was based on the following criteria:

- Implementation time for highest Priority Areas:
  - 3 points for less than or equal to 30 years
  - 2 points for less than or equal to 45 years
  - 1 point for less than or equal to 60 years
  - 0 points for greater than 60 years
- Implementation time for all Priority Areas:
  - 3 points for less than or equal to 45 years
  - 2 points for less than or equal to 60 years
  - 1 point for less than or equal to 75 years
  - 0 points for greater than 75 years
- Accommodation of industry and RME growth:
  - 3 points for incremental upgrade rate increase less than or equal to 2,500 systems/year
  - 2 points for incremental upgrade rate increase less than or equal to 5,000 systems/year

  - 1 point for incremental upgrade rate increase less than or equal to 7,500 systems/year
  - 0 points for incremental upgrade rate increase greater than 7,500 systems/year
- Estimated annual funding need for stable and recurring revenue source:
  - 3 points for annual revenue need of less than or equal to $50M/year
  - 2 points for annual revenue need of less than or equal to $75M/year
  - 1 point for annual revenue need of less than or equal to $100M/year
  - 0 points for annual revenue need of greater than $100M/year

Scoring totals for each of the alternatives are provided in **Table 4-3**, which shows that out of the eight alternatives evaluated, Alternative 4 received the highest score of 10 points. Alternatives 3, 5 and 6 received the second highest score of seven points each. The remaining alternatives each received a score of six points. While all of the alternatives have advantages and disadvantages, Alternative 4 represents the most balanced approach that meets the environmental and human health timeframe objectives, accommodates industry and RME growth, and has an annual revenue need consistent with the stable and recurring revenue source models evaluated in Section 8 of this SWP.

Runners-up Alternatives 3, 5 and 6 also have advantages, but these alternatives possess inherent implementation concerns as well. For example, Alternative 6 received the second highest number of points due to its short timeframe to upgrade priority areas. However, the largest incremental increase in upgrades per year is greater than 12,000 systems per year, which is far greater than the anticipated growth rate of both the industry and RME. Therefore, while attractive in some respects, Alternative 6 is likely not implementable due to the gap in required upgrade rates and industry and RME capacity. As described previously, Alternative 3 does not include system failure as an upgrade trigger mechanism and relies primarily on upgrades at property transfer as the primary driving force for upgrades. Because it is presumed that property transfer is not eligible for incentive funding, this results in a low annual revenue need for upgrade incentives under the stable and recurring revenue source. In addition, the maximum incremental step increase in annual installs is within the range that is forecast to be acceptable for accommodating industry and RME ramp up. However, since there is no system failure trigger, the amount of time to complete upgrades in the highest priority areas (50 years) is nearly 70 percent greater than the 30-year target. Alternative 5 is similar to the recommended Alternative 4, but does not include the program ramp-up sub-phases designed to accommodate industry and RME ramp-up. Alternative 5 is attractive due to the short timeframe to complete upgrades within all priority areas. However, the largest incremental increase in upgrades per year is greater than 9,500 systems per year, which is far greater than the estimated growth capacity of both the industry and RME. In addition, the estimated annual revenue needed to offset upgrade costs to property owners exceeds the revenue projections estimated from the various revenue models. The remaining evaluated Alternatives 1, 2, 7 and 8 each have significant shortcomings and do not meet the majority of the overall program objectives. In summary, Alternative 4 represents the recommended implementation alternative based upon the scoring evaluation and its ability to balance all of the overarching program objectives. A detailed description of the recommended wastewater alternative is provided in the following subsection.

4.4.3 Recommended Alternative

As shown in **Table 4-4** and **Figure 4-6**, and described previously, the Program consists of four primary phases. The phases are intended to build upon each other through an aggressive, but achievable, timeline that allows for:

1) Establishment of critical administrative elements such as a Countywide Water Quality Management District (WQMD) and stable recurring revenue source before advancing widescale I/A OWTS upgrades;

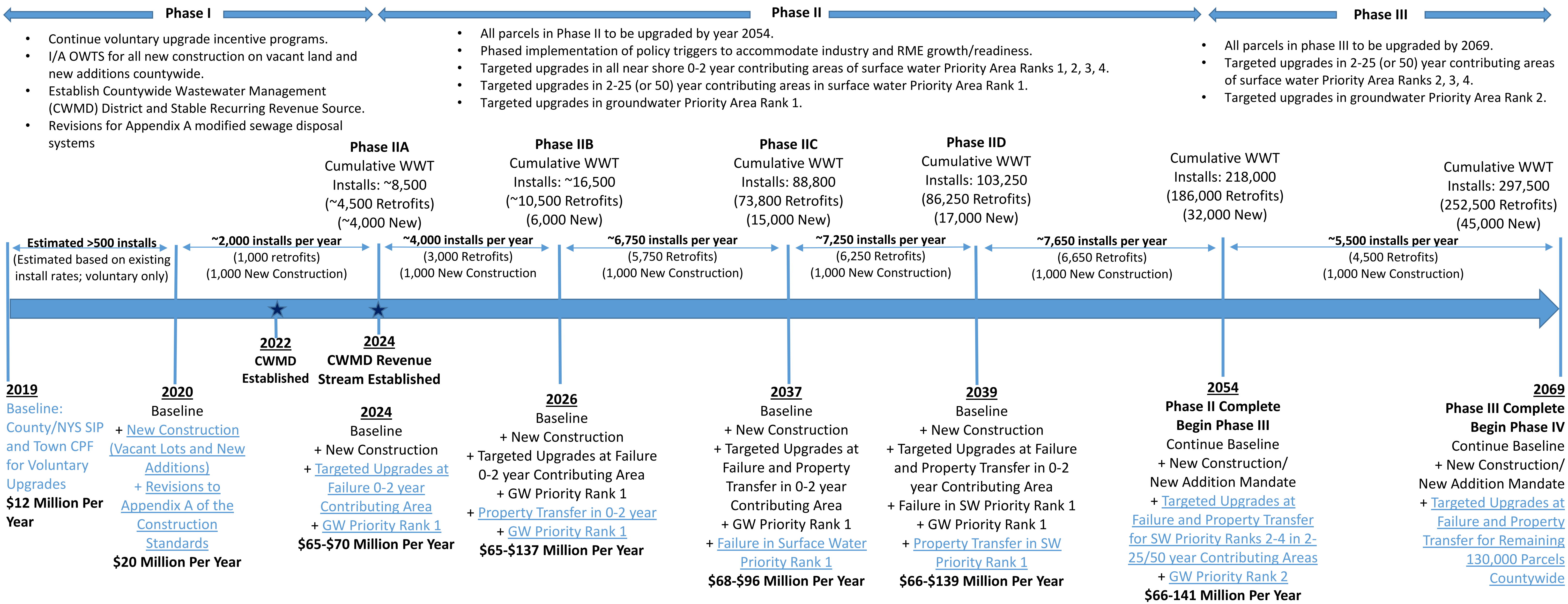
2) A steady, but controlled, annual upgrade target rate that can accommodate industry and RME readiness; and

3) The Program timeline goals for the protection of human health and the environment.

Table 4-4 Recommended I/A OWTS Implementation Alternative

Program Phase	Program Phase Objectives	Approximate Cost
I Program Ramp Up 9,000 WWT Upgrades (5,000 retrofit; 4,000 new construction)	-Continue voluntary upgrade incentive programs -Ramp up RME and Industry Capacity -Establish Countywide Water Quality Management District -Establish Stable Recurring Revenue Source	$12-20M/year* 5 Years (2019-2023)
II Upgrades in Near Shore and Highest Priority Areas 207,000 WWT Upgrades (177,000 retrofit; 30,000 new construction)	-Continue Program Ramp Up (RME and Industry Capacity) -Address all highest priority areas including: *Upgrades in all near shore 0-2 year contributing areas. *Upgrades in surface water priority area rank 1. * Upgrades in groundwater/drinking priority area rank 1.	Alternative 4A: $65M-$69M/year Alternative 4B: $65M-$101M/year Alternative 4C: $71M-$140M/year 30 Years (2024-2053) [95% complete]
III Upgrades in All Other Priority Areas 296,000 WWT Upgrades (253,000 retrofit; 43,000 new construction)	-Upgrades in all remaining priority areas. *Remaining parcels in surface water priority area ranks 2,3 and 4. *Groundwater/drinking water priority area rank 2	Alternative 4A: $67M/year Alternative 4B: $102M/year Alternative 4C: $141M/year 15 Years (2054-2068)
IV Upgrades in Remaining Areas (Central Suffolk) 427,000 WWT Upgrades (384,000 retrofit; 43,000 new construction)	-Upgrades in all remaining areas (primarily central Suffolk County)	Annual Cost Target $67M/year Timeframe = TBD
*** WWTP upgrades represent cumulative installations of either I/A OWTS, sewering, or clustering ** Actual annual cost during Phase I will depend on funding availability from existing programs through County and NYS Septic Improvement Programs and Town Community Preservation Funds * Retrofit = upgrade of existing onsite disposal system		

Figure 4-6 Subwatersheds Wastewater Plan Conceptual Program Timeline



Notes

1. Blue Font = new requirement set forth in that particular year; Black Font = preexisting requirement(s) set forth in previous years(s).
2. Retrofits include upgrade of existing OSDS only (no new construction or building addition). New Construction = new construction on vacant land for purposes of this figure.
3. Upgrade rates shown are estimated using the best available data and are rounded for simplification.
4. All dollar values shown are estimated capital costs in current dollars (no inflation) for grants to offset costs to property owners through a stable and recurring revenue source and/or existing funding mechanisms (SIP, CPF, etc.)
5. WWT = Wastewater Treatment via individual I/A OWTS, Sanitary Sewer Connection, or Clustering. All costs based upon use of I/A OWTS; however, select parcels may benefit more from connection to existing sewer districts, connection to a new STP, or through the use of clustered/decentralized systems. Final recommendations for targeted sewer expansion areas and/or clustered systems to be provided once a stable and recurring revenue source and Countywide Wastewater Management District have been established.
6. Revision to Appendix A of the Construction Standards in 2020 includes revised setbacks based on land use and increase in allowable flow up to 30,000 gpd.
7. 2019-2023: assumes a $12 to $20 Million annual incentive allotment from State and County SIP and Town CPF programs to fund voluntary upgrades and upgrades at new construction with a building addition. Funding range to account for uncertainty in funding availability wherein $12 million represents minimum available to maintain County/NYS SIP programs and $20 million represents the maximum funding need to fund existing voluntary plus building addition upgrades.
8. 2024-2069: assumes $12 Million annual incentive allotment to fund 600 voluntary upgrades within priority areas and failures outside of mandated area

2/4/20

It should be noted that the Program recommendations are intended to be a guide that builds upon the information, data, and assumptions defined within this SWP. As discussed in Section 8.4.11, Adaptive Management Plan, it is recommended that the Program be reviewed periodically and adjusted based upon the availability of new data obtained through Program implementation and/or other data sources generated through the LINAP or related initiatives.

The map summarizing the priorities for wastewater management includes four phases as shown by **Figure 4-7**. A summary of the four phases is provided below in **Table 4-4** and a detailed description of the recommended program is provided in Section 8.1.6.

The proposed timeline is one possible timeline and may be modified and refined based upon factors such as the actual amount of financial resources available once a stable and recurring revenue source is procured. If the Countywide Water Quality Management District and the revenue source are established faster than anticipated under Phase I, then implementation may move faster, which will accelerate the resulting water quality improvements. If additional funding is procured, implementation may move faster. If implementation moves more slowly than identified above, this will be identified via the Adaptive Management Plan (Section 8.4.11) which may trigger re-evaluation of the program.

As shown in **Table 4-4**, Phase I is a five-year program ramp-up phase that provides the time necessary for Suffolk County to establish a WQMD, a stable and recurring source of revenue to fund the program, and RME staffing, and for establishment of design professionals and manufacturer capacity to support the program. During Phase I, up to 1,000 I/A OWTS installations can be implemented each year. These installations will be initiated based on voluntary I/A OWTS and can be implemented anywhere in the County in accordance with the existing Septic Improvement Program.

Phase II of SWP implementation will focus on the 0 to 2-year groundwater contributing area to surface waters, all Groundwater Priority Rank 1 areas and all Surface Water Priority Rank 1 areas, as shown in purple on **Figure 4-7**. Installation of I/A OWTS within the 0 to 2-year groundwater contributing area will enable the quickest reduction in overall nitrogen loading to each surface water body in anticipation that water quality benefits will result. Implementation of I/A OWTS in Groundwater Priority Rank 1 areas will address potential human health impacts associated with consumption of high nitrogen water and implementation of I/A OWTS in Surface Water Priority Rank 1 areas will address those surface waters with the greatest need for nitrogen load reduction. During this time, I/A OWTS installations would continue for new construction and the existing County, Town and Village voluntary I/A OWTS upgrades and Town and Village I/A OWTS upgrade mandates would continue.

During the Phase III period, I/A OWTS installations would continue for new construction and the existing County, Town and Village voluntary I/A OWTS upgrades and Town and Village I/A OWTS upgrade mandates would continue. In addition, I/A OWTS installations would be required in the groundwater contributing areas for all surface water Priority Rank 2, 3 and 4 areas, and all groundwater/drinking water Priority Rank 2 areas shown in light blue. During the Phase IV period, wastewater management would be addressed at all remaining parcels in the County that were not addressed during Phases I through III. The Phase IV schedule has not yet been identified as it will be established based on the evaluations conducted during the first three phases of the program, but it would begin when Phase III is complete.

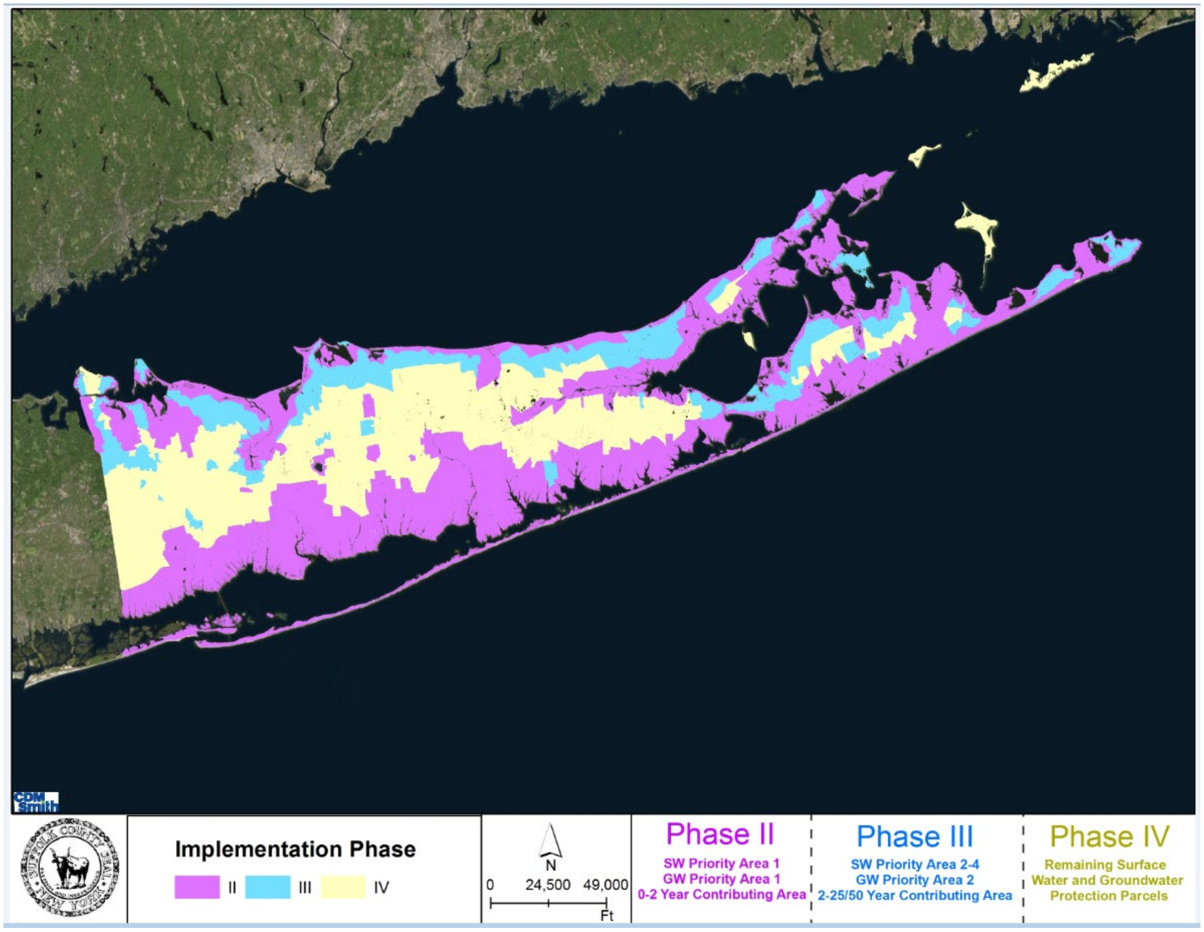


Figure 4-7 Phased SWP Implementation

4.4.3.1 Implementation Phase Line Smoothing

The SWP Phases were developed based on groundwater modeling delineations of the land surface areas contributing groundwater baseflow to the priority surface water bodies and community supply wells, and areas where model-simulated nitrogen concentrations in the shallow upper glacial aquifer exceed target nitrogen concentrations. Therefore, the boundaries between subwatersheds, priority areas, Wastewater Management Areas and SWP Phases do not coincide with physical landmarks (e.g., roads, tax lot boundaries, etc.) that are administratively implementable. Consequently, the modeling delineations were modified by moving the SWP Implementation Phase boundaries to the nearest road or other above-ground landmark, such as individual tax lot boundaries, for administrative purposes.

In each case, the Phase boundary was extended outwards from the model-delineated boundary to the next roadway where possible. In some areas, where the road network did not accommodate this approach, the Phase boundary was extended to the property line of a nearby park or institution. As a last resort, the Phase boundary was occasionally drawn between individual parcel boundaries.

Because revisions to the Phase boundaries were extended outwards to be more protective, the number of parcels in Phase II increased at the expense of Phase III, and the number of parcels in Phase IV also decreased. Overall, adjustments of the administrative Phase boundaries result in inclusion of more parcels in Phase II, providing earlier nitrogen load reductions.

Areas where the 0 to 2-year contributing area did not encompass any developed parcels, or where the original implementation boundaries did not encompass sewered areas were also subsequently modified to be inclusive of all areas defined by the Phase descriptions as summarized on **Table 4-5.**

Table 4-5 Modification of Original SWP Implementation Boundaries

Area with Modified Boundary	Reason/Summary
Lloyd Harbor	Lack of roads to use as boundaries, line smoothing adjusted to border either parcels or 0-2 year contributing area
Cold Spring Harbor	Lack of roads to use as boundaries, line smoothing adjusted to border either parcels or 0-2 year contributing area
Mt. Sinai Harbor	Lack of roads to use as boundaries, line smoothing adjusted to border either parcels or 0-2 year contributing area
Long Island Sound Central (North Shore)	Lack of roads to use as boundaries, line smoothing adjusted to border either parcels or 0-2 year contributing area
Long Island Sound Central (North Shore-Rocky Point)	Lack of roads to use as boundaries, line smoothing adjusted to border either parcels or 0-2 year contributing area
Peconic River Area	Line smoothing to incorporate additional Phase I parcels within sewered area
Shelter Island	Southeast island (e.g., Mashomack Preserve) changed from Phase 4 to Phase 3 at SCDHS direction
North Sea Area	Updated to incorporate 0-2 year contributing area by bordering side roads, parcels and 0-2 year contributing area
Big/little Fresh Ponds	Line smoothing updated to encompass area around subwatershed
Carlls River	Expanded to incorporate original Phase II Border including sewered parcels
Northport Bay	Lack of roads to use as boundaries, line smoothing adjusted to border either parcels or 0-2 year contributing area
Huntington Bay	Lack of roads to use as boundaries, line smoothing adjusted to border either parcels or 0-2 year contributing area
Old Field Area	Lack of roads to use as boundaries, line smoothing adjusted to border either parcels or 0-2 year contributing area
Mattituck Area	Lack of roads to use as boundaries, line smoothing adjusted to border either parcels or 0-2 year contributing area

Figure 4-8 shows the line smoothing adjusted SWP phases that provide the framework for implementation. As part of the Adaptive Management process (described in Section 8.4.11) the Management Area boundaries may be re-evaluated and modified in response to changed conditions.

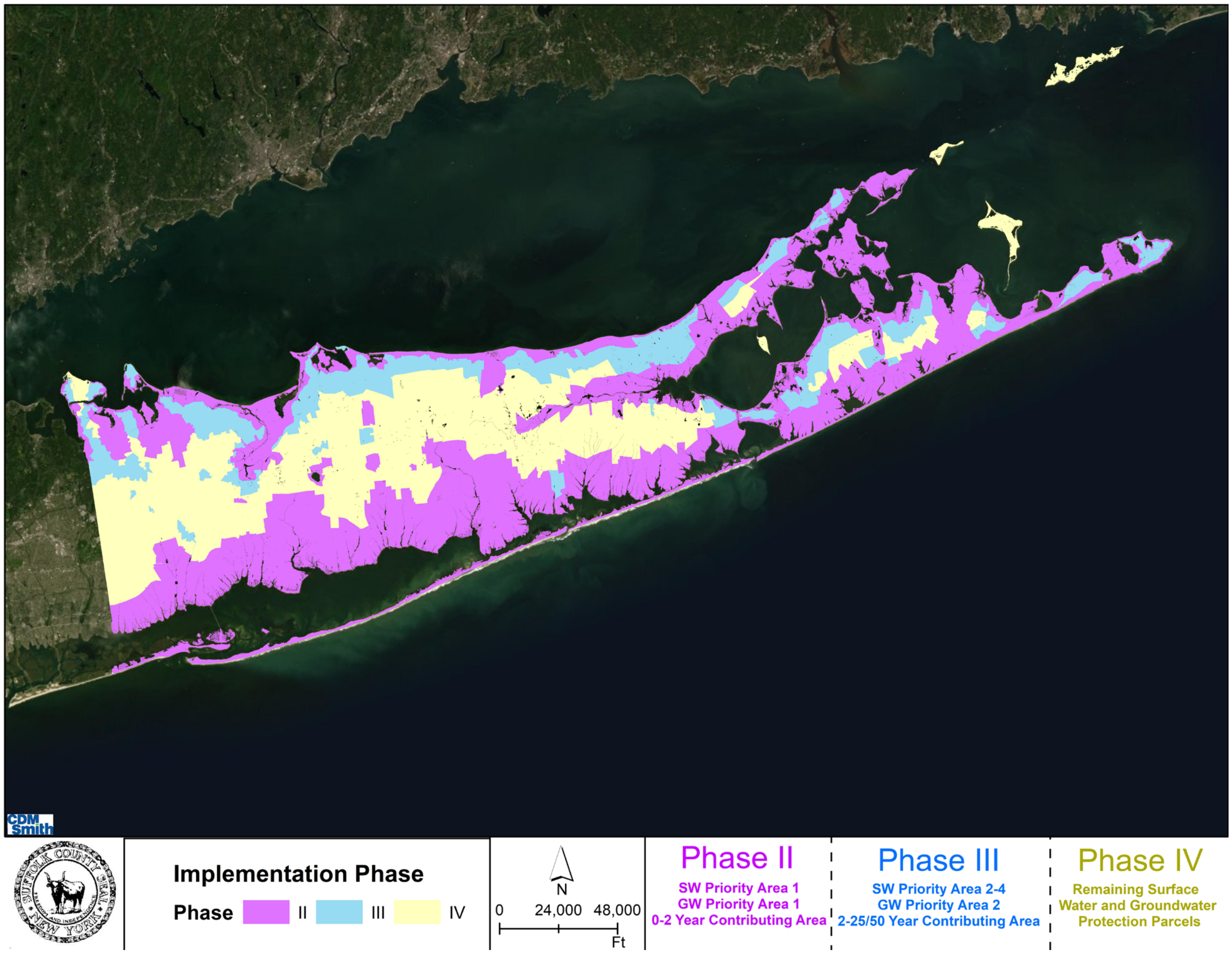


Figure 4-8 SWP Implementation Phases (after Line-Smoothing to Administrative Boundaries)

4.5 Countywide Sewering and Clustering Alternatives Evaluation

As discussed in Section 1.1.6, sewering plays an important role in the overall wastewater management strategy in Suffolk County. While the use of I/A OWTS represents the most cost effective solution in many areas of the County, sewer expansion may have advantages over I/A OWTS in locations with significant water quality impairments due to nitrogen, in areas with challenging site conditions (e.g. small lots, high groundwater, poor soils), in areas within close proximity to existing sewer districts, and in areas with special considerations such as areas that may be prone to flooding or sea level rise. For example, while I/A OWTS generally can be engineered and installed on most sites in Suffolk County, the cost gap between I/A OWTS and sewering diminishes as individual lot sizes approach 0.25 acres or less, particularly in areas with high groundwater. This is demonstrated by comparing the average estimated cost for installation of an I/A OWTS on the most difficult residential sites in Suffolk County (greater than $40,000 per parcel) to the average estimated cost per parcel for the same parcels assuming sewer connection to an existing WWTP (approximately $55,000 per parcel). In water bodies with extremely high nitrogen load reduction goals such as the Great South Bay and its contributing subwatersheds, connection to the adjacent SWSD provides a significant benefit towards achieving load reduction goals since the outfall for the SWSD discharges to the Atlantic Ocean. In essence, 100 percent of the wastewater nitrogen emanating from parcels connected to the SWSD is removed from the Great South Bay subwatershed. Finally, in addition to providing significant environmental benefits, sewering has expanded socioeconomic benefits such as facilitating economic growth of local businesses. The following subsections provide initial recommendations for sewering in Suffolk County. Sewering recommendations were generated using a three-step approach which included:

1. Inventory of existing sewering proposals in Suffolk County and documentation of current status;

1. A parcel-specific scoring analysis, referred to as the "Wastewater Management Response Evaluation," to identify parcels where sewering and/or clustering may represent the preferred means of wastewater management; and,

2. Development of three sewer implementation scenarios based upon a range of potential funding availability and the findings of Steps 1 and 2 above.

Individual sewer and clustering projects would require project-specific Feasibility Studies to develop cost estimates and assess overall project feasibility. In addition, project-specific State Environmental Quality Review Act (SEQRA) evaluations would be required to assess and mitigate project-specific environmental concerns. Finally, it should be noted that the evaluation and findings presented herein are intended to be an initial planning tool to support recommendations for stable recurring revenue source needs and present initial findings regarding areas that may benefit from sewering or clustering. The findings are not intended to be binding in any way.

4.5.1 Inventory of Existing Sewer Proposals in Suffolk County

The first step completed under the sewering evaluation was to develop an inventory and status table of all known existing County, Town, and Village sewer proposals evaluated over approximately the past two decades. These proposals represent a logical starting point for the identification of sewer expansion projects as they have already been identified for evaluation by their respective project leads. In addition, some proposals have already undergone feasibility study and been deemed infeasible for various reasons.

A summary of the proposals for County-led proposals is provided in **Table 4-6** (please see tables at the end of this section). A summary of Town/Village led proposals is provided in **Table 4-7** (please see tables at the end of this section). A map showing the location of all sewer proposals and estimated District boundaries is provided on **Figure 4-9**. Please note that for the purposes of this evaluation, projects that were deemed infeasible through feasibility study or projects that were identified as having no plan to move forward by Towns/Villages were omitted from the map. Overall, the County has identified 21 County led proposals and 15 Town/Village led projects. Individual projects shown in **Tables 4-6** and **4-7** have been categorized and color-coded based upon project status. A summary of the project categories and their respective projects is provided below.

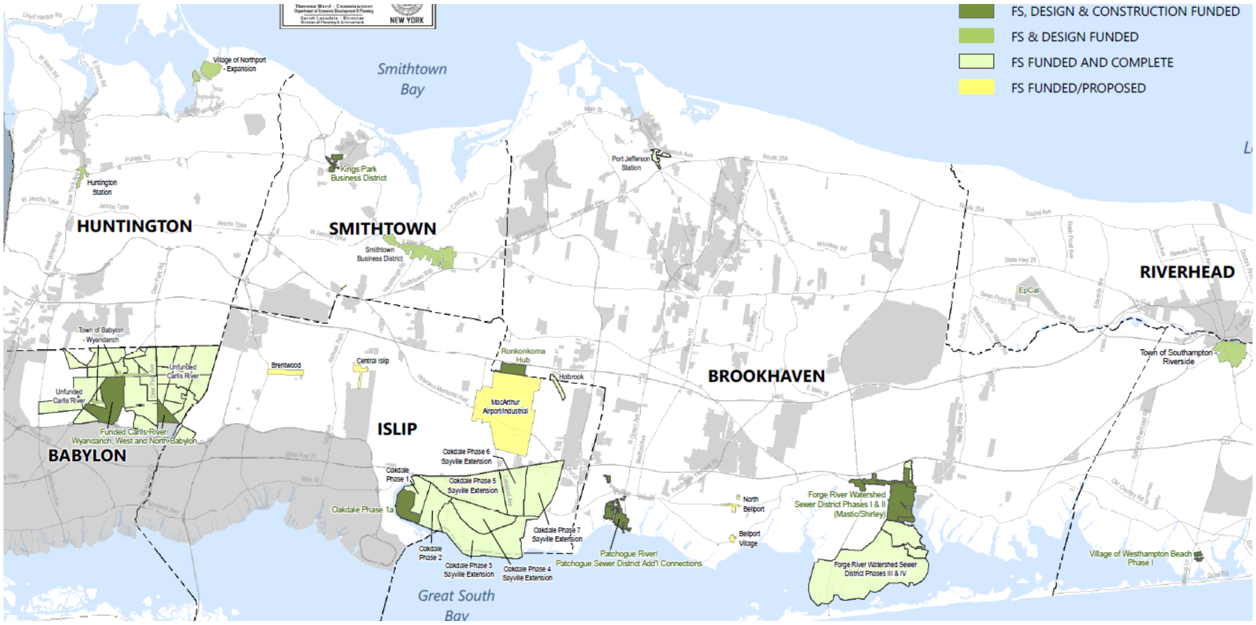


Figure 4-9 Location of Existing Sewer Proposals for Suffolk County Led Sewer Proposals

4.5.2 Projects Presumed as Moving Forward in the Subwatersheds Wastewater Plan

Projects with the highest likelihood of moving forward include projects that have been deemed feasible via project-specific feasibility study and have both design and construction funding procured. These projects have been assigned the color code dark green in **Tables 4-6** and **4-7**. For the purposes of modeling the Countywide Recommended Wastewater Scenario in the SWP, it is presumed that all parcels within the proposed district boundaries for these projects will be connected to the proposed treatment facility.

Projects presumed to be moving forward include:

- Carlls River (funded portions) within West Babylon, Wyandanch, and North Babylon (areas 108-8, 108-11, 110-2, shown on **Figure 4-10**);
- Forge River Watershed Sewer District Phases I & II (Mastic/Shirley);
- Patchogue / Patchogue River;
- Oakdale Phase 1a / Connetquot River;
- Kings Park Business District;
- Ronkonkoma Hub;
- Calverton/EPCAL – Town of Riverhead; and,
- Westhampton Downtown – Village of Westhampton Beach (Phase I of 4, **Figure 4-11**).

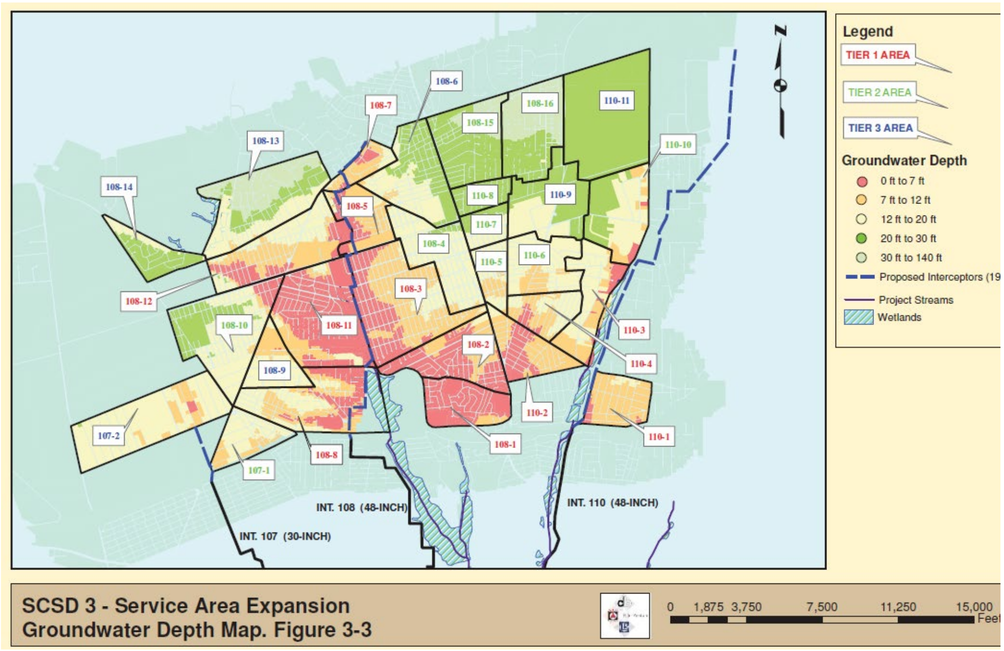


Figure 4-10 Proposed District Boundaries for Carll's River Expansion and Village of Westhampton Beach

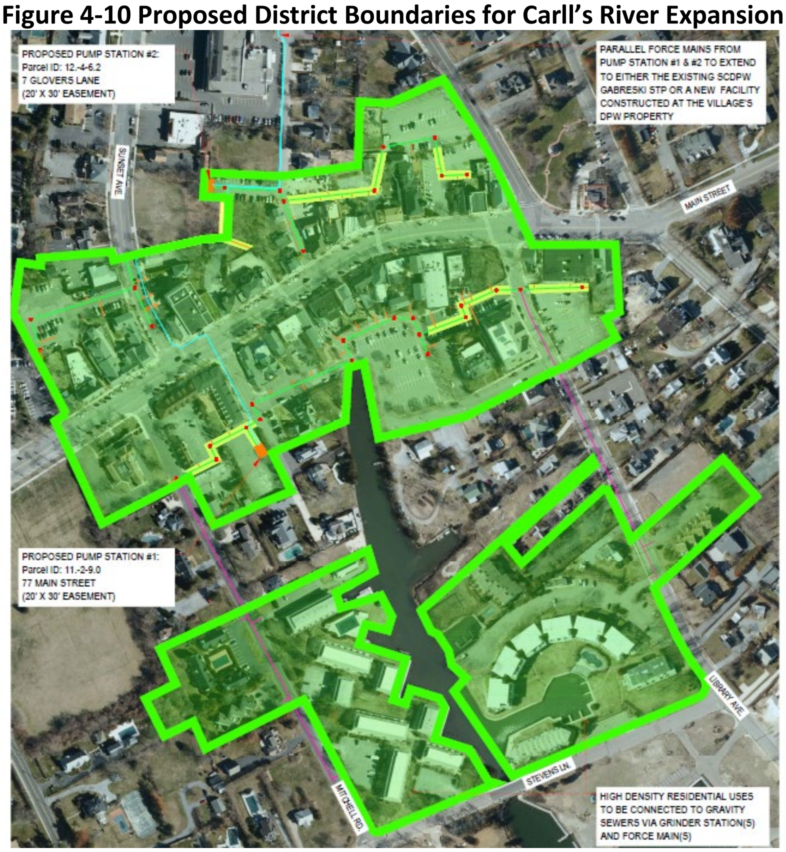


Figure 4-11 Proposed District Boundaries for the Village of Westhampton Beach

A short summary of the projects identified above can be found in Section 1.1.6.6.

In addition to the projects identified above, Suffolk County has funding allocated through the Suffolk County Coastal Resiliency Initiative (SCCRI) program to connect all unconnected parcels in the SWSD. This project will accommodate up to 1,491 individual connections and result in an estimated nitrogen reduction of nearly 45,000 pounds per year.

4.5.3 Other Sewer Proposals

An additional 28 sewer proposals were identified and included in the project inventory but are not presumed as moving forward for the purposes of modeling in the SWP. The status of these projects varies significantly, ranging from deemed “feasible with design initiated and pending construction funding procurement” to projects that have essentially hit a dead end for various reasons. As these projects had previously been identified as potentially beneficial to both the environment and/or economic development, a brief evaluation of these projects has been completed relative to the findings of the Wastewater Management Response Evaluation and the priority areas established within this SWP as discussed further below.

4.5.4 Wastewater Management Response Evaluation

The second step completed under the sewering evaluation was the identification of individual parcels where sewer connections and/or the use of clustered/decentralized systems could represent the preferred approach to wastewater management. To provide an initial planning tool that identifies these parcels, the Suffolk County Department of Economic Planning and Development completed a geospatial, parcel-specific scoring analysis that expanded upon the methodology used by the Maryland Department of Environment for the Chesapeake Bay Program (TetraTech, 2011). While clustering was not explicitly evaluated during this analysis, parcels recommended for sewering through the scoring analysis that are not within close proximity to an existing common collection system or, are in proximity to an existing STP with no expansion capacity, should be considered as clustering candidates if a suitable lot is identified for siting of the clustered treatment system.

A summary of the scoring analysis criteria, methodology, and results is provided below.

4.5.4.1 Wastewater Management Response Evaluation Methodology

The scoring evaluation considered criteria such as parcel size, distance to existing STP collection systems, and wastewater upgrade priority rank and scored each parcel in Suffolk County as either recommended for upgrade to I/A OWTS or recommended connection to new or existing STPs. A description of each of the scoring criteria is provided below.

4.5.4.1.1 Parcel Size

Existing feasibility studies completed for sewering proposals in Suffolk County and the I/A OWTS cost analysis completed within Section 2.2.2 of this SWP have shown that parcel size is a significant factor in the overall economic feasibility of installing I/A OWTS versus sewering. As shown in **Table 4-8**, smaller parcels favor the options of sewering and clustering whereas larger parcels favor upgrade to I/A OWTS.

Table 4-8 Parcel Size Scoring Criterion

Parcel Size Range	Upgrade Score	Sewer/Clustered Score
<0.125 acre	0	10
0.125-0.25 acre	5	7.5
0.25-0.5 acre	7.5	5
0.5->1 acre	10	0

4.5.4.1.2 Proximity to Existing Collection System

Each individual parcel in Suffolk County located outside of an existing or pending sewer district was evaluated and scored based on the collection system proximity criteria. As shown in **Table 4-9**, parcels in close proximity to an existing or pending collection system were graded highly for the sewer option, while parcels distant from existing and pending collection systems were graded highly for the upgrade to I/A OWTS option. Pending sewer districts include previously discussed existing sewer proposals where construction funding has been designated and that are presumed as moving forward for the purposes of the evaluations in the SWP. These projects include the following:

- Carlls River (funded portions) within West Babylon, Wyandanch, and North Babylon (areas 108-8, 108-11, 110-2);
- Forge River Watershed Sewer District Phases I & II (Mastic/Shirley);
- Patchogue / Patchogue River;
- Oakdale Phase 1a / Connetquot River;
- Kings Park Business District;
- Ronkonkoma Hub;
- Calverton/EPCAL – Town of Riverhead; and,
- Westhampton Downtown – Village of Westhampton Beach (Phase I of 4).

Table 4-9 Proximity to Existing or Pending Public Collection Systems Scoring Criterion

Sewer Proximity Range	Upgrade	Sewer/Clustered
< 0.25 mile	0	10
0.25-0.5 mile	2.5	7.5
0.5-0.75	5	5
0.75-1 mile	7.5	2.5
>1 mile	10	0

Additional information regarding pending sewer projects can be found in Section 1.1.6.6.

4.5.4.1.3 Environmental Scoring Criterion

Each individual parcel in Suffolk County located outside of an existing or pending sewer district was evaluated and scored based on the environmental scoring criterion. As shown in **Table 4-10,** the environmental scoring criterion is based upon an individual parcel's wastewater upgrade priority rank for the protection of surface waters. While groundwater/drinking water priority areas also warrant wastewater upgrades, modeling performed in the SWP indicates that I/A OWTS (e.g., treatment to 19 mg/L) alone would be sufficient for the protection of groundwater and drinking water resources in Suffolk County. As such, the geospatial scoring analysis completed herein focused on the protection of surface water resources, which in some cases, have extremely high nitrogen load reduction goals (e.g., high density unsewered areas with poor flushing such as the Great South Bay). Ultimately, parcels located within the highest surface water priority rank for wastewater upgrades (e.g., Priority Rank 1) were scored in favor of sewer/clustering and parcels with lower priority rank were scored higher for upgrade to I/A OWTS for this criterion.

Table 4-10 Environmental Scoring Criterion

Surface Water Priority Rank	Upgrade	Sewer/Clustered
4	10	2.5
3	7.5	5
2	5	7.5
1	2.5	10

4.5.4.1.4 Sea Level Rise Prone Areas

This final criterion was applied to areas designated as sea level rise prone areas. In these areas, the cost of I/A OWTS and local recharge of treated wastewater may be higher if sea level rise projections come to fruition as modeled in the Comp Water Plan. In many cases, the result could be the requirement for increased separation distance between leaching structures and groundwater which would likely require the installation of costly retaining walls. Because of the potential long-term cost implications to these parcels, transmission of the wastewater via sewering to areas located outside of areas prone to sea level rise may represent a more sustainable and cost-effective solution to wastewater management. Therefore, parcels located within sea level rise areas were given an additional 2.5 points in favor of sewering/clustering.

4.5.4.2 Wastewater Management Response Evaluation Results

Graphical representation of the Wastewater Management Response Evaluation results are presented on **Figure 4-12.** As shown on **Figure 4-12**, individual parcels were either scored as Upgrade (I/A OWTS), Sewer, or Tie (parcel-specific score for sewer or upgrade was a tie). **Figure 4-12** also includes an overlay of the existing sewage treatment plant locations and the proposed District boundaries for all sewer proposals that have been evaluated for feasibility over the past two decades in Suffolk County. Sewer proposals that were deemed infeasible by an existing Feasibility Study were omitted from the overlay, as were individual proposals where no proposed district boundaries exist, or individual Town/Village projects that were deemed as no longer being pursued by their respective project lead. A summary of individual parcel counts separated by evaluation score and SWP implementation phase is

SUFFOLK COUNTY, NEW YORK

Phase	Number of Parcels		
	Upgrade	Sewer	Tie
II	72,843	85,898	8,833
III	33,539	19,628	3,420
IV	46,933	76,242	10,148
Parcel totals	153,315	181,768	22,401

Figure 4-12

WASTEWATER MANAGEMENT EVALUATION RESPONSE

Proposed Management Response for Residential Parcels

Rev. May 22, 2020 CD-20-50

Source: Suffolk County Department of Economic Development & Planning, Division of Planning & Environment; Suffolk County Department of Health Services; Suffolk County Department of Public Works, NYS Office of Information Technology.

Map is subject to revision. This map is not to be used for surveying, conveyance of land, or other precise purposes.

provided below in **Table 4-11**. An example of the scoring map output for the north shore of Suffolk County is presented on **Figure 4-13**.

Table 4-11 Summary of Wastewater Management Evaluation Results

Phase	Number of Parcels		
	Upgrade	Sewer	Tie
II	72,843	85,898	8,833
III	33,539	19,628	3,420
IV	46,933	76,242	10,148
Parcel totals	153,315	181,768	22,401

The following general observations and conclusions are made from the results of the analysis:

- Over 50 percent of the parcels in Suffolk County scored as sewer. While this assessment is preliminary and for initial planning and discussion purposes only, it underscores that sewering is still an essential component to the overall wastewater management strategy in Suffolk County;
- The scoring analysis supports the use of sewers as the preferred wastewater management strategy for all proposed sewer projects that were included on the proposed sewer project overlay;

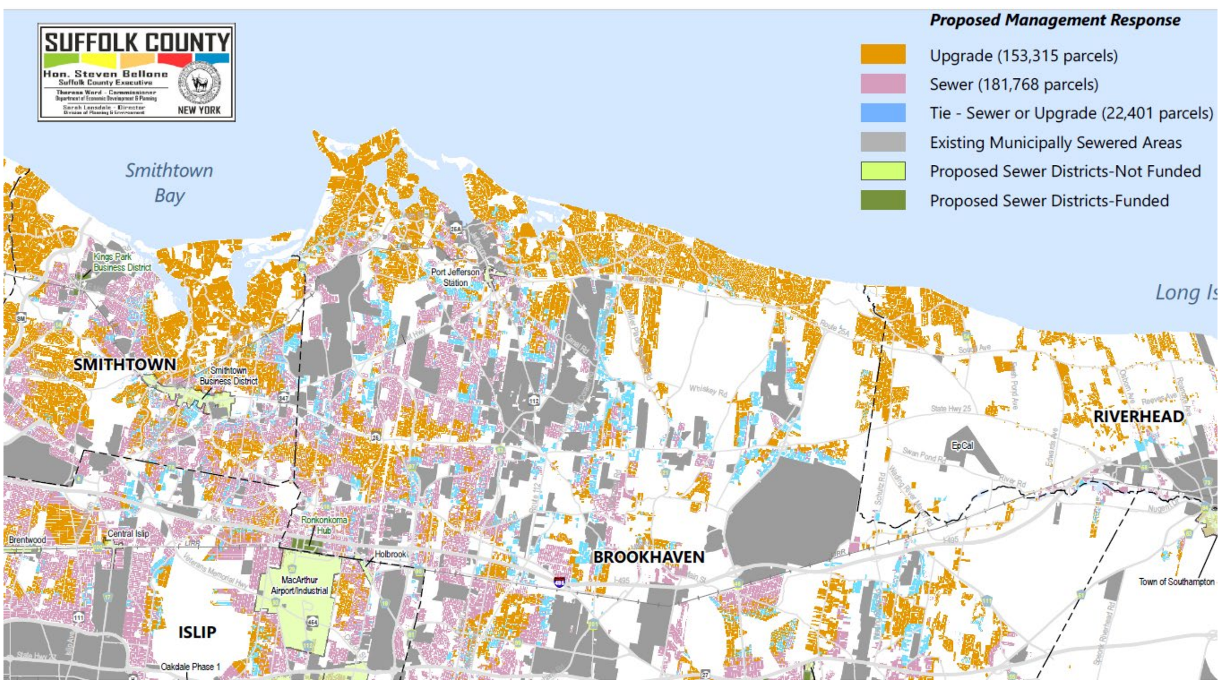


Figure 4-13 Example Wastewater Management Response Evaluation Map Output

- Individual parcels located within subwatersheds with the highest wastewater upgrade priority rank (e.g., poorest water quality, highest nitrogen loads, poorest flushing), and/or located within proximity to existing or proposed sewer districts scored highest for sewering. Notable areas include:
  - Unsewered areas of the Great South Bay contributing area including areas to the east of the SWSD and areas to the north of the SWSD;
  - Unsewered areas of Huntington Harbor, Mill Pond (e.g., Centerport Harbor), and Northport Harbor;
  - Select unsewered parcels in the Nissequogue River contributing area including parcels in and around the Kings Park and Smithtown Business Districts;
  - Select unsewered parcels in the Port Jefferson Harbor, South contributing area including parcels in and around the Port Jefferson Station business area;
  - Select unsewered parcels in the Sag Harbor Cove contributing area;
  - Select parcels in the Heady and Taylor Creek and adjacent coastal ponds contributing areas, including the downtown area of the Village of Southampton;
  - Select parcels in the Quantuck Bay and Creek contributing areas, including the Village of Westhampton Beach; and,
  - Unsewered areas of the Forge River contributing area.
- Individual parcels located within subwatersheds with comparably lower wastewater upgrade priority (e.g., comparably good water quality, low to moderate nitrogen loads, well flushed) and/or located in areas with no existing sewer district scored highest for upgrades to I/A OWTS.

It should be reiterated that the intent of the Wastewater Management Response Evaluation is to serve as an initial planning tool for the development of initial recommendations pertaining to wastewater management methods in Suffolk County. As discussed previously within this SWP, individual sewer and clustering projects would require project-specific Feasibility Studies to develop cost estimates and assess overall project feasibility. In addition, project-specific SEQRA evaluations would be required to assess and mitigate project-specific environmental concerns.

4.5.4.3 Evaluation of Sewer Implementation Scenarios

The final step completed under the sewering evaluation was to develop and evaluate a range of possible sewer expansion scenarios that considered potential revenue streams, relative geographic priority rank as identified in the SWP priority areas, and the results of the parcel-specific sewer scoring analysis. The analysis incorporated the evaluation of three sewer expansion scenarios that were built upon a range of estimated revenue streams. In addition, the analysis assumed that sewer expansion projects would be implemented through five, 10-year projects, which would be constructed over a period of 50 years. Each 10-year project would include the construction of several sewer expansion proposals simultaneously, as discussed further in this section.

A summary of the evaluation methodology and its findings is presented below.

4.5.4.3.1 Potential Revenue Streams and Financial Assumptions

Three potential revenue stream scenarios were developed to evaluate a range of sewer expansion options. For the purposes of the analysis, the Aquifer Protection Fee model was used as the basis for the revenue stream. However, and as described within this SWP, there are multiple options available for providing the stable and recurring revenue source. The three potential revenue scenarios and associated financial assumptions are summarized in **Table 4-12** below.

Table 4-12 Sewer Evaluation Scenario Financial Assumptions

Scenario	Revenue Source Assumption
1	Stable Recurring Revenue Source of $75M/year ($1.00/1,000-gallon Aquifer Protection Fee cost model) from 2024 to 2073. Assumes 10-year County bond @ 3% interest. No additional capital for debt service through connection fees.
2	Stable Recurring Revenue Source of $75M/year ($1.00/1,000-gallon Aquifer Protection Fee cost model) from 2024-2033 and increase to $93.7M/year ($1.25/1,000-gallon Aquifer Protection Fee cost model) from 2034-2073. Assumes 10-year County bond @ 3% interest. No additional capital for debt service from connection fees.
3	Stable Recurring Revenue Source of $93.7M/year ($1.25/1,000-gallon Aquifer Protection Fee cost model) from 2024-2073. Assumes 10-year County bond @ 3% interest. No additional capital for debt service from connection fees.

The purpose of the various revenue scenarios is to explore how various revenue assumptions impact the quantity of sewer expansion projects that can be funded through the stable and recurring revenue source and how they impact the timing in which projects can be implemented. It should be noted that parcels that are not connected to sewers under a proposed scenario are presumed to be upgraded to I/A OWTS. As shown in **Table 4-12**, the total revenue stream under each scenario generally increases with scenario number. Scenario 1 assumes the annual revenue stream remains consistent throughout the life of the project at an estimated $75 million per year. This assumption is consistent with the base assumption used for development of the overall recommended Countywide wastewater upgrade program timeline presented in Section 4.4.3. Scenarios 2 and 3 build upon Scenario 1 by assuming an increase in the available revenue stream revenue stream versus the baseline condition assumed in the SWP. Scenario 2 assumes that a 25 percent increase in the revenue source occurs approximately ten years after establishment of the revenue source (e.g., an increase to $93.7 million per year) while Scenario 3 assumes that the baseline revenue source starts at $93.7 million per year immediately. **Table 4-13** below also clarifies that the assumed debt service will be funded through 10-year County bonds at a three percent interest rate and that no additional capital will be obtained from property owners to offset the debt service through connection fees.

The annual revenue available for debt service to bond the proposed sewer projects was calculated for each scenario based on several factors. Specifically, this included the assumed stable and recurring revenue stream ($75 million or $93.7 million per year) for the scenario, the approximate amount of funding originally allocated for I/A OWTS upgrades in these proposed sewer project areas, and the amount of funding that is needed to accommodate I/A OWTS upgrades and RME funding based on the Implementation Plan discussed in Section 8. For the purpose of this analysis, it was assumed that I/A OWTS Alternative 4A (see **Table 4-4**) is implemented. The resulting annual funding available for proposed sewer projects was used to determine the minimum annual revenue stream available for debt service – specifically the lowest annual revenue over each 10-year sub-project timeframe was used to calculate the financing that could be available to the County. As previously identified, the financing assumption to fund the proposed sewer projects would be through 10-year County bonds at a three percent interest rate. The minimum annual revenue stream available for debt service and the 10-year financed value for each scenario and 10-year sub-project timeframe are detailed in **Table 4-13**.

Table 4-13 Summary of Sewer Implementation Scenario Funding

	Scenario 1		Scenario 2		Scenario 3	
Target Implementation Times	Minimum Annual Revenue Stream Available for Debt Service	10-Year Financed Value	Minimum Annual Revenue Stream Available for Debt Service	10-Year Financed Value	Minimum Annual Revenue Stream Available for Debt Service	10-Year Financed Value
2024 - 2033	$16,669,556	$142,194,689	$16,669,556	$142,194,689	$35,419,556	$302,135,988
2034 - 2043	$13,485,259	$115,031,990	$32,235,259	$274,973,288	$32,235,259	$274,973,288
2044 - 2053	$15,472,324	$131,982,062	$34,222,324	$291,923,360	$34,222,324	$291,923,360
2054-2063	$40,891,671	$348,814,239	$59,641,671	$508,755,538	$59,641,671	$508,755,538
2064-2073	$47,354,924	$403,947,097	$66,104,924	$563,888,395	$66,104,924	$563,888,395

4.5.4.3.2 Existing Sewer Proposal Assumptions

Sewer Project Priority Order

To establish an initial basis for the order in which individual sewer projects would be constructed during each 10-year project, the existing sewer proposals documented in the sewer expansion project inventory were categorized into relative priority categories for implementation. The following general rules were applied:

- Sewer proposals with a project status identified as undetermined, unfeasible, or no longer being pursued OR for which a feasibility study has not been completed yet were not included in the analysis;
- Sewer proposals that have at least 25 percent of the proposed district boundaries located within the highest priority areas, as defined within the SWP, have first priority for implementation; these include proposals within:
  - Groundwater/Drinking Water Priority Rank 1 areas,
  - Surface Water Priority Rank 1 areas; and,
  - The 0-2-year groundwater contributing area to surface waters.
- For proposals with the same relative SWP priority rank, sewer proposals that have the design completed, underway, or funded were assumed to have a higher likelihood for moving forward when compared to projects that do not have design funding allocated; and,
- For proposals with the same relative SWP Priority Rank, efforts were made to spatially distribute construction funding across a wide range of projects across the County simultaneously. For example, rather than apply all funds at one time to a single large project (e.g., Sayville Extension, Carll's River, etc.), funds would be distributed to several separate projects so that the benefits of sewering expansion can be realized more broadly in an equal fashion. Large projects would be implemented in project sub-phases in order to meet this objective.

In total, seven County-led sewer proposals and four Town/Village-led proposals were included in the analysis. Of the 11 projects included, three were considered large projects that were divided into smaller project sub-phases including Forge River Phases III and IV, the Sayville Extension, and the Carll's River Extension. In general, sub-phase implementation preference was given for areas located within highest priority areas of the SWP. The locations of the projects can be seen on **Figure 4-12** and **4-14.**

Sewer projects located within the highest priority areas of the SWP (e.g. SWP "Phase II" areas) include:

- Smithtown Business District (0-2-year groundwater contributing area);
- Huntington Station (surface water Priority Rank 1);

- Carll's River (surface water Priority Rank 1);
- Forge River (surface water Priority Rank 1);
- Sayville Extension (surface water Priority Rank 1);
- Riverside Sewer District (Town of Southampton; surface water Priority Rank 1);
- Wyandanch Extension (Town of Babylon; surface water Priority Rank 1);
- Northport Expansion (Village of Northport; 0-2-year groundwater contributing area); and,
- Patchogue WWTP Expansion (Village of Patchogue; surface water Priority Rank 1).

Sewer projects located within other priority areas of the SWP (e.g. SWP "Phase III or IV" areas) include:

- Holbrook Extension (groundwater/drinking water Priority Rank 3); and
- Port Jefferson Station (surface water Priority Rank 3).

4.5.4.3.3 Sewer Project Capital Cost Assumptions

Sewer project capital costs were obtained through a combination of existing Feasibility Study or Engineering Report estimates, updated estimates provided by consultants, and/or the use of existing unit cost estimates (expressed in terms of unit cost per connection) for projects where recent consultant or Feasibility Study data were unavailable. Capital cost assumptions are summarized on **Table 4-14**. In general, projects that were broken down into multiple phases and required the development of a cost basis for each project phase used the unit cost estimate methodology as did projects with no existing or no recent cost estimates. The unit costs incorporated into the unit cost methodology were broken down into three primary unit cost categories as follows:

- Unit Cost via Gravity Sewer (no dewatering) = $39,250 per connection;
- Unit Cost via Gravity Sewer (with dewatering) = $70,000 per connection; and,
- Unit Cost via Low Pressure Sewer = $55,000 per connection.

The unit costs described above were calculated using average costs for current SCCRI estimates, with a simplified adjustment for inflation (e.g., assuming a 2024 start date). Unit costs were used as the cost estimate basis for the following projects:

- Carll's River;
- Sayville Extension; and,
- Wyandanch Extension.

Figure 4-14

SUFFOLK COUNTY

Presumptive Sewered Areas

Proposed Management Response for Residential Parcels

Table 4-14 Summary of Estimated Project Costs for Proposed Sewer Projects

Carlls River 107-1	$13,580,500
Carlls River 107-2	$14,326,250
Carlls River 108-1	$33,330,000
Carlls River 108-2	$49,940,000
Carlls River 108-3	$104,005,000
Carlls River 108-4	$40,506,000
Carlls River 108-5	$18,150,000
Carlls River 108-6	$35,325,000
Carlls River 108-7	$14,300,000
Carlls River 108-9	$16,092,500
Carlls River 108-10	$48,042,000
Carlls River 108-12	$59,510,000
Carlls River 108-13	$38,308,000
Carlls River 108-14	$10,597,500
Carlls River 108-15	$31,792,500
Carlls River 108-16	$41,212,500
Carlls River 110-1	$28,490,000
Carlls River 110-3	$16,610,000
Carlls River 110-4	$27,830,000
Carlls River 110-5	$15,425,250
Carlls River 110-6	$22,254,750
Carlls River 110-7	$7,575,250
Carlls River 110-8	$11,343,250
Carlls River 110-9	$7,496,750
Carlls River 110-10	$4,199,750
Carlls River 110-11	$0
Forge River - Phase 3	$100,000,000
Forge River - Phase 4	$400,000,000
Holbrook	$9,000,000
Huntington Station	$51,500,000
Northport Expansion – Village of Northport *	$11,000,000
Patchogue Expansion – Village of Patchogue *	$10,400,000
Port Jefferson Station	$22,840,000
Riverside – Town of Southampton *	$56,000,000
Sayville Extension – Phase 1b	$27,280,000
Sayville Extension – Phase 2	$36,630,000
Sayville Extension – Phase 3	$66,220,000
Sayville Extension – Phase 4	$123,750,000
Sayville Extension – Phase 5	$63,742,000
Sayville Extension – Phase 6	$53,458,500
Sayville Extension – Phase 7	$57,187,250
Smithtown Business District	$55,000,000
Wyandanch – Town of Babylon *	$3,997,250
*Indicates Town/Village lead project.	

4.5.4.4 Sewer Implementation Scenario Findings

A summary of the sewer implementation scenario findings is presented in **Table 4-15**. A summary of the estimated reduction in mass loading realized through sewering for each scenario is presented on **Figure 4-15.** As shown on **Table 4-1** and **Figure 4-15,** proposed sewer projects were grouped into five, 10-year sub-projects. Consistent with the assumption in the SWP, it was assumed the first 10- year project would kick off in the year 2024, which represents the estimated year that funding from a stable and recurring revenue source will be available. Rationale used for the implementation order of individual projects was discussed previously; however, it should be noted that in some cases, an individual project(s) were moved up in the overall priority order if the estimated project cost was low enough to be financed by excess/surplus funds during an individual project sub-phase. For example, the Town of Babylon's Wyandanch commercial district project and the Village of Northport's expansion project had relatively lower project costs than the other high priority projects, so these projects would be funded earlier than the overall priority order suggested when surplus funds were available.

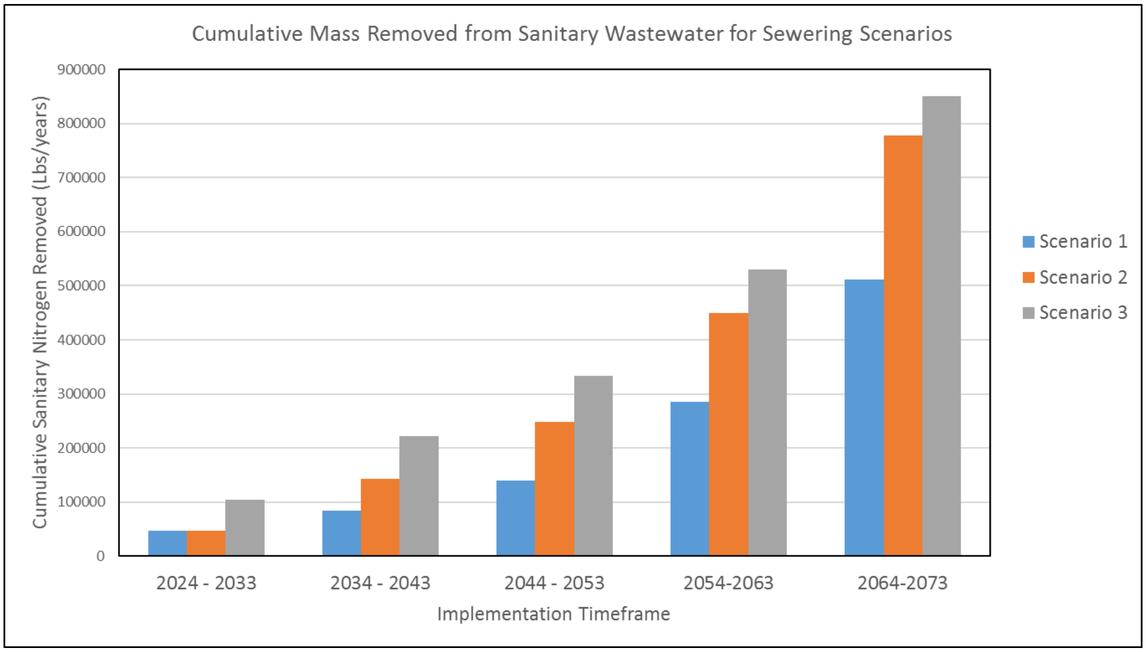


Figure 4-15 Summary of Sewer Implementation Scenario Nitrogen Mass Removed

The results of the sewer implementation scenario evaluation were generally as expected: an increase in the annual funding available through the stable and recurring revenue source increases the total number of projects that can be executed and accelerates the start date of many of the projects. The primary findings include:

Scenario 1: The annual funding available through the stable and recurring revenue stream provides enough funding throughout the 50-year timeframe to fund most of the proposed sewer projects, except Forge River Phase 4, Sayville Extension Phase 6, eleven Carlls River sub-projects (108-12, 108-5, 108-6, 108-7, 110-3, 110-10, 110-11, 108-10, 107-2, 108-13, 108-14) and Holbrook. The individual amount of connections funded is shown in **Table 4-15** and the cumulative

Table 4-15 Summary of Sewer Implementation Scenario Evaluation

	Scenario 1		Scenario 2		Scenario 3	
Target Implementation Times	Projects that can be completed	Amount of Connections	Projects that can be completed	Amount of Connections	Projects that can be completed	Amount of Connections
2024 - 2033	Carlls River 108-1 Carlls River 108-2 Smithtown Business District	1,864	Carlls River 108-1 Carlls River 108-2 Smithtown Business District	1,864	Carlls River 108-1 Carlls River 108-2 Smithtown Business District Sayville Extension – Phase 1b Sayville Extension – Phase 2 Huntington Station Carlls River 110-1 Wyandanch – Town of Babylon* Northport Expansion – Village of Northport*	4,074
2034 - 2043	Sayville Extension – Phase 1b Sayville Extension – Phase 2 Huntington Station	1,452	Sayville Extension – Phase 1b Sayville Extension – Phase 2 Huntington Station Forge River - Phase 3 Carlls River 110-1 Wyandanch – Town of Babylon* Northport Expansion – Village of Northport* Patchogue Expansion – Village of Patchogue*	3,778	Forge River - Phase 3 Carlls River 108-3 Sayville Extension – Phase 3	4,663
2044 - 2053	Forge River - Phase 3 Carlls River 110-1 Wyandanch – Town of Babylon*	2,175	Sayville Extension – Phase 3 Carlls River 110-4 Sayville Extension – Phase 4 Riverside – Town of Southampton*	4,119	Carlls River 110-4 Sayville Extension – Phase 4 Patchogue Expansion – Village of Patchogue* Riverside – Town of Southampton* Sayville Extension – Phase 7	4,372
2054-2063	Carlls River 108-3 Sayville Extension – Phase 3 Northport Expansion – Village of Northport* Carlls River 110-4 Sayville Extension – Phase 4 Patchogue Expansion – Village of Patchogue *	5,732	Carlls River 108-3 Forge River – Phase 4	7,930	Port Jefferson Station Forge River – Phase 4 Sayville Extension – Phase 5	7,789
2064-2073	Riverside – Town of Southampton* Sayville Extension – Phase 7 Carlls River – 108-4 Carlls River - 110-5 Carlls River - 110-6 Carlls River - 110-7 Carlls River - 110-8 Carlls River – 108-15 Carlls River – 108-16 Carlls River – 110-9 Carlls River – 107-1 Carlls River - 108-9 Port Jefferson Station Sayville Extension – Phase 5	8,917	Sayville Extension – Phase 7 Carlls River – 108-4 Carlls River - 110-5 Carlls River - 110-6 Carlls River - 110-7 Carlls River - 110-8 Carlls River – 108-15 Carlls River – 108-16 Carlls River – 110-9 Port Jefferson Station Sayville Extension – Phase 5 Sayville Extension – Phase 6 Carlls River – 107-1 Carlls River - 108-9 Holbrook Carlls River 108-12 Carlls River 108-5 Carlls River 108-6 Carlls River 108-7 Carlls River 110-3 Carlls River 110-10 Carlls River 110-11	12,978	Sayville Extension – Phase 6 Carlls River – 108-4 Carlls River - 110-5 Carlls River - 110-6 Carlls River - 110-7 Carlls River - 110-8 Carlls River – 108-15 Carlls River – 108-16 Carlls River – 110-9 Carlls River – 107-1 Carlls River - 108-9 Holbrook Carlls River 108-12 Carlls River 108-5 Carlls River 108-6 Carlls River 108-7 Carlls River 110-3 Carlls River 110-10 Carlls River 110-11 Carlls River 108-10 Carlls River 107-2 Carlls River 108-13 Carlls River 108-14	12,606
Remaining Projects; Insufficient Financing Available	Forge River – Phase 4 Sayville Extension – Phase 6 Holbrook Carlls River 108-12 Carlls River 108-5 Carlls River 108-6 Carlls River 108-7 Carlls River 110-3 Carlls River 110-10 Carlls River 110-11 Carlls River 108-10 Carlls River 107-2 Carlls River 108-13 Carlls River 108-14	13,364	Carlls River 108-10 Carlls River 107-2 Carlls River 108-13 Carlls River 108-14	2,835	None	

number of connections over the course of the 50-year timeframe is 20,140. The total estimated annual mass removed at Year 2073 is approximately 511,250 pounds per year which is approximately 66 percent lower than the theoretical maximum annual mass removal that could be achieved if all sewer proposals were implemented. While the total annual mass removed (in pounds/year) at Year 2073 is 66 percent lower than the maximum achievable, the annual mass removed at Year 2043 is 70 percent and 163 percent lower when compared to Scenarios 2 and 3, respectively. Similarly, the annual mass removed at Year 2053 is 78 percent and 139 percent lower when compared to Scenarios 2 and 3, respectively. This analysis supports that during early program implementation, Scenario 1 removes significantly less mass when compared to Scenarios 2 and 3.

In summary, the benefits of Scenario 1 include:

- Lowest required annual revenue needed from a stable and recurring revenue source; and,
- Achievement of 60 percent of the total estimated annual nitrogen removal rates for all proposed sewer projects evaluated.

The primary disadvantages of Scenario 1, when compared to the other scenarios include:

- Unable to complete all sewer projects within the 50-year target timeframe;
- Significantly less nitrogen removed (expressed in terms of pounds removed per year) during the first 30 years of the project when compared to Scenarios 2 and 3; and,
- Insufficient surplus funds to support installation of a scavenger plant for I/A OWTS maintenance (if necessary).

Scenario 2: The annual funding available through the stable and recurring revenue stream and bonding provides enough funding for all but four Carlls River sub-projects (108-10, 107-2, 108-13, 108-14) throughout the 50-year timeframe to fund all of the proposed sewer projects, due to the increase in the revenue stream which occurs in the Year 2034. One project that was slated for the SWP Phase II timeframe needed to be pushed back to be funded during the SWP Phase III timeframe due to insufficient funding (Carlls River sub-project 108-3). The individual number of connections funded is shown in **Table 4-15** and cumulative amount of connections over the course of the 50-year timeframe is 30,669, which represents an annual estimated nitrogen mass removal rate of greater than 778,521 pounds per year. The total estimated annual mass removed at Year 2073 in Scenario 2 is only 9 percent lower than in Scenario 3. However, the annual mass removed in Year 2043 is 55 percent lower when compared to Scenario 3 and is 34 percent lower in Year 2053. This analysis shows that during early program implementation Scenario 2 removes less mass when compared to Scenario 3, but the mass removal is only slightly less by Year 2073.

It should also be noted that by 2033 the estimated excess funding is $3.9 million, by 2043 the cumulative excess funding is $9.6 million and by 2053 the cumulative excess funding is $27.7 million. By the end of the 50-year timeframe, the overall excess funding is approximately $35 million. This funding could be used to offset costs for construction of an additional scavenger plant to support long-term I/A OWTS maintenance needs (e.g., pump outs) during implementation of the countywide upgrade program, if necessary.

In summary, the benefits of Scenario 2 include:

- Annual revenue need from a stable and recurring revenue source that begins lower than Scenario 3 and increases over time; and,
- Able to complete all but four sewer projects within the 50-year target timeframe.

The primary disadvantages of Scenario 2, when compared to the other scenarios include:

- Unable to complete all sewer projects within the 50-year target timeframe;
- Significantly less mass removed (expressed in terms of pounds removed per year) during the first 30 years of the project when compared to Scenario 3; and,
- Sufficient surplus funds would likely not be available to support installation of a scavenger plant for I/A OWTS maintenance (if necessary) until the year 2053.

Scenario 3: The annual funding available through the stable and recurring revenue stream provides enough funding throughout the 50-year timeframe to fund all of the proposed sewer projects. One project that was slated for the SWP Phase III timeframe was able to be funded early in the SWP Phase II timeframe due to the availability of excess funds through the increase in stable and recurring revenue source (Sayville Extension Phase 7). The individual amount of connections funded is shown in **Table 4-15** and cumulative amount of connections over the course of the 50-year timeframe is 33,504 which represents an annual estimated mass removal rate of greater than 850,486 pounds per year, consistent with Scenario 2. However, as discussed in Scenario 2 above, the annual mass removed by Year 2043 is 55 percent higher than Scenario 2 and 34 percent higher by Year 2053, an overall marginal increase when compared to Scenario 2. This analysis shows that during early program implementation Scenario 3 removes more mass when compared to Scenario 2, but that the mass removal is similar by the Year 2073.

Similar to Scenario 2, excess funds would be available during implementation of Scenario 3. By 2033 the excess funding is $4.9 million, by 2043 the cumulative excess funding is $9.7 million and by 2053 the cumulative excess funding is $26.5 million, which are similar to the excess funds available during Scenario 2. However, by the end of the 50-year timeframe the estimated excess funding available is $83 million, which is about double the amount of excess funds than in Scenario 2. This funding could be used to offset costs for construction of an additional scavenger plant to support long-term I/A OWTS maintenance needs (e.g., pump outs) during implementation of the countywide upgrade program, if necessary.

In summary, the benefits of Scenario 3 include:

- Only scenario able to complete all sewer projects within the 50-year target timeframe, and with more projects completed earlier than scenario 2; and,
- Achievement of all the estimated annual nitrogen removal rates for all proposed sewer projects evaluated by the end of the 50-year timeframe.

The primary disadvantages of Scenario 3, when compared to the other scenarios include:

- Sufficient surplus funds would likely not be available to support installation of a scavenger plant for I/A OWTS maintenance (if necessary) until the year 2053; and,
- Requires a higher annual revenue stream from a stable and recurring revenue source when compared to Scenarios 1 and 2.

4.5.4.4 Preliminary Identification of Other Areas for Sewer Expansion or Clustering

The previous evaluations focused on presenting potential sewer implementation scenarios using existing sewering proposals and an assumed range of revenue sources. While this represents a logical first step, the initial evaluations completed within this SWP can also be used to identify locations where new sewer expansion projects might be beneficial beyond those already proposed and inventoried herein. A summary of additional areas that might benefit from sewer expansion, new STPs, or clustering is provided below.

4.5.4.4.1 Potential Sewer Expansion Locations

The following areas were preliminarily identified as possibly benefitting from additional sewer expansion beyond the project already presented within this SWP:

- Residential neighborhoods surrounding Huntington Harbor and Northport Harbor. As shown on **Figure 4-12**, these parcels scored in favor of sewering due to their proximity to existing sewer districts and their ecological rank of Priority Rank 1. In addition, these harbors were identified as potentially requiring nitrogen load reductions above the reduction that could be achieved through the use of I/A OWTS alone to meet the overall water quality goal.
- Residential neighborhoods located east of the proposed Sayville Extension project including the hamlets of Bayport, Bluepoint, and Patchogue. As shown on **Figure 4-12**, these parcels scored in favor of sewering due to their proximity to existing sewer districts and their ecological rank of Priority Rank 1. In addition, the unsewered portions of the Great South Bay have some of the highest load reduction goals in Suffolk County and require nitrogen load reductions above the reduction that could be achieved through the use of I/A OWTS alone.
- Residential neighborhoods located west of Forge River Phase I and II. These neighborhoods appear to contribute groundwater to either the Forge River or to Great South Bay, East and could potentially benefit from sewering given their proximity to the pending Forge River sewer project. Both of these water bodies have been identified as Priority Rank 1, have some of the highest load reduction goals in Suffolk County, and have been identified as requiring nitrogen load reductions above the reduction that could be achieved through the use of I/A OWTS alone and the existing Forge River Phase I and II sewer projects.
- Finally, **Figure 4-12** shows various residential neighborhoods that are not situated directly adjacent to an existing sewer district but scored in favor of sewering as part of this preliminary scoring exercise. These parcels would have scored in favor of sewering due to a combination of small lot size, high ecological priority rank, and/or vulnerability to sea level

rise. These parcels could potentially benefit from small clustered systems and/or connection to a new STP.

It should be noted that all of the areas identified above are solely for preliminary screening and discussion purposes only. The viability of each area to connect to existing or new sewer districts and/or use clustering will vary significantly based upon a variety of known and unknown factors including available capacity at adjacent sewer districts (both hydraulically and for compliance with mass loading restrictions per existing TMDL[s]). Ultimately, each area would require project-specific feasibility study to determine implementability, cost feasibility, and overall viability as a wastewater management option.

4.6 Areas with Special Considerations

While the recommendations in the SWP are implementable throughout most of Suffolk County, there are certain land use types, site conditions, and information data gaps that warrant special consideration. Examples of sites that warrant special condition have been discussed throughout the SWP in the form of pilot areas, existing commercial parcels with high design flow (e.g., greater than 1,000 gpd) and constrained sites (e.g., small lots with high groundwater). One example of parcels with special considerations was identified by the parcel-specific database developed for this project. The database indicates that approximately 2,946 residential and 211 commercial parcels are less than 5,000 square feet and have a depth to groundwater less than ten feet where implementation of I/A OWTS could be challenging. This category represents just over one percent of the unsewered parcels in the County.

Other areas that will require further study or consideration include but are not limited to:

- Grandfathered commercial parcels;
- Commercial parcels with design flows of >1,000 gpd;
- Exempt sites such as school districts;
- Commercial sites with EPA defined large capacity cesspools;
- Sites with failed passive denitrification systems;
- Downtown hamlets with insufficient space for the use of individual I/A OWTS;
- Freshwater lakes (including potential phosphorus loading from wastewater);
- Management and treatment strategies for CECs in wastewater;
- Management and treatment strategies for pathogens;
- Constrained residential sites with high groundwater, small lot size and/or poor soils; and,
- Parcels anticipated to be impacted by sea level rise in the future.

In many cases, additional data is needed before detailed recommendations can be provided for the areas defined above. Section 8 presents a recommended roadmap and initial steps that can be taken to fill the individual data gaps associated with each situation identified above, so that detailed recommendations to wastewater management can be made in future SWP addendum(s) or other studies, as necessary.

4.7 Wastewater Management Methods

As discussed throughout the SWP, three primary wastewater management tools were identified in the Comp Water Plan for implementation as part of an overall Countywide wastewater upgrade program including the use of advanced onsite treatment systems (e.g., I/A OWTS, polishing units, alternate leaching methods), sewer expansion, and decentralized/clustered systems. While the SWP has confirmed that the use of onsite treatment systems represents the most cost-effective approach to reducing nitrogen for most parcels in Suffolk County, an initial planning exercise suggested that there are certain locations that may benefit more from sewering or clustered/decentralized systems. The initial planning evaluation used a parcel-specific georeferenced scoring analysis based on the methodology used in the Chesapeake Bay Restoration TMDL study, and supported that parcels with small lot size, high environmental priority rank, and within close proximity to existing sewer districts may benefit more from connection to existing or new STPs, or clustered systems. An evaluation of possible sewer expansion scenarios built off of the initial planning analysis and combined with a review and inventory of existing sewer proposals concluded that while the evaluation supports the potential benefits of the proposed sewer projects, the ability to implement potential sewer expansion projects is tied directly to the quantity of funding obtained through a stable and recurring revenue source. As could be expected, assumptions of the availability of increased funding to offset the cost of sewer projects (or decentralized/clustered projects) to individual property owners results in the expansion of the number of projects that could ultimately be executed.

Evaluations in the SWP also acknowledged the potential administrative and technical hurdles associated with private clustered/decentralized projects, particularly with existing project approval requirements and issues that could arise when multiple property owners move to connect to a common treatment system (e.g., overall responsibility for long-term maintenance). Ultimately, clustered/decentralized projects are unlikely to be broadly used as a wastewater management method unless the obstacles defined within the SWP are adequately addressed.

In summary, the SWP identifies that all existing OSDS would benefit from upgrade to I/A OWTS, but that some parcels may benefit more from sewer connection or connection to a clustered/decentralized system. However, additional information is needed to finalize the recommended wastewater upgrade strategy for parcels identified as benefitting from sewers or clustering. To minimize the potential for multiple wastewater upgrade investments into individual tax lots, the following general initial recommendations are made:

- Continue to implement voluntary upgrade programs in all priority areas established by the County and/or Town Community Preservation Fund (CPF) programs;
- Reevaluate the initial sewer evaluation provided here after identification of a stable and recurring revenue source and determination of actual funding availability to offset the costs to individual property owners for sewer expansion and/or clustering;

- Using information obtained in the updated sewer evaluation, identify locations where the preferred upgrade option is sewering and consider identifying these as temporary I/A OWTS exemption areas or similar designation;
- Exemption areas designation should also consider the anticipated implementation timeframe for individual sewer projects. For example, projects that are estimated to be completed after the expected useful life of an I/A OWTS would still benefit from implementation of I/A OWTS, and
- Continue to reevaluate locations identified as sewering or clustered/decentralized candidates as part of the SWP Adaptive Management Plan.

In addition, consideration should be given to the implementation of novel methods to recoup upgrade investment costs, such as I/A OWTS buybacks for systems in good working condition.

Finally, the recommendations in the SWP provide one possible timeline based upon a presumed revenue source range to make the recommended upgrades affordable to the residents of Suffolk County. Additional evaluation of how, when, and where to expend the financial resources (including funding for upgrades using individual I/A OWTS, clustering, sewering, etc.), as well as the overall timing of the recommended upgrades, will be considered as part of the Adaptive Management Plan, (see Section 8.4.11) after the nature and value of the recurring funding source is clarified.

4.8 Buildout Considerations

As described in Section 2.1.5.3, a build-out evaluation was developed to estimate the potential future nitrogen loading that would result if a new residence was built on each undeveloped (or underdeveloped) residential parcel in the County. Suffolk County Department of Economic Development and Planning developed the conditions used for potential future build-out which were based on the more stringent of Suffolk County Sanitary Code Article 6 or local zoning for all:

- Vacant parcels without development restrictions,
- Agricultural parcels without development restrictions, and
- Sub-dividable low density residential parcels.

Because it is unknown whether these changes will occur within any specific timeframe, or even whether they will ever occur at all, the nitrogen load reduction goals were based upon existing conditions of nitrogen loading. As previously discussed, the projected potential build-out loads summarized on **Tables 2-20** and **2-21** represent the potential maximum loading that would be anticipated in the future.

The projected future nitrogen loads were calculated based on existing conditions of wastewater management. Under this scenario, nitrogen loads in approximately 15 percent of the subwatersheds (28) are projected to decline, as fertilized areas are developed for residential use and atmospheric deposition loads are reduced based on the conditions simulated; while nitrogen loads in the remaining subwatersheds are projected to increase.

The build-out nitrogen loads were calculated based on implementation of OSDS on each additional parcel. Presumption of I/A OWTS at the new parcels would significantly reduce the impact of the additional development.

As discussed in Section 2.1.5.3, the overall nitrogen loading to Suffolk County subwatersheds is projected to increase by only 2.9 percent should all of the projected potential build-out be completed. The percentage of the total nitrogen load from onsite wastewater sources only increased by four percent when comparing build-out loading simulations to current conditions. Despite the overall modest increase in predicted buildout nitrogen load of a Countywide basis, some subwatersheds do present with increased potential buildout loads that warrant mitigation. For example:

- Ninety-seven subwatersheds are predicted to have a 0 to 10 percent increase in nitrogen load at buildout when compared to baseline conditions. Mitigation of nitrogen through wastewater management alone (e.g., requiring a nitrogen removing sanitary system) is sufficient to address nitrogen loads for these water bodies.

- Forty-six subwatersheds are predicted to have a greater than 10 percent to 20 percent increase in nitrogen load at buildout when compared to baseline conditions. Mitigation of nitrogen through wastewater management alone (e.g., requiring a nitrogen removing sanitary system) is likely sufficient to address nitrogen loads for many of these water bodies; however, policymakers should consider coupling wastewater management mitigation with other mitigating measures such as purchasing open space, revising local zoning, increasing minimum Article 6 lot size, and/or TDR programs; and,

- Thirteen subwatersheds are predicted to have a greater than 20 percent increase in nitrogen load at buildout when compared to baseline conditions. Mitigation of nitrogen through wastewater management alone (e.g., requiring a nitrogen removing sanitary system) may be insufficient for some of these water bodies. As such, policymakers should consider coupling wastewater management mitigation with other mitigating measures such as purchasing open space, revising local zoning, increasing minimum Article 6 lot size, and/or TDR programs.

It is recommended that Suffolk County work with policymakers through the Article 6 Workgroup or similar forum to develop approaches for addressing individual subwatersheds that are prone to increased nitrogen loading from buildout.

4.9 Predicted Benefits of SWP Implementation

Implementation of the SWP is anticipated to provide significant surface water and groundwater quality benefits resulting from reduced nitrogen loading. Suffolk County has developed a phased program focused first on high priority surface water and groundwater/drinking water areas along with coastal areas where the anticipated water quality benefits can be most rapidly realized.

The significant declines in nitrogen load to groundwater from sanitary wastewater as the SWP is implemented is shown on **Figure 4-16**. The figure shows that the 3,000,000 pounds of nitrogen loading from sanitary wastewater removed during Phase II will reduce the existing nitrogen load by approximately one third, providing significant environmental benefits. Anticipated benefits of

SWP implementation on surface waters and groundwater are further described in the following sections.

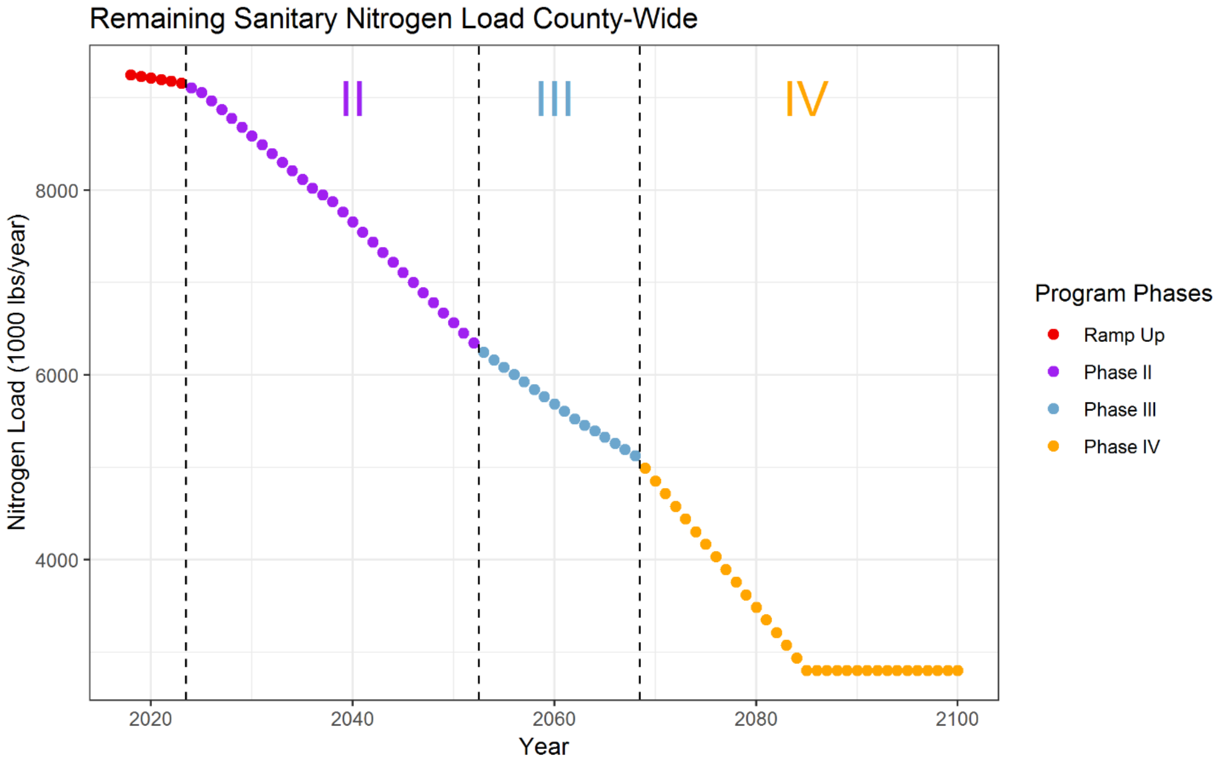


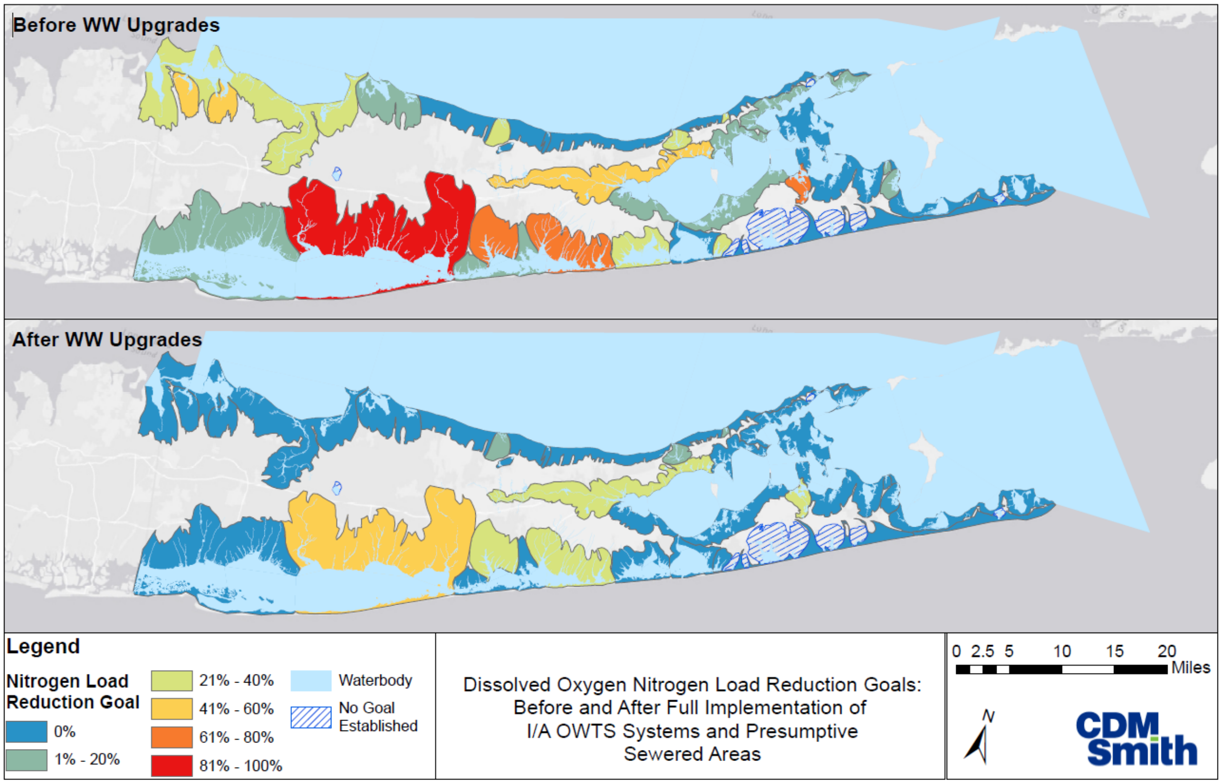
Figure 4-16 Countywide Reduction in Nitrogen Loading Resulting from SWP Implementation

Note: Phase IV Nitrogen reductions were developed assuming that the stable and recurring revenue source remained available and the Phase II and Phase III triggers were implemented throughout the remaining groundwater priority areas throughout the County.

4.9.1 Predicted Benefits of SWP Implementation on Surface Waters

Evaluation of existing surface water quality data and calculated nitrogen loads and residence times has shown that lower unit nitrogen loads and well flushed water bodies are associated with better water quality as defined by compliance with dissolved oxygen criteria, reduced levels of chlorophyll-*a,* increased water clarity and reduced incidence of HABs as described in detail in Section 2.1.8. Nitrogen load reductions were established on a subwatershed-specific basis to replicate the nitrogen loads associated with the surface water bodies where desired water quality was observed. The recommended reductions in nitrogen loads that will result from SWP implementation are expected to significantly improve water quality in downgradient surface waters.

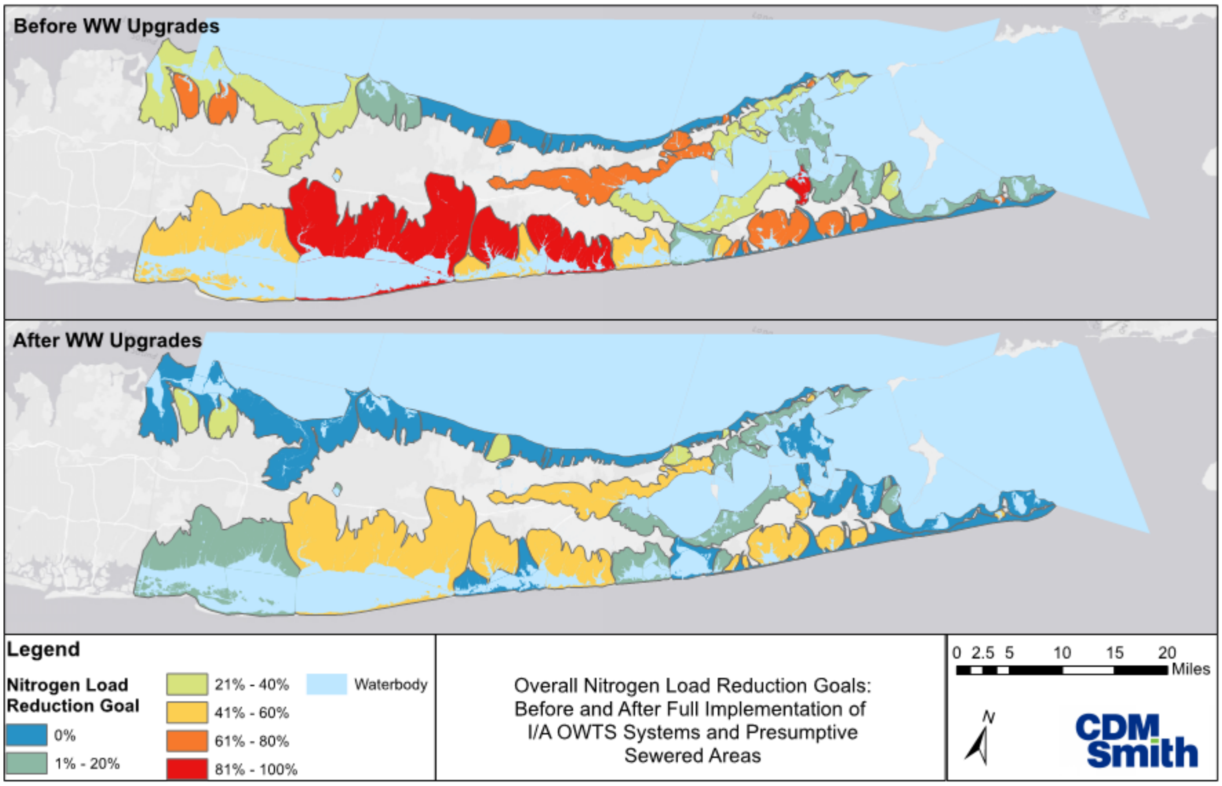
The anticipated benefits of SWP implementation on surface waters were assessed by consideration of progress towards achievement of the Wastewater Management Area nitrogen load reduction goals defined in Section 2.1.8. **Figures 4-17** and **4-18** illustrate the anticipated progress towards ideal water quality and the significantly improved water quality that will result from SWP implementation. **Figure 4-17** compares the reductions in sanitary wastewater nitrogen loading that would be required to achieve the dissolved oxygen/HAB endpoints (e.g., dissolved oxygen criteria and no HABs) before and after SWP implementation. The figure shows that implementation of the SWP will fully achieve these water quality objectives for all of the Long Island Sound Wastewater Management Areas, except for Wastewater Management Area 5 which includes the poorly characterized Wading River, for four of the Peconic Estuary Wastewater Management Areas and for four of the South Shore Estuary Wastewater Management Areas. While significant progress in water quality improvement will be provided for Wastewater Management Areas 7, 10, 16 and 18, additional nitrogen load reductions would be required to achieve their respective load reduction goals.



Note: The upper panel in the figure shows the nitrogen load reductions required to achieve the same unit nitrogen load observed in Suffolk County waters with no hypoxic or HAB events. The lower panel shows the much lower nitrogen load reductions required to achieve the unit nitrogen loads after SWP implementation.

Figure 4-17 Progress Towards Achievement of Unit Nitrogen Loads Consistent with Water Bodies that Have Experienced No Dissolved Oxygen Hypoxic Events and No HAB Events in the Past 10 Years

Figure 4-18 compares baseline conditions – that is, the nitrogen load reduction required to achieve all surface water quality endpoints under 2016 conditions, and the remaining nitrogen load reduction required to achieve all surface water quality endpoints after SWP implementation. The top figure in the panel shows that the highest nitrogen load reduction goals shown in red (80 to 100 percent) and orange (60 to 80 percent) tend to be located in densely populated areas discharging to poorly flushed water bodies and are also associated with the highest Priority Rank areas. The lower panel depicts the substantial progress that will be made towards achievement of these nitrogen load reduction goals when I/A OWTS installations are complete. The figure shows that I/A OWTS implementation will be successful in completely achieving water quality goals for four of the six LIS wastewater management areas, one of the six Peconic Estuary watershed wastewater management areas, two of the six South Shore Estuary wastewater management areas and the Atlantic Ocean.



Note: The upper panel in the figure shows the nitrogen load reductions required to achieve the same unit nitrogen load observed in Suffolk County waters exhibiting ideal water quality. The lower panel shows the much lower nitrogen load reductions required to achieve the unit nitrogen loads after SWP implementation.

Figure 4-18 Surface Waters Progress Towards Ideal Water Quality Goals Based on Nitrogen Load Reductions after SWP Implementation

4.9.2 Predicted Benefits of SWP Implementation on Groundwater and Drinking Water

Groundwater model simulations of the reduced nitrogen loading that will result from I/A OWTS implementation throughout the groundwater and drinking water supply priority areas confirm that nitrogen concentrations in the shallow upper groundwater aquifer will be significantly reduced as shown by **Figures 4-19** and **4-20**. **Figure 4-19** shows the simulated nitrogen concentrations in the shallow upper glacial aquifer after 50 years of the reduced nitrogen loading resulting from I/A OWTS installation throughout the priority areas.

The figure shows that SWP implementation will be successful in significantly improving groundwater quality throughout the County, with nitrogen concentrations throughout most of the shallow upper glacial aquifer declining to less than 4 mg/L (e.g., all areas shown in dark blue, light blue and green).

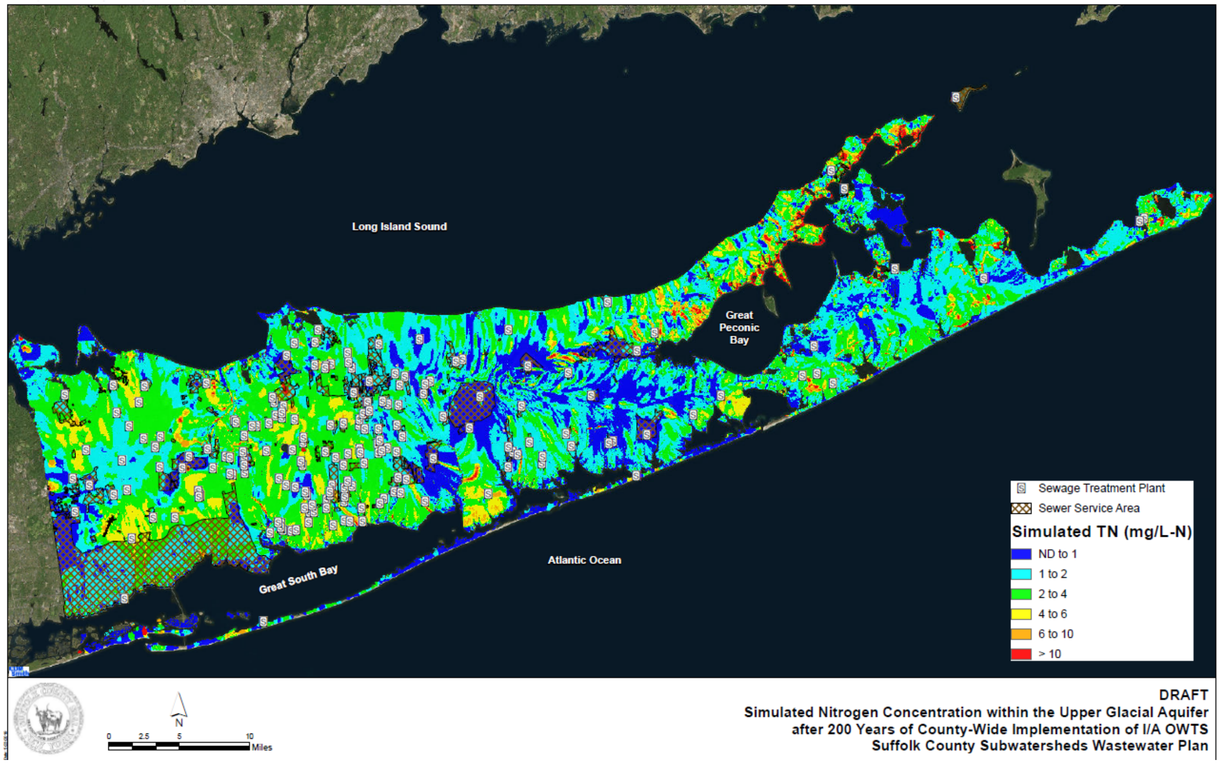


Figure 4-19 Simulated Concentrations of Nitrogen in the Shallow Upper Glacial Aquifer after SWP Implementation

Comparison of **Figures 4-19** and **3-1** illustrates the reductions in simulated nitrogen concentrations in the shallow upper glacial aquifer that will result from I/A OWTS implementation. This comparison of before and after I/A OWTS implementation is facilitated by **Figure 4-20,** which presents the difference between the simulated shallow upper glacial nitrogen concentrations resulting from existing conditions of land use and wastewater management and projected shallow upper glacial nitrogen concentrations resulting from I/A OTWS implementation throughout the County. The deeper the shade of blue on **Figure 4-20**, the greater the predicted nitrogen concentration reduction (improvement) resulting from I/A OWTS implementation. The results show the significant predicted improvements in groundwater quality in the currently unsewered densely populated areas of Huntington, Smithtown, Islip and Brookhaven that will result from I/A OWTS implementation.

Significant changes in water quality are not anticipated to result from I/A OWTS implementation in areas shown in white; these tend to be already protected areas such as the Pine Barrens, or less densely populated areas where the existing nitrogen load from sanitary wastewater is not significant.

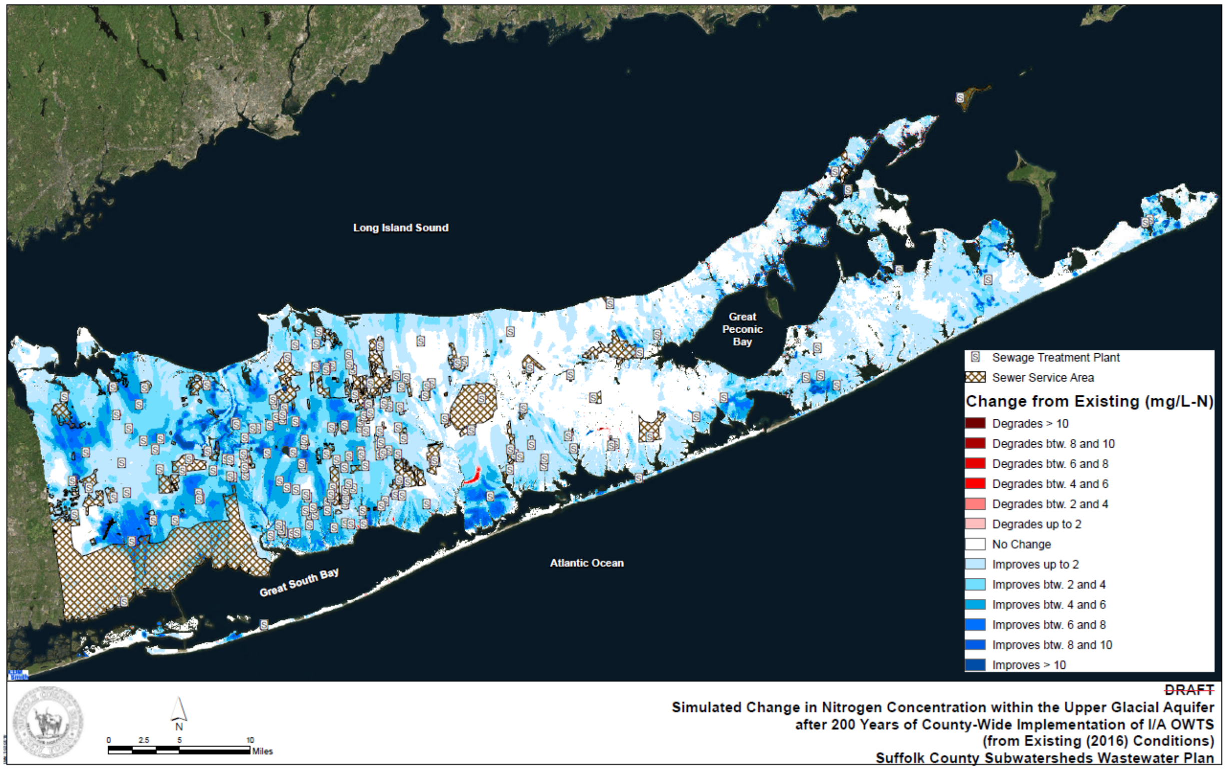


Figure 4-20 Simulated Improvement in Shallow Upper Glacial Nitrogen Concentrations after SWP Implementation

Under 2016 conditions of land use and existing wastewater management, nitrogen concentrations in only three wellfields were simulated to exceed 10 mg/L. After SWP implementation, this is reduced to one wellfield with nitrogen contributions from agricultural fertilization (Browns Hills).

Under 2016 conditions of land use and existing wastewater management, nitrogen concentrations in untreated water from 76.9 percent of community wells were simulated to be less than 4 mg/L as shown by **Figure 4-21**. After SWP implementation, shown by **Figure 4-22**, nitrogen concentrations in over 96 percent of community wells are simulated to be less than 4 mg/L, a significant improvement. **Figure 4-22** shows that nitrogen concentrations in 2.2 percent of the wells are simulated to be reduced to between 4 and 6 mg/L, only one percent is simulated to be between 6 and 10 mg/L after I/A OWTS implementation (down from 6.4 percent) and 0.4 percent of the community supply wells are simulated to exceed 10 mg/L after I/A OWTS implementation.

The model results illustrate dramatic benefits in improved groundwater quality. As noted above, the wells in the single wellfield where untreated raw water is simulated to exceed 10 mg/L are in an agricultural area where sanitary wastewater treatment alone is not predicted to reduce the nitrogen concentrations to less than 10 mg/L; additional fertilization limitations would be required.

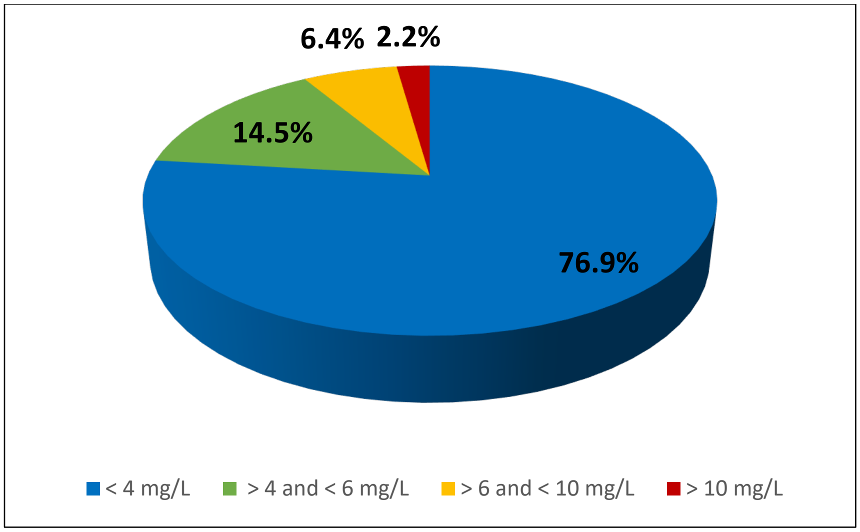


Figure 4-21 Model-simulated Distribution of Nitrogen Concentrations in Community Supply Wells before SWP Implementation

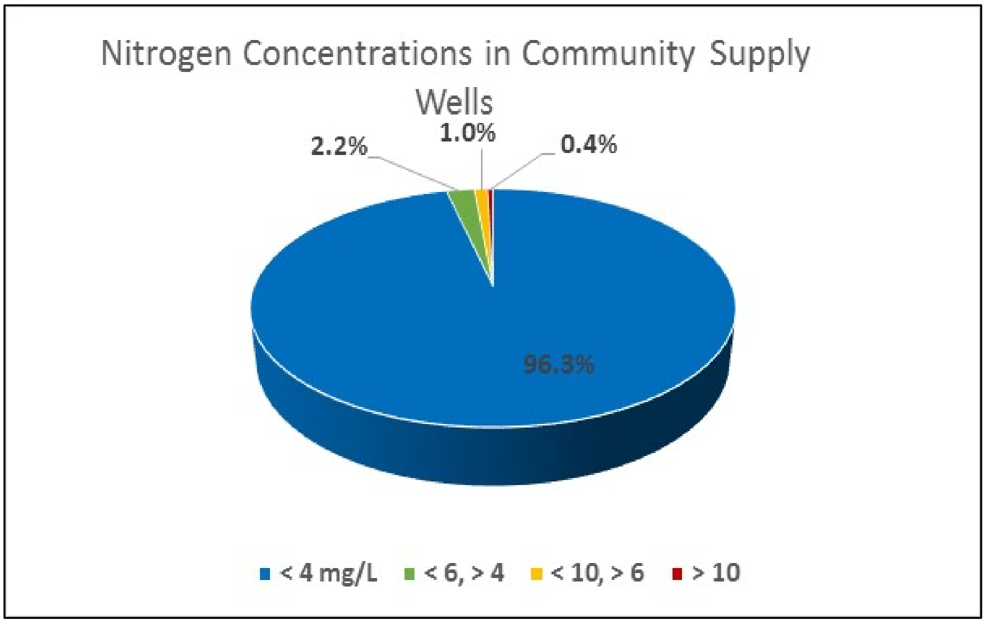


Figure 4-22 Model-simulated Distribution of Nitrogen Concentrations in Community Supply Wells after SWP Implementation

It should be cautioned that sanitary wastewater management will have no effect on legacy nitrogen in the aquifer system; it can take decades for the predicted groundwater quality improvements to be observed, particularly in the five West End towns where the aquifer is thicker and community supply wells are screened deep within the aquifer system.

4.9.3 Geographic Cost-Benefit Considerations

As discussed previously, the phased SWP implementation approach incorporating the 0 to 2-year groundwater contributing area to surface waters will result in the most cost-effective approach to remove nitrogen from surface waters. This is shown by **Figure 4-23** which illustrates the capital cost per pound of nitrogen load removed from each groundwater contributing area travel time interval over a 50-year period. A Countywide Microsoft Access database was assembled to include many of the characteristics of each and every Suffolk County parcel considered in the Nitrogen Loading Model. Characteristics included physical parameters such as size and parcel-use and modeled parameters such as depth to groundwater and nitrogen load. This database enabled estimation of nitrogen load reductions and associated costs for specific areas. The database is described in **Appendix F** and it was used to evaluate a variety of nitrogen load removal and groundwater contributing area travel times that helped to guide the evaluation of alternatives described above in Section 4.4.

To calculate the 50-year capital cost per pound of nitrogen removed, parcel-specific nitrogen load reductions and costs were aggregated by travel time. The load reduction to downstream surface waters over the total 50-year time period considered was estimated for each travel-time interval by multiplying the annual load reduction by 50-years less the median travel time of each group. The following equation demonstrates the calculations:

$$\text{Nitrogen load reduction to surface water (lbs) over 50 years} =$$

$$Annual\ load\ reduction\ \left(\frac{lbs}{year}\right) * \left(\ 50\ years - median\ travel\ time\ (years)\right)$$

$$\text{50-year capital cost per pound of nitrogen removed (\$/lbs)} = \frac{Capital\ Cost\ (\$)}{\text{50-year load reduction to surface water (lbs)}}$$

The annual nitrogen removal for each travel time area was calculated assuming all unsewered parcels implement I/A systems that successfully remove 70 percent of the sanitary nitrogen load to the groundwater. The cost of upgrading each parcel was based on land use (residential vs commercial), parcel size, and the depth to groundwater as previously summarized on **Table 2-54**.

Figure 4-23 shows that the greatest reduction in annual nitrogen loading to the surface waters would be achieved by implementation of I/A OWTS within the 0 to 2-year groundwater contributing area, followed sequentially by the longer contributing area travel times. For example, because the median travel time for the 0-2 year contributing area is one, the 50-year load reduction to downstream surface water bodies is the annual load reduction to the groundwater for 49-years. This information supported incorporation of the Countywide 0 to 2-year groundwater travel time contributing area as a high priority for SWP implementation. In addition to maximizing the nitrogen load reduction realized from I/A OWTS investment, reducing the nitrogen load in the near shore areas will accelerate the benefits of I/A OWTS installations.

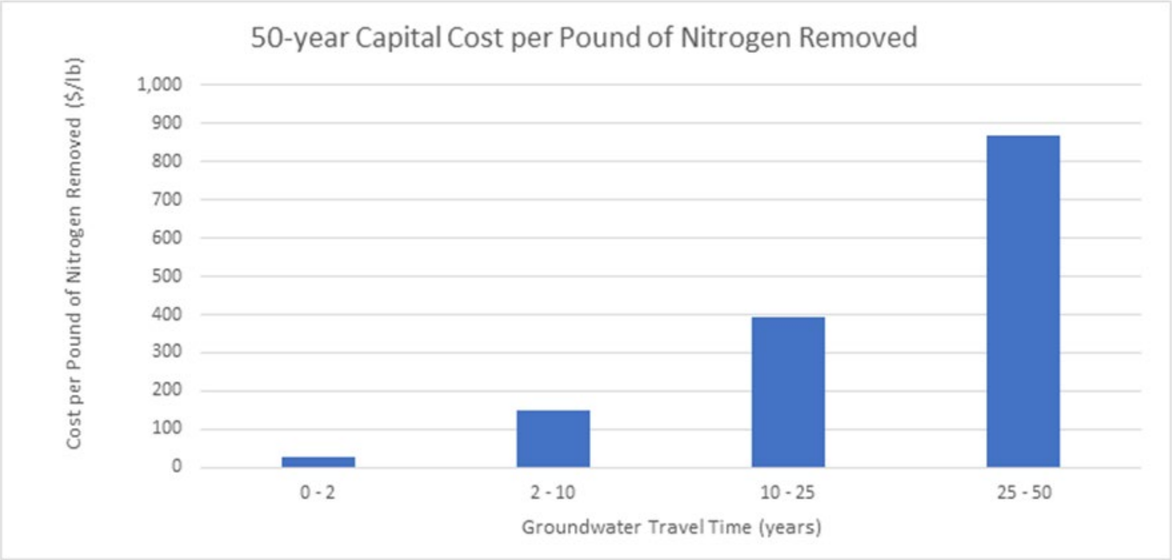


Figure 4-23 50-Year Capital Cost Per Pound of Nitrogen Removed by I/A OWTS Implementation in Each Groundwater Travel Time Interval

Implementing I/A OWTS in the coastal areas incorporating the relatively short 0 to 2-year travel time from the water table to surface water discharge represents the most cost-effective approach to remove nitrogen from surface waters and will also enable the County to begin to realize improved water quality as quickly as possible.

Figures 4-24, 4-25 and **4-26** illustrate the unsewered parcel counts, the capital cost of I/A OWTS implementation and the pounds of nitrogen removed associated with each phase of SWP implementation. The figures also provide the number of unsewered parcels, capital costs and nitrogen removal associated with each of the major estuaries. The parcels in the NA category primarily include parcels in groundwater priority areas, parcels within contributing areas to inland water bodies (e.g., Lake Ronkonkoma) and parcels within longer travel time intervals (e.g., > 50 years) to coastal subwatersheds.

Figure 4-24 shows that the majority of parcels within the Phase II area are located within the South Shore Estuary watershed. In fact, the greatest total number of unsewered parcels are within the contributing areas to the South Shore Estuary, and the majority of the surface water Priority Rank 1 Wastewater Management Areas are also located here, based on the high sanitary load from the densely developed watershed and longer surface water residence times. I/A OWTS implementation is completed within all surface water priority areas during Phases I (program ramp-up phase which is not shown here), II and III. While I/A OWTS implementation occurs in Groundwater Priority Rank 1 and 2 areas during Phases I, II and III, the greatest number of parcels will be upgraded during Phase IV.

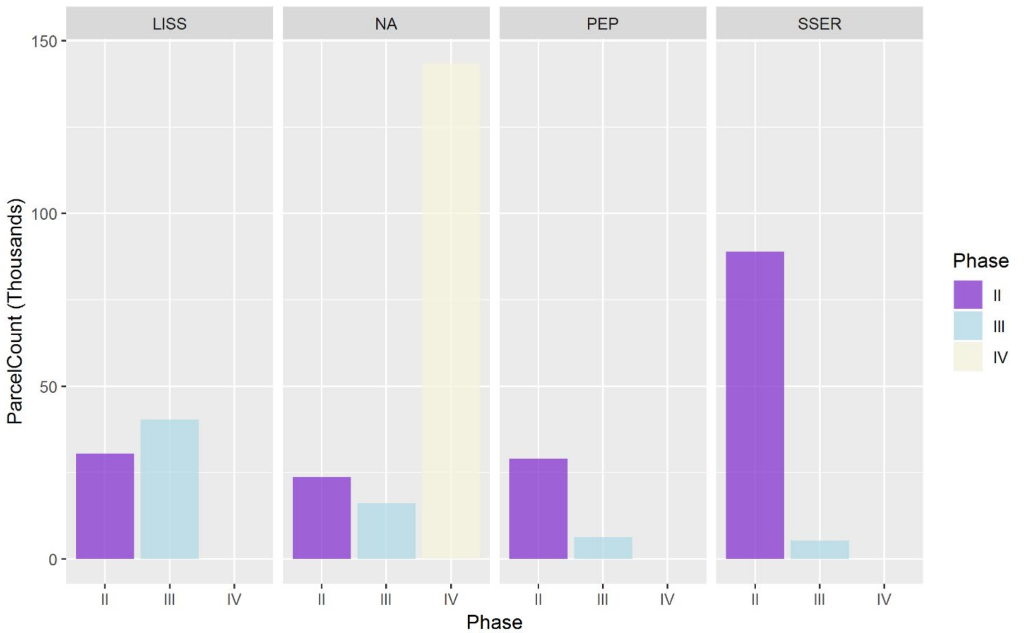


Figure 4-24 Unsewered Parcels Included in SWP Phase and Estuary Watershed

Figure 4-25 summarizes the cost of implementing I/A OWTS throughout each project phase and watershed. Phase II implementation costs total over \$3B over 30 years, including almost \$2B in the South Shore Estuary watershed. Phase II costs exceed \$1B for I/A OWTS installations primarily located within the Long Island Sound watersheds. Phase IV implementation costs approach \$3B, for I/A OWTS installations in groundwater protection areas.

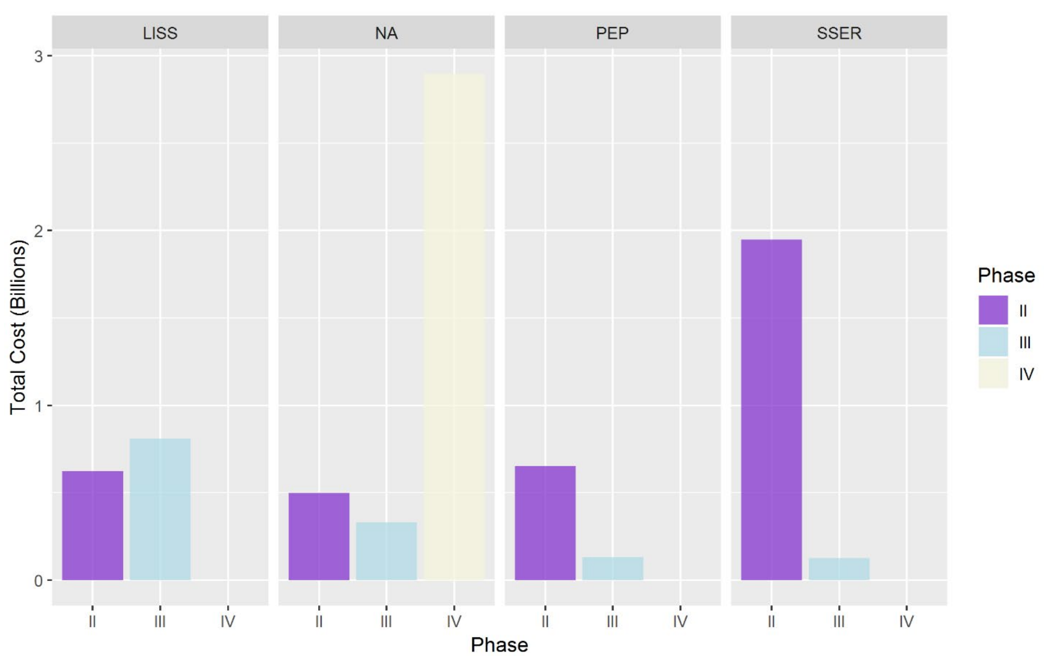


Figure 4-25 Cost of I/A OWTS Implementation in SWP Phases and Estuary Watersheds

Phase II of SWP implementation will result in reduced nitrogen loading to groundwater of almost 8,000 pounds of nitrogen each day as shown by **Figure 4-26**, including over 4,000 pounds that would discharge to the South Shore Estuary, over 1,000 pounds from the Long Island Sound, over 1,000 pounds from the Peconic Estuary, and 1,000 pounds from areas contributing to supply wells. Nearly 3,000 additional pounds of nitrogen will be removed from groundwater when Phase III implementation is complete. Almost 7,000 pounds of nitrogen will be removed each day when Phase IV is complete.

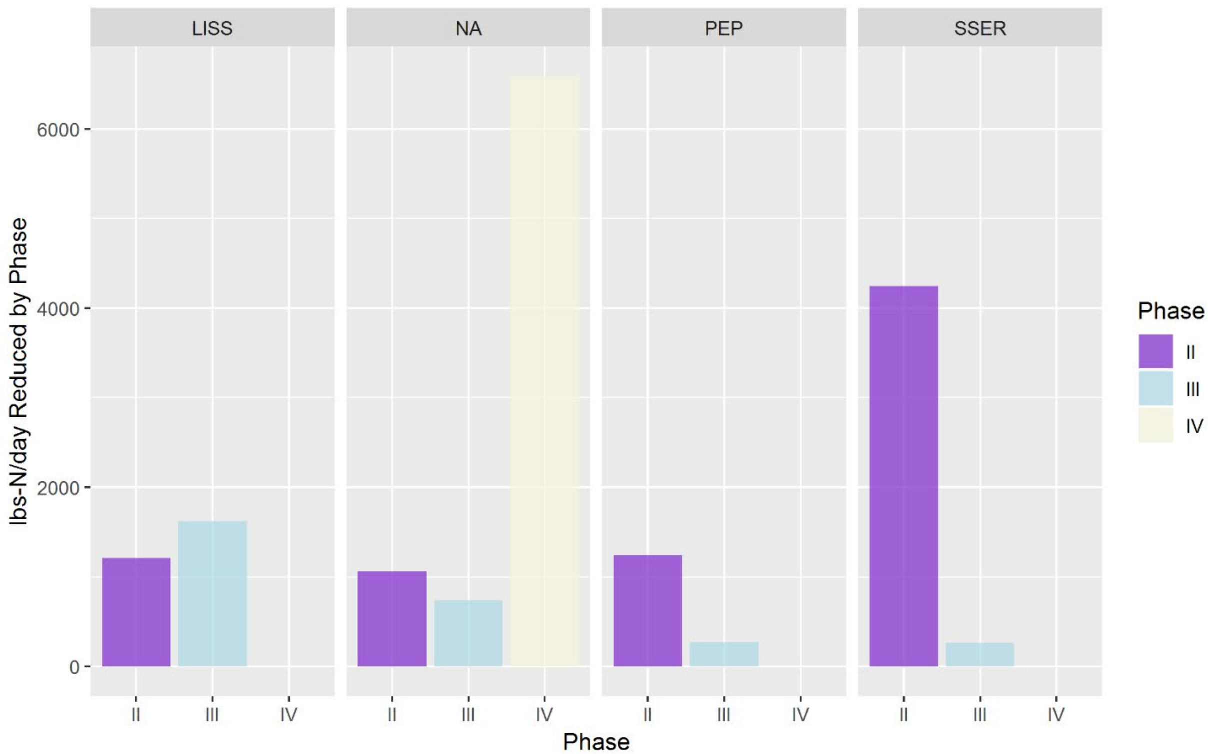


Figure 4-26 Reduction in Nitrogen Load Accomplished by I/A OWTS Installation in SWP Phases and Estuary Watersheds

Section 4 Tables

Table 4-1 Wastewater Management Nitrogen Load Reduction Goals

Wastewater Management Area	Water Bodies in Management Area	Goal Based on HAB DO Target	Goal Based on Ideal Water Quality	Achieved by I/A OWTS	Goal to Protect Down Stream Water Bodies
1. Western Long Island Sound Harbor Restoration Areas	**Huntington Harbor**	**44%**	**72%**	**45%**	**0%**
	Mill Pond	80%	90%	56%	0%
	Northport Harbor	**44%**	**72%**	**54%**	**0%**
2. Long Island Sound Harbors and Bays Restoration and Protection Area I	Cold Spring Harbor	0%	0%	44%	N/A
	Centerport Harbor	**0%**	**0%**	**53%**	**0%**
	Northport Bay	**0%**	**0%**	**46%**	**0%**
	Huntington Bay	**0%**	**0%**	**36%**	**0%**
	Lloyd Harbor	**0%**	**0%**	**21%**	**0%**
	Duck Island Harbor	**0%**	**0%**	**42%**	**0%**
	Flax Pond	0%	25%	28%	0%
	Smithtown Bay	**0%**	**0%**	**21%**	**0%**
	Stony Brook Harbor and West Meadow Creek	**19%**	**60%**	**47%**	**0%**
	Nissequogue River Lower/Sunken Meadow Creek	**57%**	**78%**	**48%**	**0%**
	Nissequogue River Upper, and Tribs	N/A	67%	48%	78%
	Crab Meadow Creek	19%	60%	50%	0%
3 Long Island Sound Harbors and Bays Restoration and Protection Area II	**Port Jefferson Harbor, North, and Tribs**	**0%**	**0%**	**42%**	**0%**
	Port Jefferson Harbor, South, and Tribs	**0%**	**0%**	**34%**	**0%**
	Setauket Harbor	**22%**	**61%**	**50%**	**0%**
	Conscience Bay and Tidal Tribs	16%	58%	46%	0%
	Mount Sinai Harbor	**0%**	**0%**	**49%**	**0%**
4 Central and Western Long Island Sound Open Waters Protection Area	**Long Island Sound West**	**0%**	**0%**	**4%**	**N/A**
	Long Island Sound Central	**0%**	**0%**	**18%**	**N/A**
5 Long Island Sound Inlets and Creeks Restoration Area	Wading River	76%	88%	41%	0%
	Mattituck Inlet/Creek	**32%**	**66%**	**37%**	**0%**
	Goldsmith Inlet	**58%**	**79%**	**39%**	**0%**
6 Eastern Long Island Sound Open Waters and Long Island Sound Fresh Waters Protection Area	Deep Pond	N/A	N/A	22%	0%
	Fresh Pond Creek and Tribs	N/A	N/A	9%	0%
	Lake Panamoka	N/A	N/A	48%	0%
	Long Island Sound East	**0%**	**0%**	**5%**	**N/A**
7 Peconic Estuary Restoration and Protection Area I	**Flanders Bay, East/Center, and Tribs (North)**	**43%**	**71%**	**19%**	**73%**
	Meetinghouse Creek and Tribs	**14%**	**57%**	**35%**	**73%**
	Terry's Creek and Tribs	**82%**	**91%**	**30%**	**73%**
	Flanders Bay, West/Lower Sawmill Creek	**11%**	**56%**	**16%**	**73%**
	Peconic River, Lower, and Tidal Tribs	**71%**	**86%**	**35%**	**73%**

Table 4-1 Wastewater Management Nitrogen Load Reduction Goals

Wastewater Management Area	Water Bodies in Management Area	Goal Based on HAB DO Target	Goal Based on Ideal Water Quality	Achieved by I/A OWTS	Goal to Protect Down Stream Water Bodies
	Peconic River Middle, and Tribs	N/A	N/A	11%	86%
	Peconic River Upper, and Tribs	N/A	N/A	8%	86%
	Wildwood Lake (Great Pond)	N/A	N/A	24%	86%
	Great Peconic Bay and minor coves (north)	**47%**	**73%**	**17%**	**0%**
	Brushes Creek	81%	90%	15%	73%
	Laurel Pond	N/A	N/A	15%	73%
	James Creek	80%	90%	53%	73%
	Deep Hole Creek	**79%**	**90%**	**35%**	**73%**
	Mattituck (Marratooka) Pond	N/A	N/A	15%	90%
	West Creek and Tidal Tribs	0%	46%	29%	73%
8 Peconic Estuary Restoration and Protection Area II	**Flanders Bay, East/Center, and Tribs (South)**	**43%**	**71%**	**19%**	**73%**
	Little Peconic Bay	**0%**	**0%**	**19%**	**0%**
	Wooley Pond	**0%**	**42%**	**43%**	**0%**
	North Sea Harbor and Tribs	**0%**	**0%**	**43%**	**0%**
	Fish Cove	0%	31%	38%	0%
	Big/Little Fresh Ponds	N/A	33%	44%	0%
	Cutchogue Harbor	**0%**	**0%**	**33%**	**0%**
	Cutchogue Harbor - East Creek	**24%**	**62%**	**41%**	**0%**
	Cutchogue Harbor - Mud Creek	38%	69%	41%	0%
	Cutchogue Harbor - Wickham Creek	49%	74%	28%	0%
	Richmond Creek and Tidal Tribs	31%	66%	21%	0%
	Cedar Beach Creek and tidal tribs	0%	0%	37%	0%
	Corey Creek and Tidal Tribs	28%	64%	46%	0%
	Great Peconic Bay (South)	**47%**	**73%**	**17%**	**0%**
	Sebonac Cr/Bullhead Bay and Tidal Tribs	**0%**	**11%**	**32%**	**73%**
	Little Sebonac Creek	**0%**	**0%**	**18%**	**73%**
	Goose Neck Creek	51%	76%	40%	73%
	Reeves Bay and Tidal Tribs	**35%**	**67%**	**49%**	**73%**
	Scallop Pond	0%	11%	11%	73%
	Cold Spring Pond and Tribs	**0%**	**50%**	**42%**	**73%**
	Noyack Bay (P/O)	**0%**	**0%**	**28%**	**0%**
	Hog Creek and Tidal Tribs	56%	78%	49%	0%
	Acabonack Harbor	**41%**	**70%**	**42%**	**0%**
	Noyack Creek and Tidal Tribs	**45%**	**73%**	**31%**	**0%**
	Mill Creek and Tidal Tribs	**4%**	**52%**	**46%**	**0%**
	Red Creek Pond and Tidal Tribs	0%	10%	38%	73%
9 Peconic Estuary Restoration and Protection Area III	**Southold Bay**	**0%**	**0%**	**35%**	**0%**
	Pipes Cove	0%	0%	43%	0%
	Goose Creek	18%	59%	45%	0%

Table 4-1 Wastewater Management Nitrogen Load Reduction Goals

Wastewater Management Area	Water Bodies in Management Area	Goal Based on HAB DO Target	Goal Based on Ideal Water Quality	Achieved by I/A OWTS	Goal to Protect Down Stream Water Bodies
	Town/Jockey Creek	**26%**	**63%**	**53%**	**0%**
	Hashamomuck Pond/Long Creek and Budd's Pond	**0%**	**12%**	**35%**	**0%**
	SI Sound Trib/Moores Drain, Lower, Tribs	26%	63%	18%	0%
	Stirling Creek and Basin	0%	43%	44%	0%
	Shelter Island Sound, North, and tribs (P/O)	**0%**	**0%**	**22%**	**0%**
	Orient Harbor and minor tidal tribs (P/O)	**0%**	**0%**	**21%**	**0%**
	Dam Pond	0%	0%	16%	0%
	Gull Pond	0%	40%	34%	0%
	Spring Pond	0%	34%	50%	0%
	Hallock/Long Beach Bay and Tidal Tribs	**34%**	**67%**	**7%**	**0%**
10 Sag Harbor Cove and Connected Creeks	**Sag Harbor Cove and Tribs**	**62%**	**81%**	**48%**	**0%**
	Ligonee Brook and Tribs	N/A	31%	31%	81%
11 West Neck Bay and Creek and Menantic Creek	**West Neck Bay and Creek**	**37%**	**68%**	**39%**	**0%**
	Menantic Creek	45%	72%	46%	0%
12 Peconic Estuary Restoration and Protection Area IV	**Northwest Creek and Tidal Tribs**	**0%**	**45%**	**27%**	**0%**
	Three Mile Harbor	**0%**	**31%**	**46%**	**0%**
	Fresh Pond	0%	30%	29%	0%
	Napeague Harbor	**0%**	**0%**	**18%**	**0%**
	Lake Montauk	**0%**	**0%**	**40%**	**N/A**
	Big Reed Pond	N/A	N/A	0%	0%
	Block Island Sound	N/A	N/A	1%	0%
	Shelter Island Sound, North, and tribs (P/O)	**0%**	**0%**	**22%**	**0%**
	Orient Harbor and minor tidal tribs (P/O)	**0%**	**0%**	**21%**	**0%**
	Noyack Bay (P/O)	**0%**	**0%**	**28%**	**0%**
	Dering Harbor	0%	0%	38%	0%
	Gardiners Bay	**0%**	**0%**	**9%**	**N/A**
	Coecles Harbor	**0%**	**0%**	**30%**	**0%**
	Napeague Bay	0%	0%	3%	N/A
	Dickerson Creek	0%	22%	39%	0%
	West Neck Harbor	**0%**	**0%**	**26%**	**0%**
	Shelter Island Sound, South, and tribs	**0%**	**0%**	**18%**	**0%**
	Northwest Harbor	**0%**	**0%**	**17%**	**0%**
	Sag Harbor	**0%**	**0%**	**36%**	**0%**
	Cedar Beach Creek and tidal tribs	**0%**	**0%**	**37%**	**0%**

Table 4-1 Wastewater Management Nitrogen Load Reduction Goals

Wastewater Management Area	Water Bodies in Management Area	Goal Based on HAB DO Target	Goal Based on Ideal Water Quality	Achieved by I/A OWTS	Goal to Protect Down Stream Water Bodies
	Fort Pond Bay	0%	0%	22%	0%
	Oyster Pond / Lake Munchogue	N/A	N/A	0%	N/A
13 Coastal Ponds Restoration and Protection Water bodies	Fort Pond	N/A	N/A	48%	N/A
	Marion Lake	N/A	N/A	45%	0%
	Hook Pond	N/A	N/A	53%	N/A
	Georgica Pond	N/A	58%	38%	N/A
	Wainscott Pond	N/A	N/A	16%	N/A
	Sagaponack Pond / Poxabogue Pond	N/A	N/A	32%	N/A
	Mecox Bay	N/A	N/A	26%	N/A
	Kellis Pond	N/A	N/A	39%	N/A
	Little, Long, and Short Ponds	N/A	N/A	16%	N/A
	Mill and Seven Ponds	N/A	N/A	24%	N/A
	Wickapogue Pond	N/A	N/A	42%	N/A
	Old Town Pond	N/A	N/A	48%	N/A
	Agawam Lake	N/A	72%	61%	N/A
	Halsey Neck Pond	N/A	N/A	33%	N/A
14 Shinnecock Bay Restoration and Protection Area I	**Shinnecock Bay West**	**42%**	**71%**	**41%**	**3%**
	Shinnecock Bay Central	**0%**	**3%**	**11%**	**0%**
	Penny Pond, Wells, Smith, and Gilberts Creeks	0%	0%	52%	3%
	Tiana Bay and Tidal Tribs	36%	68%	50%	3%
	Weesuck Creek and Tidal tribs	44%	72%	39%	71%
	Phillips Creek, Lower, and Tidal Tribs	60%	80%	46%	71%
	Penniman Creek and Tidal Tribs	**0%**	**30%**	**41%**	**71%**
	Heady and Taylor Creeks	74%	87%	45%	0%
15 Shinnecock Bay Restoration and Protection Area II	**Shinnecock Bay East**	**0%**	**0%**	**31%**	**N/A**
	Shinnecock Bay - Bennet Cove (Cormorant Cove)	**0%**	**50%**	**52%**	**0%**
	Old Fort Pond	12%	56%	51%	0%
	Middle Pond	3%	52%	52%	0%
	Far Pond	0%	19%	48%	0%
16 Moriches Bay Restoration Area I	**Moriches Bay East**	**57%**	**79%**	**43%**	**N/A**
	Beaverdam Pond	77%	89%	46%	79%
	Speonk River	76%	88%	48%	79%
	Seatuck Cove and Tidal Tribs	**71%**	**86%**	**39%**	**37%**
	Terrell River	44%	72%	40%	37%
	Mud and Senix Creeks	79%	89%	55%	69%
	Orchard Neck Creek	83%	92%	54%	69%
	Forge River and Tidal Tribs	**86%**	**93%**	**54%**	**69%**
	Forge River Cove and Tidal Tribs	**38%**	**69%**	**43%**	**37%**

Table 4-1 Wastewater Management Nitrogen Load Reduction Goals

Wastewater Management Area	Water Bodies in Management Area	Goal Based on HAB DO Target	Goal Based on Ideal Water Quality	Achieved by I/A OWTS	Goal to Protect Down Stream Water Bodies
	Quantuck Canal/Moneybogue Bay	**82%**	**91%**	**52%**	**93%**
	Quantuck Bay	**85%**	**93%**	**43%**	**93%**
	Quantuck Creek and Old Ice Pond	61%	80%	40%	93%
	Aspatuck Creek and River	61%	80%	52%	93%
	Quogue Canal	86%	93%	44%	37%
	Ogden Pond	0%	31%	40%	93%
17 Moriches Bay Restoration Area II	**Moriches Bay West**	**0%**	**37%**	**9%**	**N/A**
	Harts Cove	**0%**	**0%**	**44%**	**37%**
	Tuthill Cove	0%	40%	46%	37%
	Narrow Bay	**38%**	**69%**	**49%**	**37%**
	Pattersquash Creek	65%	82%	59%	69%
	Sheepen Creek	7%	54%	59%	69%
	Unchachogue/Johns Neck Creeks	0%	18%	60%	69%
18 Great South Bay Restoration Area I	**Great South Bay, East**	**91%**	**95%**	**31%**	**N/A**
	Bellport Bay	**79%**	**89%**	**44%**	**95%**
	Beaverdam Creek	82%	91%	51%	95%
	Carmans River Lower, and Tribs	**90%**	**95%**	**39%**	**95%**
	Carmans River Upper, and Tribs	N/A	55%	39%	95%
	Howell's Creek	74%	87%	52%	95%
	Dunton Lake, Upper, and Tribs and Hedges Creek	88%	94%	57%	95%
	Abets Creek	83%	91%	53%	95%
	Mud Creek, Robinson Pond, and Tidal Tribs	75%	87%	48%	95%
	Swan River, Swan Lake, and Tidal Tribs	92%	96%	55%	95%
	Patchogue River	86%	93%	54%	95%
	Patchogue Bay	**81%**	**91%**	**43%**	**95%**
	Tuthills Creek	88%	94%	52%	95%
	Corey Lake and Creek, and Tribs	84%	92%	52%	95%
	Stillman Creek	94%	97%	56%	95%
	Brown Creek	91%	96%	57%	95%
	Sans Souci Lakes	N/A	N/A	53%	96%
	Green Creek, Upper, and Tribs	88%	94%	57%	95%
	Nicoll Bay	**83%**	**92%**	**50%**	**95%**
	Connetquot River, Lower, and Tribs	**84%**	**92%**	**45%**	**95%**
	Grand Canal	71%	86%	54%	95%

Table 4-1 Wastewater Management Nitrogen Load Reduction Goals

Wastewater Management Area	Water Bodies in Management Area	Goal Based on HAB DO Target	Goal Based on Ideal Water Quality	Achieved by I/A OWTS	Goal to Protect Down Stream Water Bodies
	Connetquot River, Upper, and Tribs	N/A	78%	53%	95%
19 Great South Bay Restoration Area II	**Great South Bay, Middle**	**6%**	**53%**	**6%**	**N/A**
	Great Cove	**0%**	**42%**	**8%**	**53%**
	Champlin Creek	72%	86%	29%	53%
	Pardees, Orowoc Lakes, Creek, and Tidal Tribs	67%	83%	43%	53%
	Awixa Creek	57%	79%	32%	53%
	Penataquit Creek	67%	83%	36%	53%
	Lawrence Creek, O-co-nee and Lawrence Lakes	3%	51%	15%	53%
	Brightwaters Canal, Nosreka, Mirror, and Cascade Lakes	18%	59%	16%	53%
	Carlls River	72%	86%	52%	39%
	Belmont Lake	N/A	N/A	60%	86%
	Sampawams Creek	59%	80%	44%	39%
	Great South Bay, West	**0%**	**39%**	**6%**	**N/A**
	Willets Creek	0%	0%	7%	39%
	Santapogue Creek	0%	56%	10%	39%
	Neguntatogue Creek	0%	19%	11%	39%
	Amityville Creek	0%	0%	14%	39%
20 Lake Ronkonkoma	**Lake Ronkonkoma**	**N/A**	**52%**	**48%**	**N/A**
21 Atlantic Ocean	Atlantic Ocean	N/A	N/A	N/A	N/A

Bold - Well characterized water body and load reduction goal driver for management area.
N/A Not applicable to water body. No goal was calculated
Overall Water Quality Improvement Goal based on reference water body approach for marine and mixed waters and EPA guidance value for freshwater

Table 4-6 Suffolk County Sewer Projects

Sewer Project	Project Description	Status	Funding	Estimated Population Equivalent	Priority Rank & Contributing Area
Carlls River (funded portions) West Babylon, Wyandanch, North Babylon (areas 108-11, 108-8, 110-2)	Connection of 4,297 residential parcels to Bergen Point WWTP under Suffolk County Coastal Resiliency Initiative (SCCRI)	Design underway, environmental review underway.	FEMA/GOSR to fund construction after design is complete.	12,800	Surface Water 1 Groundwater 3
Forge River Watershed Sewer District Phases I & II (Mastic/Shirley)	Construction of 1 MGD WWTP and connection of 2,893 parcels as part of SCCRI	Design underway, environmental reviews underway.	FEMA/GOSR to fund construction after design is complete.	9,000	Surface Water 1 Groundwater 3 0-2 Year
Patchogue / Patchogue River	Connection of 648 parcels to existing Village WWTP as part of SCCRI	Design contract awarded, environmental review completed. Final design work underway, contract letting expected by early 2019.	FEMA/GOSR to fund $18 million construction costs after design is completed.	3,000	Surface Water 1 Groundwater 3 0-2 Year
Oakdale Phase 1a / Connetquot River	Connection of 420 residential parcels to Suffolk County Sewer District No. 3, Southwest.	Pre-design phase. Phase 1a boundaries mapped and undergoing study.	State funds of $26.4 million have been allocated.	1,250	Surface Water 1 Groundwater 3 0-2 Year
Kings Park Business District	Connection of 140 commercial parcels in business district, Kingswood Apartment complex (144 units) and six residential parcels to SD#6 at estimated cost of $18 million	Project design is 95% complete. State enabling legislation required for use of town-owned parcel as site for pump station.	New York State FY 2017-18 Budget includes $20 million to advance project.	1,400	Surface Water 2 Groundwater 3
Ronkonkoma Hub	Construction of 1.5 million GPD pump station and force main to to Bergen Point WWTP to connect the Ronkonkoma Hub Transit-Oriented Development project. Project would also provide capacity for MacArthur Industrial Sewer District project (see below).	Design completed, construction contract for force main awarded. Town of Brookhaven's selected Master Developer to construct pump station.	$31 million in sewer bonds and $4M Empire State Development Corporation (ESDC) Grant appropriated.	5,000	Surface Water N/A Groundwater 3
Smithtown Business District	Siting, design and construction of new WWTP to serve 350 parcels in Smithtown business district at estimated cost of $55 million.	Design of collection system essentially complete, but need to identify potentially viable locations for WWTP.	New York State FY 2017-18 Budget includes $20 million to advance project.	2,500	Surface Water 2 Groundwater 3 0-2 Year
Huntington Station	Connection of 290 parcels in proposed Huntington Station TOD to Bergen Point WWTP/SD#3 via Walt Whitman pump station (SD 17) at an estimated cost of $20 million.	The RFP for Planning and Design Services was issued in July 2017. Consultant selected and award process underway.	Planning and Design RFP - $1.25 million appropriated through "Start-Up NY" funds. No funding identified for construction.	1,500	Surface Water 1 Groundwater 3
Carlls River - unsewered areas in West Islip, North Babylon, West Babylon, Deer Park, Wyandanch	Connect 15,706 parcels not being funded through SCCRI to Bergen Point/SD#3 at estimated cost of $800 million.	Feasibility Study completed in 2012.	No funding identified for construction of these remaining projects.	47,100	Surface Water 1 Groundwater 2

Table 4-6 Suffolk County Sewer Projects

Sewer Project	Project Description	Status	Funding	Estimated Population Equivalent	Priority Rank & Contributing Area
Forge River Watershed Sewer District Phases III & IV (Mastic/Mastic Beach)	Connection of 7,607 parcels not being funded under SCCRI to Forge River WWTP at estimated cost of $500 million.	Feasibility Study completed.	No funding identified for design or construction.	22,800	Surface Water 1 Groundwater 3 0-2 Year
Holbrook	Connection of 71 existing commercial parcels and 76 residential units to Bergen Point/SD#3 via Ronkonkoma Hub at estimated cost of $9 million	Feasibility Study completed in 2016.	No funding identified for design or construction.	700	Surface Water N/A Groundwater 3
Port Jefferson Station	Connection of 126 commercial and residential parcels in Port Jefferson Station and Terryville to SD#2, Tallmadge Woods.	Feasibility Study completed. RFP for project design issued 10/17, proposals due 1/12/18. Although $5M in sewer bonds is included the 2018 Capital budget, it cannot be used because a sewer district has not been created.	$500k in sewer bonds appropriated for design in 2017. If additional design funds are needed, a portion of the $5m in 2018 sewer bonds could be appropriated.	1,500	Surface Water 3 Groundwater 3
Sayville Extension (Oakdale, W. Sayville, Sayville, Bayport)	Connection of 8,947 parcels in south Islip communities to Bergen Point/SD #3 estimated cost of $700 million.	Town Feasibility Study completed in 2012. Design contract awarded for Force Main only (estimated project cost $45 million), not for complete collection system.	Design cost of $3 million is funded. No funding identified for construction.	28,100	Surface Water 1 Groundwater 3 0-2 Year
SC SD # 7 Woodside/ Bellport Village/N. Bellport	Upgrades to STP to expand capacity by 160,000 GPD to connect 128 commercial and residential properties in N. Bellport and Bellport (est. cost between $25M and $30M)	SC to begin improvements to expand existing STP capacity and proposed connection to SD #7 using $1.75 million appropriated in Capital Budget.	Capital Budget includes $1.75 million in construction sewer bonds appropriated for upgrades at the STP/No funding identified for connection of new parcels	1,600	Surface Water 1 Groundwater 3
Central Islip	Connection of business district to Bergen Point/SD #3 (# of parcels to be determined)	RFP for Feasibility Study issued in September 2017. Contractor selection process underway.	$200k appropriated for FS. No source of design or construction funds identified.	TBD	Surface Water N/A Groundwater 3
Brentwood	Connection of business district to Bergen Point/SD #3 (# of parcels TBD)	RFP for Feasibility Study to be issued in Spring 2018.	$200k appropriated for FS. No source of design of construction funds identified.	TBD	Surface Water N/A Groundwater 3
MacArthur Industrial Sewer District	Create new district to connect MacArthur Airport and industrial commercial area to Bergen Point WWTP/SD #3 via Ronkonkoma Hub Pump Station at an estimated cost of $125 million	An RFP was issued for Planning and Design Services for Pump station and force main only, not collection system (estimated project cost for force main and pump station is $10 million).	No funding identified for construction.	TBD	Surface Water 1 Groundwater 3
Yaphank	FS to evaluate potential development of County owned land surrounding existing STP.	FS funding never approved	No further funding.	Unknown	Surface Water 1 Groundwater 3

Table 4-6 Suffolk County Sewer Projects

Sewer Project	Project Description	Status	Funding	Estimated Population Equivalent	Priority Rank & Contributing Area
Rte. 25/Middle Island/Selden	FS to evaluate sewering options along Rte. 25A between NYS Rte. 347 and County Rte. 21	FS funding never approved	No further funding.	Unknown	Surface Water N/A Groundwater 3
Rocky Point	277 mixed use parcels. Cost est. of $17M to $35M	FS completed. Sewers not recommended.	No further funding.	1,500	Surface Water 3 Groundwater 3
Center Moriches	Connection of 102 commercial and 45 residential parcels to a new STP. Cost est. $30 Million.	FS completed in 2013. No land for STP.	No further funding.	2,000	Surface Water 1 Groundwater 3

Legend
FS, Design & Construction Funded
FS & Design Funded
FS Funded & Complete
FS Funded/Proposed
Undetermined / Under Consideration
Unfeasible

Priority Rank dependent on 25% or more of project area falling within the contributing area

Table 4-7 Town/Village Sewer Projects

Sewer Project	Project Description	Status	Funding	Equivalent	Contributing Area
Calverton/EPCAL - Town of Riverhead	Proposed plant improvements to increase water quality treatment to treat 100,000 gpd for future EPCAL flow and relocation of discharge outfall with 1.4 mile force main to new recharge beds north of the groundwater divide. Total project costs including FS is $10.2 million.	FS report to upgrade/expand existing WWTP completed in 2014. Project design to be completed by the end of January 2018. Project went to bid and construction slated to begin in summer/fall 2019. Additional expansions with modules to 200,000 gpd and 300,000 gpd are planned for ultimate maximum buildout of property in the future, not included in this project.	$476,000 Water Quality Improvement Project (WQIP) grant for relocation of EPCAL sewer outfall from the Peconic Estuary - contract not quite executed. $5M NYSDEC grant for upgrade of Calverton WWTP and relocation of outfall - contract not quite executed. $125,000 appropriated SC WQPRP grant for elimination of EPCAL point source discharge to the Peconic Estuary. Total of $7.5 million in grants received.	TBD	Surface Water N/A Groundwater 3
Westhampton Downtown - Village of Westhampton Beach (Phase 1 of 4)	Connection of 66 commercial lots on Main Street and condos on Moneybogue Bay to existing SD #24 Gabreski WWTP. Phase 1 is 60,000 gpd.	Initial map and plan completed. Village Board passed a resolution to create a sewer district. Engineering design work is finalize for the collection and conveyance system and also future upgrades to Gabreski STP. Bid for construction in 2020. May conduct season construction. Construction and start-up for Phase 1 expected 2020-2022. Engineering, construction, soft costs budgets at $16,750,000 total for the conveyance and collection system as well as upgrades to the STP.	Construction funding to be in place by 2020. Village to fund engineering design for Gabreski WWTP improvements. Southampton Town CPF funding engineering design and EPG funding toward the map and plan. $5M NYSDEC WQIP grant to help fund construction.	500 (156 parcels)	Surface Water 1 Groundwater 3 0-2 Year
Riverside - Town of Southampton	New sewer district required to manage wastewater generated by Riverside redevelopment project.	Draft map and plan completed. Engineering design work completed. Meeting with Suffolk IDA to finalize the sewer district. SEQRA review (supplemental GEIS) to be completed July 2019. Town Board anticipates to create the sewer district by August 2021. Construction and start-up for Phase 1 expected to be completed 2021.	Funding in place: project listed on 2019 NYS EFC Annual Intended Use Plan for $57 million in low interest loans set aside for the construction of the plant and associated infrastructure.	1,500	Surface Water 1 Groundwater 3 0-2 Year
Wyandanch - Town of Babylon	Connection of commercial lots on Acorn Street (32 parcels) and Wyandanch Avenue (57 parcels) to existing Bergen Point WWTP/SD#3.	Acorn Street and Wyandanch Avenue projects are at the RFP stage for design work and cost estimates. Project is expected to be project completed in 2021. Town IDA project. There is overlap with the County's Carlls River projects.	Funding may be coordinated with the IDA, Environmental Facilities Corporation (EFC) loan, and SC Sewer Infrastructure grant. No cost estimates prepared yet.	TBD	Surface Water 1 Groundwater 3

Table 4-7 Town / Village Sewer Projects

Sewer Project	Project Description	Status	Funding	Estimated Population Equivalent	Priority Rank & Contributing Area
Northport Expansion - Village of Northport	Expansion of sewer district into two near-shore areas, Steers Pit and Bluff Point Road. Approx. 40,000 gpd.	Feasibility Study completed. Conceptual construction cost for collection system is $9M to $11M. Preparing maps/surveys/plans.	Awarded $5M Water Quality Improvement Project (WQIP) NYS grant. Additional funding from SC Sewer Infrastructure requested.	450 (149 residential + 2 commercial)	Surface Water 2 Groundwater 3 0-2 Year
Patchogue Expansion - Village of Patchogue	Proposed expansion of existing WWTP capacity from 800K to 1.2M gpd to accommodate new commercial growth.	Facility Plan' feasibility study completed; under Village review. Total project cost, including construction and engineering cost is $10.4M	$100,000 for 'facility plan' funded. Village to apply for NYS water qual. funding for STP improvements project construction. Received $30,000 grant from NYSDEC.	TBD	Surface Water 1 Groundwater 3 0-2 Year
Hampton Bays Downtown - Town of Southampton	Proposed new sewer district for existing commercial development is being planned.	Feasibility Study not completed.	No funding identified for construction.	TBD	Surface Water N/A Groundwater 3
Southampton Downtown - Village of Southampton	Proposed new sewer district for downtown area.	FS/design complete but construction bids came in too high; considering alternative project.	Funding requirements uncertain.	1,500	Surface Water 1 Groundwater 1 0-2 Year
Montauk Downtown - Town of East Hampton	Proposed sewer district for commercial lots around Fort Pond and include Montauk Manor and Rough Riders.	Feasibility Study underway with Lombardo Associates.	FS funded. Initial project costs at $32M. Town applied for $5M in NYS water quality funding for design/construction. $10M in Town CPF funding is uncertain.	TBD	Surface Water 4 Groundwater 1 0-2 Year
East Hampton Downtown - Village of East Hampton	Village has discussed creating a sewer district in the commercial area.	No plans or studies in place.	No funding identified for construction.	TBD	Surface Water 1 Groundwater 1
Springs School District - Town of East Hampton	Town of East Hampton has discussed constructing advanced treatment at the Springs School.	Town is considering package STP or I/A OWTS. No plans or studies in place.	No funding identified for construction.	TBD	Surface Water 3 Groundwater 1 0-2 Year
Port Jefferson – Village of Port Jefferson	FS for expansion/additional connection of parcels within the Village boundary to the existing Village WWTP completed under SC CP 8185	Since the Village is not completely within the district it is possible that use of available capacity that has been discussed for the Village would be for an outside connection. Village indicated no plans to move forward.	No further funding.	2,300	Surface Water 3 Groundwater 3

Table 4-7 Town / Village Sewer Projects

Sewer Project	Project Description	Status	Funding	Estimated Population Equivalent	Priority Rank & Contributing Area
Sag Harbor - Village of Sag Harbor	FS for expansion/additional connections to existing Village WWTP completed under SC CP 8185	Possible expansion of the sewer service area under potential built-out scenario (85,000 gpd) - has to be owned/decided on by the Village and requires funding. Village indicated no plans to move forward.	No further funding identified.	800	Surface Water 2 Groundwater 3
Riverhead - Town of Riverhead	FS for expansion/additional connections to existing Riverhead Sewer District WWTP completed under SC CP 8185	No additional capacity for outside connections and no plans for expansion. Owned by Town of Riverhead. Town indicated no plans to move forward.	No further funding identified.	Unknown	Surface Water 1 Groundwater 2
Fire Island Expansion - Village of Ocean Beach	Rebuild STP/collection system to expand sewer service district.	Village indicated no plans to move forward.	No further funding identified.	8,000	Surface Water 1 Groundwater 3

Legend
FS, Design & Construction Funded
FS & Design Funded
FS Funded & Complete
FS Funded/Proposed
No Plans to Move Forward with Project

Priority Rank dependent on 25% or more of project area falling within the contributing area

Section 5

Long Island Sound Subwatersheds

Sections 5, 6, and 7 summarize the SWP findings and wastewater management recommendations for each of the major estuaries in Suffolk County. An overview of the subwatersheds located within the Long Island Sound (LIS) watershed, nitrogen loads to the Long Island Sound subwatersheds, priorities for LIS subwatershed nitrogen load reduction and wastewater planning is provided in the following pages. Details of the approaches used to develop the nitrogen loads, priority rankings and nitrogen load reductions and wastewater planning may be found in Section 2 of this SWP.

5.1 LIS Subwatersheds

A total of 27 individual surface water bodies were evaluated within the Long Island Sound watershed/study area, which is shown by **Figure 5-1**. The 27 individual water bodies were eventually grouped into six aggregated wastewater management areas based on similar priority ranks and load reduction goals as described in Sections 2.1.10 and 4.1.1. A list of the individual Long Island Sound subwatersheds in alphabetical order, along with the assigned SWP PWL number may be found in **Table 5-1.**

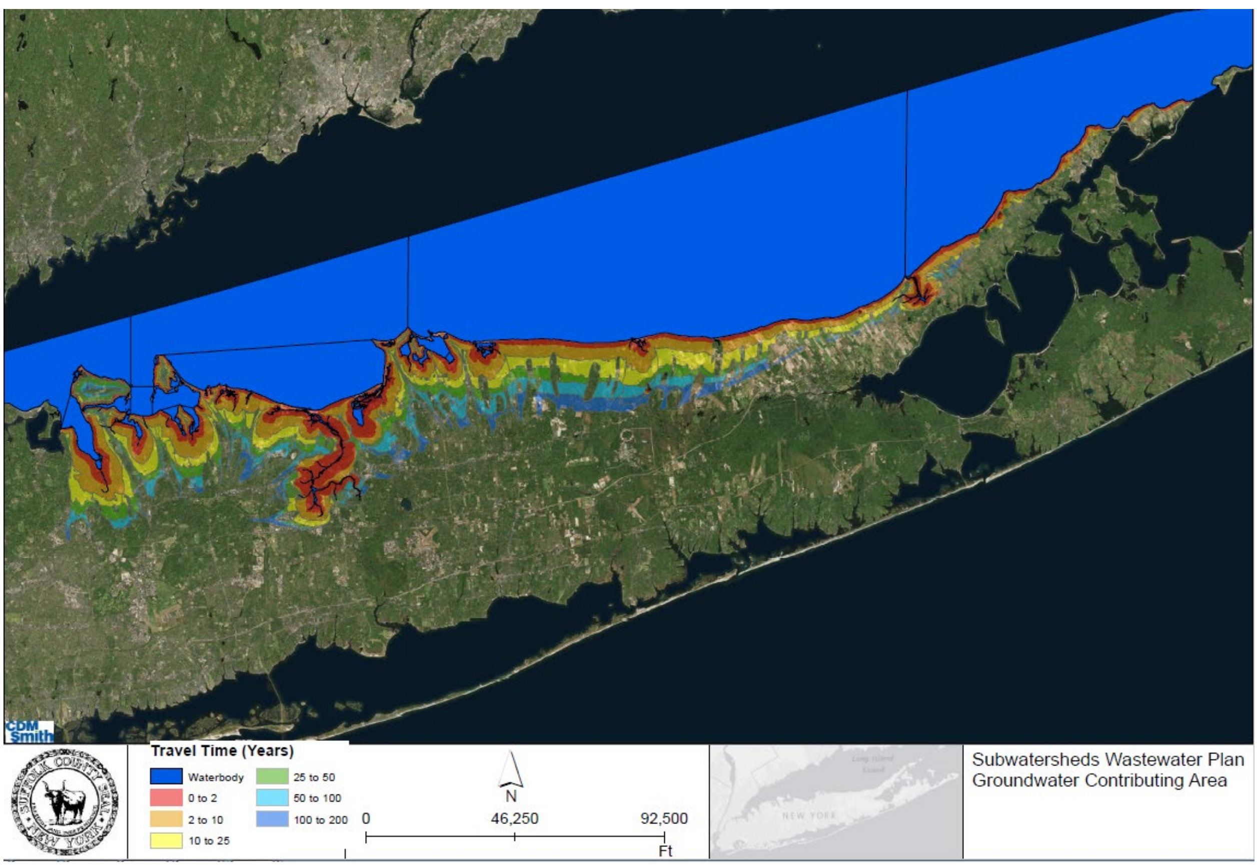


Figure 5-1 Long Island Sound Subwatersheds

Table 5-1 Long Island Sound Subwatersheds

Subwatershed	SWP PWL Number
Centerport Harbor	1702-0229
Cold Spring Harbor, and Tidal Tribs	1702-0018+0156
Conscience Bay and Tidal Tribs	1702-0091
Crab Meadow Creek	1702-0232-CMC+0234
Duck Island Harbor	1702-0262
Flax Pond	1702-0240
Fresh Pond Creek and Tribs	1702-0244
Goldsmith Inlet	1702-0026
Huntington Bay	1702-0014
Huntington Harbor	1702-0228+0231
Lloyd Harbor	1702-0227
Long Island Sound, Suffolk Co, Central	1702-0265
Long Island Sound, Suffolk County, East	1702-0266
Long Island Sound, Suffolk County, West	1702-0098+0232
Mattituck Inlet/Cr, Low, and Tidal Tribs	1702-0020+0245
Mill Pond	1702-0261
Mt Sinai Harbor and Tidal Tribs	1702-0019
Nissequogue River Lower/Sunken Meadow Creek	1702-0025+0234+0232
Nissequogue River Upper	1702-0235+0013+0238+0237+0236
Northport Bay	1702-0256
Northport Harbor	1702-0230
Port Jefferson Harbor, North, and Tribs	1702-0015
Port Jefferson Harbor, South, and Tribs	1702-0241
Setauket Harbor	1702-0242
Smithtown Bay	1702-0023+0233+0234
Stony Brook Harbor and West Meadow Creek	1702-0047+0239
Wading River	1702-0099+0243

The areas contributing groundwater baseflow to the Long Island Sound surface water bodies were delineated using both the Main Body and the North Fork groundwater models. Based upon the individual water body-specific subwatershed delineations, the groundwater baseflow contributions were also compiled, based on the land surface area contributing recharge to the water body within each travel time interval simulated. These percentages, along with the subwatershed mappings, provide a first assessment of the areas where management actions such as reductions in nitrogen load can provide the most benefit to the downgradient surface water.

The percentages are based on the total baseflow discharged to each surface water body over the 200-year simulation period. For some of the water bodies in the Long Island Sound watershed, the complete contributing area is not delineated by a 200-year simulation, as it may take centuries for recharging precipitation to travel vertically down through the aquifer system and then northwards to discharge. However, the 200-year simulations do capture the majority of the contributing areas and provide a reasonable framework for nitrogen management planning.

A summary of the groundwater baseflow contributions to each subwatershed from each travel time interval is provided by **Figure 5-2** and **Table 5-2** (please see tables at the end of this section). The figure and table show that based on the average baseflow contributions to each subwatershed, over twenty-five percent of the groundwater baseflow and associated nitrogen loading originates within the 0 to two-year travel time, over 50 percent of the groundwater baseflow and associated nitrogen loading originates within the 0 to 10-year travel time, and almost 85 percent of the groundwater baseflow originates within the 0 to 50-year travel time (based on the 200-year simulations).

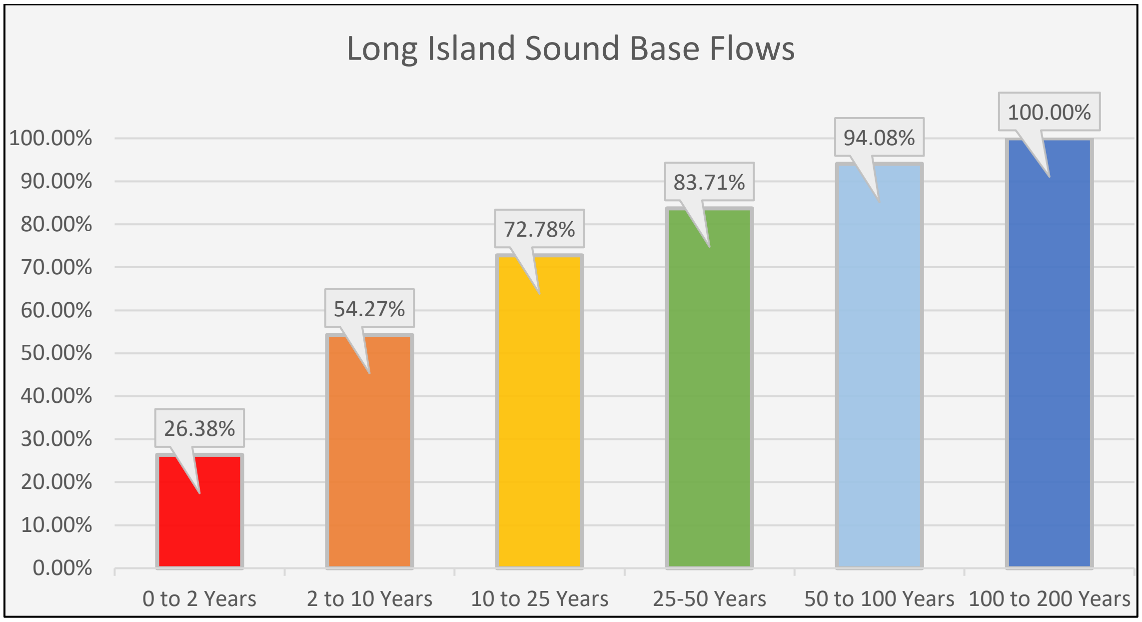


Figure 5-2 Groundwater Baseflow Travel Times in the Long Island Sound Watershed

On average, nearly 80 percent of the groundwater baseflow to the western Long Island Sound, central Long Island Sound and contributing subwatersheds originated within the past fifty years. Just over 80 percent of the groundwater baseflow discharging to the eastern Long Island Sound and contributing subwatersheds originated at the water table within the past 25 years. Wastewater management in these contributing areas will result in significant nitrogen reductions in baseflow originating from Suffolk County to the Long Island Sound water bodies. The table also shows that it will take centuries before the precipitation currently recharging the aquifer system in some parts of the contributing area will be discharged to the Long Island Sound subwatersheds.

5.2 LIS Subwatershed Nitrogen Loads

Parcel-specific nitrogen loading was incorporated into three-dimensional solute transport models to simulate nitrogen concentrations and nitrogen migration throughout the aquifer system and to estimate the nitrogen loading to each of the LIS subwatersheds.

To calculate parcel-specific nitrogen loads for existing conditions, parcel-specific land uses were defined by the 2016 land use coverages provided by Suffolk County Department of Economic Development and Planning. Nitrogen sources, nitrogen loading rates and nitrogen attenuation factors were developed in consultation with the Nitrogen Loading Model Focus Area Work Group convened by SCDHS.

As described in Section 2.1.5, nitrogen from the following sources was incorporated into the nitrogen loading model:

- Sanitary wastewater
- Fertilization
- Pet Waste
- Atmospheric Deposition

Nitrogen loading rates from sanitary wastewater, fertilizer and pet wastes were based on each parcel's land use. Nitrogen loads from atmospheric deposition were applied uniformly across all land use types in the County.

5.2.1 Existing Nitrogen Loads

The nitrogen load components to each Long Island Sound subwatershed from the 200-year contributing area are listed on **Table 5-3** (please see tables at the end of this section) and are summarized on **Figure 5-3.** Under existing average annual conditions, on-site sanitary wastewater systems contribute approximately 43 percent of the total nitrogen load to the Sound, followed by almost 33 percent direct atmospheric deposition to the Sound surface waters. Point sources, including sewage treatment plants discharging to groundwater and directly to surface waters are the smallest components of the total nitrogen load at 0.4 percent and 1.5 percent respectively.

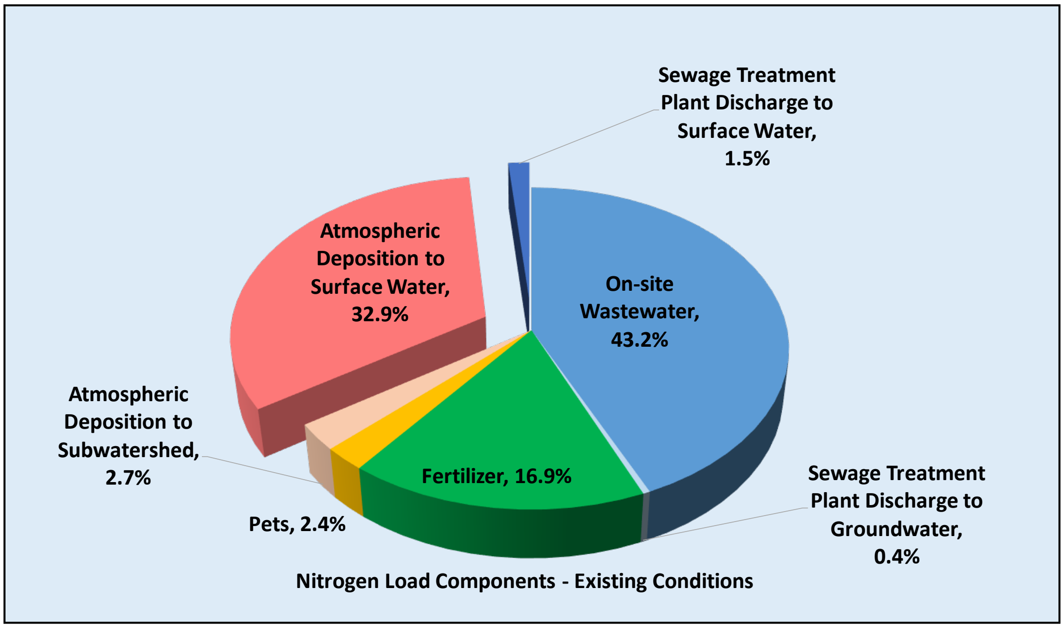


Figure 5-3 Components of Existing Nitrogen Loads to Long Island Sound Subwatersheds

Review of the nitrogen load components to groundwater from the 200-year contributing area to the Long Island Sound subwatersheds shows that on-site sanitary wastewater contributes over 65 percent of the nitrogen load to groundwater, followed by fertilizer at almost 26 percent, as shown by **Figure 5-4.** Atmospheric deposition to the subwatersheds, pets, and discharge of treated sanitary effluent from sewage treatment plants combine to contribute less than ten percent of the nitrogen load from groundwater.

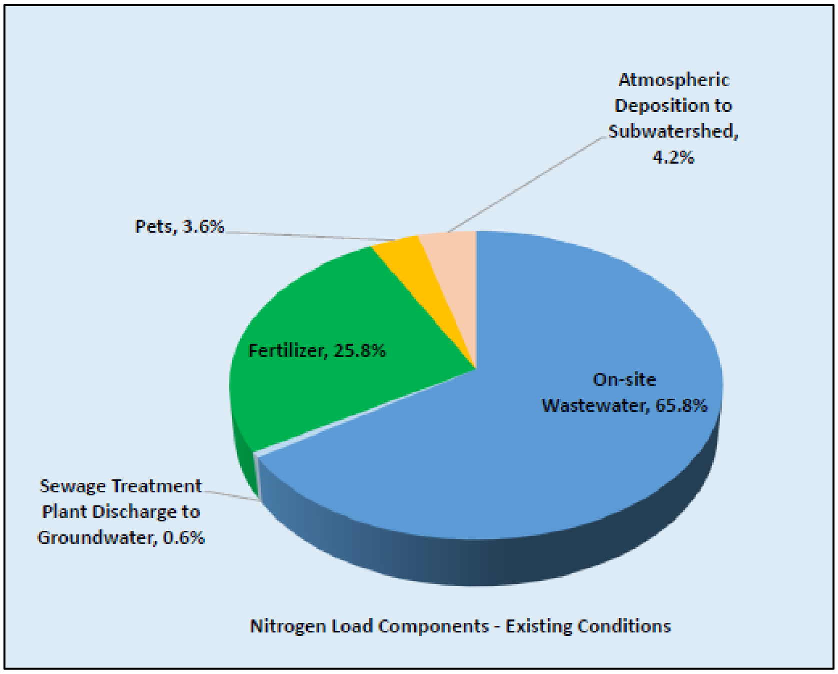


Figure 5-4 Summary of Existing Groundwater Nitrogen Load Components to Long Island Sound Subwatersheds

5.2.2 Potential Future Build-out Nitrogen Loads

As described in Section 2.1.5.3, in addition to evaluating the nitrogen loading to each subwatershed based on existing conditions, the potential future nitrogen loading if each undeveloped (or underdeveloped) residential parcel in the County was ultimately built-upon was also calculated. Suffolk County Department of Economic Development and Planning developed the conditions used for potential future build-out, which were based on the more stringent of Suffolk County Sanitary Code Article 6 or local zoning for all:

- Vacant parcels without development restrictions
- Agricultural parcels without development restrictions, and
- Subdividable low density residential parcels.

This does not indicate that these changes will occur within any specific timeframe, or even that they will ever occur at all, but it does provide a reasonable upper limit on anticipated future loading from on-site sanitary wastewater disposal in specific areas of the County.

The flow fields used for the existing conditions simulations were used for the future build-out simulations; e.g., boundary conditions such as recharge from precipitation and water supply pumping remained constant. In addition, parameters used to establish the nitrogen loading from on-site sanitary wastewater, pets and fertilizer remained unchanged from the existing conditions evaluation.

In addition to the changes in land use that were incorporated in the build-out evaluation, two other changes were made to better reflect future anticipated conditions:

- Flows and nitrogen loads from sanitary wastewater treatment plants were adjusted to match permit conditions. In some cases, the future flows were increased, based on anticipated future development; the increased flow and existing nitrogen concentrations combined to increase the total assigned nitrogen loads. In other cases, nitrogen concentrations were anticipated to be reduced to comply with permit limits, resulting in a net reduction in nitrogen load.
- Nitrogen loading from atmospheric deposition was reduced by ten percent, based upon unpublished information provided by USEPA.

Nitrogen loads from future potential build-out conditions were simulated using the solute transport model; the results of these simulations are discussed in Sections 3 and 4. The percentages of each nitrogen load component that are anticipated to result if the additional development takes place are shown in **Figure 5-5.**

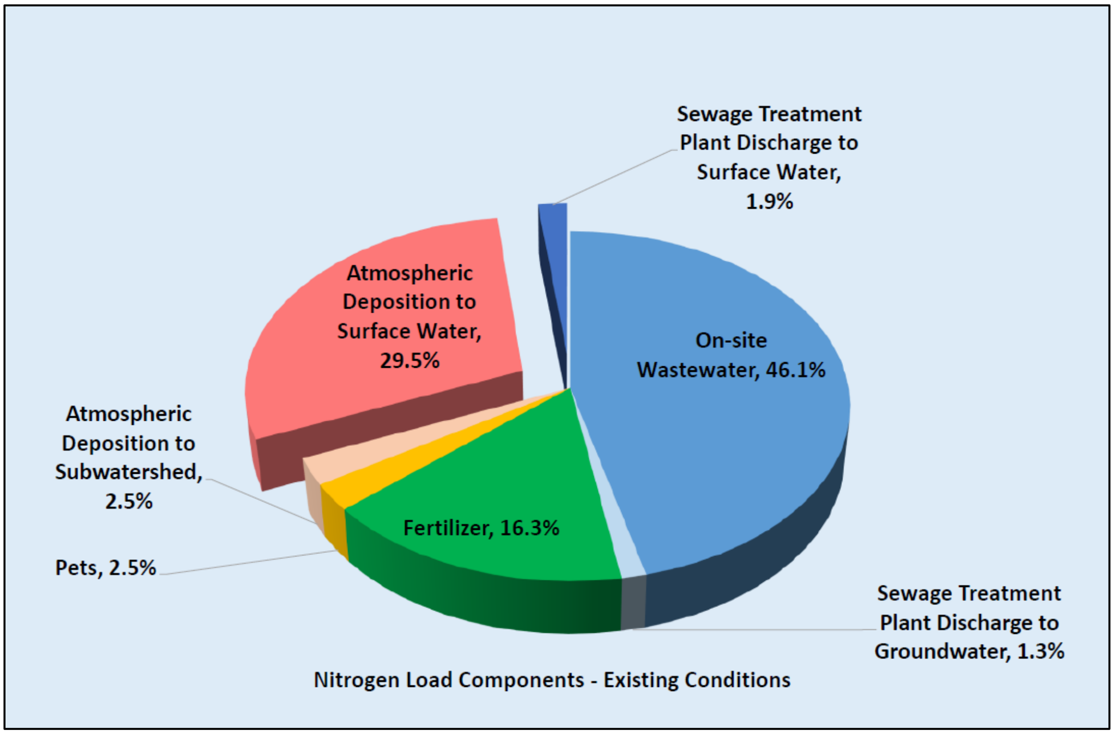


Figure 5-5 Components of Potential Future Build-out Nitrogen Loads to Long Island Sound Subwatersheds

Review of the nitrogen load components shows that the on-site sanitary wastewater contribution would increase slightly to just over 46 percent of the total nitrogen load, if full build-out were to occur, followed by atmospheric deposition to the surface waters at 29.5 percent. Direct discharge of point sources to the surface waters and to groundwater would remain the lowest nitrogen load components after future build-out at 1.9 percent and 1.3 percent respectively.

Review of the nitrogen load components to groundwater shows that on-site sanitary wastewater would contribute over 67 percent of the nitrogen load to groundwater, followed by fertilizer at almost 24 percent, as shown by **Figure 5-6**. Atmospheric deposition to the subwatersheds, pets, and discharge of treated sanitary effluent from sewage treatment plants combine to contribute less than ten percent of the nitrogen load from groundwater.

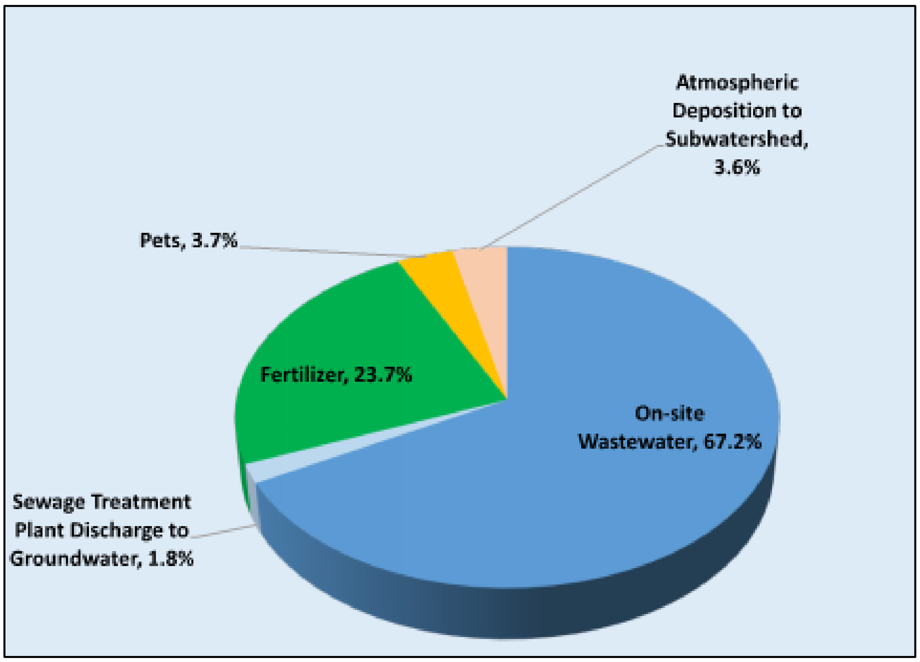


Figure 5-6 Summary of Potential Future Build-out Groundwater Nitrogen Load Components to Long Island Sound Subwatersheds

At build-out, the nitrogen load to the LIS subwatersheds is projected to increase by 0.5 percent conditions based on existing conditions of wastewater management. Increased nitrogen loading associated with projected development would be offset to some degree by the reduction in nitrogen loading from atmospheric deposition that has been identified by the USEPA. In some cases, conversion of agricultural parcels to low density residential development also results in a lower nitrogen load.

5.3 LIS Subwatershed Priority Areas and Nitrogen Load Reduction Requirements

5.3.1 Individual LIS Subwatershed Priority Area Rankings

The 27 individual Long Island Sound subwatersheds were ranked amongst the entire set of 190 Suffolk County subwatersheds based on the modeled nitrogen loads, residence times and surface water quality characterizations. Based on the available data, six subwatersheds were ranked as Priority 1 for nitrogen load removal, and five subwatersheds were ranked as Priority 2 for nitrogen load removal. Thirteen subwatersheds were ranked as Priority 3 for nitrogen load reduction and three subwatersheds were ranked as Priority 4.

The priority rankings anticipated to result in improved water quality are summarized below by **Table 5-4**, which is organized alphabetically for easy reference.

Table 5-4 Long Island Sound Subwatersheds Nitrogen Load Priority Areas

Long Island Sound Subwatersheds	SWP PWL Number	Priority for Nitrogen Load Reduction
Centerport Harbor	1702-0229	2
Cold Spring Harbor, and Tidal Tribs	170.2-0018+0156	3
Conscience Bay and Tidal Tribs	1702-0091	3
Crab Meadow Creek	1702-0232-CMC+0234	2
Duck Island Harbor	1702-0262	3
Flax Pond	1702-0240	3
Fresh Pond Creek and Tribs	1702-0244	3
Goldsmith Inlet	1702-0026	1
Huntington Bay	1702-0014	2
Huntington Harbor	1702-0228+0231	2
Lloyd Harbor	1702-0227	3
Long Island Sound, Suffolk Co, Central	1702-0265	3
Long Island Sound, Suffolk County, East	1702-0266	4
Long Island Sound, Suffolk County, West	1702-0098+0232	3
Mattituck Inlet/Cr, Low, and Tidal Tribs	1702-0020+0245	2
Mill Pond	1702-0261	1
Mt Sinai Harbor and Tidal Tribs	1702-0019	4
Nissequogue River Lower/Sunken Meadow Creek	1702-0025+0234+0232	3
Nissequogue River Upper	1702-0235+0013+0238+0237+0236	1
Northport Bay	1702-0256	1
Northport Harbor	1702-0230	1
Port Jefferson Harbor, North, and Tribs	1702-0015	4
Port Jefferson Harbor, South, and Tribs	1702-0241	3
Setauket Harbor	1702-0242	3
Smithtown Bay	1702-0023+0233+0234	3

Long Island Sound Subwatersheds	SWP PWL Number	Priority for Nitrogen Load Reduction
Stony Brook Harbor and West Meadow Creek	1702-0047+0239	3
Wading River	1702-0099+0243	1

5.3.2 LIS Subwatershed Nitrogen Load Reduction Requirements

A range of nitrogen load reductions were developed for the LIS subwatersheds based upon the reductions required to achieve ideal water quality (reference water body approach), dissolved oxygen water quality goals (reference water body approach) and chlorophyll-*a* goals (probabilistic approach) as described in Section 2.1.9. The range of sanitary wastewater nitrogen load reduction goals to achieve ideal water quality ranged from 0 for the well-flushed open waters of eastern Long Island Sound to 90 percent for the poorly characterized Mill Pond as summarized on **Table 5-5** (please see tables at the end of this section). The overall load reduction goal for nitrogen from sanitary wastewater for the LIS watershed based on the well-characterized subwatersheds is 27 percent.

5.3.3 Aggregated Wastewater Management Area Priority Ranking and Load Reduction Goals

The 27 individual surface water bodies within the Long Island Sound watershed were aggregated into six larger, administratively manageable wastewater management areas based on similar priority for nitrogen load reduction, nitrogen load reduction goals and the downstream receiving water body nitrogen load reduction priority and target nitrogen reduction. The six Long Island Sound wastewater management areas are shown on **Figure 5-7**, described below and summarized on **Table 5-6**.

Table 5-6 Nitrogen Load Reduction Goals and Nitrogen Load Reductions Achievable through On-Site Wastewater Management

Management Area	Management Area Name	Management Area Reference Water Body HAB/DO Improvement Goal*	Management Area Reference Water body Overall Water Quality Improvement Goal*	Achievable Reduction through On-Site Wastewater Management
1	Western Long Island Sound Harbor Restoration Areas	44%	72%	50%
2	Long Island Sound Harbors and Bays Restoration and Protection Area I	23%	37%	43%
3	Long Island Sound Harbors and Bays Restoration and Protection Area II	5%	13%	45%
4	Central and Western Long Island Sound Open Waters Protection Area	0%	0%	16%
5	Long Island Sound Inlets and Creeks Restoration Area	34%	67%	39%

Management Area	Management Area Name	Management Area Reference Water Body HAB/DO Improvement Goal*	Management Area Reference Water body Overall Water Quality Improvement Goal*	Achievable Reduction through On-Site Wastewater Management
6	Eastern Long Island Sound Open Waters and Long Island Sound Fresh Waters Protection Area	0%	0%	5%

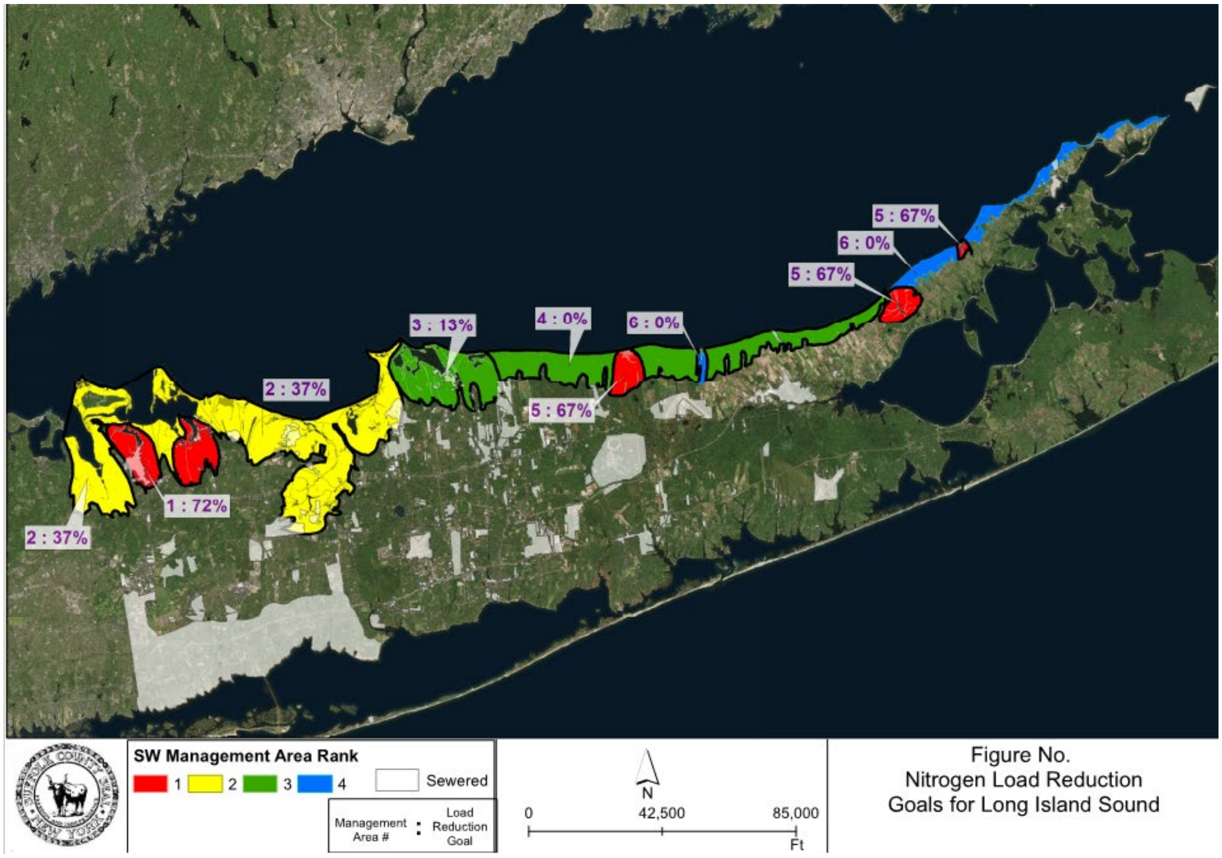


Figure 5-7 Priority Areas for Nitrogen Load Reduction

5.3.3.1 Wastewater Management Area 1 – Western Long Island Sound Harbors Restoration Area

The Western LIS Harbors Restoration Area includes Huntington Harbor, Mill Pond, and Northport Harbor. Northport Harbor and Huntington Harbor are well characterized and received individual surface water priority ranks of Priority Rank 1 and Priority Rank 2, respectively. Huntington Harbor and Northport Harbor have seen frequent occurrences of the red tide HAB *Alexandrium*. Mill Pond, which is connected to Centerport Harbor, is unique in that it is manually closed and isolated from Centerport Harbor by the community during times of high tide through a control valve. Mill Pond has been the subject of several fish kills and although poorly characterized, received an individual rank of Priority Rank 1. Load reduction goals for ideal water quality are amongst the highest in the Long Island Sound watershed ranging from 72 to 90 percent for these three water bodies.

Combined, the wastewater management priority area rank is Priority Rank 1 with an overall nitrogen reduction goal of 72 percent to achieve ideal water quality.

5.3.3.2 Wastewater Management Area 2 – Long Island Sound Harbors and Bays Restoration and Protection Area I

The LIS Harbors and Bays Restoration and Protection Area I area includes 13 western Suffolk water bodies with varying individual priority rank and load reduction goals. Four of the water bodies (Cold Spring Harbor, Flax Pond, Nissequogue River Upper, and Crab Meadow Creek) are poorly characterized for water quality while the remaining nine are well characterized. Well characterized water bodies have individual surface water Priority Ranks of 2 and 3, with the exception of Northport Bay (individual Priority Rank 1). The larger bays within Wastewater Management Area 2 generally shared low nitrogen load reduction goals while the connected harbors, creeks, and streams had load reduction goals to achieve ideal water quality ranging from 25 to 78 percent. Land use in the area includes low, medium, and high-density residential development. Despite having an individual Priority Rank of 1, Northport Bay was included within Wastewater Management Area 2 area because its direct groundwater contributing area is very small and its load reduction goal is estimated to be 0 percent due to the large volume of the water body. Ultimately, Northport Bay's water quality concerns should be addressed through nitrogen reductions obtained from connected Wastewater Management Area 1 water bodies. Water quality within Wastewater Management Area 2 water bodies is generally characterized by the occurrence of occasional (but not frequent) HABs, acceptable water clarity, acceptable dissolved oxygen, and low total nitrogen. Notable exceptions are frequent HABs in Northport Bay, which likely originate from its connected water bodies such as Northport Harbor, and low dissolved oxygen in Smithtown Bay. Low dissolved oxygen in Smithtown Bay has been the subject of previous study, "Physical Processes Contributing to Localized, Seasonal Hypoxic Conditions in the Bottom Waters of Smithtown Bay, Long Island Sound, New York", (Swanson et. al, 2016) and is likely due to thermally controlled stratification that inhibits vertical mixing and a hydrodynamic gyre caused by the surrounding land areas which results in weak currents, little mixing with the Sound and increased residence time in Smithtown Bay.

Combined, the wastewater management priority area rank is Priority Rank 2 with an overall ideal water quality goal of 37 percent.

5.3.3.3 Wastewater Management Area 3 – Long Island Sound Harbors and Bays Restoration and Protection Area II

The LIS Harbors and Bays Restoration and Protection Area II area includes five water bodies with individual surface water priority ranks of Priority Ranks 3 and 4. Individual load reduction goals for ideal water quality range from 0 to 61 percent. There is one poorly characterized water body (Conscience Bay) for water quality. Water quality within Wastewater Management Area 2 water bodies is generally characterized by the occurrence of occasional (but not frequent) HABs, acceptable water clarity, acceptable dissolved oxygen, and low total nitrogen. Of the five individual water bodies, Setauket Harbor has the poorest observed water quality and the highest load reduction goal while Mount Sinai Harbor generally has excellent water quality and a resulting load reduction goal of 0 percent. Mount Sinai Harbor was selected as a reference water body used for establishing acceptable nitrogen loads under the ideal load reduction goal methodology.

Combined, the wastewater management priority area rank is Priority Rank 3 with an overall ideal water quality goal of 13 percent.

5.3.3.4 Wastewater Management Area 4 – Central and Western Long Island Sound Open Waters Protection Area

The Central and Western Long Island Sound Open Waters Protection Area includes one water body with an individual surface water priority rank of Priority Rank of 3. As denoted, this management area includes the direct groundwater contributing areas to the open waters of Suffolk County Long Island Sound Central. Observed water quality is generally very good with occasional, but infrequent HABs, acceptable water clarity, and acceptable dissolved oxygen.

The wastewater management priority area rank is Priority Rank 3 with an overall ideal water quality goal of 0 percent.

5.3.3.5 Wastewater Management Area 5 – Long Island Sound Inlets and Creek Restoration Area

The Long Island Sound Inlets and Creek Restoration Area includes three eastern Suffolk water bodies with individual priority ranks of Priority Ranks of 1, 2 and 3. Individual water bodies within this management area include Wading River, Mattituck Inlet/Creek and Goldsmith Inlet. Observed water quality is generally poor with occasional HABs (primarily Mattituck Inlet/Creek), poor water clarity, and low dissolved oxygen. The poor water quality correlates with relatively high nitrogen load reduction goals to achieve ideal water quality ranging from 66 to 88 percent. It should be noted that Wading River is considered poorly characterized for water quality (e.g., insufficient data to properly characterize existing conditions).

Combined, the wastewater management priority area rank is Priority Rank 1 with an overall nitrogen reduction goal of 67 percent to achieve ideal water quality.

5.3.3.6 Wastewater Management Area 6 – Eastern Long Island Sound Open Waters and Long Island Sound Freshwaters Protection Area

The Eastern Long Island Sound Open Waters and Long Island Sound Freshwaters Protection Area includes four eastern Suffolk water bodies with individual surface water priority ranks of Priority Ranks 3 and 4. Three of the four individual water bodies include freshwater ponds that are poorly characterized for water quality (Deep Pond, Fresh Pond Creek and Tribs, and Lake Panamoka) while one water body is well characterized (Long Island Sound, East). Observed water quality using the limited data for freshwater ponds is very good. Observed water quality for Long Island Sound, East, is also very good. The observation of good/acceptable water quality correlates well with adjacent land use which is typically less intense when compared to other water bodies in Suffolk County.

Combined, the wastewater management priority area rank is Priority Rank 4 with an overall ideal water quality goal of 0 percent; however, it should be noted that insufficient data was available to develop ideal water quality load reduction goals for the freshwater ponds.

Table 5-6 shows that Wastewater Management Areas 3 and 4 achieve both the HAB/DO water quality goals and the overall water quality goals; additional nitrogen load reductions achievable from wastewater management in these areas will be provided. I/A OWTS installations throughout Wastewater Management Area 2 will reduce nitrogen loading sufficiently to achieve both the HAB/DO water quality goals and the overall water quality goals. I/A OWTS installations throughout Wastewater Management Areas 1 and 5 will reduce nitrogen loading sufficiently to achieve the HAB/DO water quality goal and will make significant progress towards achievement of the overall water quality goals.

Additional load reductions realized above those required to restore water quality will ensure water quality preservation and support attainment of regional, estuary-wide goals, such as the non-point source target of 10 percent reduction in the LIS TMDL.

5.4 LIS Watershed Wastewater Planning

The following subsections provide recommendations for wastewater management planning specific to the LIS subwatersheds.

5.4.1 Overall Wastewater Management Strategy

As described in Section 4.4, the recommended wastewater management program includes four phases. While the primary means of wastewater management will focus on the use of I/A OWTS, sewering and clustering are also important elements of the overall wastewater management strategy. A summary of key statistics for the recommended Countywide wastewater management alternative, Alternative 4, specific to the LIS watershed is provided below followed by a summary of LIS-specific recommendations for sewering and/or clustered/decentralized systems.

During the Phase I ramp-up period from 2019 to 2023, I/A OWTS installations will continue to be implemented based on voluntary upgrades at a Countywide rate of 1,000 per year; this will include I/A OWTS installations in the LIS watershed. I/A OWTS will be installed at all parcels within the 0 to 2-year groundwater contributing area to the Sound and its subwatersheds and within the Phase II Wastewater Management Areas 1 (Western Long Island Sound Harbor Restoration Areas) and 5 (Long Island Sound Inlet and Creeks Restoration Area) from 2024 to 2054. **Figures 5-8, 5-9 and 5-10** summarize the number of I/A OWTS installations per SWP implementation phase and the number of pounds of nitrogen reduced per SWP phase and the cost per phase, respectively. This information is also provided in **Table 5-7**.

Table 5-7 Nitrogen Load Reduction Provided by I/A OWTS Implementation in Long Island Sound Subwatersheds

Area	Parcels Implementing I/A OWTS	Nitrogen Removed Daily (pounds)	Cost ($)
0 to 2-year Contributing Area	18,851	708	$391,582,000

Area	Parcels Implementing I/A OWTS	Nitrogen Removed Daily (pounds)	Cost ($)
Phase II Area (includes 0 to 2-year contributing area)	30,564	1,210	$625,596,500
Phase III Area	40,429	1,624	$811,489,000
Total	70,993	2,834	$1,437,084,000

The number of I/A OWTS installations during Phase II in the Long Island Sound watershed exceeds 30,000 including almost 19,000 parcels located within the 0 to 2-year groundwater contributing area. The nitrogen load to the LIS watershed will be reduced by over 1,200 pounds per day when Phase II is completed, including over 700 pounds per day from the 0 to 2-year groundwater contributing area.

During Phase III, I/A OWTS will be installed on the remaining 40,429 priority parcels, removing an additional 1,624 pounds per day.

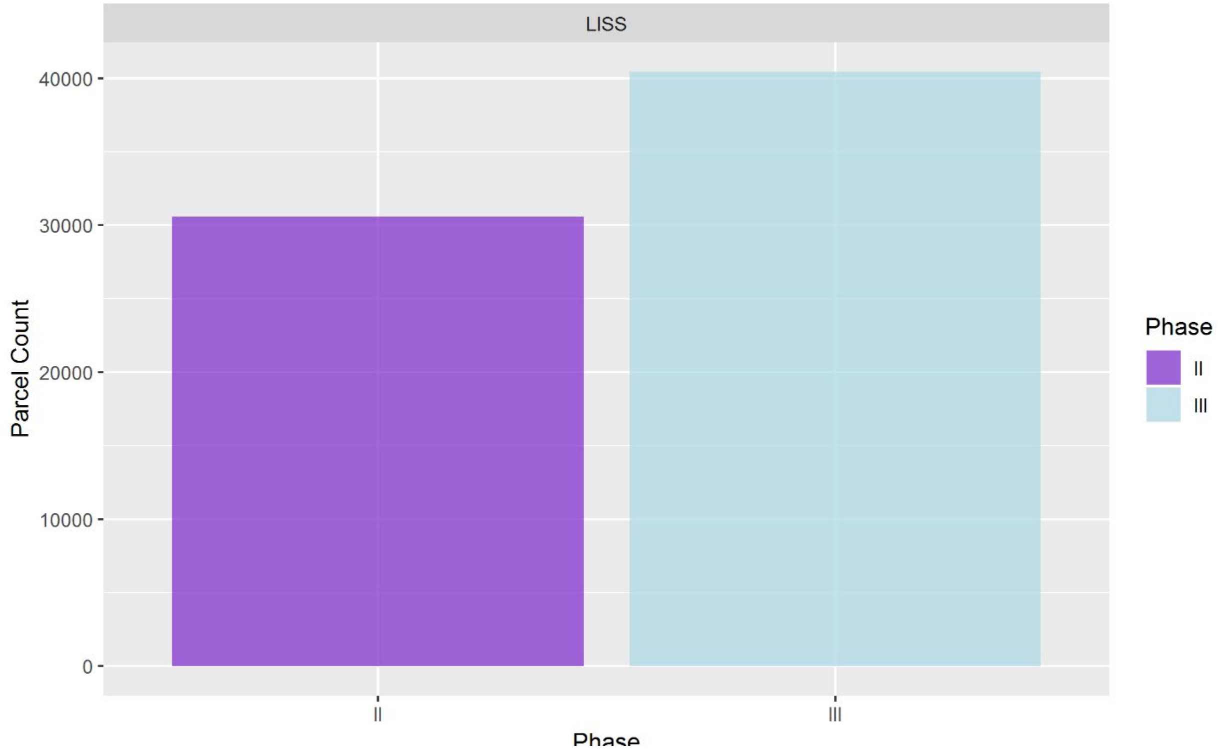


Figure 5-8 Number of I/A OWTS Installed in the Long Island Sound Watershed by Phase

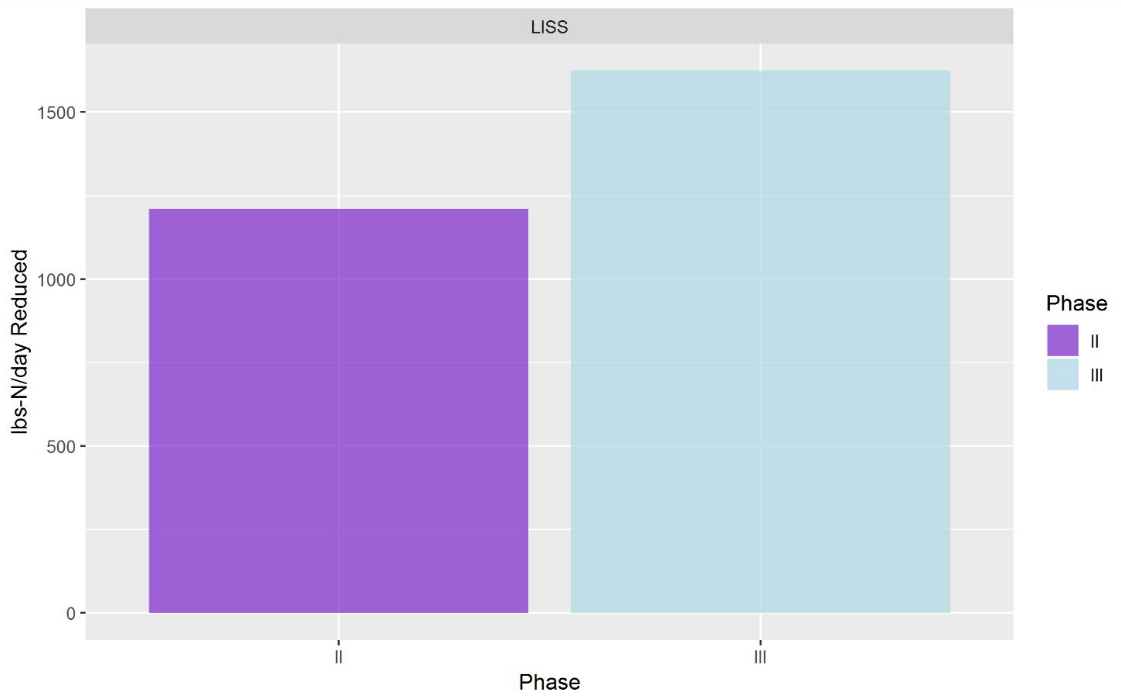


Figure 5-9 Pounds of Nitrogen Removed by I/A OWTS Installation in the Long Island Sound Watershed by Phase

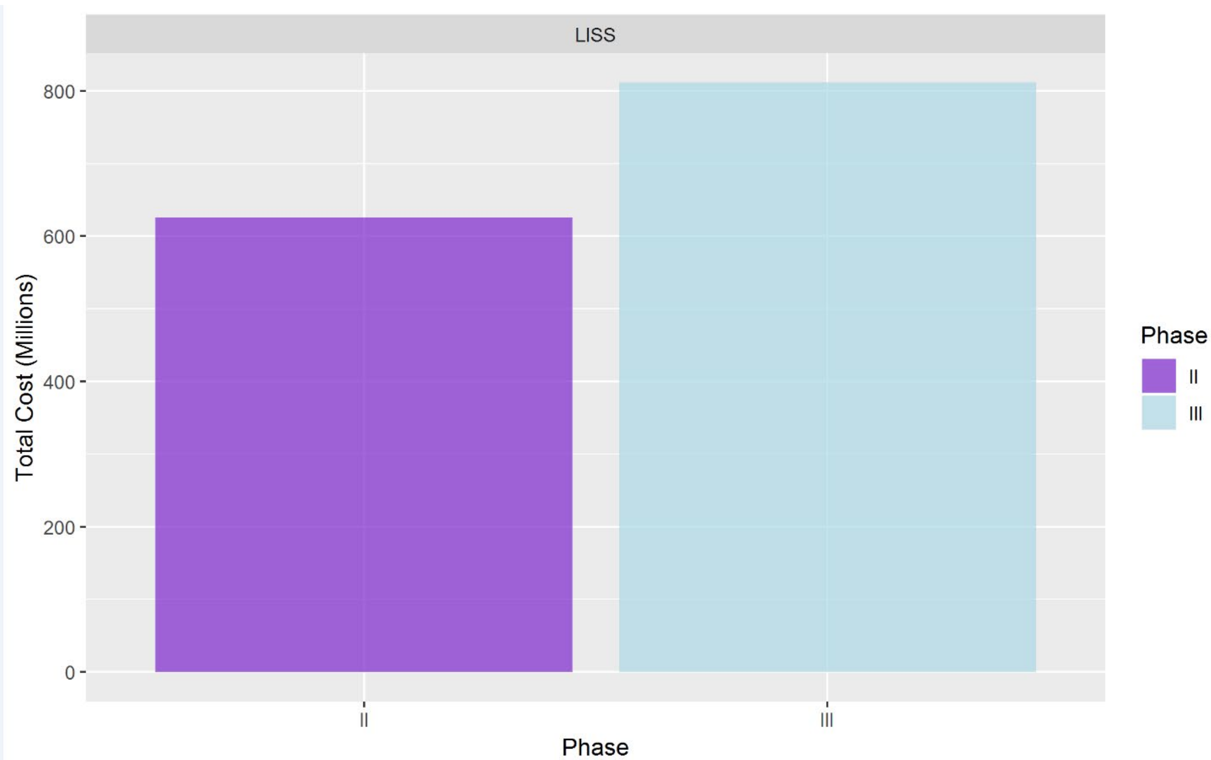


Figure 5-10 Estimated I/A OWTS Implementation Cost in the Long Island Sound Subwatershed by SWP Phase

5.4.2 Sewering/Clustering Recommendations for the Long Island Sound Watershed

The following subsections provide initial recommendations for sewering and clustering for the Long Island Sound subwatersheds. Recommendations were generated using the three-step approach documented in Section 4.5 which included:

- Inventory of existing sewering proposals in Suffolk County and documentation of current status;
- A parcel-specific scoring analysis, referred to as the "Wastewater Management Response Evaluation," to identify parcels where sewering and/or clustering may represent the preferred means of wastewater management; and
- Development of three sewer implementation scenarios based upon a range of potential funding availability and the findings of Steps 1 and 2 above.

Individual sewer and clustering projects would require project-specific Feasibility Studies to develop cost estimates and assess overall project feasibility. In addition, project-specific SEQRA evaluations would be required to assess and mitigate project-specific environmental concerns. Finally, it should be noted that the evaluation and findings presented herein are intended to be an initial planning tool to support recommendations for stable recurring revenue source needs and present initial findings regarding areas that may benefit from sewering or clustering. The findings are not intended to be binding in any way.

5.4.2.1 Inventory of Existing Sewer Proposals in the Long Island Sound Watershed

Review of the inventory and status table of all known existing County, Town, and Village sewer proposals identified five existing sewer expansion proposals in the Long Island Sound watershed that have not been deemed infeasible through existing Feasibility Study including:

- Huntington Station Expansion Project;
- Village of Northport Expansion Project;
- Kings Park Business District Project;
- Smithtown Business District Project; and,
- Port Jefferson Station Expansion Project.

A summary of the County led-proposals is provided in **Table 4-6** located in Section 4.5. A summary of Town/Village led proposals is provided in **Table 4-7** located in Section 4.5. A map showing the location of all sewer proposals and estimated District boundaries is provided below on **Figure 5-11**. Please note that for the purposes of this evaluation, projects that were deemed infeasible through feasibility study or projects that were identified as having no plan to move forward by Towns/Villages were omitted from the map.

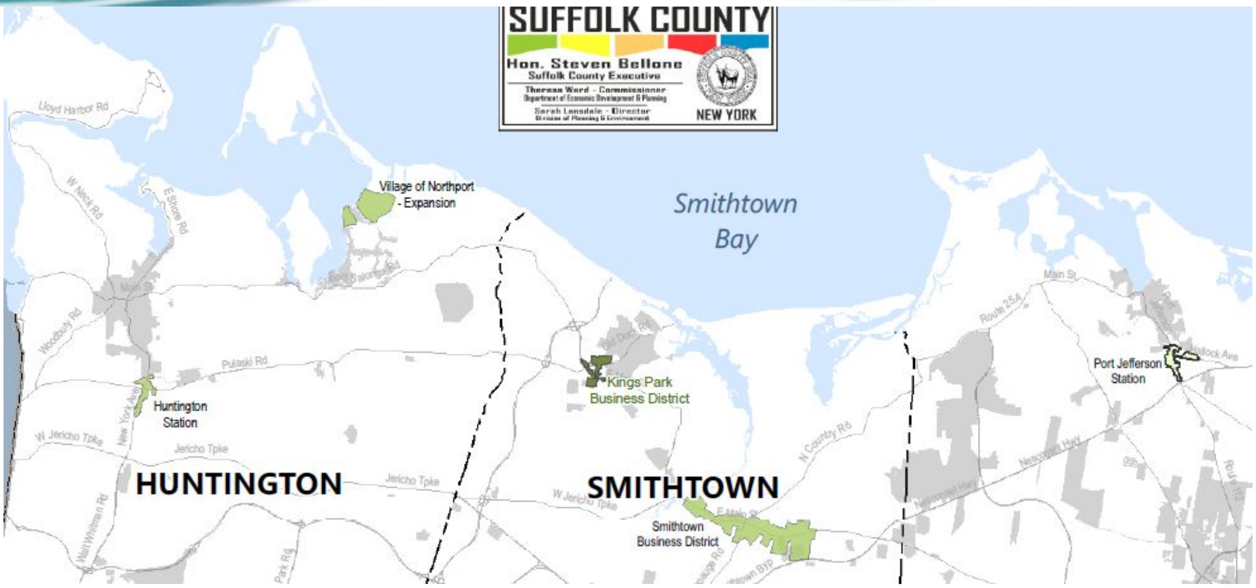


Figure 5-11 Location of Existing Sewer Proposals for Long Island Sound Watershed

5.4.2.2 Wastewater Management Response Evaluation Findings for the Long Island Sound

To provide an initial planning tool that identifies parcels that might benefit from sewering or clustering, the Suffolk County Department of Economic Planning and Development completed a geospatial, parcel-specific scoring analysis that expanded upon the methodology used by the Maryland Department of Environment for the Chesapeake Bay Program (TetraTech, 2011). While clustering was not explicitly evaluated during this analysis, parcels recommended for sewering through the scoring analysis that are not within close proximity to an existing common collection system; or, are in proximity to an existing STP with no expansion capacity, should be considered as clustering candidates if a suitable lot is identified for siting of the clustered treatment system.

A summary of the scoring analysis criteria, methodology, and results are summarized in Section 4.5 of this SC SWP. An example of the output for the Long Island Sound watershed region is provided below on **Figure 5-12**.

As shown on **Figure 5-12**, the majority of the parcels in the Long Island Sound watershed scored in favor of I/A OWTS. However, parcels located within the groundwater contributing area for surface water bodies with high ecological priority rank and/or medium-high density parcels located in close proximity to an existing sewer district scored in favor of sewering or clustering. Examples of locations that scored in favor of sewering include parcels in the Huntington Harbor, Northport Harbor, and Mill Pond contributing areas; select parcels located in the Nissequogue River contributing area; and, select parcels located in the Port Jefferson Harbor contributing area. It should be reiterated that the intent of the Wastewater Management Response Evaluation is to serve as an initial planning tool for the development of initial recommendations pertaining to

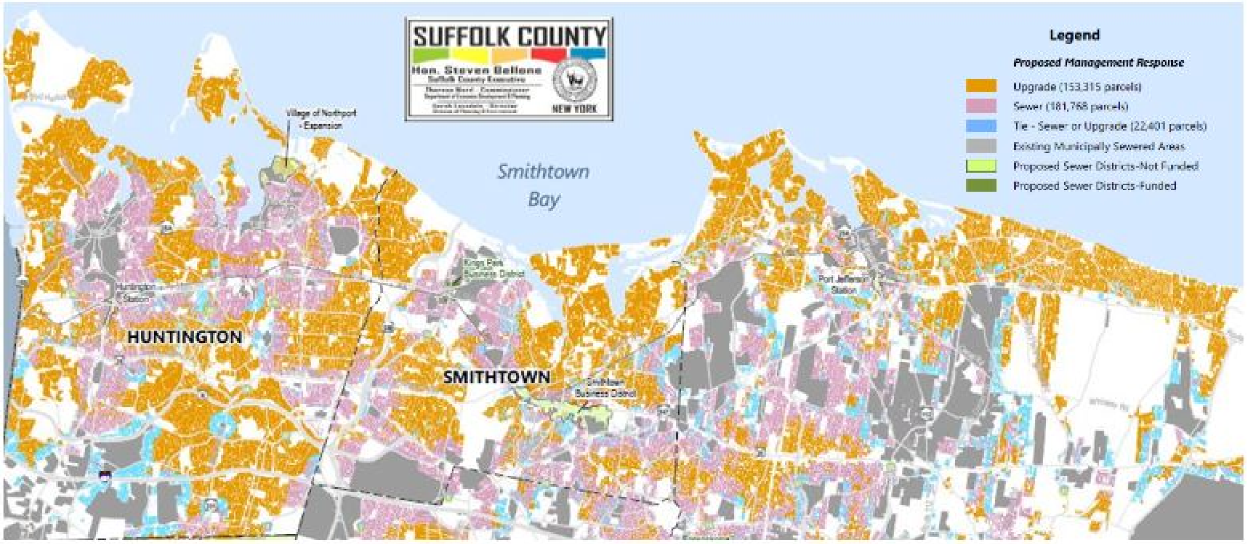


Figure 5-12 Wastewater Management Response Evaluation Map Output for Long Island Sound

wastewater management methods in Suffolk County. As discussed previously within this SWP, individual sewer and clustering projects would require project-specific Feasibility Study to develop cost estimates and assess overall project feasibility. In addition, project-specific SEQRA evaluations would be required to assess and mitigate project-specific environmental concerns.

5.4.2.3 Sewer Implementation Scenario Findings for Long Island Sound Sewer Proposals

The final step completed under the sewering evaluation was to develop and evaluate a range of possible sewer expansion scenarios that built upon the existing sewer proposal inventory table and considered potential revenue streams, relative geographic priority rank as identified in the SWP priority areas, and the results of the parcel-specific sewer scoring analysis. The analysis incorporated existing sewer proposals identified in the sewer project inventory table that have already been deemed feasible through project-specific feasibility and which the project sponsor/lead is actively pursuing. These projects include all medium to light green shaded projects on **Tables 4-6** and **4-7** located in Section 4.5 (note that dark green projects on these tables are excluded from the analysis since they already have construction funding identified and are anticipated to move forward). Projects with incomplete or draft feasibility study, or projects where the project sponsor/lead is no longer interested in pursuing the project, were omitted from the analysis. These projects include all yellow and red shaded projects on **Tables 4-6** and **4-7** located in Section 4.5 The analysis then evaluated three possible sewer expansion scenarios that were built upon a range of estimated revenue streams. Scenario 1 represented the lowest revenue assumption for the stable and recurring revenue source of \$75 million dollars per year and Scenario 3 represents the highest revenue assumption of \$93.7 million dollars per year. In addition, the analysis assumed that sewer expansion projects would be implemented through five 10-year projects, which would be constructed over a period of 50 years. Each 10-year project would include the construction of several sewer expansion proposals simultaneously.

A detailed summary of the evaluation methodology and its findings is presented in Section 4.5 of the SWP. A summary of the sewer implementation scenario findings for the LIS watershed are summarized below in **Table 5-8**.

Table 5-8 Summary of Sewer Implementation Scenario Evaluation Findings for the Long Island Sound

	Scenario 1	Scenario 2	Scenario 3
Target Implementation Times	Projects that can be completed	Projects that can be completed	Projects that can be completed
2024 - 2033	Smithtown Business District	Smithtown Business District	Smithtown Business District Huntington Station Northport Expansion – Village of Northport*
2034 - 2043	Huntington Station	Huntington Station Northport Expansion – Village of Northport*	No LIS Projects Implemented
2044 - 2053	No LIS Projects Implemented	No LIS Project Implemented	No LIS Projects Implemented
2054-2063	Northport Expansion – Village of Northport*	No LIS Project Implemented	Port Jefferson Station
2064-2073[(1)]	No LIS Projects Implemented	Port Jefferson Station	No LIS Projects Implemented

(1) Insufficient funding would be available to support implemention of the Port Jefferson Station expansion project under Scenario 1.

As shown in **Table 5-8** the scenario evaluation findings indicate that at an assumed stable and recurring revenue source of $75 million dollars per year, three of the four proposed sewer projects can be accommodated during the 50-year implementation timeframe, with insufficient funding being available for the Port Jefferson Station expansion project. Under Scenario 3, all four LIS sewering proposals can be implemented, and at an accelerated timeframe, when compared to Scenario 1. The results of the sewering evaluation underscore the obvious conclusion: more funding available to offset the cost of individual projects results in more projects being completed and at an accelerated timeframe. It should be reiterated that the sewer evaluation was completed as an initial planning study and that the priority implementation order of individual projects was assumed for the sole purposes of this initial analysis.

5.4.2.4 Preliminary Identification of Other Areas for Sewer Expansion or Clustering in the Long Island Sound Watershed

The previous evaluations focused on presenting potential sewer implementation scenarios using existing sewering proposals and an assumed range of revenue sources. While this represents a logical first step, the initial evaluations completed within this SWP can also be used to identify locations where new sewer expansion projects might be beneficial beyond those already proposed and inventoried herein. A summary of additional areas that might benefit from sewer expansion, new STPs, or clustering in the LIS watershed is provided below.

5.4.2.4.1 Potential Sewer Expansion Locations

The following areas were preliminarily identified as possibly benefitting from additional sewer expansion beyond the project already presented within this SWP:

- Residential neighborhoods surrounding Huntington Harbor and Northport Harbor. As shown on **Figure 5-12**, these parcels scored in favor of sewering due to their proximity to existing sewer districts and their ecological rank of Priority Rank 1. In addition, these harbors were identified as potentially requiring nitrogen load reductions above the reduction that could be achieved through the use of I/A OWTS alone to meet the overall water quality goal.
- Finally, **Figure 5-12** shows various residential neighborhoods that are not situated directly adjacent to an existing sewer district but scored in favor of sewering as part of this preliminary scoring exercise. These parcels would have scored in favor of sewering due to a combination of small lot size, high ecological priority rank, and/or vulnerability to sea level rise. These parcels could potentially benefit from small clustered systems and/or connection to a new STP.

It should be noted that all of the areas identified above are solely for preliminary screening and discussion purposes only. The viability of each area to connect to existing or new sewer districts and/or use clustering will vary significantly based upon a variety of known and unknown factors including available capacity at adjacent sewer districts (both hydraulically and for compliance with mass loading restrictions per existing TMDL[s]). Ultimately, each area would require project-specific feasibility study to determine implementability, cost feasibility, and overall viability as a wastewater management option.

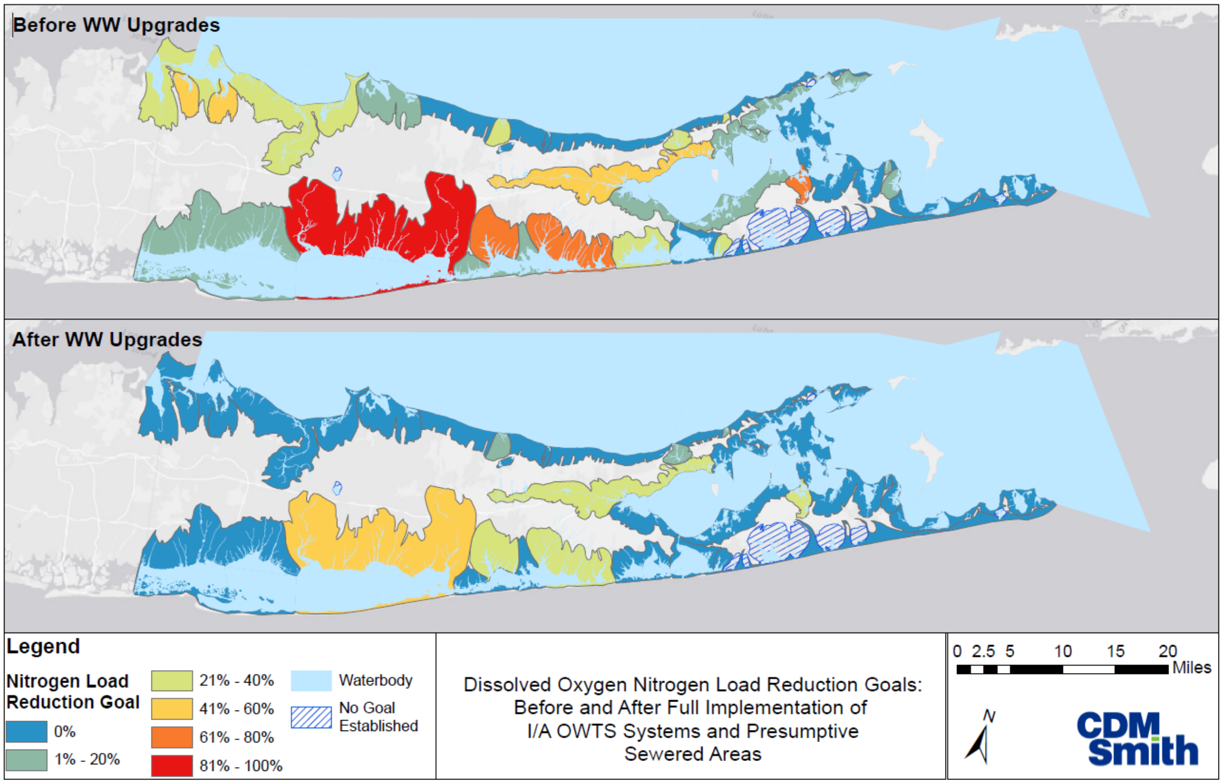
5.4.3 Environmental Benefits

Figure 5-13 shows that I/A OWTS implementation will be successful in reducing the unit nitrogen load * residence time to the same unit nitrogen load * residence time that characterizes the water bodies meeting the HAB/DO targets for all Wastewater Management Areas except Wastewater Management Area 5 which includes the poorly characterized Wading River. Additional data collection would be useful to refine the nitrogen load reduction target for Wading River.

Implementation of I/A OWTS will throughout the six LIS Wastewater Management Areas will result in significant progress towards achievement of overall nitrogen load reduction goals as shown on **Figure 5-14. Figure 5-14** shows that for four of the six LIS wastewater management areas, I/A OWTS implementation will be successful in achieving the same unit nitrogen load * residence time as was described in Section 2.1.9 for the reference water bodies that completely achieve water quality goals.

5.4.4 Water Bodies Requiring Additional Nitrogen Load Reduction

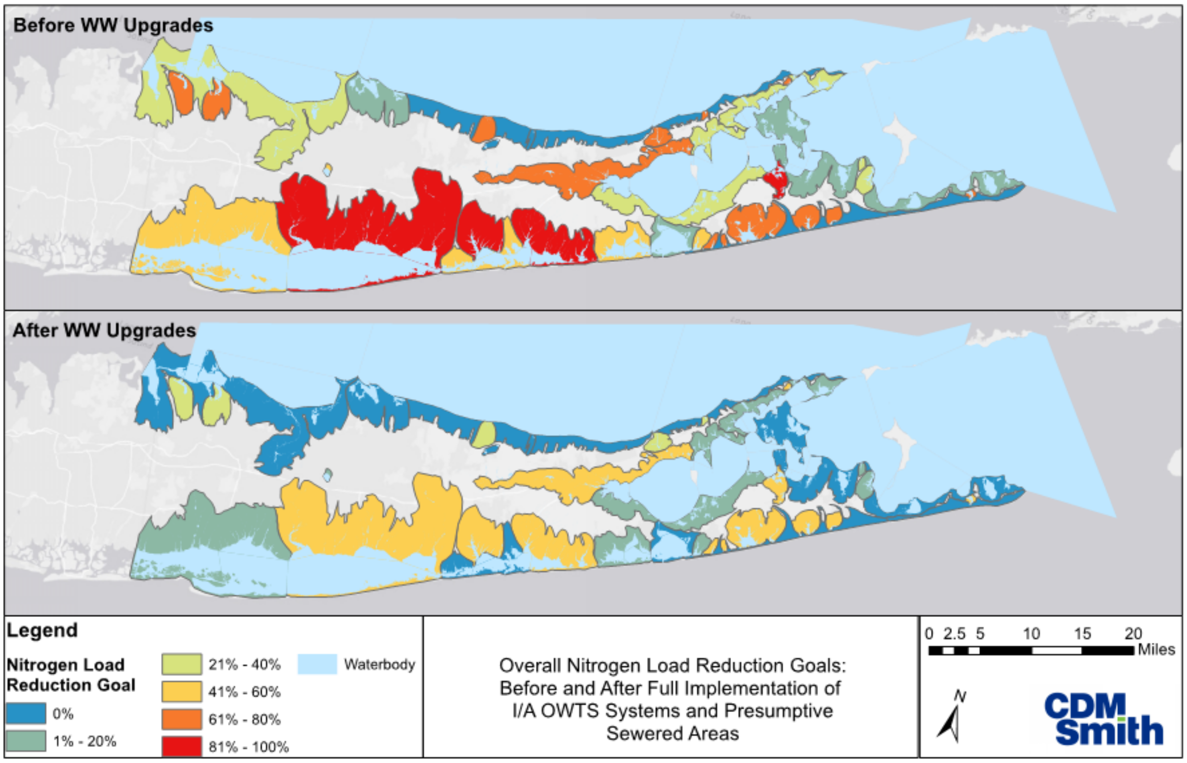
Seventy-one percent of the overall nitrogen load reduction goal for Wastewater Management Area 1 Western Long Island Sound Harbors Restoration Area will be achieved and 45 percent of the Wastewater Management Area 5 – Long Island Sound Inlets and Creek Restoration Area as shown by **Figure 5-15**. While significant water quality benefits are anticipated to result from wastewater management in the Long Island Sound watershed, based on the reference water body approach, additional nitrogen load reductions would be required to achieve ideal water quality in the 12 subwatersheds shown on **Table 5-9**. Water quality in five of the water bodies were not well characterized; additional characterization would help to refine the nitrogen load reductions required.



Note: The upper panel in the figure shows the nitrogen load reductions required to achieve the same unit nitrogen load observed in Suffolk County waters with no hypoxic or HAB events. The lower panel shows the much lower nitrogen load reductions required to achieve the unit nitrogen loads after SWP implementation.

Figure 5-13 Progress Towards Achievement of Unit Nitrogen Loads Consistent with Water Bodies that Have Experienced No Dissolved Oxygen Hypoxic Events and No HAB Events in the Past 10 Years

This SWP is one aspect of a Countywide program to reduce the total nitrogen mass load to groundwater and surface water within the County. Suffolk County remains dedicated to tracking the implementation of the program and to working with local jurisdictions and continuing coordination with related programs (e.g., estuary programs, LINAP, LICAP, Towns, Villages) to ensure the Countywide implementation strategy addressing nitrogen sources is advanced. As part of the adaptive management plant described in Section 8.4.11, other nitrogen removal or mitigation alternatives including sewering targeted areas, addition of pressurized shallow drainfields hydromodification, nutrient bioextraction, permeable reactive barriers and/or fertilizer management can be studied and considered further.



Note: The upper panel in the figure shows the nitrogen load reductions required to achieve the same unit nitrogen load observed in Suffolk County waters exhibiting ideal water quality. The lower panel shows the much lower nitrogen load reductions required to achieve the unit nitrogen loads after SWP implementation.

Figure 5-14 Overall Nitrogen Load Reduction Goals Attained by SWP Implementation

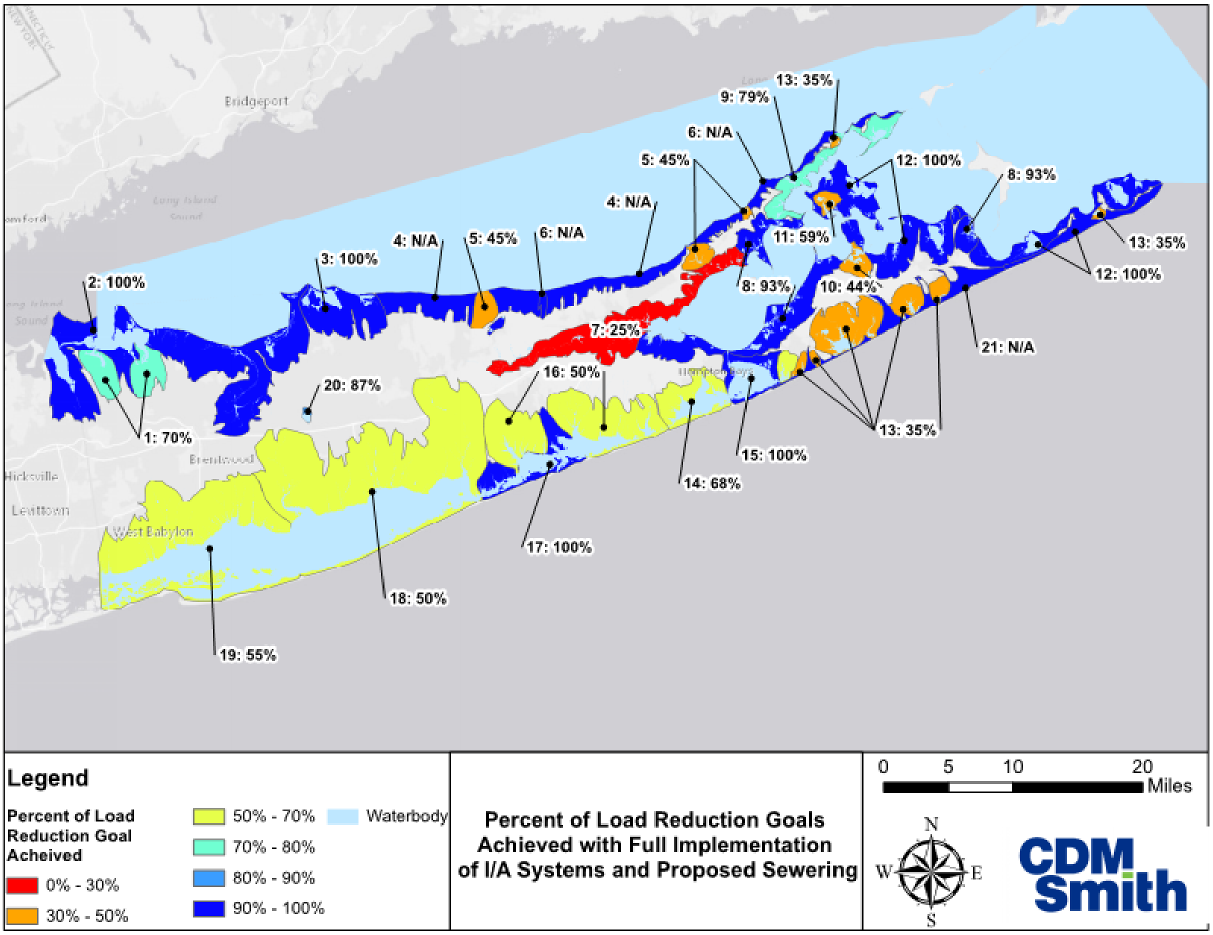


Figure 5-15 Overall Nitrogen Load Reduction Goals Attained by SWP Implementation

Table 5-9 Long Island Sound Water Bodies Requiring Additional Nitrogen Reduction to Achieve Overall Water Quality Goals

	Wastewater Management Area	Water Bodies in Management Area	Nitrogen Reduction Goal for Overall Water Quality Improvement	Achievable Reduction through On-Site Wastewater Management
1	Western Long Island Sound Harbor Restoration Areas	**Huntington Harbor**	**72%**	**45%**
		Mill Pond	90%	56%
		Northport Harbor	**72%**	**54%**
2	Long Island Sound Harbors and Bays Restoration and Protection Area I	**Stony Brook Harbor and West Meadow Creek**	**60%**	**47%**
		Nissequogue River Lower/Sunken Meadow Creek	**78%**	**48%**
		Nissequogue River Upper, and Tribs	67%	48%
		Crab Meadow Creek	60%	50%
		Setauket Harbor	**61%**	**50%**
		Conscience Bay and Tidal Tribs	58%	46%
5	Long Island Sound Inlets and Creeks Restoration Area	Wading River	88%	41%
		Mattituck Inlet/Creek	**66%**	**37%**
		Goldsmith Inlet	**79%**	**39%**

Note: Bold text indicates the subwatershed was well-characterized.

Section 5 Tables

Table 5-2 Groundwater Baseflow Contributions to Long Island Sound Subwatersheds

Water Body	SWP PWL Number	0 to 2 Years	0 to 10 Years	0 to 25 Years	0 to 50 Years	0 to 100 Years	0 to 200 Years
Centerport Harbor	1702-0229	20.09%	47.75%	68.95%	78.83%	92.41%	100.00%
Cold Spring Harbor, and Tidal Tribs	1702-0018+0156	13.68%	41.58%	68.30%	81.50%	96.70%	100.00%
Conscience Bay and Tidal Tribs	1702-0091	22.33%	46.48%	65.52%	76.55%	92.67%	100.00%
Crab Meadow Creek	1702-0232-CMC+0234	27.83%	53.73%	76.03%	89.64%	99.96%	100.00%
Duck Island Harbor	1702-0262	38.50%	73.02%	88.06%	95.21%	98.35%	100.00%
Flax Pond	1702-0240	40.07%	66.09%	78.76%	86.55%	88.52%	100.00%
Fresh Pond Creek and Tribs	1702-0244	21.96%	64.30%	97.90%	100.00%	100.00%	100.00%
Goldsmith Inlet	1702-0026	41.21%	79.74%	92.04%	92.35%	96.21%	100.00%
Huntington Bay	1702-0014	19.79%	46.67%	65.36%	78.47%	90.73%	100.00%
Huntington Harbor	1702-0228+0231	19.21%	48.55%	76.03%	87.69%	99.22%	100.00%
Lloyd Harbor	1702-0227	22.10%	39.80%	57.81%	85.79%	95.89%	100.00%
Long Island Sound, Suffolk Co, Central	1702-0265	13.82%	36.33%	59.07%	69.46%	82.53%	100.00%
Long Island Sound, Suffolk County, East	1702-0266	42.88%	82.36%	92.65%	93.01%	96.02%	100.00%
Long Island Sound, Suffolk County, West	1702-0098+0232	43.38%	71.65%	87.40%	94.67%	98.19%	100.00%
Mattituck Inlet/Cr, Low, and Tidal Tribs	1702-0020+0245	40.92%	77.37%	89.62%	90.49%	98.50%	100.00%
Mill Pond	1702-0261	19.02%	53.08%	76.59%	99.12%	100.00%	100.00%
Mt Sinai Harbor and Tidal Tribs	1702-0019	18.43%	46.13%	66.11%	80.69%	96.23%	100.00%
Nissequogue River Lower/Sunken Meadow Creek	1702-0025+0234+0232	35.89%	58.93%	72.76%	83.41%	95.10%	100.00%

Table 5-2 Groundwater Baseflow Contributions to Long Island Sound Subwatersheds

Water Body	SWP PWL Number	0 to 2 Years	0 to 10 Years	0 to 25 Years	0 to 50 Years	0 to 100 Years	0 to 200 Years
Nissequogue River Upper, and Tribs	1702-0235+0013+0238+0237+0236	41.30%	59.40%	71.54%	83.92%	91.82%	100.00%
Northport Bay	1702-0256	25.52%	58.03%	76.20%	86.15%	94.96%	100.00%
Northport Harbor	1702-0230	19.11%	52.33%	75.31%	89.09%	96.91%	100.00%
Port Jefferson Harbor, North, and Tribs	1702-0015	18.94%	35.78%	46.57%	56.07%	79.31%	100.00%
Port Jefferson Harbor, South, and Tribs	1702-0241	18.33%	43.68%	67.71%	89.50%	99.99%	100.00%
Setauket Harbor	1702-0242	19.48%	43.97%	65.89%	82.35%	99.19%	100.00%
Smithtown Bay	1702-0023+0233+0234	19.42%	37.30%	45.31%	52.39%	73.23%	100.00%
Stony Brook Harbor and West Meadow Creek	1702-0047+0239	35.48%	59.32%	67.26%	81.01%	95.73%	100.00%
Wading River	1702-0099+0243	13.60%	41.90%	70.39%	76.38%	91.66%	100.00%
Average		26.38%	54.27%	72.78%	83.71%	94.08%	100.00%

Table 5-3 Nitrogen Load Components for Long Island Sound Subwatersheds (page 1 of 2)

PWL ID	Subwatershed	On Site Sanitary Wastewater (lbs/day)	Fertilizer (lbs/day)	Pets (lbs/day)	Atmospheric Deposition to Subwatershed (lbs/day)	STP Discharge to GW (lbs/day)	Total Nitrogen Load from GW (lbs/day)	STP Discharge to Surface Water (lbs/day)	Atmospheric Deposition to Surface Water (lbs/day)	Total Nitrogen Load (lbs/day)
1702-0229	Centerport Harbor	183.6	40.9	8.9	5.9	0.0	239.4	0.0	4.41	243.8
1702-0018+0156	Cold Spring Harbor, and Tidal Tribs	460.4	150.2	23.8	32.3	0.0	666.7	0.0	28.50	695.2
1702-0091	Conscience Bay and Tidal Tribs	62.2	21.8	3	4.0	0.0	91.0	0.0	2.79	93.8
1702-0232-CMC+0234	Crab Meadow Creek	104.0	29.8	4.8	7.5	0.0	146.2	0.0	0.25	146.4
1702-0262	Duck Island Harbor	14.1	4.6	0.7	1.1	0.0	20.4	0.0	2.98	23.4
1702-0240	Flax Pond	10.2	8.6	0.5	1.4	0.0	20.8	0.0	0.61	21.4
1702-0244	Fresh Pond Creek and Tribs	1.1	5.0	0.1	2.2	0.0	8.4	0.0	0.29	8.6
1702-0026	Goldsmith Inlet	6.0	3.8	0.3	1.1	0.0	11.2	0.0	0.24	11.5
1702-0014	Huntington Bay	46.9	13.0	2.2	2.2	0.0	64.3	0.0	17.11	81.4
1702-0228+0231	Huntington Harbor	428.6	77.2	23.9	15.1	0.0	544.8	72.2	4.17	621.2
1702-0227	Lloyd Harbor	16.3	21.8	0.9	4.4	0.0	43.4	0.0	8.15	51.5
1702-0265	Long Island Sound, Suffolk Co, Central	1158.3	745.6	69.6	94.3	24.2	2092.0	0.0	2237.25	4329.3
1702-0266	Long Island Sound, Suffolk County, East	110.2	159.3	6.3	19.7	0.0	295.5	46.1	1236.90	1578.5
1702-0098+0232	Long Island Sound, Suffolk County, West	35.2	37.8	1.7	7.0	0.0	81.8	0.0	549.23	631.0
1702-0020+0245	Mattituck Inlet/Cr, Low, and Tidal Tribs	69.0	53.7	3.1	7.5	0.0	133.3	0.0	1.61	135.0

Table 5-3 Nitrogen Loads to Long Island Sound Subwatersheds

PWL ID	Subwatershed	On Site Sanitary Wastewater (lbs/day)	Fertilizer (lbs/day)	Pets (lbs/day)	Atmospheric Deposition to Subwatershed (lbs/day)	STP Discharge to GW (lbs/day)	Total Nitrogen Load from GW (lbs/day)	STP Discharge to Surface Water (lbs/day)	Atmospheric Deposition to Surface Water (lbs/day)	Total Nitrogen Load (lbs/day)
1702-0261	Mill Pond	123.9	21.5	5.7	4.8	0.0	155.9	0.0	0.94	156.8
1702-0019	Mt Sinai Harbor and Tidal Tribs	240.4	80.5	15.1	12.4	2.7	351.1	0.0	3.79	354.9
1702-0025+0234+0232	Nissequogue River Lower/Sunken Meadow Creek	606.8	188.5	35.2	32.9	3.5	866.8	6.2	2.84	875.9
1702-0235+0013+0238 +0237+0236	Nissequogue River Upper, and Tribs	421.7	126.3	20.7	22.2	11.3	602.2	0.0	2.28	604.4
1702-0256	Northport Bay	115.3	24.1	5.7	3.7	0.0	148.8	0.0	22.98	171.8
1702-0230	Northport Harbor	345.7	63.1	17.4	12.4	1.1	439.8	10.1	4.97	454.9
1702-0015	Port Jefferson Harbor, North, and Tribs	150.2	39.4	8.9	6.5	3.6	208.7	0.0	11.76	220.4
1702-0241	Port Jefferson Harbor, South, and Tribs	125.8	29.8	8.4	7.2	0.8	172.0	31.2	1.40	204.6
1702-0242	Setauket Harbor	137.7	38.6	5.9	6.8	0.3	189.3	0.0	2.41	191.7
1702-0023+0233+0234	Smithtown Bay	420.1	115.8	21.4	20.3	1.1	578.6	0.0	272.21	850.8
1702-0047+0239	Stony Brook Harbor and West Meadow Creek	328.6	114.8	21.2	23.2	5.0	492.8	31.2	6.58	530.5
1702-0099+0243	Wading River	84.2	61.2	3.7	11.0	0.0	160.1	0.0	0.21	160.3

Table 5-5 Long Island Sound Subwatersheds Nitrogen Load Reduction Goals

	Management Area Name	Individual Water Bodies in Management Area	Individual Water Body HAB/DO Improvement Goal	Individual Water Body Overall Water Quality Improvement Goal	Achievable Reduction through On-Site Wastewater Management	Reduction Goal for Protection of Down Gradient Water Bodies
1	Western Long Island Sound Harbor Restoration Areas	**Huntington Harbor**	**44%**	**72%**	**45%**	**0%**
		Mill Pond	80%	90%	56%	0%
		Northport Harbor	**44%**	**72%**	**54%**	**0%**
2	Long Island Sound Harbors and Bays Restoration and Protection Area I	Cold Spring Harbor	0%	0%	44%	N/A
		Centerport Harbor	**0%**	**0%**	**53%**	**0%**
		Northport Bay	**0%**	**0%**	**46%**	**0%**
		Huntington Bay	**0%**	**0%**	**36%**	**0%**
		Lloyd Harbor	**0%**	**0%**	**21%**	**0%**
		Duck Island Harbor	**0%**	**0%**	**42%**	**0%**
		Flax Pond	0%	25%	28%	0%
		Smithtown Bay	**0%**	**0%**	**21%**	**0%**
		Stony Brook Harbor and West Meadow Creek	**19%**	**60%**	**47%**	**0%**
		Nissequogue River Lower/Sunken Meadow Creek	**57%**	**78%**	**48%**	**0%**
		Nissequogue River Upper, and Tribs	N/A	67%	48%	78%
		Crab Meadow Creek	19%	60%	50%	0%
3	Long Island Sound Harbors and Bays Restoration and Protection Area II	**Port Jefferson Harbor, North, and Tribs**	**0%**	**0%**	**42%**	**0%**
		Port Jefferson Harbor, South, and Tribs	**0%**	**0%**	**34%**	**0%**
		Setauket Harbor	**22%**	**61%**	**50%**	**0%**
		Conscience Bay and Tidal Tribs	16%	58%	46%	0%
		Mount Sinai Harbor	**0%**	**0%**	**49%**	**0%**
4	Central and Western Long Island Sound Open Waters Protection Area	**Long Island Sound West**	**0%**	**0%**	**4%**	**N/A**
		Long Island Sound Central	**0%**	**0%**	**18%**	**N/A**
5	Long Island Sound Inlets and Creeks Restoration Area	Wading River	76%	88%	41%	0%
		Mattituck Inlet/Creek	**32%**	**66%**	**37%**	**0%**

Table 5-5 Long Island Sound Subwatersheds Nitrogen Load Reduction Goals

		Goldsmith Inlet	**58%**	**79%**	**39%**	**0%**
6	Eastern Long Island Sound Open Waters and Long Island Sound Fresh Waters Protection Area	Deep Pond	N/A	N/A	22%	0%
		Fresh Pond Creek and Tribs	N/A	N/A	9%	0%
		Lake Panamoka	N/A	N/A	48%	0%
		Long Island Sound East	**0%**	**0%**	**5%**	**N/A**

Section 6

Peconic Estuary Subwatersheds

Sections 5, 6, and 7 summarize the SWP findings and wastewater management recommendations for each of the major estuaries in Suffolk County. An overview of the subwatersheds located within the Peconic Estuary watershed, nitrogen loads to the Peconic Estuary subwatersheds, priorities for Peconic Estuary subwatershed nitrogen load reduction and wastewater planning is provided in the following pages. Details of the approaches used to develop the nitrogen loads, priority rankings and nitrogen load reductions and wastewater planning may be found in Section 2 of this SWP.

6.1 PEP Subwatersheds

A total of 75 individual subwatersheds was evaluated within the Peconic Estuary watershed, which is shown by **Figure 6-1**. The 75 individual water bodies were eventually grouped into six aggregated wastewater management areas based on similar priority rank and load reduction goals as described in Sections 2.1.10 and 4.3.3. A list of Peconic Estuary subwatersheds in alphabetical order, along with the assigned SWP PWL number may be found in **Table 6-1** (please see tables at the end of this section).

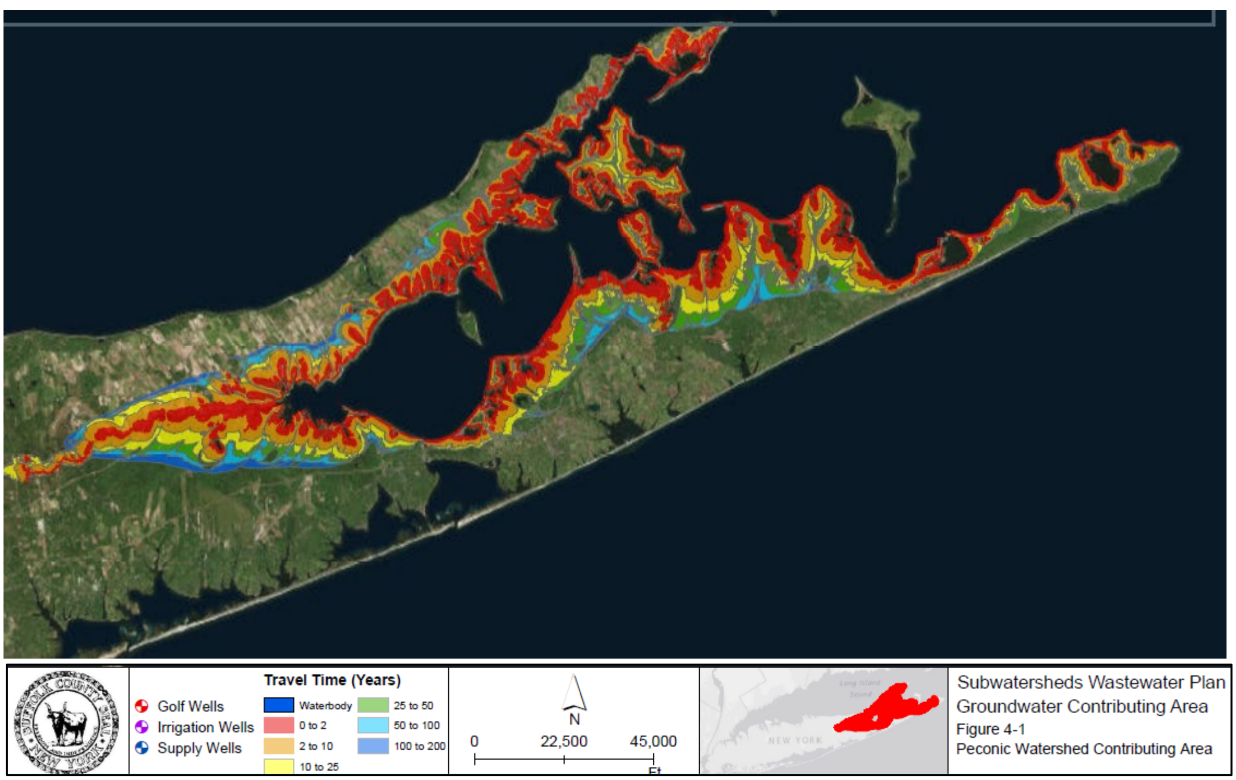


Figure 6-1 Groundwater Contributing Areas to the Peconic Estuary Subwatersheds

The areas contributing to the Peconic Estuary subwatersheds were delineated using all four Suffolk County groundwater models, the Main Body, North Fork, South Fork and Shelter Island models.

Based upon the water body-specific subwatershed delineations, the groundwater baseflow contributions to each water body were also compiled, based on the land surface area contributing recharge to the water body within each travel time interval simulated. These baseflow percentages, along with the subwatershed mappings, provide a first assessment of the areas where management actions such as reductions in nitrogen load can provide the most benefit to the downgradient surface water. The percentages are based on the total baseflow discharged to the surface water body over the 200-year simulation period. For some of the water bodies in the Peconic Estuary watershed, the complete groundwater contributing area is not delineated by a 200-year simulation as it may take longer for recharging precipitation to travel vertically down through the aquifer system and out to surface water discharge. For other Peconic Estuary subwatersheds (e.g., Coecles Harbor, Cutchogue Harbor, Napeague Harbor, West Neck Harbor, etc.) all recharging precipitation travels from the water table to surface water discharge in less than 100 years.

A summary of the groundwater baseflow contributions to each subwatershed from each travel time interval is provided by **Figure 6-2** and **Table 6-2** (please see tables at the end of this section). The figure shows that based on the average baseflow contributions to each subwatershed, 45 percent of the groundwater baseflow and associated nitrogen loading originates within the 0 to two-year travel time, and almost 75 percent of the groundwater baseflow and associated nitrogen loading originates within the 0 to ten-year travel time (based on the 200-year simulations). Wastewater management in these contributing areas will result in a significant reduction of the nitrogen load from sanitary wastewater to the Peconic Estuary water bodies, and over ninety percent of the nitrogen load from sanitary wastewater would be addressed by addressing the 50-year contributing area.

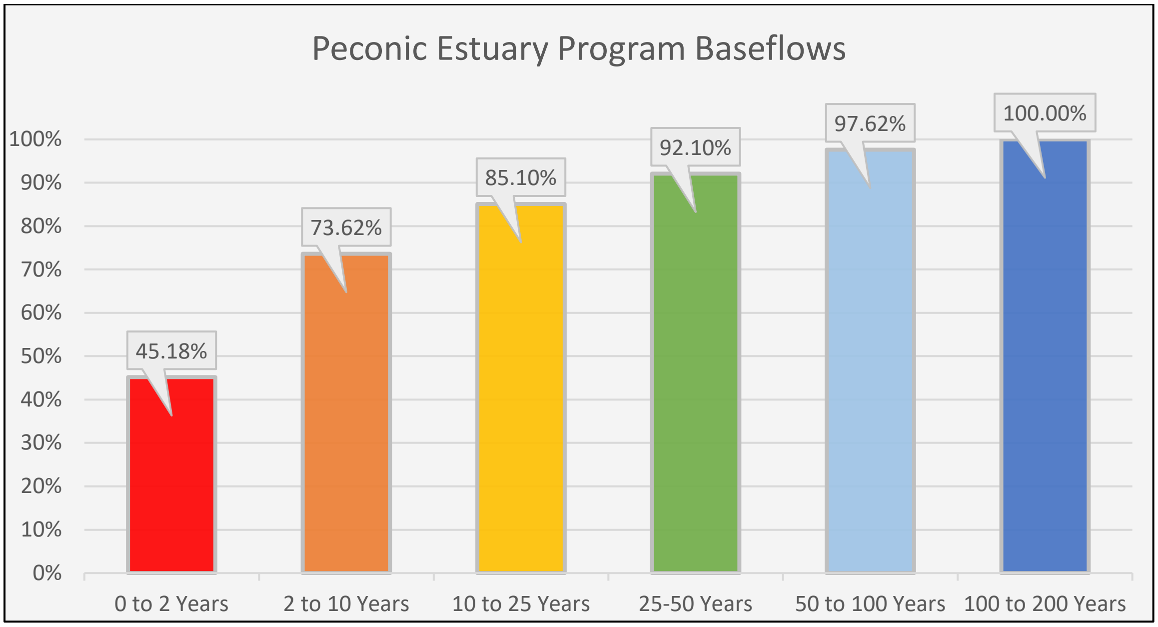


Figure 6-2 Groundwater Baseflow Travel Times in the Peconic Estuary Watershed

6.2 Peconic Estuary Subwatershed Nitrogen Loads

Parcel-specific nitrogen loading was incorporated into three-dimensional solute transport models to simulate nitrogen concentrations and nitrogen migration throughout the aquifer system and to estimate the nitrogen loading to each of the Peconic Estuary subwatersheds.

To calculate parcel-specific nitrogen loads for existing conditions, parcel-specific land uses were defined by the 2016 land use coverages provided by Suffolk County Department of Economic Development and Planning. Potential nitrogen sources, nitrogen loading rates and nitrogen attenuation factors were developed in cooperation with the Nitrogen Loading Model Focus Area Work Group convened by SCDHS.

As described in Section 2.1.5, nitrogen from the following sources was incorporated into the nitrogen loading model:

- Sanitary wastewater
- Fertilization
- Pet Waste
- Atmospheric Deposition

6.2.1 Existing Nitrogen Loads

Nitrogen loading rates from sanitary wastewater, fertilizer and pet wastes were based on each parcel's land use. Nitrogen loads from atmospheric deposition were applied uniformly across all land use types in the County.

The nitrogen load components to the Peconic Estuary subwatersheds from the 200-year contributing area are summarized on **Table 6-3,** at the end of this section. **Figure 6-3** summarizes the components of the total nitrogen loading from Suffolk County to the Peconic Estuary subwatersheds. Under existing average annual conditions, atmospheric deposition to surface waters contributes approximately 39.3 percent of the nitrogen load to the estuary, followed by on-site sanitary wastewater systems and fertilizer at 27.9 percent of the total nitrogen load and 25.6 percent of the nitrogen load respectively. Point sources, including sewage treatment plants discharging to groundwater and directly to surface waters are the smallest components of the total nitrogen load at 0.1 percent and 2.2 percent respectively.

Figure 6-4 shows that over 47 percent of the nitrogen load to groundwater originates from on-site wastewater systems, while almost 44 percent is estimated to be contributed by fertilizer.

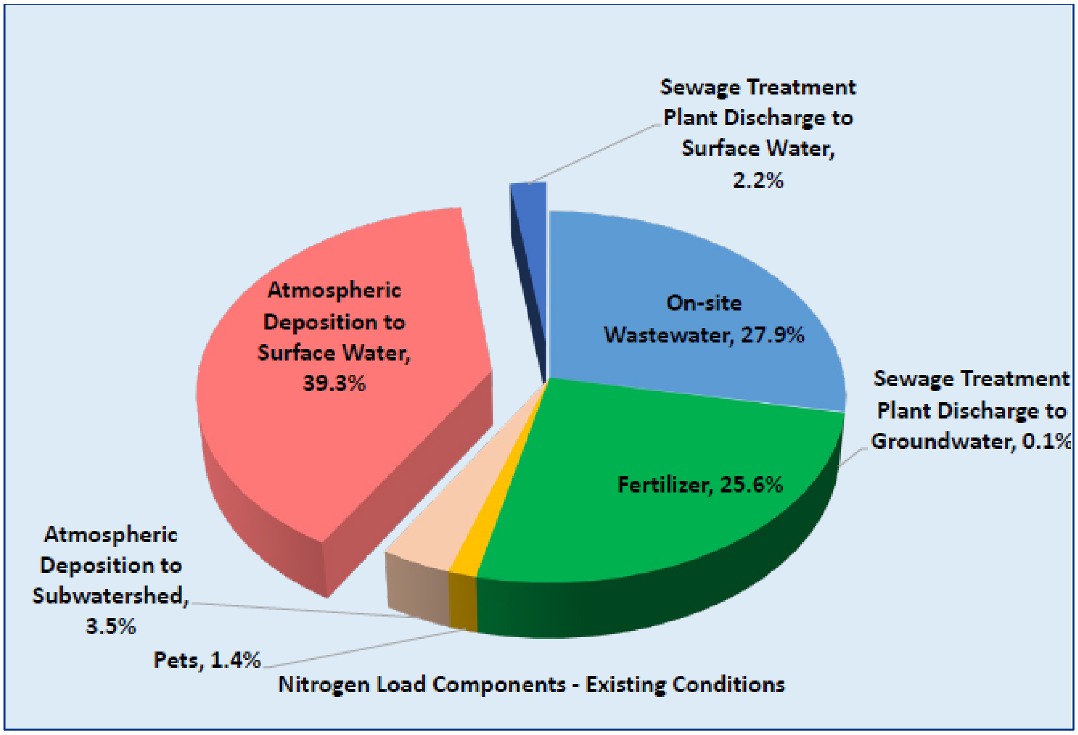


Figure 6-3 Components of Existing Nitrogen Loads to Peconic Estuary Subwatersheds

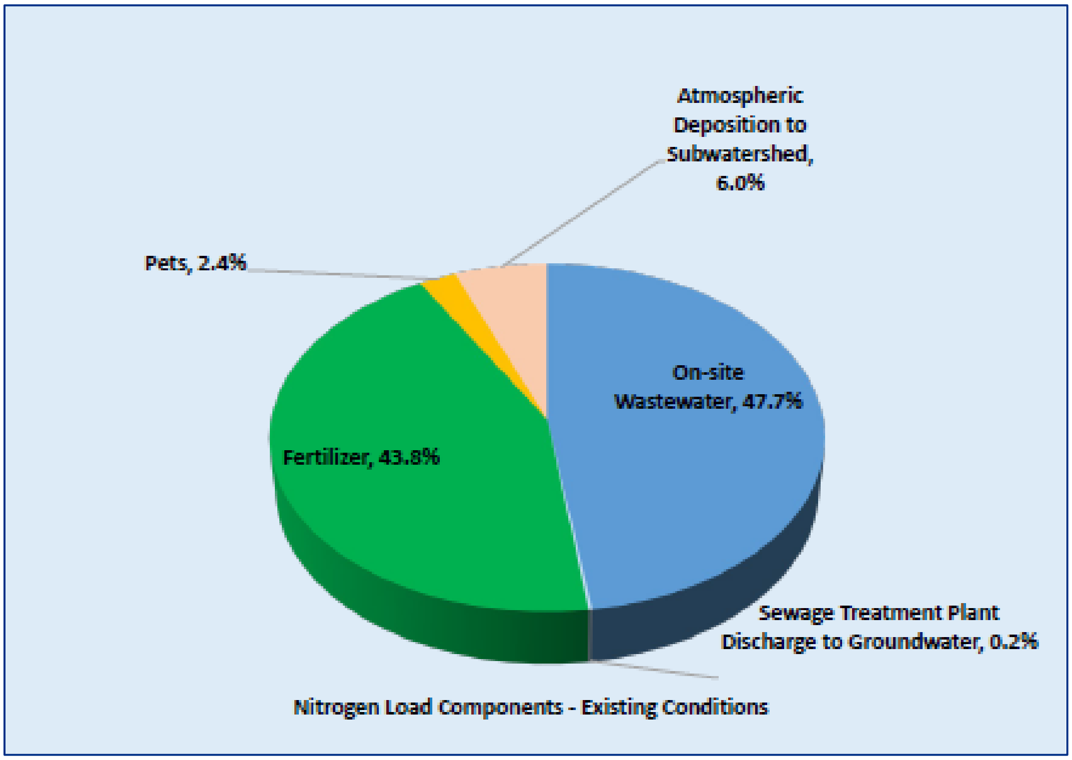


Figure 6-4 Summary of Groundwater Nitrogen Load Components to Peconic Estuary Subwatersheds

6.2.2 Potential Future Build-out Nitrogen Loads

As described in Section 2.1.5.3, in addition to evaluating the nitrogen loading to each subwatershed based on existing conditions, the potential future nitrogen loading if each undeveloped (or underdeveloped) residential parcel in the County was ultimately built-upon was also calculated. Suffolk County Department of Economic Development and Planning developed the conditions used for potential future build-out which were based on the more stringent of Suffolk County Sanitary Code Article 6 or local zoning for all:

- Vacant parcels without development restrictions
- Agricultural parcels without development restrictions, and
- Subdividable low density residential parcels.

The flow fields used for the existing conditions simulations were used for the future build-out simulations; e.g., boundary conditions such as recharge from precipitation and water supply pumping remained constant. In addition, parameters used to establish the nitrogen loading from on-site sanitary wastewater, pets and fertilizer remained unchanged from the existing conditions evaluation.

In addition to the changes in land use that were incorporated in the build-out evaluation, two other changes were made to better reflect future anticipated conditions:

- Flows and nitrogen loads from sanitary wastewater treatment plants were adjusted to match permit conditions. In some cases, the future flows were increased, based on anticipated future development; the increased flow and existing nitrogen concentrations combined to increase the total assigned nitrogen loads. In other cases, nitrogen concentrations were anticipated to be reduced to comply with permit limits, resulting in a net reduction in nitrogen load.
- Nitrogen loading from atmospheric deposition was reduced by ten percent, based upon unpublished information provided by USEPA.

Nitrogen loads from future potential build-out conditions were simulated using the solute transport model; the results of these simulations are discussed in Section 3. The percentages of each nitrogen load component that are expected to result if the additional development takes place are shown in **Figure 6-5.**

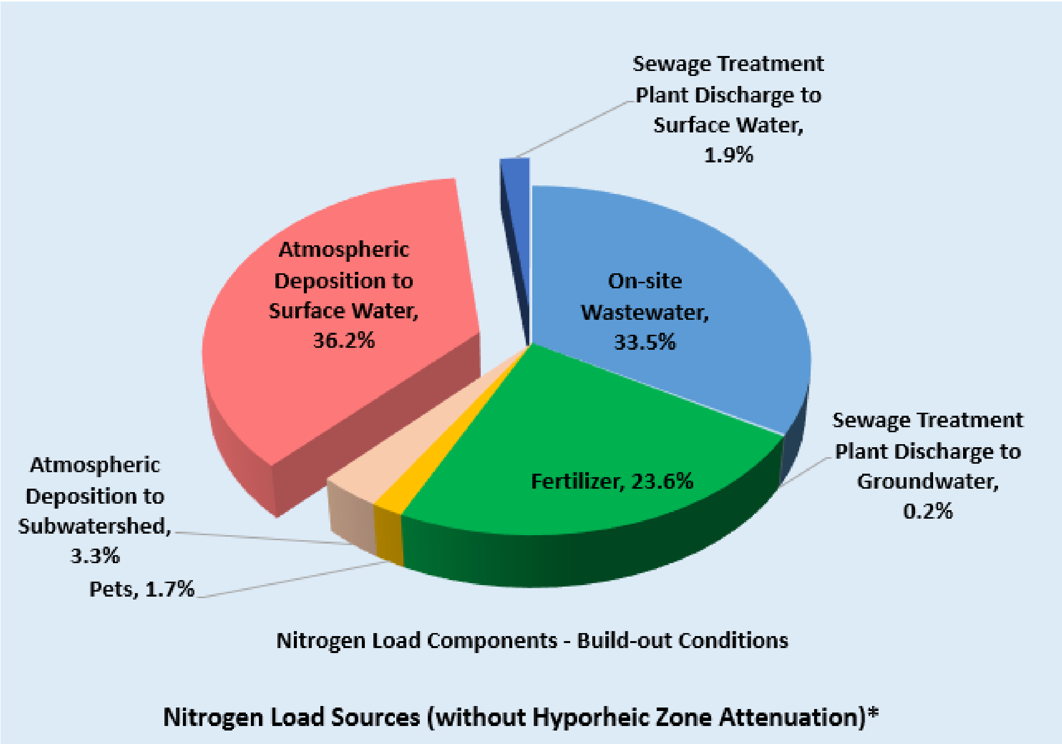


Figure 6-5 Components of Potential Future Build-out Nitrogen Loads to Peconic Estuary Subwatersheds

Review of the nitrogen load components to groundwater shows that atmospheric deposition to surface waters contributes over 36 percent of the nitrogen load to the subwatersheds within the Peconic Estuary, followed by on-site wastewater at 33.5 percent and fertilizer at almost 24 percent. Atmospheric deposition to the subwatersheds, pets, and discharge of treated sanitary effluent from sewage treatment plants combine to contribute less than ten percent of the nitrogen load from groundwater.

Review of the nitrogen load components to groundwater shows that on-site sanitary wastewater contributes over 53 percent of the nitrogen load to groundwater, followed by fertilizer at almost 38 percent, as shown by **Figure 6-6**. Atmospheric deposition to the subwatersheds, pets, and discharge of treated sanitary effluent from sewage treatment plants combine to contribute less than ten percent of the nitrogen load from groundwater.

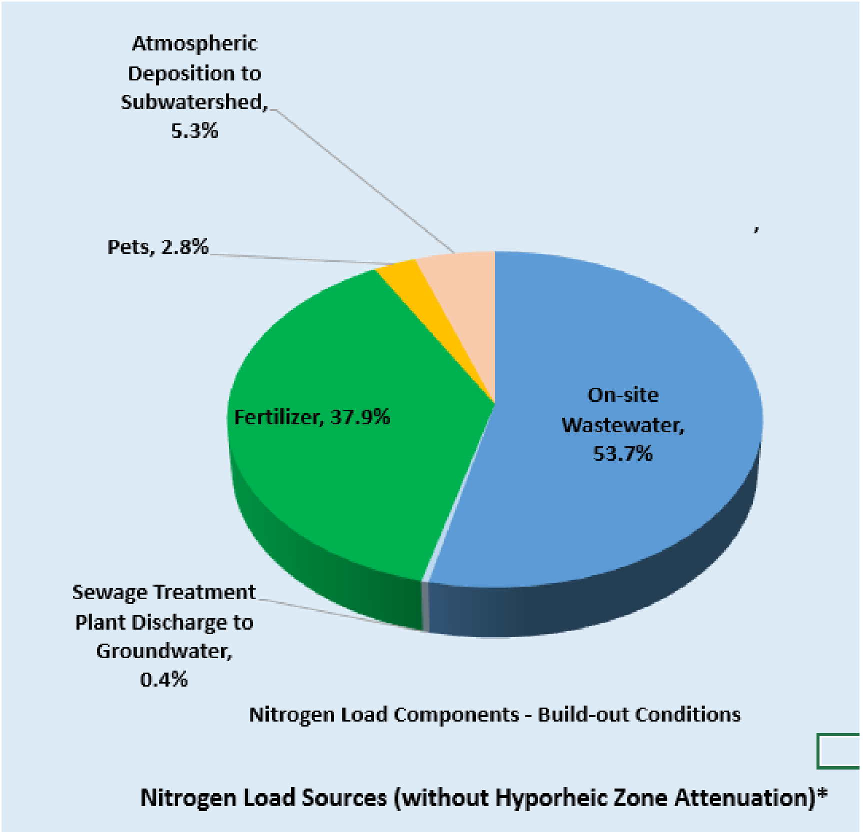


Figure 6-6 Summary of Potential Future Build-out Groundwater Nitrogen Load Components to Peconic Estuary Subwatersheds

At build-out, the nitrogen load to the Peconic Estuary subwatersheds is projected to decline by 1.3 percent, as a result of both reduced atmospheric deposition and conversion of agricultural lands to residential development.

6.3 PEP Subwatershed Nitrogen Reduction Requirements and Priority Areas

6.3.1 PEP Subwatershed Priority Areas

The 74 Peconic Estuary subwatersheds were ranked amongst the entire set of 191 Suffolk County subwatersheds based on the modeled nitrogen loads and residence times and surface water quality characterizations (Block Island Sound was not ranked, because it was not characterized by a residence time). Based on the available data, 15 subwatersheds were ranked as Priority 1 for nitrogen load reduction, and ten subwatersheds were ranked as Priority 2 for nitrogen load removal. Twenty-one of the subwatersheds were ranked Priority 3 for nitrogen load reduction while the highest percentage of subwatersheds – 38 percent, or 28 subwatersheds – was ranked Priority 4 for nitrogen load reduction.

Priority Rank 1 subwatersheds are listed in **Table 6-4**, below. The priority rankings are summarized by **Table 6-5** at the end of this section, which is organized alphabetically for easy reference.

Table 6-4 Priority Rank 1 Subwatersheds in the Peconic Estuary

Subwatershed Name	Subwatershed Name
Brushes Creek	Peconic River Upper, and Tribs
Deep Hole Creek	Peconic River Lower, and Tidal Tribs
Flanders Bay, West/Lower Sawmill Creek	Red Creek Pond and Tidal Tribs
Great Peconic Bay and minor coves	Scallop Pond
James Creek	Terry's Creek and Tribs
Mattituck (Marratooka Pond)	West Creek and Tidal Tribs
Meetinghouse Creek and Tribs	West Neck Bay and Creek
Peconic River Middle, and Tribs	

6.3.2 Peconic Estuary Subwatershed Nitrogen Load Reduction Requirements

A range of nitrogen load reductions were developed for the Peconic Estuary subwatersheds based upon the reductions required to achieve ideal water quality (reference water body approach), dissolved oxygen water quality goals (reference water body approach) and chlorophyll-*a* goals (probabilistic approach) as described in Section 2.1.9. The range of sanitary wastewater nitrogen load reduction goals ranged from 0 for the better-flushed open waters located in the eastern part of the estuary such as Gardiners Bay up to 91 percent for the more densely populated and poorly flushed Terry's Creek as shown on **Table 6-5** (please see tables at the end of this section). In general, the nitrogen load reduction targets are highest for the subwatersheds located in the western Peconic, and on the North Fork. The overall goal for nitrogen from sanitary wastewater for the Peconic Estuary watershed based on well- characterized subwatersheds is 43 percent.

6.3.3 Aggregated Wastewater Management Area Priority Ranking and Load Reduction Goals

The 74 individual surface water bodies within the Peconic Estuary watershed were aggregated into six larger, administratively manageable wastewater management areas based on priority for nitrogen load reduction, nitrogen load reduction goals and the downstream receiving water body nitrogen load reduction priority and target nitrogen reduction. The six Peconic Estuary wastewater management areas are shown on **Figure 6-7**, described below and summarized on **Table 6-6** (please see tables at the end of this section).

6.3.3.1 Wastewater Management Area 7 – Peconic Estuary Restoration and Protection Area I

The Peconic Estuary Restoration and Protection Area I includes 15 individual water bodies located within the western Peconic Estuary. Eight of the water bodies are poorly characterized for water quality while the remaining seven are well characterized. Wastewater Management Area 7 generally includes water bodies with the poorest water quality and highest sensitivity to nitrogen within the Peconic Estuary and includes two water bodies with an individual rank of Priority Rank

2 (Flanders Bay East/Center, and Tribs [North] and Laurel Pond), one water body with Priority Rank 4 (Wildwood Lake), with the remaining water bodies identified as Priority Rank 1. Individual nitrogen load reduction goals for ideal water quality range from 46 percent to 91 percent with the majority of the individual goals around 70 percent. Land use around the area is diverse and includes a mix of low, medium, and high-density residential development and agricultural uses, with the majority of parcels assigned as medium density residential. The land use intensity in the estuary varies dramatically when comparing the northern estuary groundwater contributing areas to the southern estuary groundwater contributing areas. For example, the land use along the north side of Flanders Bay, East is primarily low, medium, and high density residential and agricultural whereas the land use along the south side of the Bay is predominantly open space and recreation. For this reason, the groundwater contributing areas along the north side of the estuary were included in Wastewater Management Area 7 and the groundwater contributing areas along the south side were included in Wastewater Management Area 8. Water quality within Wastewater Management Area 7 water bodies is generally poor and characterized by the occurrence of frequent HABs, elevated chlorophyll-*a*, low dissolved oxygen and poor water clarity. The most notable exception is the comparatively better water quality in Great Peconic Bay which benefits from a large water body volume, tidal exchange/flushing from water bodies with good water quality to the east, and the less intense land use along the south side of the bay. However, because of the intense land use along the north side of Great Peconic Bay and observation of poor water quality in all connected north shore estuaries, the north shore of Great Peconic Bay was included in Wastewater Management Area 7.

Combined, the wastewater management priority area rank is Priority Rank 1 with an overall ideal nitrogen reduction goal to water quality goal of 74 percent.

6.3.3.2 Wastewater Management Area 8 – Peconic Estuary Restoration and Protection Area II

The Peconic Estuary Restoration and Protection Area II includes 27 individual water bodies located within the central Peconic Estuary and also includes groundwater contributing areas located along the south shore of the western Peconic Bays (e.g., Reeves Bay, Flanders Bay, East, and Great Peconic Bay). Eleven of the water bodies are poorly characterized for water quality while the remaining 16 are well characterized. Wastewater Management Area 8 generally includes water bodies with good water quality and moderate sensitivity to nitrogen. While surface waters within this wastewater management area currently exhibit good water quality, the individual load reduction goals for many of the same waters are elevated, suggesting that these water bodies may be vulnerable to water quality degradation in the future. Individual surface water priority ranks vary in Wastewater Management Area 8; however, the majority of the water bodies are ranked as Priority Rank 3 or Priority Rank 4, particularly for the water bodies that are well characterized. Similarly, individual load reduction goals for ideal water quality typically fall between 30 and 78 percent; however, the overall range is from 0 percent to 73 percent. It should be noted that the large range in load reduction goals is, in part, a function of aggregating proximate individual water bodies with minimal land contributing area (e.g., water bodies with low load reduction goals include part of Noyack Bay, Little Sebonac Creek, and Sebonac Creek/Bullhead Bay). Land use around the Area is diverse and includes a mix of low, medium, and high-density residential development and agricultural uses, with the majority of parcels assigned as medium density residential. However, Wastewater Management Area 8 also includes a significant number of open space and recreational parcels when compared to Wastewater Management Area 7, which results in improved water quality and lower nitrogen load reduction goals. Water quality within Wastewater Management Area 8 water bodies is generally acceptable and characterized by the occurrence of infrequent HABs, and acceptable chlorophyll-*a*, dissolved oxygen, and water clarity.

There are eight reference water bodies located within Wastewater Management Area 8. Combined, the wastewater management priority area rank is Priority Rank 3 with an overall ideal water quality nitrogen reduction goal of 30 percent.

6.3.3.3 Wastewater Management Area 9 – Peconic Estuary Restoration and Protection Area III

The Peconic Estuary Restoration and Protection Area III includes 14 individual water bodies located on the North Fork of the eastern Peconic Estuary. Nine of the 14 water bodies are poorly characterized for water quality. The characteristics of Wastewater Management Area 9 are very similar to Wastewater Management Area 8, with the predominant difference being the geographic location of the aggregated water bodies. In general, water bodies within this wastewater management area exhibit good water quality and moderate sensitivity to nitrogen. While surface waters within this wastewater management area currently exhibit good water quality, the individual load reduction goals for many of the same waters are elevated, suggesting that these water bodies may be vulnerable to water quality degradation in the future. Individual surface water priority ranks in Wastewater Management Area 9 are ranked as Priority Rank 3 or Priority Rank 4 with the exception of Stirling Creek as Priority Rank 2. Individual load reduction goals for ideal water quality typically fall between 12 and 67 percent; however, the overall range is from 0 percent to 67 percent. It should be noted that the large range in load reduction goals is, in part, a function of aggregating proximate individual water bodies with minimal land contributing area (e.g., water bodies with low load reduction goals include part of Orient Harbor, part of Shelter Island Sound, North, and Southold Bay). Land use around the area is diverse and includes a mix of low, medium, and high-density residential development and agricultural uses, with the majority of parcels assigned as medium density residential. Water quality within Wastewater Management Area 9 water bodies is generally acceptable and characterized by the occurrence of infrequent HABs, and acceptable chlorophyll-*a*, dissolved oxygen, and water clarity.

There are six reference water bodies located within Wastewater Management Area 9. Combined, the wastewater management priority area rank is Priority Rank 3 with an overall ideal water quality goal of 33 percent.

6.3.3.4 Wastewater Management Area 10 – Sag Harbor Cove and Connected Creeks

The Sag Harbor Cove and Connected Creeks Wastewater Management Area includes the subwatersheds of Sag Harbor Cove and Tribs and Ligonee Brook and Tribs. Sag Harbor Cove and Tribs is well characterized and received an individual surface water priority rank of Priority Rank 3 while Ligonee Brook and Tribs is poorly characterized and received Priority Rank 2. While the water quality in Sag Harbor Cove is generally acceptable, the individual load reduction goal for ideal water quality of 81 percent is elevated due to the combination of high nitrogen load coupled with long residence time, suggesting that this water body may be vulnerable to water quality degradation in the future. Ligonee Brook is hydraulically connected to Sag Harbor Cove and represents the headwaters that feed the cove. Land use in this management area is predominantly medium density residential with a significant number of open space parcels within the Ligonee Brook subwatershed.

Combined, the wastewater management priority area rank is Priority Rank 2 with an overall ideal water quality goal of 81 percent.

6.3.3.5 Wastewater Management Area 11 – West Neck Bay and Creek and Menantic Creek

The West Neck Bay and Creek and Menantic Creek Wastewater Management Area includes the two subwatersheds with the highest sensitivity to nitrogen located in the Town of Shelter Island; West Neck Bay and Creek and Menantic Creek. Both water bodies are well-characterized and West Neck Bay and Creek received an individual surface water priority rank of Priority Rank 1, while Menantic Creek received a rank of Priority Rank 2. Land use in this management area is predominantly medium density residential. The water quality of West Neck Bay and Creek is moderately degraded with recurring HABs, elevated chlorophyll-*a* and low dissolved oxygen. West Neck Bay and Creek has an ideal water quality nitrogen load reduction goal of 68 percent, while Menantic Creek has an ideal water quality load reduction goal of 72 percent.

Combined, the wastewater management priority area rank is Priority Rank 1 with an overall ideal water quality goal of 68 percent.

6.3.3.6 Wastewater Management Area 12 – Peconic Estuary Restoration and Protection Area IV

The Peconic Estuary Restoration and Protection Area IV Wastewater Management Area includes 21 individual water bodies located within the eastern Peconic Estuary. The water quality in this management area relevant to nutrient-related endpoints is generally excellent with 11 water bodies serving as reference water bodies for the establishment of ideal water quality load reduction goals and most water bodies are ranked as Priority Rank 4.

Eight of the water bodies are poorly characterized for water quality, while the remaining 13 are well characterized. While surface waters within this wastewater management area currently exhibit good water quality relative to nutrient-related impacts, Big Reed Pond and Lake Montauk have pathogen-related water quality degradation. Further, Three Mile Harbor exhibits good water quality at its central monitoring stations, but recent data has documented nutrient related degradation within a hydrodynamically-isolated area at the head of the harbor. Accordingly, Three Mile Harbor has been recommended for further study in the recommendations of this SWP. It should be noted that Three Mile Harbor's groundwater contributing area overlaps a Groundwater/Drinking Water Priority Rank 1 area and, as such, all parcels within the Three Mile Harbor subwatershed will receive the benefit of being prioritized as Priority Rank 1 within this SWP. Individual load reduction goals for ideal water quality typically fall between 0 and 45 percent. Land use around the area is diverse and includes a mix of low, medium, and high-density residential development and open space and recreational parcels.

Water quality within the majority of the Wastewater Management Area 12 water bodies is generally excellent and characterized by the occurrence of infrequent HABs, and acceptable chlorophyll-*a*, dissolved oxygen, and water clarity. Combined, the wastewater management priority area rank is Priority Rank 4 with an overall ideal water quality goal of 6 percent.
5.

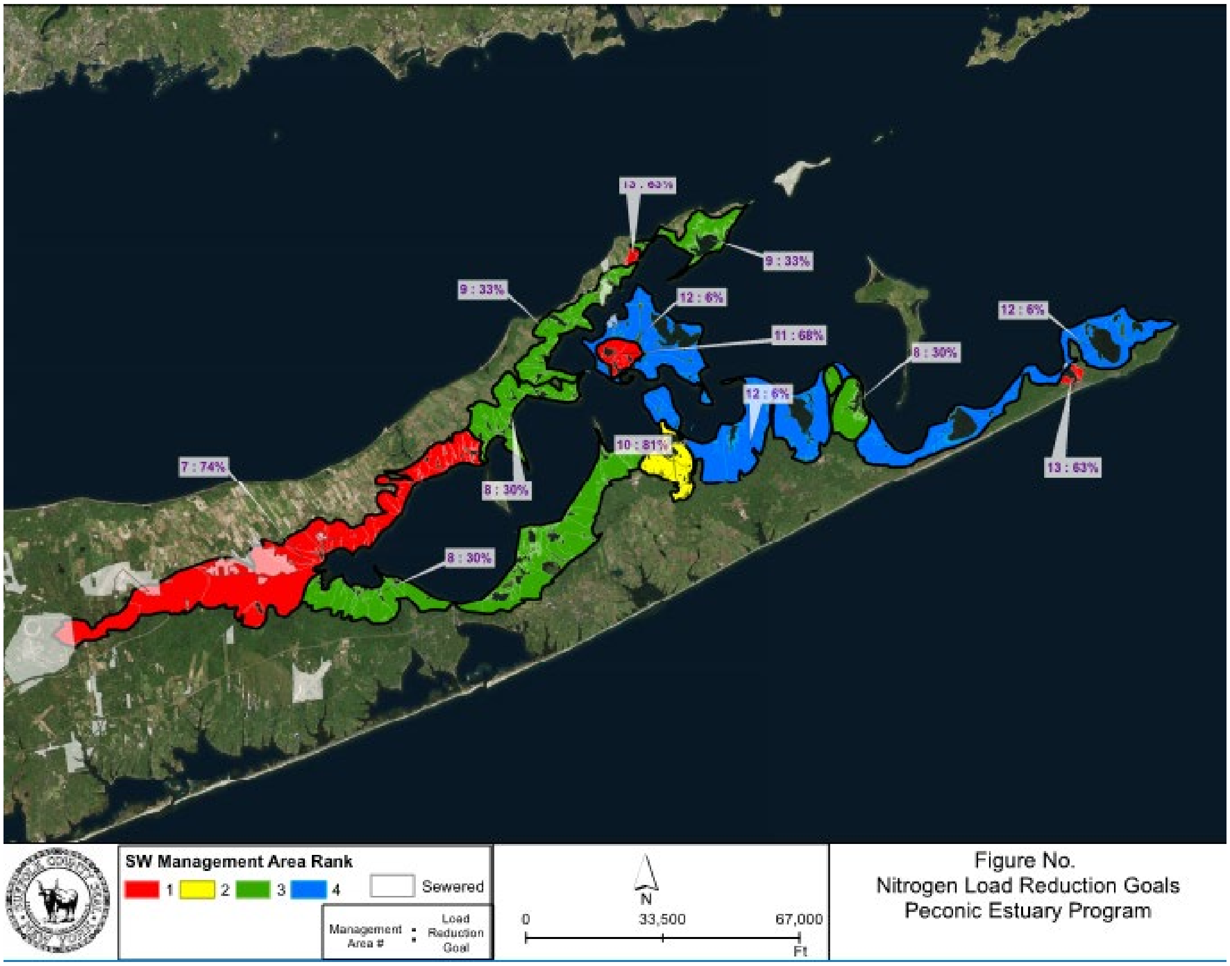


Figure 6-7 Priority Areas for Nitrogen Load Reduction in the Peconic Estuary

Table 6-7 Nitrogen Load Reduction Goals and Nitrogen Load Reductions Achievable through On-Site Wastewater Management

Management Area	Management Area Name	Management Area Reference Water Body HAB/DO Improvement Goal*	Management Area Reference Water body Overall Water Quality Improvement Goal*	Achievable Reduction through On-Site Wastewater Management
7	Peconic Estuary Restoration and Protection Area I	49%	74%	23%
8	Peconic Estuary Restoration and Protection Area II	14%	30%	34%

Management Area	Management Area Name	Management Area Reference Water Body HAB/DO Improvement Goal*	Management Area Reference Water body Overall Water Quality Improvement Goal*	Achievable Reduction through On-Site Wastewater Management
9	Peconic Estuary Restoration and Protection Area III	15%	33%	30%
10	Sag Harbor Cove and Connected Creeks	62%	81%	45%
11	West Neck Bay and Creek and Menantic Creek	37%	68%	42%
12	Peconic Estuary Restoration and Protection Area IV	0%	6%	11%

Table 6-7 shows that Wastewater Management Areas 8 and 12 achieve both the HAB/DO water quality goals and the overall water quality goals with I/A OWTS implementation; additional nitrogen load reductions achievable from wastewater management in these areas will be provided. I/A OWTS installations throughout Wastewater Management Areas 9 and 11 will reduce nitrogen loading sufficiently to achieve the HAB/DO water quality goals. I/A OWTS installations throughout Wastewater Management Areas 7 and 10 will reduce nitrogen loading sufficiently to achieve the HAB/DO water quality goal and will make significant progress towards achievement of the overall water quality goals.

6.4 Peconic Estuary Watershed Wastewater Planning

The following subsections provides recommendations for wastewater management planning specific to the Peconic Estuary subwatersheds.

6.4.1 Overall Wastewater Management Strategy

As described in Section 4.4, the recommended wastewater management program includes four phases. While the primary means of wastewater management will focus on the use of I/A OWTS, sewering and clustering are also important elements of the overall wastewater management strategy. During the Phase I ramp-up period from 2019 to 2023, I/A OWTS installations will continue to be implemented based on voluntary upgrades at a Countywide rate of 1,000 per year; this will include I/A OWTS installations in the Peconic Estuary watershed. I/A OWTS will be installed at all parcels within the 0 to 2-year groundwater contributing area to the Estuary and its subwatersheds and within the Phase II Wastewater Management Areas 7 (Peconic Estuary Restoration and Protection Area 1) and 11 (West Neck Bay and Creek and Menantic Creek) from 2024 to 2054. **Figures 6-8, 6-9** and **6-10** summarize the number of I/A OWTS installations per SWP implementation phase and the number of pounds of nitrogen reduced per SWP phase and the cost per phase, respectively. This information is also provided in **Table 6-8**.

The number of I/A OWTS installations during Phase II in the Peconic Estuary watershed exceeds 35,000 including over 18,000 parcels located within the 0 to 2-year groundwater contributing area. The nitrogen load to the Peconic Estuary will be reduced by over 1,200 pounds per day when Phase

II is completed, including almost 800 pounds per day from the 0 to 2-year groundwater contributing area.

During Phase III, I/A OWTS will be installed on the remaining 6,389 priority parcels, removing an additional 270 pounds per day.

Table 6-8 Nitrogen Load Reduction Provided by I/A OWTS Implementation in Peconic Estuary Subwatersheds

Area	Parcels Implementing I/A OWTS	Nitrogen Removed Daily (pounds)	Cost ($)
0 to 2-year Contributing Area	18,093	787	$440,356,700
Phase II Area (includes 0 to 2-year contributing area)	29,023	1,243	651,366,600
Phase III Area	6,389	270	131,391,700
Total	35,412	1,513	782,758,300

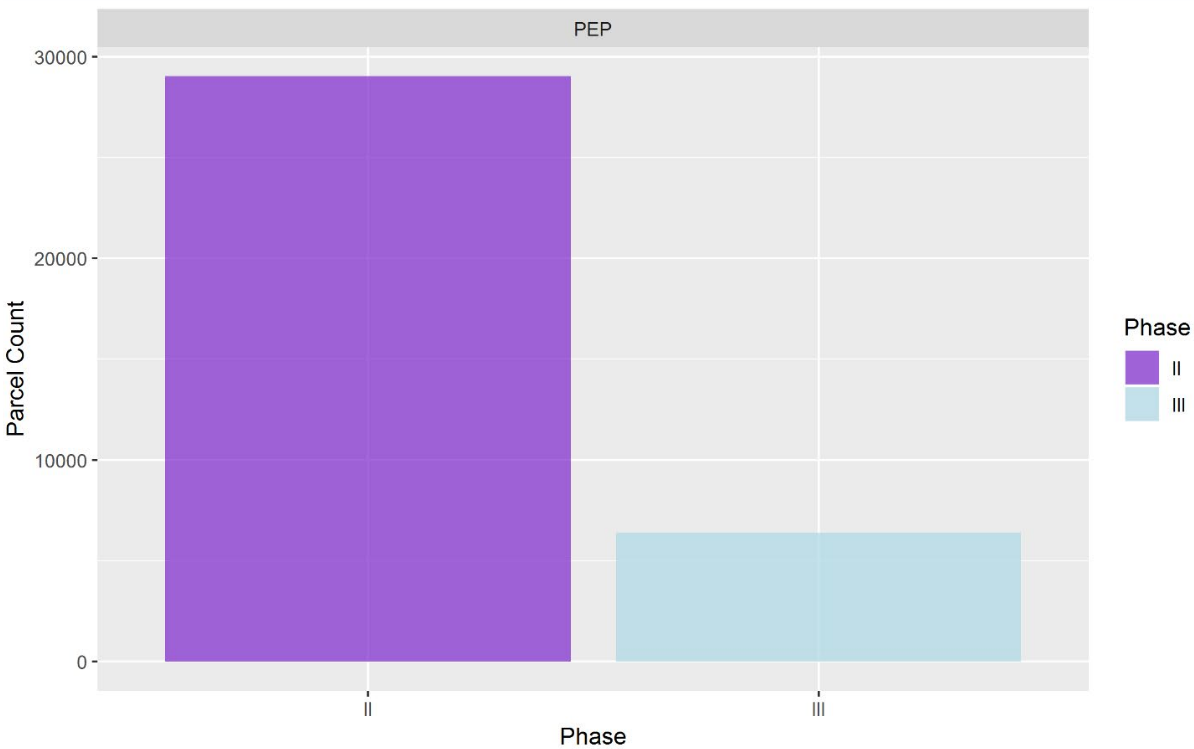


Figure 6-8 Number of I/A OWTS Installed in the Peconic Estuary Watershed by Phase

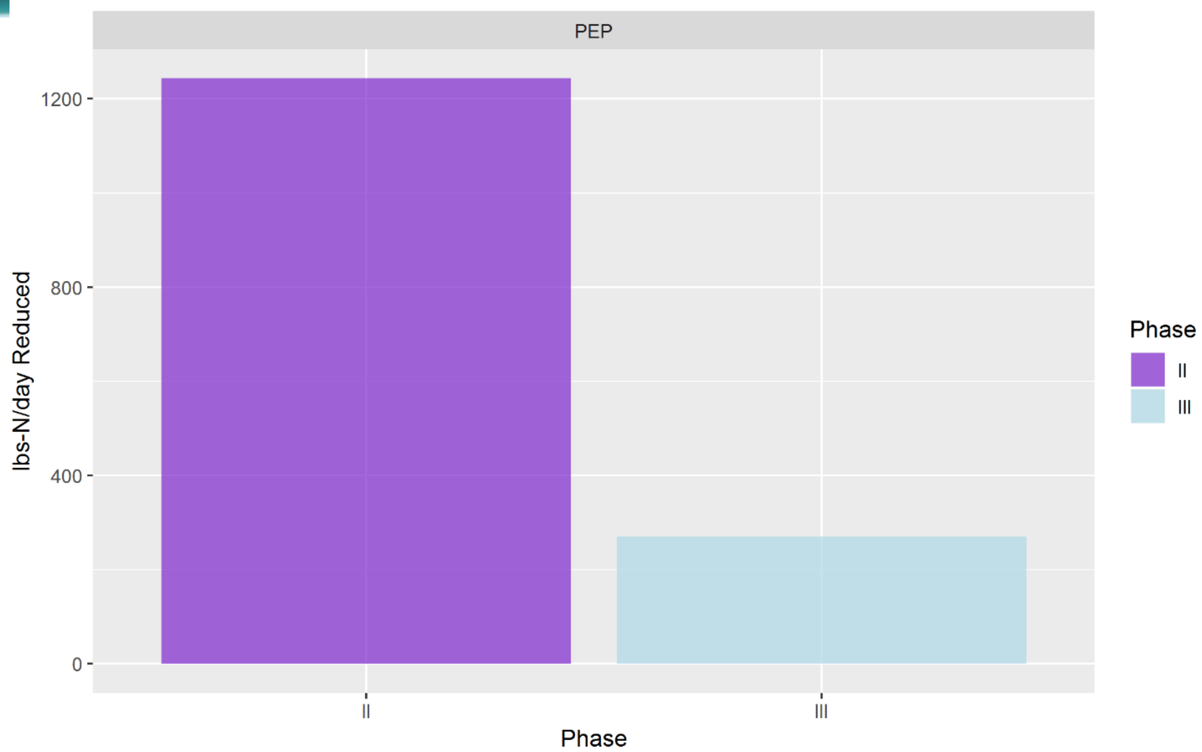


Figure 6-9 Pounds of Nitrogen Removed by I/A OWTS Installation in the Peconic Estuary Watershed by Phase

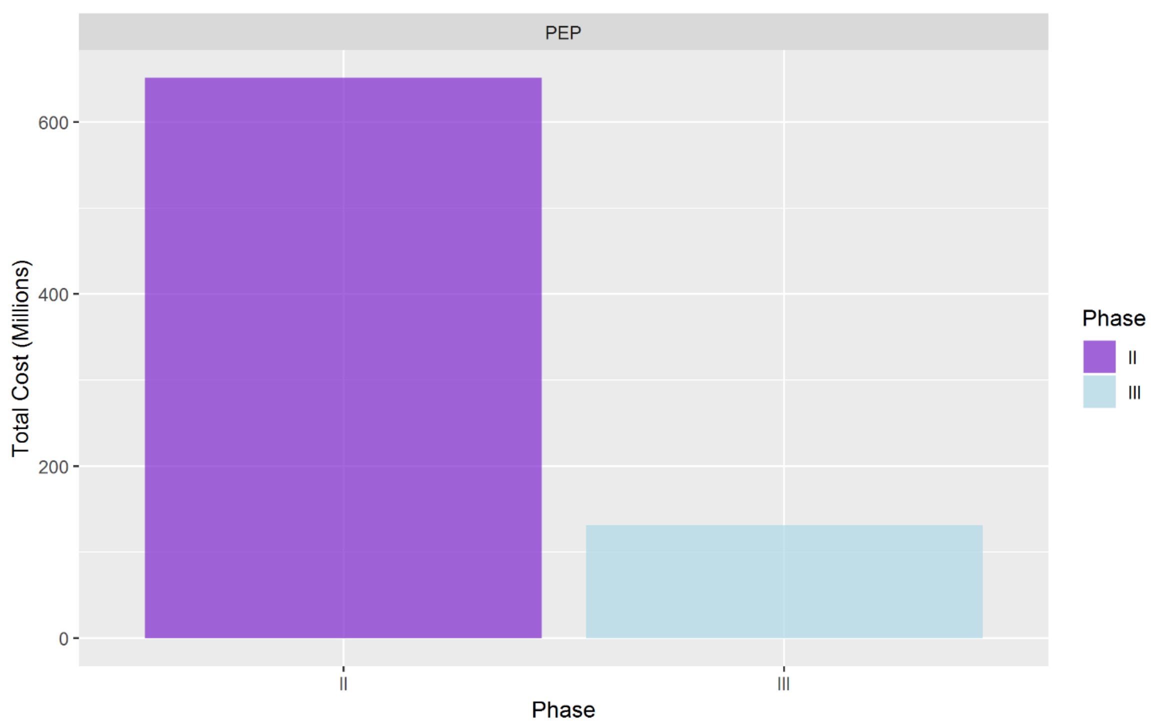


Figure 6-10 Estimated I/A OWTS Implementation Cost in the Peconic Estuary Watershed by SWP Phase

6.4.2 Sewering/Clustering Recommendations for Peconic Estuary Watershed

The following subsections provide initial recommendations for sewering and clustering for the Peconic Estuary subwatersheds. Recommendations were generated using the three-step approach documented in Section 4.5 which included:

- Inventory of existing sewering proposals in Suffolk County and documentation of current status;
- A parcel-specific scoring analysis, referred to as the "Wastewater Management Response Evaluation" to identify parcels where sewering and/or clustering may represent the preferred means of wastewater management; and
- Development of three sewer implementation scenarios based upon a range of potential funding availability and the findings of Steps 1 and 2 above.

Individual sewer and clustering projects would require project-specific Feasibility Studies to develop cost estimates and assess overall project feasibility. In addition, project-specific SEQRA evaluations would be required to assess and mitigate project-specific environmental concerns. Finally, it should be noted that the evaluation and findings presented herein are intended to be an initial planning tool to support recommendations for stable recurring revenue source needs and present initial findings regarding areas that may benefit from sewering or clustering. The findings are not intended to be binding in any way.

6.4.2.1 Inventory of Existing Sewer Proposals in the Peconic Estuary Watershed

Review of the inventory and status table of all known existing County, Town, and Village sewer proposals identified three existing sewer expansion proposals in the Peconic Estuary watershed that have not been deemed infeasible through existing Feasibility Study including:

- Riverside Revitalization Project (Town of Southampton);
- Springs School District sewer project (Town of East Hampton); and,
- Downtown Montauk Sewer Project (Town of East Hampton).

A summary of the proposals for County led proposals is provided in **Table 4-6** located in Section 4.5. A summary of Town/Village led proposals is provided in **Table 4-7** located in Section 4.5. A map showing the location of all sewer proposals and estimated District boundaries is provided below on **Figure 6-11**. Please note that for the purposes of this evaluation, projects that were deemed infeasible through feasibility study or projects that were identified as having no plan to move forward by Towns/Villages were omitted from the map.

Figure 6-11 Location of Existing Sewer Proposals for Peconic Estuary Watershed

6.4.2.2 Wastewater Management Response Evaluation Findings for the Peconic Estuary

To provide an initial planning tool that identifies parcels that might benefit from sewering or clustering, the Suffolk County Department of Economic Planning and Development completed a geospatial, parcel-specific scoring analysis that expanded upon the methodology used by the Maryland Department of Environment for the Chesapeake Bay Program (TetraTech, 2011). While clustering was not explicitly evaluated during this analysis, parcels recommended for sewering through the scoring analysis that are not within close proximity to an existing common collection system; or, are in proximity to an existing STP with no expansion capacity, should be considered as clustering candidates if a suitable lot is identified for siting of the clustered treatment system.

A summary of the scoring analysis criteria, methodology, and results are summarized in Section 4.5 of this SWP. An example of the output for the Peconic Estuary watershed region is provided below on **Figure 6-12**.

Figure 6-12 Wastewater Management Response Evaluation Map Output for the Peconic Estuary

As shown on **Figure 6-12**, the majority of the parcels in the Peconic Estuary watershed scored in favor of I/A OWTS. This is consistent with the findings of the SWP which indicate that many of the subwatersheds in the Peconic Estuary water bodies have less development when compared to western Suffolk County and therefore benefit with comparatively good water quality and lower load reduction goals. However, medium to high density residential parcels located within close proximity to existing sewer districts in the Peconic Estuary (e.g., Riverhead, Greenport, and Sag Harbor) scored in favor of sewering. It should be reiterated that the intent of the Wastewater Management Response Evaluation is to serve as an initial planning tool for the development of initial recommendations pertaining to wastewater management methods in Suffolk County. As discussed previously within this SWP, individual sewer and clustering projects would require a project-specific Feasibility Study to develop cost estimates and assess overall project feasibility. In addition, a project-specific EIS would be required to assess and mitigate project-specific environmental concerns.

6.4.2.3 Sewer Implementation Scenario Findings for Peconic Estuary Sewer Proposals

The final step completed under the sewering evaluation was to develop and evaluate a range of possible sewer expansion scenarios that built upon the existing sewer proposal inventory table and considered potential revenue streams, relative geographic priority rank as identified in the SWP priority areas, and the results of the parcel-specific sewer scoring analysis. The analysis incorporated existing sewer proposals identified in the sewer project inventory table that have already been deemed feasible through project-specific feasibility and which the project sponsor/lead is actively pursuing. These projects include all medium to light green shaded projects on **Tables 4-6** and **4-7** located in Section 4.5 (note that dark green projects on these tables are excluded from the analysis since they already have construction funding identified and are anticipated to move forward). Projects with incomplete or draft feasibility studies, or projects where the project sponsor/lead is no longer interested in pursuing the project, were omitted from the analysis. These projects include all yellow and red shaded projects on **Tables 4-6** and **4-7** located in Section 4.5. The analysis then evaluated three possible sewer expansion scenarios that were built upon a range of estimated revenue streams. Scenario 1 represented the lowest revenue assumption for the stable and recurring revenue source of $75 million dollars per year and Scenario 3 represents the highest revenue assumption of $93.7 million dollars per year. In addition, the analysis assumed that sewer expansion projects would be implemented through five 10-year projects, which would be constructed over a period of 50 years. Each 10-year project would include the construction of several sewer expansion proposals simultaneously.

Based upon the assumptions identified above, the Riverside Revitalization project in the Town of Southampton is the only existing sewer proposal in the Peconic Estuary with a completed Final Feasibility Study where the project lead/sponsor is actively pursuing execution of the project. The results of the sewer scenario evaluation provided in Section 4.5 indicate that this project can be completed under all presumed funding scenarios; however, Scenarios 2 and 3 accommodate completion of the project in a more timely fashion due to the availability of additional funding in the earlier stages of the presumed wastewater upgrade timeline.

6.4.2.4 Preliminary Identification of Other Areas for Sewer Expansion or Clustering in the Peconic Estuary Watershed

The previous evaluations focused on presenting potential sewer implementation scenarios using existing sewering proposals and an assumed range of revenue sources. While this represents a logical first step, the initial evaluations completed within this SWP can also be used to identify locations where new sewer expansion projects might be beneficial beyond those already proposed and inventoried herein. A summary of additional areas that might benefit from sewer expansion, new STPs, or clustering in the Peconic Estuary watershed is provided below.

6.4.2.4.1 Potential Sewer Expansion Locations

The following areas were preliminarily identified as possibly benefitting from additional sewer expansion beyond the projects already presented within this SWP:

- Residential neighborhoods surrounding Sag Harbor Cove. As shown on **Figure 6-12**, these parcels scored in favor of sewering due to their proximity to the existing Sag Harbor sewer district and the ecological rank of Priority Rank 1. In addition, Sag Harbor Cove is identified as potentially requiring nitrogen load reductions above the reduction that could be achieved through the use of I/A OWTS alone to meet water quality goals; and,

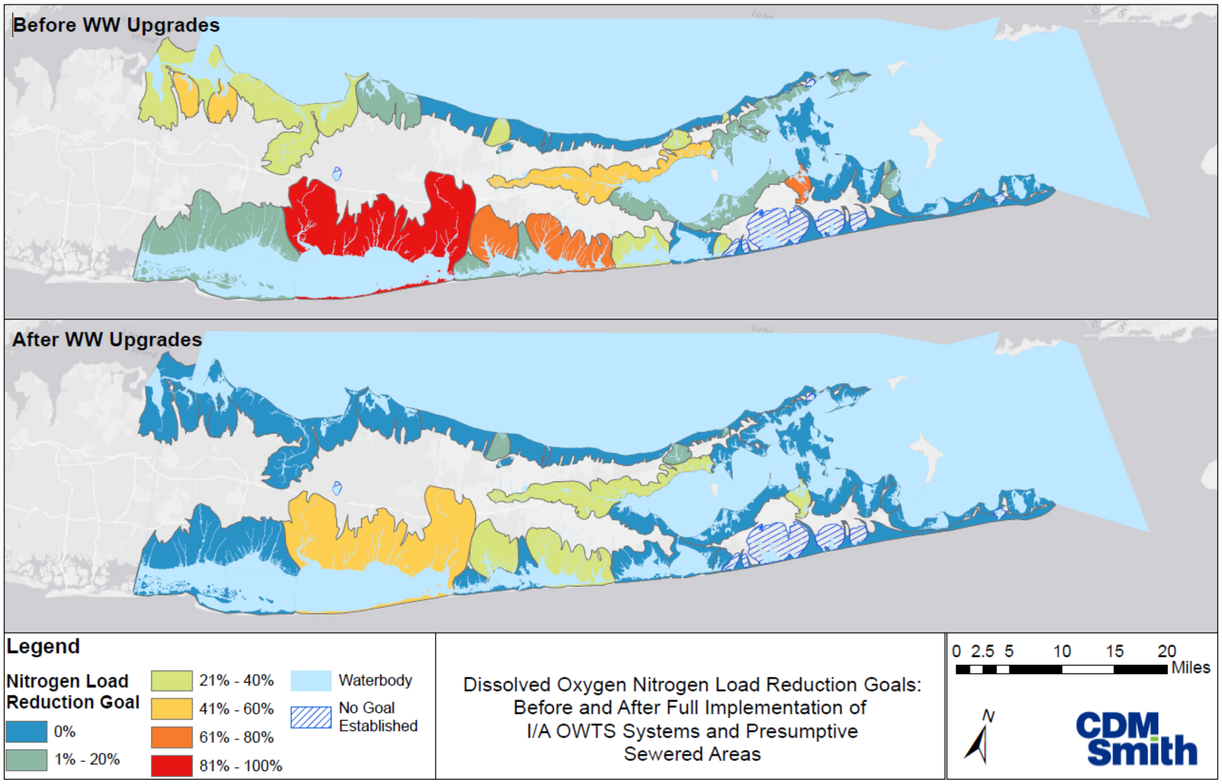
- Residential neighborhoods located in proximity to the Riverhead Sewer District and located within Wastewater Management Area 7 - Peconic Estuary Restoration and Protection Area I (western Peconic Estuary). As shown on **Figure 6-12**, these parcels scored in favor of sewering due to their proximity to the existing Riverhead sewer district and the ecological rank of Priority Rank 1. In addition, Wastewater Management Area 7 is identified as potentially requiring nitrogen load reductions above the reduction that could be achieved through the use of I/A OWTS alone to meet water quality goals.

It should be noted that all of the areas identified above are solely for preliminary screening and discussion purposes only. The viability of each area to connect to existing or new sewer districts and/or use clustering will vary significantly based upon a variety of known and unknown factors including available capacity at adjacent sewer districts (both hydraulically and for compliance with mass loading restrictions per existing TMDL[s]). Ultimately, each area would require project-specific feasibility study to determine implementability, cost feasibility, and overall viability as a wastewater management option.

6.4.3 Environmental Benefits

Figure 6-13 shows that I/A OWTS implementation will be successful in reducing the unit nitrogen load * residence time in the Peconic Watershed to the same unit nitrogen load * residence time that characterizes the water bodies meeting the HAB/DO targets for four of the Peconic Estuary Wastewater Management Areas. While significant progress in water quality improvement will be provided for Wastewater Management Areas 7 and 10, additional nitrogen load reductions would be required to achieve the desired endpoints.

Implementation of I/A OWTS throughout the six Peconic Estuary Wastewater Management Areas will result in significant progress towards achievement of overall nitrogen load reduction goals as shown on **Figure 6-14. Figure 6-14** shows that for one of the six Peconic Estuary Wastewater Management Areas, I/A OWTS implementation will be successful in achieving the same unit nitrogen load * residence time as was described in Section 2.1.9 for the reference water bodies that completely achieve ideal water quality goals.



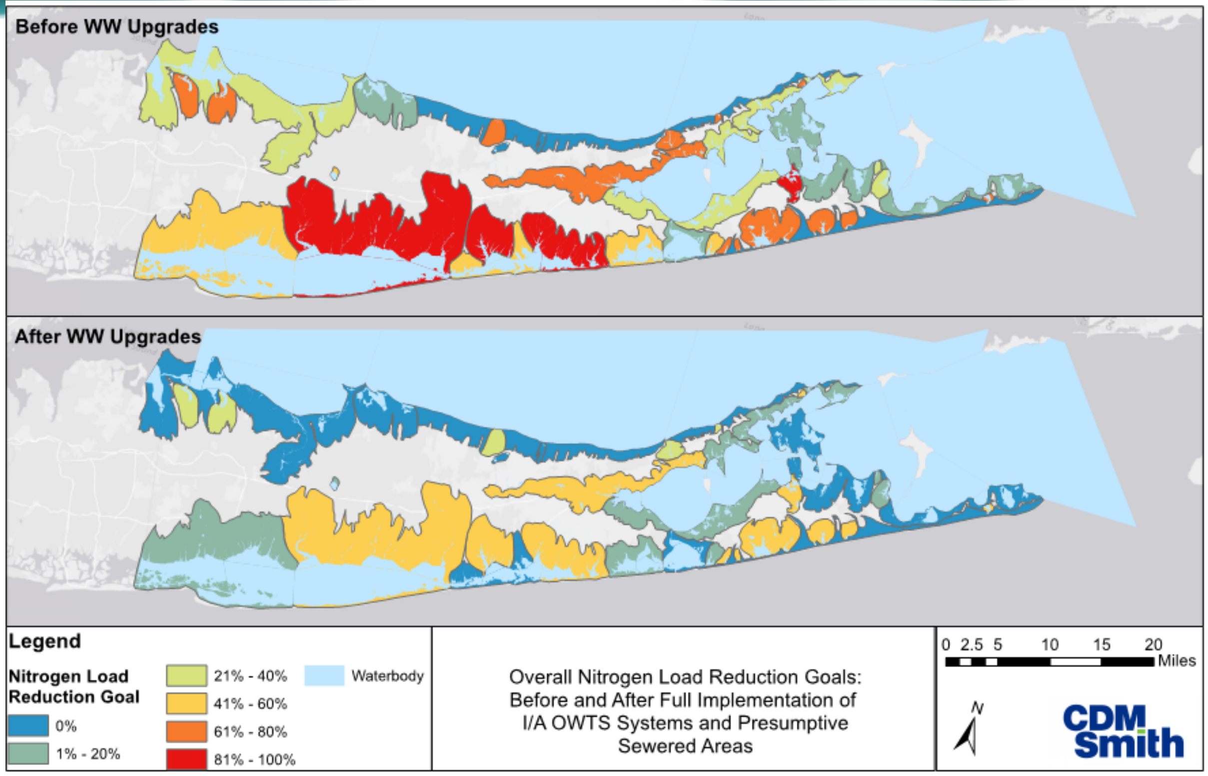
Note: The upper panel in the figure shows the nitrogen load reductions required to achieve the same unit nitrogen load observed in Suffolk County waters with no hypoxic or HAB events. The lower panel shows the much lower nitrogen load reductions required to achieve the unit nitrogen loads after SWP implementation.

Figure 6-13 Progress Towards Achievement of Unit Nitrogen Loads Consistent with Water Bodies that Have Experienced No Dissolved Oxygen Hypoxic Events and No HAB Events in the Past 10 Years

6.4.4 Water Bodies Requiring Additional Nitrogen Load Reduction

While significant water quality benefits are anticipated to result from wastewater management in the Peconic Estuary watershed, based on the reference water body approach, additional nitrogen load reductions would be required to achieve ideal water quality in the 34 subwatersheds shown on **Figure 6-15** and listed on **Table 6-9**. Water quality in five of the water bodies was not well characterized; additional characterization would help to refine the nitrogen load reductions required.

Only twenty-six percent of the overall nitrogen load reduction goal for Wastewater Management Area 7 Peconic Estuary Restoration and Protection Area I, 59 percent of the overall nitrogen load reduction goal for Wastewater Management Area 11 West Neck Bay and Menantic Creek and 45 percent of the nitrogen load reduction goal for Wastewater Management Area 10 – Sag Harbor Cover and Connected Creeks will be achieved as shown by **Figure 6-15**. Additional nitrogen load reductions will be needed in these areas. However eighty percent of the overall water quality nitrogen load reduction goal will be achieved for Wastewater Management Area 9 Peconic Estuary Restoration and Protection Area III, 93 percent of the overall nitrogen load reduction goal will be achieved for Wastewater Management Area 8 Peconic Estuary Restoration and Protection Area II and 100 percent of the nitrogen load reduction goal will be achieved for Wastewater Management 12, Peconic Estuary Restoration and Protection Area IV, providing substantial anticipated water



Note: The upper panel in the figure shows the nitrogen load reductions required to achieve the same unit nitrogen load observed in Suffolk County waters exhibiting ideal water quality. The lower panel shows the much lower nitrogen load reductions required to achieve the unit nitrogen loads after SWP implementation.

Figure 6-14 Ideal Water Quality Nitrogen Load Reduction Goals Attained by SWP Implementation

quality improvement and/or protection to these areas which include all or part of 59 of the Peconic Estuary subwatersheds.

This SWP is one aspect of a Countywide program to reduce the total nitrogen mass load to groundwater and surface water within the County. Suffolk County remains dedicated to tracking the implementation of the program and to working with local jurisdictions and continuing coordination with related programs (e.g., estuary programs, LINAP, LICAP, Towns, Villages) to ensure the Countywide implementation strategy addressing nitrogen sources is advanced. As part of the adaptive management plant described in Section 8.4.11, other nitrogen removal or mitigation alternatives including sewering targeted areas, addition of pressurized shallow drainfields, hydromodification, nutrient bioextraction, permeable reactive barriers and/or fertilizer management can be studied and considered further.

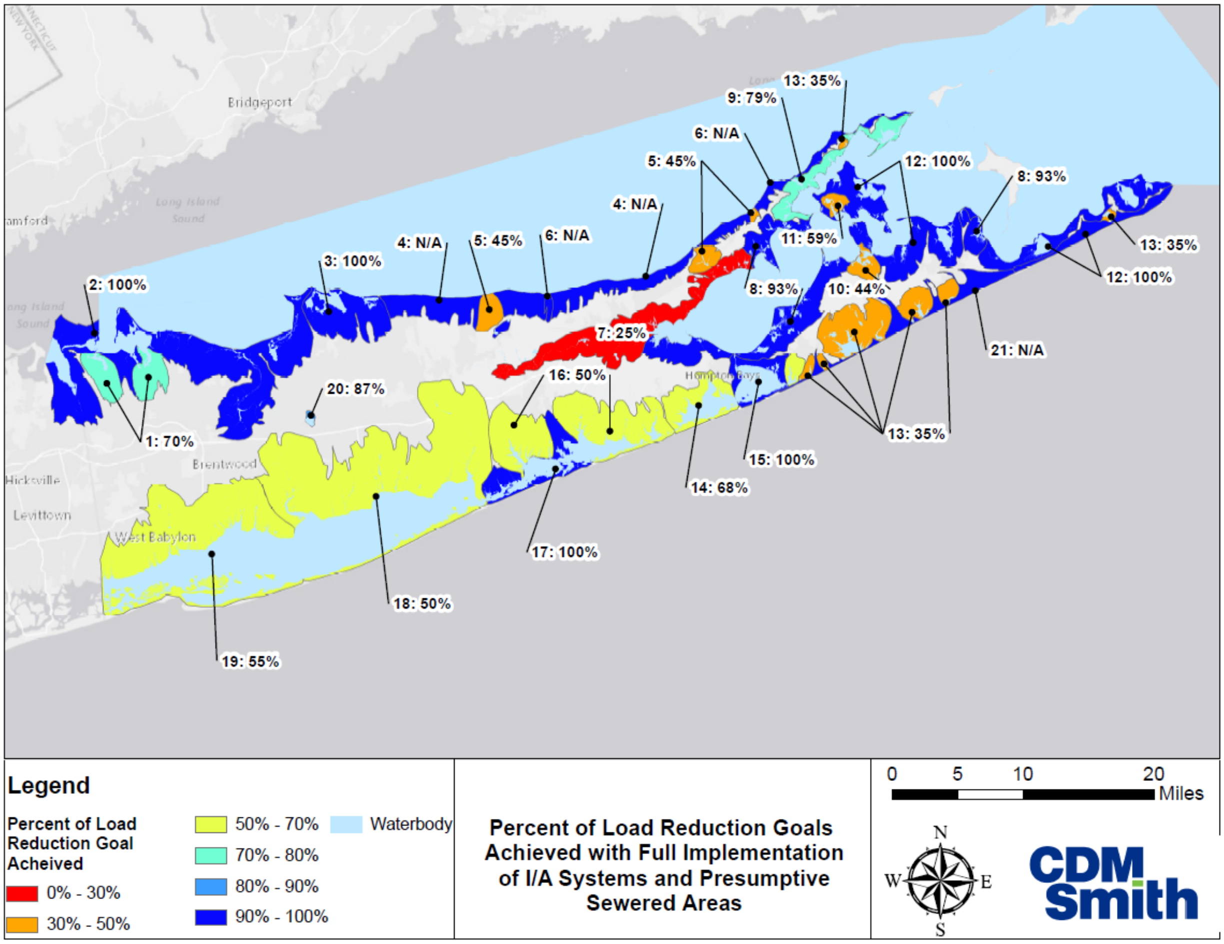


Figure 6-15 Overall Nitrogen Load Reduction Goals Attained by SWP Implementation

Table 6-9 Peconic Estuary Water Bodies Requiring Additional Nitrogen Reduction to Achieve Overall Water Quality Goals

Note: Bold text indicates the subwatershed was well-characterized.

	Wastewater Management Area	Water Bodies in Management Area	Nitrogen Reduction Goal for Overall Water Quality Improvement	Achievable Reduction through On-Site Wastewater Management
7	Peconic Estuary Restoration and Protection Area I	**Flanders Bay, East/Center, and Tribs (North)**	**71%**	**19%**
		Meetinghouse Creek and Tribs	**57%**	**35%**
		Terry's Creek and Tribs	**91%**	**30%**
		Flanders Bay, West/Lower Sawmill Creek	**56%**	**16%**
		Peconic River, Lower, and Tidal Tribs	**86%**	**35%**
		Great Peconic Bay and minor coves (north)	**73%**	**17%**

	Wastewater Management Area	Water Bodies in Management Area	Nitrogen Reduction Goal for Overall Water Quality Improvement	Achievable Reduction through On-Site Wastewater Manage-ment
		Brushes Creek	90%	15%
		James Creek	90%	53%
		Deep Hole Creek	**90%**	**35%**
		West Creek and Tidal Tribs	46%	29%
8	Peconic Estuary Restoration and Protection Area II	**Flanders Bay, East/Center, and Tribs (South)**	**71%**	**19%**
		Cutchogue Harbor - East Creek	**62%**	**41%**
		Cutchogue Harbor - Mud Creek	69%	41%
		Cutchogue Harbor - Wickham Creek	74%	28%
		Richmond Creek and Tidal Tribs	66%	21%
		Corey Creek and Tidal Tribs	64%	46%
		Great Peconic Bay (South)	**73%**	**17%**
		Goose Neck Creek	76%	40%
		Reeves Bay and Tidal Tribs	**67%**	**49%**
		Cold Spring Pond and Tribs	**50%**	**42%**
		Hog Creek and Tidal Tribs	78%	49%
		Acabonack Harbor	**70%**	**42%**
		Noyack Creek and Tidal Tribs	**73%**	**31%**
		Mill Creek and Tidal Tribs	**52%**	**46%**
9	Peconic Estuary Restoration and Protection Area III	Goose Creek	59%	45%
		Town/Jockey Creek	**63%**	**53%**
		SI Sound Trib/Moores Drain, Lower, Tribs	63%	18%
		Gull Pond	40%	34%
		Hallock/Long Beach Bay and Tidal Tribs	**67%**	**7%**
10	Sag Harbor Cove and Connected Creeks	**Sag Harbor Cove and Tribs**	**81%**	**48%**
11	West Neck Bay and Creek and Menantic Creek	**West Neck Bay and Creek**	**68%**	**39%**
		Menantic Creek	72%	46%
12	Peconic Estuary Restoration and Protection Area IV	**Northwest Creek and Tidal Tribs**	**45%**	**27%**
		Fresh Pond	30%	29%

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Section 6 Tables

Table 6-1 Subwatersheds Contributing to the Peconic Estuary Watershed

Peconic Estuary Subwatersheds	PWL Number
Acabonack Harbor	1701-0047
Big Reed Pond	1701-0281
Block Island Sound	1701-0278
Brushes Creek	1701-0247-BC+0249
Cedar Beach Creek and Tidal Tribs	1701-0243
Coecles Harbor	1701-0163
Cold Spring Pond and Tribs	1701-0127
Corey Creek and Tidal Tribs	1701-0244
Cutchogue Harbor	1701-0045-CH
Cutchogue Harbor - East Creek	1701-0045-EC
Cutchogue Harbor - Mud Creek	1701-0045-MC
Cutchogue Harbor - Wickham Creek	1701-0045-WC
Dam Pond	1701-0228
Deep Hole Creek	1701-0247-DHC+0249
Dering Harbor	1701-0050+
Dickerson Creek	1701-0242-DC
Fish Cove	1701-0037-FC
Flanders Bay, East/Center, and Tribs	1701-0030+0255+0273
Flanders Bay, West/Lower Sawmill Creek	1701-0254+0257
Fort Pond	1701-0122
Fort Pond Bay	1701-0370
Fresh Pond	1701-0279
Gardiners Bay and minor Tidal Tribs	1701-0164
Goose Creek	1701-0236
Goose Neck Creek	1701-0272-GNC
Great Peconic Bay and minor coves	1701-0165+0247+0249+0251
Gull Pond	1701-0231
Hallock/Long Beach Bay and Tidal Tribs	1701-0227
Hashamomuck Pond/Long Creek and Budd's Pond	1701-0162+0234
Hog Creek and Tidal Tribs	1701-0277
James Creek	1701-0247-JC+0249
Lake Montauk	1701-0031
Laurel Pond	1701-0128
Ligonee Brook and Tribs	1701-0352+0353
Little Peconic Bay	1701-0126+0172
Little Sebonac Creek	1701-0253
Marion Lake	1701-0229
Mattituck (Marratooka) Pond	1701-0129
Meetinghouse Creek and Tribs	1701-0256-MC
Menantic Creek	1701-0242-MC
Mill Creek and Tidal Tribs	1701-0238+

Table 6-1 Subwatersheds Contributing to the Peconic Estuary Watershed

Peconic Estuary Subwatersheds	PWL Number
Napeague Bay	1701-0369
Napeague Harbor and Tidal Tribs	1701-0166
North Sea Harbor and Tribs	1701-0037
Northwest Creek and Tidal Tribs	1701-0046
Northwest Harbor	1701-0368+0275+0276
Noyack Bay	1701-0167-rev
Noyack Creek and Tidal Tribs	1701-0237
Orient Harbor and minor Tidal Tribs	1701-0168
Oyster Pond/Lake Munchogue	1701-0169
Peconic River Middle, and Tribs	1701-0261+0262+0269
Peconic River Upper, and Tribs	1701-0108+0265+0266+0269
Peconic River, Lower, and Tidal Tribs	1701-0259+0263
Pipes Cove	1701-0366
Red Creek Pond and Tidal Tribs	1701-0250
Reeves Bay and Tidal Tribs	1701-0272-RB
Richmond Creek and Tidal Tribs	1701-0245
Sag Harbor	1701-0035-SH+0239
Sag Harbor Cove and Tribs	1701-0035-SHC
Scallop Pond	1701-0354
Sebonac Cr/Bullhead Bay and Tidal Tribs	1701-0051
Shelter Island Sound, North, and Tribs	1701-0170
Shelter Island Sound, South, and Tribs	1701-0365-rev+0240
SI Sound Trib/Moores Drain, Lower, Tribs	1701-0232+0233
Southold Bay	1701-0044
Spring Pond	1701-0230
Stirling Creek and Basin	1701-0049
Terry's Creek and Tribs	1701-0256-TC
Three Mile Harbor	1701-0036
Town/Jockey Creeks and Tidal Tribs	1701-0235
West Creek and Tidal Tribs	1701-0246
West Neck Bay and Creek	1701-0242-WB
West Neck Harbor	1701-0132-rev
Wildwood Lake (Great Pond)	1701-0264
Wooley Pond	1701-0048+

Table 6-2 Groundwater Baseflow Contributions to Peconic Estuary Subwatersheds

Water Body	PWL ID	0 to 2 Years	0 to 10 Years	0 to 25 Years	0 to 50 Years	0 to 100 Years	0 to 200 Years
Acabonack Harbor	1701-0047	35.07%	66.17%	82.25%	88.91%	95.37%	100.00%
Big Reed Pond	1701-0281	28.26%	80.98%	98.96%	100.00%	100.00%	100.00%
Block Island Sound	1701-0278	43.61%	77.94%	92.16%	96.36%	99.07%	100.00%
Brushes Creek	1701-0247-BC+0249	28.40%	66.79%	69.45%	81.37%	95.11%	100.00%
Cedar Beach Creek and Tidal Tribs	1701-0243	67.60%	88.88%	89.95%	93.01%	99.73%	100.00%
Coecles Harbor	1701-0163	41.48%	78.13%	95.42%	99.74%	100.00%	100.00%
Cold Spring Pond and Tribs	1701-0127	36.78%	75.59%	96.12%	99.15%	99.59%	100.00%
Corey Creek and Tidal Tribs	1701-0244	62.96%	86.42%	88.67%	93.16%	99.79%	100.00%
Cutchogue Harbor	1701-0045-CH	91.78%	99.84%	99.96%	100.00%	100.00%	100.00%
Cutchogue Harbor - East Creek	1701-0045-EC	75.00%	91.34%	91.99%	97.24%	99.92%	100.00%
Cutchogue Harbor - Mud Creek	1701-0045-MC	37.70%	56.08%	59.49%	84.75%	98.71%	100.00%
Cutchogue Harbor - Wickham Creek	1701-0045-WC	62.57%	84.79%	85.82%	88.90%	97.89%	100.00%
Dam Pond	1701-0228	79.72%	87.80%	94.11%	98.05%	100.00%	100.00%
Deep Hole Creek	1701-0247-DHC+0249	55.92%	81.07%	82.52%	84.81%	97.63%	100.00%
Dering Harbor	1701-0050+	37.78%	73.96%	93.41%	98.73%	99.30%	100.00%
Dickerson Creek	1701-0242-DC	44.61%	72.93%	93.52%	99.62%	99.97%	100.00%
Fish Cove	1701-0037-FC	22.41%	43.12%	77.82%	90.39%	93.88%	100.00%
Flanders Bay, East/Center, and Tribs	1701-0030+0255+0273	25.47%	54.86%	71.04%	77.89%	88.77%	100.00%
Flanders Bay, West/Lower Sawmill Creek	1701-0254+0257	35.81%	73.84%	83.20%	84.04%	89.01%	100.00%
Fort Pond	1701-0122	25.19%	63.54%	88.00%	98.08%	100.00%	100.00%
Fort Pond Bay	1701-0370	37.37%	67.51%	87.44%	98.29%	99.87%	100.00%
Fresh Pond	1701-0279	18.98%	48.01%	72.42%	93.36%	99.56%	100.00%
Gardiners Bay and minor Tidal Tribs	1701-0164	60.10%	84.09%	93.93%	98.44%	99.53%	100.00%

Table 6-2 Groundwater Baseflow Contributions to Peconic Estuary Subwatersheds

Water Body	PWL ID	0 to 2 Years	0 to 10 Years	0 to 25 Years	0 to 50 Years	0 to 100 Years	0 to 200 Years
Goose Creek	1701-0236	66.28%	89.68%	90.64%	95.58%	99.71%	100.00%
Goose Neck Creek	1701-0272-GNC	23.63%	51.81%	64.04%	77.93%	91.53%	100.00%
Great Peconic Bay and minor coves	1701-0165+0247+0249+0251	28.94%	61.81%	74.06%	79.59%	90.80%	100.00%
Gull Pond	1701-0231	73.37%	86.68%	93.48%	98.24%	99.80%	100.00%
Hallock/Long Beach Bay and Tidal Tribs	1701-0227	71.25%	93.91%	95.78%	98.14%	99.95%	100.00%
Hashamomuck Pond/Long Creek and Budd's Pond	1701-0162+0234	60.68%	88.74%	91.70%	97.20%	99.90%	100.00%
Hog Creek and Tidal Tribs	1701-0277	32.27%	69.88%	89.81%	97.52%	99.40%	100.00%
James Creek	1701-0247-JC+0249	54.01%	86.76%	95.80%	96.20%	97.45%	100.00%
Lake Montauk	1701-0031	37.31%	74.21%	92.47%	97.00%	99.06%	100.00%
Laurel Pond	1701-0128	25.83%	69.08%	83.90%	94.08%	100.00%	100.00%
Ligonee Brook and Tribs	1701-0352+0353	39.86%	70.06%	88.89%	96.69%	99.75%	100.00%
Little Peconic Bay	1701-0126+0172	42.05%	63.11%	70.09%	83.75%	95.48%	100.00%
Little Sebonac Creek	1701-0253	64.82%	85.26%	87.07%	92.67%	97.84%	100.00%
Marion Lake	1701-0229	44.57%	60.76%	78.14%	97.85%	100.00%	100.00%
Mattituck (Marratooka) Pond	1701-0129	34.67%	80.00%	85.60%	85.76%	98.46%	100.00%
Meetinghouse Creek and Tribs	1701-0256-MC	24.32%	61.50%	70.41%	77.26%	91.47%	100.00%
Menantic Creek	1701-0242-MC	38.13%	70.90%	94.62%	99.69%	99.99%	100.00%
Mill Creek and Tidal Tribs	1701-0238+	43.97%	57.75%	72.05%	89.01%	97.18%	100.00%
Napeague Bay	1701-0369	41.31%	69.86%	84.17%	95.68%	99.20%	100.00%
Napeague Harbor and Tidal Tribs	1701-0166	57.72%	89.17%	98.63%	99.77%	100.00%	100.00%
North Sea Harbor and Tribs	1701-0037	34.18%	62.02%	77.26%	90.96%	95.99%	100.00%
Northwest Creek and Tidal Tribs	1701-0046	19.90%	41.23%	62.17%	82.60%	98.30%	100.00%
Northwest Harbor	1701-0368+0275+0276	35.09%	59.16%	74.14%	85.24%	96.76%	100.00%

Table 6-2 Groundwater Baseflow Contributions to Peconic Estuary Subwatersheds

Water Body	PWL ID	0 to 2 Years	0 to 10 Years	0 to 25 Years	0 to 50 Years	0 to 100 Years	0 to 200 Years
Noyack Bay	1701-0167-rev	45.91%	72.81%	85.87%	94.70%	98.30%	100.00%
Noyack Creek and Tidal Tribs	1701-0237	21.72%	38.38%	56.90%	82.40%	97.13%	100.00%
Orient Harbor and minor Tidal Tribs	1701-0168	66.65%	89.89%	94.18%	98.34%	99.99%	100.00%
Oyster Pond/Lake Munchogue	1701-0169	22.02%	64.48%	85.46%	93.47%	97.74%	100.00%
Peconic River Middle, and Tribs	1701-0261+0262+0269	20.46%	55.21%	79.76%	84.72%	94.10%	100.00%
Peconic River Upper, and Tribs	1701-0108+0265+0266+0269	35.98%	92.51%	99.74%	99.84%	100.00%	100.00%
Peconic River, Lower, and Tidal Tribs	1701-0259+0263	20.90%	48.31%	66.31%	74.36%	85.88%	100.00%
Pipes Cove	1701-0366	62.29%	92.77%	93.29%	94.33%	98.87%	100.00%
Red Creek Pond and Tidal Tribs	1701-0250	27.03%	59.35%	81.81%	84.62%	92.64%	100.00%
Reeves Bay and Tidal Tribs	1701-0272-RB	22.49%	47.47%	53.88%	66.88%	85.70%	100.00%
Richmond Creek and Tidal Tribs	1701-0245	57.03%	86.85%	89.27%	92.94%	99.07%	100.00%
Sag Harbor	1701-0035-SH+0239	27.36%	54.64%	75.23%	91.54%	97.32%	100.00%
Sag Harbor Cove and Tribs	1701-0035-SHC	47.56%	68.27%	76.71%	84.25%	96.50%	100.00%
Scallop Pond	1701-0354	68.39%	94.98%	99.82%	100.00%	100.00%	100.00%
Sebonac Cr/Bullhead Bay and Tidal Tribs	1701-0051	26.50%	58.81%	81.16%	89.35%	96.71%	100.00%
Shelter Island Sound, North, and Tribs	1701-0170	60.01%	90.42%	97.16%	99.16%	99.81%	100.00%
Shelter Island Sound, South, and Tribs	1701-0365-rev+0240	59.79%	88.88%	98.13%	99.95%	100.00%	100.00%
SI Sound Trib/Moores Drain, Lower, Tribs	1701-0232+0233	51.70%	89.15%	96.32%	97.79%	99.41%	100.00%
Southold Bay	1701-0044	73.00%	92.27%	94.41%	98.67%	99.92%	100.00%
Spring Pond	1701-0230	98.80%	100.00%	100.00%	100.00%	100.00%	100.00%

Table 6-2 Groundwater Baseflow Contributions to Peconic Estuary Subwatersheds

Water Body	PWL ID	0 to 2 Years	0 to 10 Years	0 to 25 Years	0 to 50 Years	0 to 100 Years	0 to 200 Years
Stirling Creek and Basin	1701-0049	71.02%	92.40%	95.75%	97.58%	99.22%	100.00%
Terry's Creek and Tribs	1701-0256-TC	24.50%	60.53%	73.31%	76.29%	91.71%	100.00%
Three Mile Harbor	1701-0036	31.38%	55.38%	71.06%	85.71%	96.84%	100.00%
Town/Jockey Creeks and Tidal Tribs	1701-0235	60.81%	85.68%	87.30%	94.91%	99.17%	100.00%
West Creek and Tidal Tribs	1701-0246	72.08%	88.44%	89.32%	91.55%	98.41%	100.00%
West Neck Bay and Creek	1701-0242-WB	46.43%	84.38%	97.59%	99.92%	100.00%	100.00%
West Neck Harbor	1701-0132-rev	65.88%	90.43%	96.57%	99.96%	100.00%	100.00%
Wildwood Lake (Great Pond)	1701-0264	26.95%	80.04%	99.50%	100.00%	100.00%	100.00%
Wooley Pond	1701-0048+	25.20%	52.08%	63.06%	81.54%	96.07%	100.00%
PEP Average		**45.18%**	**73.62%**	**85.09%**	**92.10%**	**97.62%**	**100.00%**

Table 6-3 Nitrogen Load Components for Peconic Estuary Subwatersheds (page 1 of 6)

PWL ID	Subwatershed	On Site Sanitary Wastewater (lbs/day)	Fertilizer (lbs/day)	Pets (lbs/day)	Atmospheric Deposition to Subwatershed (lbs/day)	STP Discharge to GW (lbs/day)	Total Nitrogen Load from GW (lbs/day)	STP Discharge to Surface Water (lbs/day)	Atmospheric Deposition to Surface Water (lbs/day)	Total Nitrogen Load (lbs/day)
1701-0047	Acabonack Harbor	86.5	43.6	4.1	6.7	0.0	140.8	0.0	4.29	145.1
1701-0281	Big Reed Pond	0.0	1.4	0	0.2	0.0	1.6	0.0	0.66	2.3
1701-0278	Block Island Sound	31.4	21.9	1.3	3.0	0.0	57.6	0.0	1878.10	1935.7
1701-0247-BC+0249	Brushes Creek	10.7	56.7	0.5	3.0	0.0	70.9	0.0	0.07	71.0
1701-0243	Cedar Beach Creek and Tidal Tribs	9.3	6.5	0.5	1.0	0.0	17.3	0.0	0.38	17.7
1701-0163	Coecles Harbor	25.5	14.4	1.4	4.9	0.0	46.2	0.0	14.60	60.8
1701-0127	Cold Spring Pond and Tribs	30.7	15.7	1.2	2.1	0.0	49.7	0.0	2.71	52.4
1701-0244	Corey Creek and Tidal Tribs	23.2	9.2	1.3	1.5	0.0	35.1	0.0	1.10	36.2
1701-0045-CH	Cutchogue Harbor	17.8	6.9	1	1.1	0.0	26.8	0.0	12.05	38.9
1701-0045-EC	Cutchogue Harbor - East Creek	17.8	10.0	1	1.3	0.0	30.0	0.0	1.10	31.1
1701-0045-MC	Cutchogue Harbor - Mud Creek	35.7	41.2	1.6	4.9	0.0	83.4	0.0	0.69	84.1
1701-0045-WC	Cutchogue Harbor - Wickham Creek	11.8	17.3	0.6	1.2	0.0	30.8	0.0	0.51	31.3
1701-0228	Dam Pond	1.1	2.1	0.1	0.4	0.0	3.6	0.0	0.56	4.2
1701-0247-DHC+0249	Deep Hole Creek	20.9	22.4	1.1	1.9	0.0	46.4	0.0	0.43	46.8

Table 6-3 Summary of Nitrogen Loads to Peconic Estuary Subwatersheds

PWL ID	Subwatershed	On Site Sanitary Wastewater (lbs/day)	Fertilizer (lbs/day)	Pets (lbs/day)	Atmospheric Deposition to Subwatershed (lbs/day)	STP Discharge to GW (lbs/day)	Total Nitrogen Load from GW (lbs/day)	STP Discharge to Surface Water (lbs/day)	Atmospheric Deposition to Surface Water (lbs/day)	Total Nitrogen Load (lbs/day)
1701-0050+	Dering Harbor	18.3	8.2	1.1	2.8	0.0	30.4	0.0	2.91	33.3
1701-0242-DC	Dickerson Creek	4.3	2.5	0.3	0.6	0.0	7.6	0.0	0.28	7.8
1701-0037-FC	Fish Cove	19.0	14.1	1	3.0	0.0	37.1	0.0	0.35	37.5
1701-0030+0255+0273	Flanders Bay, East/Center, and Tribs	54.1	137.8	2.8	14.9	0.0	209.6	0.0	26.51	236.1
1701-0254+0257	Flanders Bay, West/Lower Sawmill Creek	35.1	20.5	2.3	3.4	0.0	61.4	184.7	1.69	247.8
1701-0122	Fort Pond	18.1	4.6	0.8	0.8	0.0	24.3	0.0	2.15	26.4
1701-0370	Fort Pond Bay	16.4	18.3	1.2	2.9	1.2	39.9	0.0	11.21	51.1
1701-0279	Fresh Pond	15.2	21.3	0.8	4.0	0.0	41.3	0.0	0.22	41.5
1701-0164	Gardiners Bay and minor Tidal Tribs	88.0	40.4	3.2	6.0	0.0	137.6	0.0	499.34	637.0
1701-0236	Goose Creek	30.0	13.9	1.7	1.8	0.0	47.4	0.0	0.88	48.3
1701-0272-GNC	Goose Neck Creek	16.5	13.3	0.7	1.9	0.0	32.4	0.0	0.38	32.8
1701-0165+0247+0249+0251	Great Peconic Bay and minor coves	140.7	168.4	6.5	15.9	0.0	331.4	0.0	235.82	567.2
1701-0231	Gull Pond	8.6	9.1	0.5	0.5	0.0	18.7	0.0	0.14	18.9
1701-0227	Hallock/Long Beach Bay and Tidal Tribs	9.6	74.9	0.6	5.8	0.0	90.9	0.0	7.83	98.7
1701-0162+0234	Hashamomuck Pond/Long Creek and Budds Pond	26.4	18.8	1.3	2.8	0.0	49.2	0.0	1.96	51.2

Table 6-3 Summary of Nitrogen Loads to Peconic Estuary Subwatershed

PWL ID	Subwatershed	On Site Sanitary Wastewater (lbs/day)	Fertilizer (lbs/day)	Pets (lbs/day)	Atmospheric Deposition to Subwatershed (lbs/day)	STP Discharge to GW (lbs/day)	Total Nitrogen Load from GW (lbs/day)	STP Discharge to Surface Water (lbs/day)	Atmospheric Deposition to Surface Water (lbs/day)	Total Nitrogen Load (lbs/day)
1701-0277	Hog Creek and Tidal Tribs	34.8	11.7	1.7	1.4	0.0	49.7	0.0	0.43	50.1
1701-0247-JC+0249	James Creek	36.5	9.7	1.4	1.7	0.0	49.3	0.0	0.20	49.5
1701-0031	Lake Montauk	66.6	29.8	2.7	4.9	0.0	104.0	0.0	13.26	117.3
1701-0128	Laurel Pond	1.4	4.2	0.1	0.7	0.0	6.4	0.0	0.36	6.8
1701-0352+0353	Ligonee Brook and Tribs	12.9	13.1	0.7	2.7	0.0	29.5	0.0	1.36	30.8
1701-0126+0172	Little Peconic Bay	80.1	56.5	4.4	8.3	0.0	149.3	0.0	158.71	308.1
1701-0253	Little Sebonac Creek	7.9	12.5	0.4	2.0	0.0	22.8	0.0	2.33	25.2
1701-0229	Marion Lake	14.0	6.0	0.8	0.8	0.0	21.5	0.0	0.28	21.8
1701-0129	Mattituck (Marratooka) Pond	1.2	3.3	0.1	0.2	0.0	4.7	0.0	0.28	5.0
1701-0034+0289+0292	Mecox Bay and Tribs	103.8	149.1	5	17.7	0.0	275.6	0.0	14.02	289.6
1701-0256-MC	Meetinghouse Creek and Tribs	28.4	29.0	0.9	2.9	0.0	61.1	0.0	1.08	62.2
1701-0242-MC	Menantic Creek	20.7	7.8	1	1.5	0.0	31.0	0.0	0.70	31.7
1701-0238+	Mill Creek and Tidal Tribs	10.7	5.6	0.6	0.8	0.0	17.7	0.0	0.44	18.1
1701-0369	Napeague Bay	15.1	48.1	0.8	7.2	0.0	71.2	0.0	236.41	307.6
1701-0166	Napeague Harbor and Tidal Tribs	14.2	26.9	0.4	3.8	0.0	45.3	0.0	11.47	56.8

Table 6-3 Summary of Nitrogen Loads to Peconic Estuary Subwatersheds

PWL ID	Subwatershed	On Site Sanitary Wastewater (lbs/day)	Fertilizer (lbs/day)	Pets (lbs/day)	Atmospheric Deposition to Subwatershed (lbs/day)	STP Discharge to GW (lbs/day)	Total Nitrogen Load from GW (lbs/day)	STP Discharge to Surface Water (lbs/day)	Atmospheric Deposition to Surface Water (lbs/day)	Total Nitrogen Load (lbs/day)
1701-0037	North Sea Harbor and Tribs	56.9	29.0	3	4.7	0.3	94.0	0.0	2.44	96.4
1701-0046	Northwest Creek and Tidal Tribs	44.8	44.4	2.3	8.0	0.0	99.4	0.0	2.27	101.7
1701-0368+0275+0276	Northwest Harbor	34.8	45.3	1.7	7.1	0.0	88.8	0.0	17.11	105.9
1701-0167-rev	Noyack Bay	37.0	13.7	2.1	2.4	0.0	55.1	0.0	43.06	98.2
1701-0237	Noyack Creek and Tidal Tribs	18.3	23.4	1	4.0	0.0	46.8	0.0	1.18	47.9
1701-0168	Orient Harbor and minor Tidal Tribs	21.8	16.2	1.3	1.7	0.0	41.0	0.0	34.30	75.3
1701-0169	Oyster Pond/Lake Munchogue	0.3	9.0	0	1.2	0.0	10.6	0.0	1.73	12.3
1701-0261+0262+0269	Peconic River Middle, and Tribs	21.9	122.6	1.3	14.1	3.0	162.9	0.0	1.65	164.5
1701-0108+0265+0266+0269	Peconic River Upper, and Tribs	4.0	43.5	0.2	7.3	0.0	55.1	0.0	2.60	57.7
1701-0259+0263	Peconic River, Lower, and Tidal Tribs	132.3	164.7	7.7	28.8	0.0	333.4	0.0	2.84	336.3
1701-0366	Pipes Cove	14.6	3.1	1	0.7	0.0	19.4	0.0	4.41	23.8
1701-0250	Red Creek Pond and Tidal Tribs	8.6	5.8	0.4	0.8	0.0	15.6	0.0	0.55	16.2

Table 6-3 Summary of Nitrogen Loads to Peconic Estuary Subwatersheds

PWL ID	Subwatershed	On Site Sanitary Wastewater (lbs/day)	Fertilizer (lbs/day)	Pets (lbs/day)	Atmospheric Deposition to Subwatershed (lbs/day)	STP Discharge to GW (lbs/day)	Total Nitrogen Load from GW (lbs/day)	STP Discharge to Surface Water (lbs/day)	Atmospheric Deposition to Surface Water (lbs/day)	Total Nitrogen Load (lbs/day)
1701-0272-RB	Reeves Bay and Tidal Tribs	68.9	34.0	3	4.8	0.0	110.7	0.0	4.03	114.7
1701-0245	Richmond Creek and Tidal Tribs	14.9	38.3	0.7	3.7	0.0	57.6	0.0	0.89	58.4
1701-0035-SH+0239	Sag Harbor	69.3	47.7	3.8	7.3	0.0	128.2	6.9	11.70	146.9
1701-0035-SHC	Sag Harbor Cove and Tribs	106.7	41.6	6	5.8	0.0	160.2	0.0	5.82	166.0
1701-0146+0286	Sagaponack Pond and Poxabogue Pond	87.2	90.0	4.3	12.1	0.0	193.7	0.0	2.41	196.1
1701-0354	Scallop Pond	0.9	3.5	0	0.7	0.0	5.1	0.0	1.75	6.9
1701-0051	Sebonac Cr/Bullhead Bay and Tidal Tribs	36.4	32.0	1.7	4.2	0.0	74.4	0.0	2.25	76.6
1701-0170	Shelter Island Sound, North, and Tribs	23.9	14.8	2.6	3.1	0.0	44.3	1.6	33.14	79.1
1701-0365-rev+0240	Shelter Island Sound, South, and Tribs	36.3	25.1	2.1	7.4	0.0	70.9	0.0	72.19	143.1
1701-0232+0233	SI Sound Trib/Moores Drain, Lower, Tribs	4.3	11.1	0.2	1.6	0.0	17.2	0.0	0.42	17.7
1701-0044	Southold Bay	21.5	10.4	1.2	1.6	0.0	34.7	0.0	8.75	43.5
1701-0230	Spring Pond	4.0	1.2	0.2	0.1	0.0	5.5	0.0	0.06	5.5
1701-0049	Stirling Creek and Basin	8.9	3.4	1.2	0.6	0.0	14.2	0.0	0.42	14.6

Table 6-3 Summary of Nitrogen Loads to Peconic Estuary Subwatersheds

PWL ID	Subwatershed	On Site Sanitary Wastewater (lbs/day)	Fertilizer (lbs/day)	Pets (lbs/day)	Atmospheric Deposition to Subwatershed (lbs/day)	STP Discharge to GW (lbs/day)	Total Nitrogen Load from GW (lbs/day)	STP Discharge to Surface Water (lbs/day)	Atmospheric Deposition to Surface Water (lbs/day)	Total Nitrogen Load (lbs/day)
1701-0256-TC	Terry's Creek and Tribs	30.7	50.6	1.3	3.9	0.0	86.4	0.0	0.05	86.5
1701-0036	Three Mile Harbor	212.7	84.3	10.3	12.3	3.2	322.8	0.0	12.18	335.0
1701-0235	Town/Jockey Creeks and Tidal Tribs	54.2	11.5	2.2	2.2	0.0	70.0	0.0	0.93	70.9
1701-0246	West Creek and Tidal Tribs	13.6	15.9	0.7	1.5	0.0	31.7	0.0	0.77	32.4
1701-0242-WB	West Neck Bay and Creek	20.7	10.3	1.2	2.5	0.0	34.8	0.0	2.69	37.5
1701-0132-rev	West Neck Harbor	4.1	2.0	0.3	0.4	0.0	6.8	0.0	4.34	11.1
1701-0264	Wildwood Lake (Great Pond)	8.5	13.9	0.4	1.7	0.0	24.5	0.0	0.79	25.3
1701-0048+	Wooley Pond	26.1	14.7	1.4	2.4	0.0	44.5	0.0	0.44	45.0

Table 6-5 Peconic Estuary Nitrogen Load Priority Areas

Peconic Estuary Subwatersheds	SWP PWL Number	Priority for Nitrogen Load Reduction
Acabonack Harbor	1701-0047	4
Big Reed Pond	1701-0281	2
Brushes Creek	1701-0247-BC+0249	1
Cedar Beach Creek and Tidal Tribs	1701-0243	3
Coecles Harbor	1701-0163	3
Cold Spring Pond and Tribs	1701-0127	4
Corey Creek and Tidal Tribs	1701-0244	3
Cutchogue Harbor	1701-0045-CH	3
Cutchogue Harbor - East Creek	1701-0045-EC	3
Cutchogue Harbor - Mud Creek	1701-0045-MC	3
Cutchogue Harbor - Wickham Creek	1701-0045-WC	3
Dam Pond	1701-0228	3
Deep Hole Creek	1701-0247-DHC+0249	1
Dering Harbor	1701-0050+	4
Dickerson Creek	1701-0242-DC	4
Fish Cove	1701-0037-FC	4
Flanders Bay, East/Center, and Tribs	1701-0030+0255+0273	2
Flanders Bay, West/Lower Sawmill Creek	1701-0254+0257	1
Fort Pond	1701-0122	2
Fort Pond Bay	1701-0370	4
Fresh Pond	1701-0279	4
Gardiners Bay and minor Tidal Tribs	1701-0164	4
Goose Creek	1701-0236	3
Goose Neck Creek	1701-0272-GNC	2
Great Peconic Bay and minor coves	1701-0165+0247+0249+0251	1
Gull Pond	1701-0231	3
Hallock/Long Beach Bay and Tidal Tribs	1701-0227	3
Hashamomuck Pond/Long Creek and Budd's Pond	1701-0162+0234	4
Hog Creek and Tidal Tribs	1701-0277	3
James Creek	1701-0247-JC+0249	1
Lake Montauk	1701-0031	4
Laurel Pond	1701-0128	2
Ligonee Brook and Tribs	1701-0352+0353	2
Little Peconic Bay	1701-0126+0172	2
Little Sebonac Creek	1701-0253	4
Marion Lake	1701-0229	3
Mattituck (Marratooka) Pond	1701-0129	1

Table 6-5 Peconic Estuary Nitrogen Load Priority Areas

Peconic Estuary Subwatersheds	SWP PWL Number	Priority for Nitrogen Load Reduction
Meetinghouse Creek and Tribs	1701-0256-MC	1
Menantic Creek	1701-0242-MC	2
Mill Creek and Tidal Tribs	1701-0238+	4
Napeague Bay	1701-0369	4
Napeague Harbor and Tidal Tribs	1701-0166	4
North Sea Harbor and Tribs	1701-0037	4
Northwest Creek and Tidal Tribs	1701-0046	4
Northwest Harbor	1701-0368+0275+0276	4
Noyack Bay	1701-0167-rev	4
Noyack Creek and Tidal Tribs	1701-0237	3
Orient Harbor and minor Tidal Tribs	1701-0168	4
Oyster Pond/Lake Munchogue	1701-0169	4
Peconic River Middle, and Tribs	1701-0261+0262+0269	1
Peconic River Upper, and Tribs	1701-0108+0265+0266+0269	1
Peconic River, Lower, and Tidal Tribs	1701-0259+0263	1
Pipes Cove	1701-0366	3
Red Creek Pond and Tidal Tribs	1701-0250	1
Reeves Bay and Tidal Tribs	1701-0272-RB	3
Richmond Creek and Tidal Tribs	1701-0245	2
Sag Harbor	1701-0035-SH+0239	4
Sag Harbor Cove and Tribs	1701-0035-SHC	3
Scallop Pond	1701-0354	1
Sebonac Cr/Bullhead Bay and Tidal Tribs	1701-0051	4
Shelter Island Sound, North, and Tribs	1701-0170	3
Shelter Island Sound, South, and Tribs	1701-0365-rev+0240	4
SI Sound Trib/Moores Drain, Lower, Tribs	1701-0232+0233	3
Southold Bay	1701-0044	4
Spring Pond	1701-0230	3
Stirling Creek and Basin	1701-0049	2
Terry's Creek and Tribs	1701-0256-TC	1
Three Mile Harbor	1701-0036	4
Town/Jockey Creeks and Tidal Tribs	1701-0235	3
West Creek and Tidal Tribs	1701-0246	1
West Neck Bay and Creek	1701-0242-WB	1
West Neck Harbor	1701-0132-rev	4
Wildwood Lake (Great Pond)	1701-0264	4
Wooley Pond	1701-0048+	4

Table 6-6 Peconic Estuary Subwatersheds Nitrogen Load Reduction Goals

	Management Area Name	Individual Water Bodies in Management Area	Individual Water Body HAB/DO Improvement Goal	Individual Water Body Overall Water Quality Improvement Goal	Achievable Reduction through On-Site Wastewater Management	Reduction Goal for Protection of Down Gradient Water Bodies
7	Peconic Estuary Restoration and Protection Area I	**Flanders Bay, East/Center, and Tribs (North)**	**43%**	**71%**	**19%**	**73%**
		Meetinghouse Creek and Tribs	**14%**	**57%**	**35%**	**73%**
		Terry's Creek and Tribs	**82%**	**91%**	**30%**	**73%**
		Flanders Bay, West/Lower Sawmill Creek	**11%**	**56%**	**16%**	**73%**
		Peconic River, Lower, and Tidal Tribs	**71%**	**86%**	**35%**	**73%**
		Peconic River Middle, and Tribs	N/A	N/A	11%	86%
		Peconic River Upper, and Tribs	N/A	N/A	8%	86%
		Wildwood Lake (Great Pond)	N/A	N/A	24%	86%
		Great Peconic Bay and minor coves (north)	**47%**	**73%**	**17%**	**0%**
		Brushes Creek	81%	90%	15%	73%
		Laurel Pond	N/A	N/A	15%	73%
		James Creek	80%	90%	53%	73%
		Deep Hole Creek	**79%**	**90%**	**35%**	**73%**
		Mattituck (Marratooka) Pond	N/A	N/A	15%	90%
		West Creek and Tidal Tribs	0%	46%	29%	73%
8	Peconic Estuary Restoration and Protection Area II	**Flanders Bay, East/Center, and Tribs (South)**	**43%**	**71%**	**19%**	**73%**
		Little Peconic Bay	**0%**	**0%**	**19%**	**0%**
		Wooley Pond	**0%**	**42%**	**43%**	**0%**
		North Sea Harbor and Tribs	**0%**	**0%**	**43%**	**0%**
		Fish Cove	0%	31%	38%	0%
		Big/Little Fresh Ponds	N/A	33%	44%	0%
		Cutchogue Harbor	**0%**	**0%**	**33%**	**0%**
		Cutchogue Harbor - East Creek	**24%**	**62%**	**41%**	**0%**
		Cutchogue Harbor - Mud Creek	38%	69%	41%	0%
		Cutchogue Harbor - Wickham Creek	49%	74%	28%	0%
		Richmond Creek and Tidal Tribs	31%	66%	21%	0%
		Cedar Beach Creek and tidal tribs	0%	0%	37%	0%
		Corey Creek and Tidal Tribs	28%	64%	46%	0%

Table 6-6 Peconic Estuary Subwatersheds Nitrogen Load Reduction Goals

	Management Area Name	Individual Water Bodies in Management Area	Individual Water Body HAB/DO Improvement Goal	Individual Water Body Overall Water Quality Improvement Goal	Achievable Reduction through On-Site Wastewater Management	Reduction Goal for Protection of Down Gradient Water Bodies
		Great Peconic Bay (South)	**47%**	**73%**	**17%**	**0%**
		Sebonac Cr/Bullhead Bay and Tidal Tribs	**0%**	**11%**	**32%**	**73%**
		Little Sebonac Creek	**0%**	**0%**	**18%**	**73%**
		Goose Neck Creek	51%	76%	40%	73%
		Reeves Bay and Tidal Tribs	**35%**	**67%**	**49%**	**73%**
		Scallop Pond	0%	11%	11%	73%
		Cold Spring Pond and Tribs	**0%**	**50%**	**42%**	**73%**
		Noyack Bay (P/O)	**0%**	**0%**	**28%**	**0%**
		Hog Creek and Tidal Tribs	56%	78%	49%	0%
		Acabonack Harbor	**41%**	**70%**	**42%**	**0%**
		Noyack Creek and Tidal Tribs	**45%**	**73%**	**31%**	**0%**
		Mill Creek and Tidal Tribs	**4%**	**52%**	**46%**	**0%**
		Red Creek Pond and Tidal Tribs	0%	10%	38%	73%
9	Peconic Estuary Restoration and Protection Area III	**Southold Bay**	**0%**	**0%**	**35%**	**0%**
		Pipes Cove	0%	0%	43%	0%
		Goose Creek	18%	59%	45%	0%
		Town/Jockey Creek	**26%**	**63%**	**53%**	**0%**
		Hashamomuck Pond/Long Creek and Budd's Pond	**0%**	**12%**	**35%**	**0%**
		SI Sound Trib/Moores Drain, Lower, Tribs	26%	63%	18%	0%
		Stirling Creek and Basin	0%	43%	44%	0%
		Shelter Island Sound, North, and tribs (P/O)	**0%**	**0%**	**22%**	**0%**
		Orient Harbor and minor tidal tribs (P/O)	**0%**	**0%**	**21%**	**0%**
		Dam Pond	0%	0%	16%	0%
		Gull Pond	0%	40%	34%	0%
		Spring Pond	0%	34%	50%	0%
		Hallock/Long Beach Bay and Tidal Tribs	**34%**	**67%**	**7%**	**0%**
10	Sag Harbor Cove and Connected Creeks	**Sag Harbor Cove and Tribs**	**62%**	**81%**	**48%**	**0%**
		Ligonee Brook and Tribs	N/A	31%	31%	81%

Table 6-6 Peconic Estuary Subwatersheds Nitrogen Load Reduction Goals

	Management Area Name	Individual Water Bodies in Management Area	Individual Water Body HAB/DO Improvement Goal	Individual Water Body Overall Water Quality Improvement Goal	Achievable Reduction through On-Site Wastewater Management	Reduction Goal for Protection of Down Gradient Water Bodies
11	West Neck Bay and Creek and Menantic Creek	**West Neck Bay and Creek**	**37%**	**68%**	**39%**	**0%**
		Menantic Creek	45%	72%	46%	0%
12	Peconic Estuary Restoration and Protection Area IV	**Northwest Creek and Tidal Tribs**	**0%**	**45%**	**27%**	**0%**
		Three Mile Harbor	**0%**	**31%**	**46%**	**0%**
		Fresh Pond	0%	30%	29%	0%
		Napeague Harbor	**0%**	**0%**	**18%**	**0%**
		Lake Montauk	**0%**	**0%**	**40%**	**N/A**
		Big Reed Pond	N/A	N/A	0%	0%
		Block Island Sound	N/A	N/A	1%	0%
		Shelter Island Sound, North, and tribs (P/O)	**0%**	**0%**	**22%**	**0%**
		Orient Harbor and minor tidal tribs (P/O)	**0%**	**0%**	**21%**	**0%**
		Noyack Bay (P/O)	**0%**	**0%**	**28%**	**0%**
		Dering Harbor	0%	0%	38%	0%
		Gardiners Bay	**0%**	**0%**	**9%**	**N/A**
		Coecles Harbor	**0%**	**0%**	**30%**	**0%**
		Napeague Bay	0%	0%	3%	N/A
		Dickerson Creek	0%	22%	39%	0%
		West Neck Harbor	**0%**	**0%**	**26%**	**0%**
		Shelter Island Sound, South, and tribs	**0%**	**0%**	**18%**	**0%**
		Northwest Harbor	**0%**	**0%**	**17%**	**0%**
		Sag Harbor	**0%**	**0%**	**36%**	**0%**
		Cedar Beach Creek and tidal tribs	**0%**	**0%**	**37%**	**0%**
		Fort Pond Bay	0%	0%	22%	0%
		Oyster Pond / Lake Munchogue	N/A	N/A	0%	N/A

Section 7

South Shore Estuary Reserve Subwatersheds

Sections 5, 6, and 7 summarize the SWP findings and wastewater management recommendations for each of the major estuaries in Suffolk County. An overview of the subwatersheds located within the South Shore Estuary Reserve (SSER) watershed, nitrogen loads to the SSER subwatersheds, priorities for SSER subwatershed nitrogen load reduction and wastewater planning is provided in the following pages. Details of the approaches used to develop the nitrogen loads, priority rankings and nitrogen load reductions and wastewater planning may be found in Section 2 of this SWP.

7.1 SSER Subwatersheds

A total of 74 individual surface water bodies were evaluated along Suffolk County's south shore, shown by **Figure 7-1**. The 74 individual water bodies were eventually grouped into six aggregated wastewater management areas based on similar priority rank and load reduction goals as described in Sections 2.1.10 and 4.3.3. A list of the individual South Shore subwatersheds in alphabetical order, along with the assigned SWP PWL number may be found in **Table 7-1** (please see tables at the end of this section).

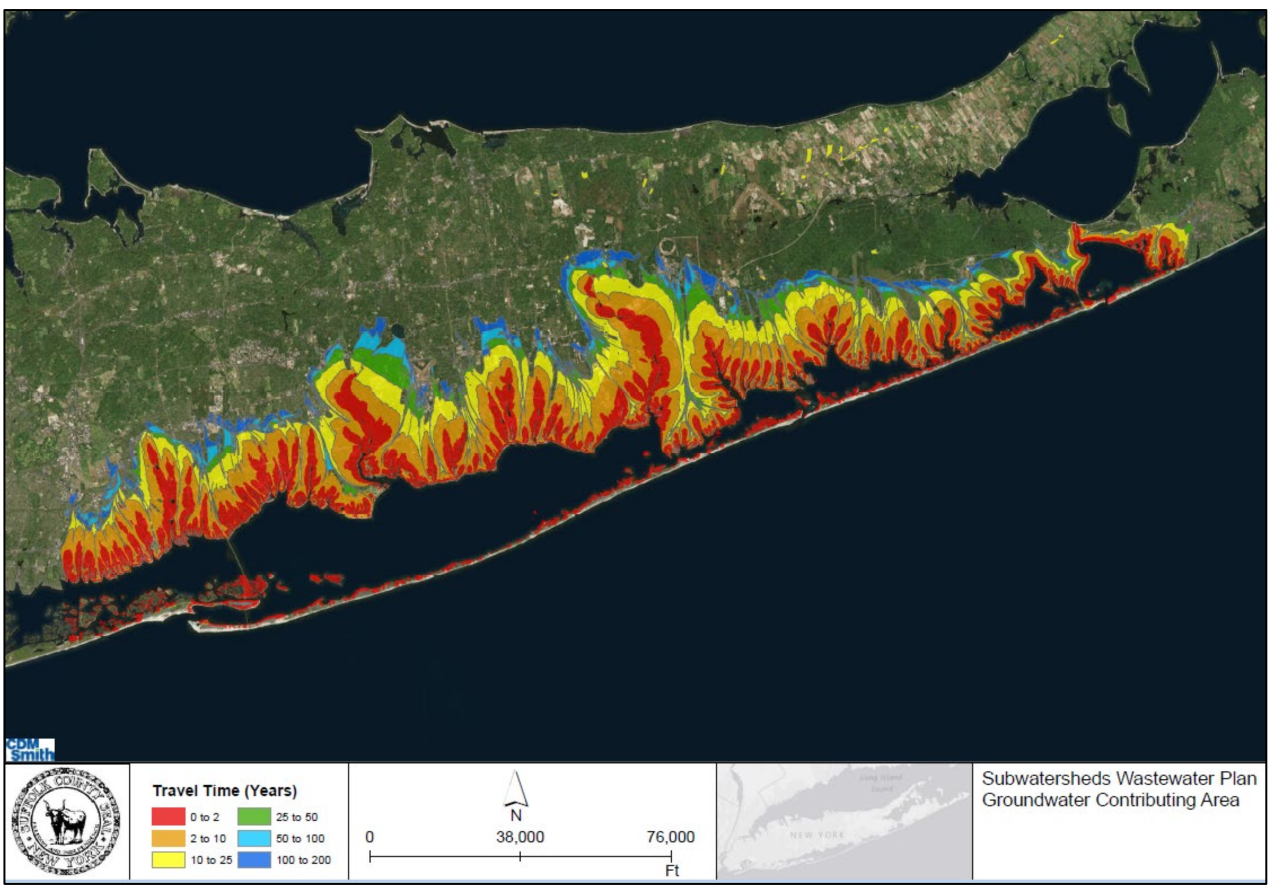


Figure 7-1 Groundwater Contributing Areas to the South Shore Estuary Reserve Subwatersheds

The areas contributing to the SSER subwatersheds were delineated using the Main Body and South Fork groundwater models. Based upon the water body-specific subwatershed delineations, the groundwater baseflow contributions to each water body were also compiled, based on the land surface area contributing recharge to the water body within each travel time interval simulated. These percentages, along with the subwatershed mappings, provide a first assessment of the areas where management actions such as reductions in nitrogen load can provide the most benefit to the downgradient surface water. The percentages are based on the total baseflow discharged to the surface water body over the 200-year simulation period. For many of the water bodies in the SSER watershed, the complete groundwater contributing area is not delineated by a 200-year simulation as it may take longer for recharging precipitation to travel vertically down through the aquifer system and out to surface water discharge. A summary of the groundwater baseflow contributions to each subwatershed from each travel time interval is provided by **Figure 7-2**. The figure shows that based on the average baseflow contributions to each subwatershed, almost one third of the groundwater baseflow and associated nitrogen loading originates within the 0 to two-year travel time, and over two-thirds of the groundwater baseflow and associated nitrogen loading originates within the 0 to ten-year travel time (based on the 200-year simulations). Wastewater management in these contributing areas will result in a significant reduction of the nitrogen load from sanitary wastewater to the SSER water bodies, and over ninety percent of the sanitary load would be addressed by prioritizing sanitary systems within the 100-year contributing area.

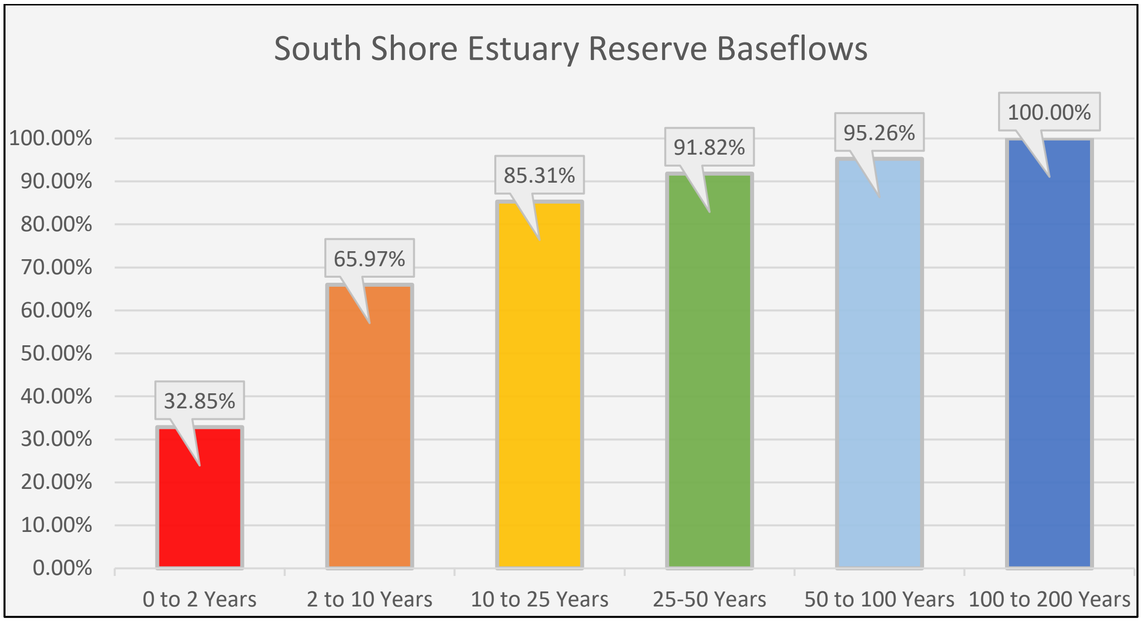


Figure 7-2 Groundwater Baseflow Travel Times in the South Shore Estuary Reserve

7.2 SSER Subwatershed Nitrogen Loads

Parcel-specific nitrogen loading was incorporated into three-dimensional solute transport models to simulate nitrogen concentrations and nitrogen migration throughout the aquifer system and to estimate the nitrogen loading to each of the SSER subwatersheds.

To calculate parcel-specific nitrogen loads for existing conditions, parcel-specific land uses were defined by the 2016 land use coverages provided by Suffolk County Department of Economic Development and Planning. Potential nitrogen sources, nitrogen loading rates and nitrogen attenuation factors were developed in cooperation with the Nitrogen Loading Model Focus Area Work Group convened by SCDHS.

As described in Section 2.1.5, nitrogen from the following sources was incorporated into the nitrogen loading model:

- Sanitary wastewater
- Fertilization
- Pet Waste
- Atmospheric Deposition

Nitrogen loading rates from sanitary wastewater, fertilizer and pet wastes were based on each parcel's land use. Nitrogen loads from atmospheric deposition was applied uniformly across all land use types in the County.

7.2.1 Existing Nitrogen Loads

The nitrogen load components to each SSER subwatershed are summarized on **Table 7-3** (please see tables at the end of this section). **Figure 7-3** summarizes the components of the total nitrogen loading from Suffolk County to the SSER subwatersheds. Under existing average annual conditions, on-site sanitary wastewater systems contribute approximately 63 percent of the total nitrogen load to the Estuary, followed by approximately 19 percent from fertilizer. Point sources, including sewage treatment plants discharging to groundwater and directly to surface waters are the smallest components of the total nitrogen load at 1.9 percent and 0.3 percent respectively. The nitrogen load from groundwater comprises a much higher percentage of the total nitrogen load to the SSER than to the Long Island Sound and Peconic Estuary subwatersheds, primarily due to the greater housing and population density within the SSER watershed.

Review of the nitrogen load components to groundwater shows that despite the presence of the County's Southwest Sewer District (SWSD) which collects sanitary wastewater from the southwest part of the County and transmits it to the Bergen Point Wastewater Treatment Plant for treatment and ocean discharge, on-site sanitary wastewater contributes over 68 percent of the nitrogen load to groundwater in this densely populated area of the County, as summarized by **Figure 7-4.**

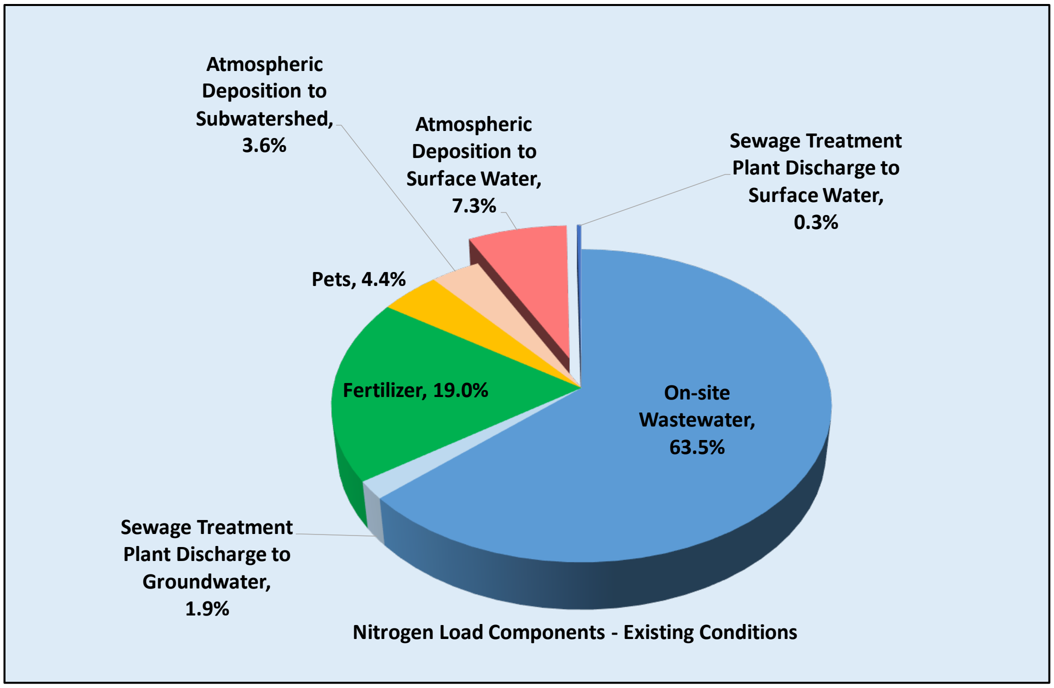


Figure 7-3 Components of Existing Nitrogen Loads to South Shore Estuary Reserve Subwatersheds

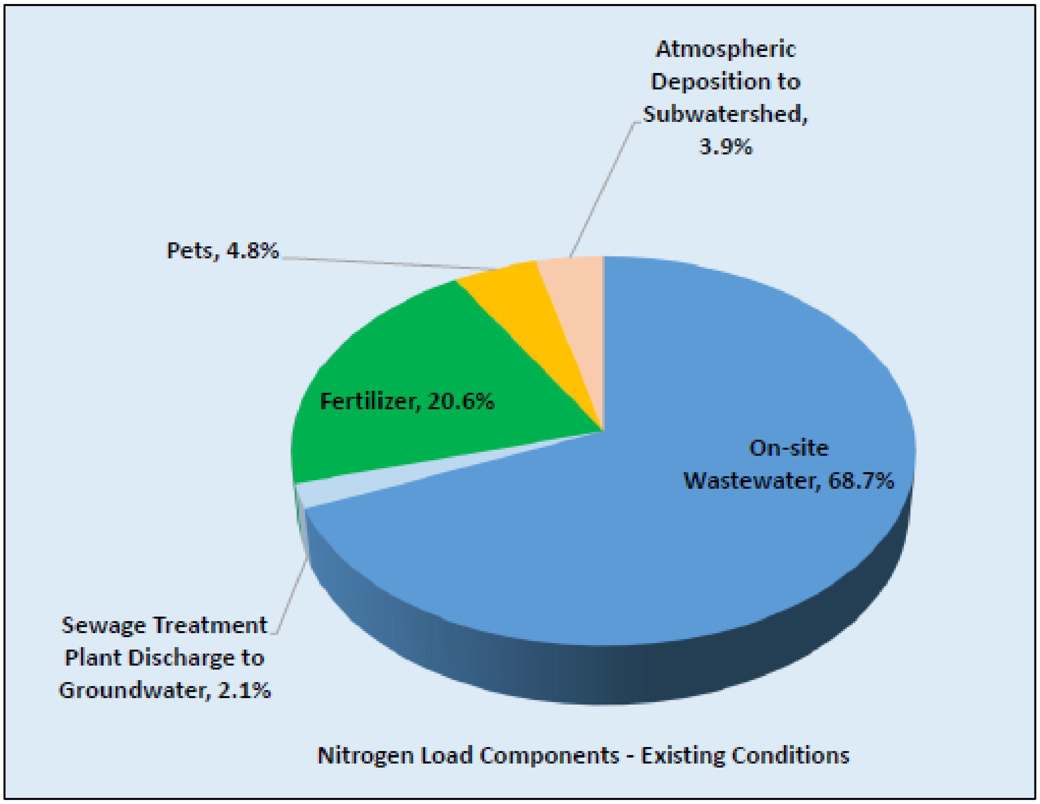


Figure 7-4 Summary of Groundwater Nitrogen Load Components to South Shore Estuary Reserve Subwatersheds

7.2.2 Potential Future Build-out Nitrogen Loads

As described in Section 2.1.5.3, in addition to evaluating the nitrogen loading to each subwatershed based on existing conditions, the potential future nitrogen loading if each undeveloped (or underdeveloped) residential parcel in the County was ultimately built-upon was also calculated. Suffolk County Department of Economic Development and Planning developed the conditions used for potential future build-out which were based on the more stringent of Suffolk County Sanitary Code Article 6 or local zoning for all:

- Vacant parcels without development restrictions
- Agricultural parcels without development restrictions, and
- Subdividable low density residential parcels.

This does not indicate that these changes will occur within any specific timeframe, or even that they will ever occur at all, but it does provide a reasonable upper limit on anticipated future nitrogen loading from on-site sanitary wastewater disposal in specific areas of the County.

The flow fields used for the existing conditions simulations were used for the future build-out simulations; e.g., boundary conditions such as recharge from precipitation and water supply pumping remained constant. In addition, parameters used to establish the nitrogen loading from on-site sanitary wastewater, pets and fertilizer remained unchanged from the existing conditions evaluation.

In addition to the changes in land use that were incorporated in the build-out evaluation, two other changes were made to better reflect future anticipated conditions:

- Flows and nitrogen loads from sanitary wastewater treatment plants were adjusted to match permit conditions. In some cases, the future flows were increased, based on anticipated future development; the increased flow and existing nitrogen concentrations combined to increase the total assigned nitrogen loads. In other cases, nitrogen concentrations were anticipated to be reduced to comply with permit limits, resulting in a net reduction in nitrogen load.
- Nitrogen loading from atmospheric deposition was reduced by ten percent, based upon unpublished information provided by USEPA.

Nitrogen loads from future potential build-out conditions were simulated using the solute transport model; the results of these simulations are discussed in Section 3. At build-out, the nitrogen load to the SSER subwatersheds is projected to increase by 7.5 percent. The percentages of each nitrogen load component that are anticipated to result if the additional development takes place are shown by **Figure 7-5.** The percentage of nitrogen loads contributed by on-site wastewater is not anticipated to change as a result of potential future build-out in the watershed.

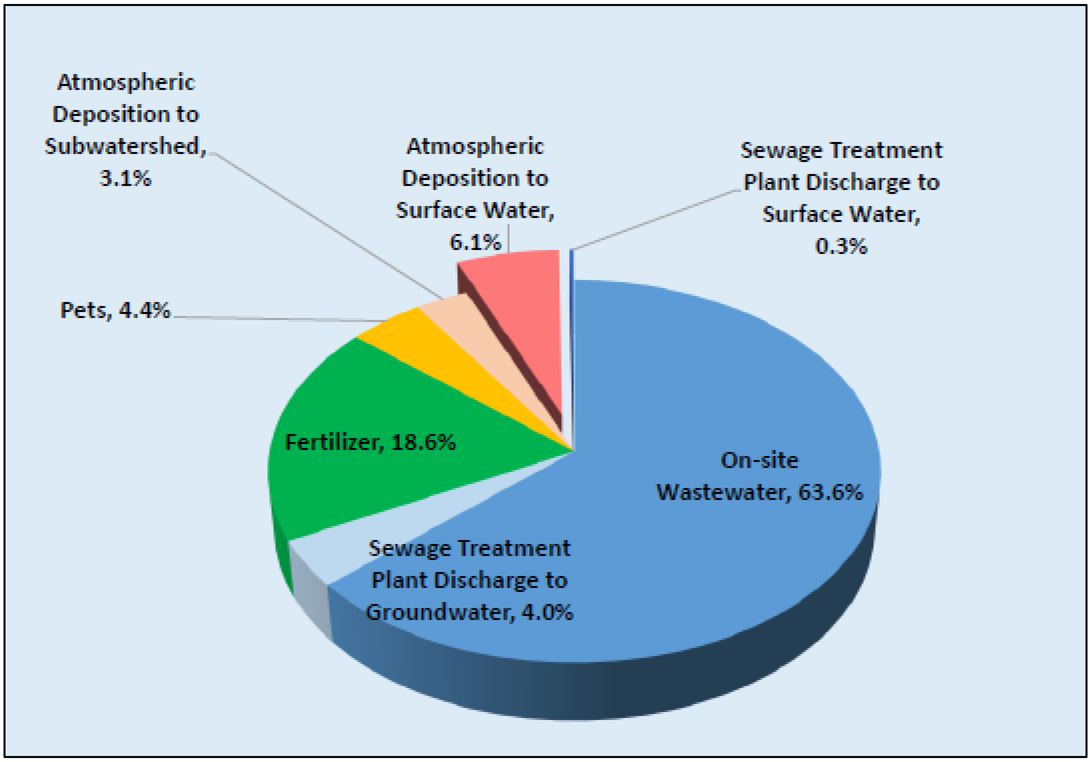


Figure 7-5 Potential Future Nitrogen Load Components in SSER Subwatersheds

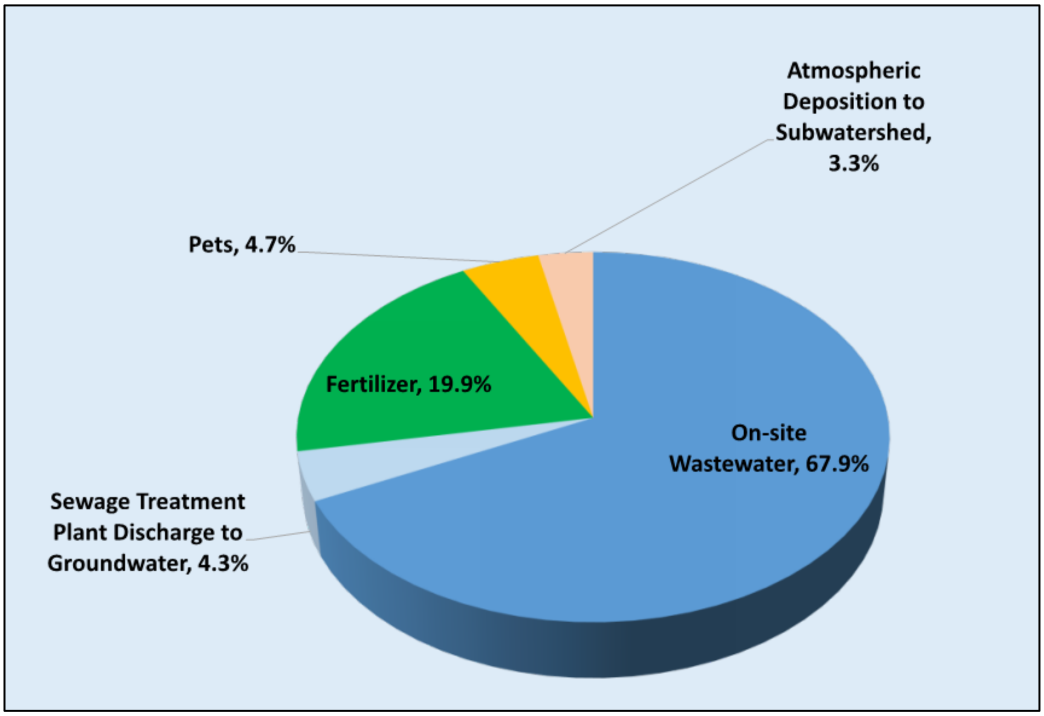


Figure 7-6 Summary of Potential Future Build-out Groundwater Nitrogen Load Components to South Shore Estuary Reserve Subwatersheds

Review of the nitrogen load components to groundwater shows that on-site sanitary wastewater would contribute just under 68 percent of the nitrogen load to groundwater, followed by fertilizer at almost 20 percent, as shown by **Figure 7-6**. Atmospheric deposition to the subwatersheds, pets, and discharge of treated sanitary effluent from sewage treatment plants combine to contribute just over 12 percent of the nitrogen load from groundwater.

7.3 SSER Subwatershed Nitrogen Reduction Requirements and Priority Areas

7.3.1 SSER Subwatershed Priority Areas

The 74 SSER subwatersheds were ranked amongst the entire set of 190 Suffolk County subwatersheds based on the modeled nitrogen loads and residence times and surface water quality characterizations. Seventy four percent of the subwatersheds (a total of 55) were ranked as Priority 1 for nitrogen load removal, and thirteen more subwatersheds were ranked as Priority 2 for nitrogen load removal. Three subwatersheds were ranked as Priority 3 for nitrogen load removal, and only three subwatersheds were ranked as Priority 4 for nitrogen load removal.

The priority ranking and required nitrogen load removal anticipated to result in improved water quality is summarized below by **Table 7-4,** which is organized alphabetically for easy reference. The Priority 1 Rank subwatersheds are summarized in **Table 7-5**.

Table 7-5 Priority Rank 1 Subwatersheds in the South Shore Estuary Reserve

Subwatershed Name	Subwatershed Name
Abets Creek	Heady and Taylor Creeks and Tribs
Amityville Creek	Howell's Creek
Aspatuck Creek and River	Moriches Bay East
Awixa Creek	Mud Creek, Robinson Pond, and Tribs
Beaverdam Creek	Neguntatogue Creek
Beaverdam Pond	Nicoll Bay
Bellport Bay	Ogden Pond
Belmont Lake	Pardees, Orowoc Lakes, Creek, & Tribs
Brightwaters Canal	Patchogue Bay
Brown Creek	Patchogue River
Carlls River	Penataquit Creek
Carmans River Lower, and Tribs	Penniman Creek and Tidal Tribs
Carmans River Upper, and Tribs	Phillips Creek, Lower, and Tidal Tribs
Champlin Creek	Quantuck Bay
Connetquot River, Lower, and Tribs	Quantuck Canal/Moneybogue Bay
Connetquot River, Upper, and Tribs	Quantuck Creek and Old Ice Pond
Corey Lake and Creek, and Tribs	Quogue Canal
Dunton Lake, Upper, and Tribs	Sampawams Creek
Forge River and Tidal Tribs	Sans Souci Lakes
Grand Canal	Santapogue Creek
Great Cove	Seatuck Cove and Tidal Tribs
Great South Bay, East	Shinnecock Bay West

Subwatershed Name	Subwatershed Name
Great South Bay, Middle	Speonk River
Great South Bay, West	Stillman Creek
Green Creek, Upper, and Tribs	Swan River, Swan Lake, and Tidal Tribs
Halsey Neck Pond	Tuthills Creek
Lawrence Creek/Lakes, O-co-nee	Weesuck Creek and Tidal Tribs
	Willets Creek

7.3.2 South Shore Estuary Watershed Nitrogen Load Reduction Requirements

A range of nitrogen load reductions were developed for the South Shore Estuary Reserve subwatersheds based upon the reductions required to achieve ideal water quality (reference water body approach), dissolved oxygen water quality goals (reference water body approach) and chlorophyll-*a* goals (probabilistic approach) as described in Section 2.1.9. The range of sanitary wastewater nitrogen load reduction goals ranged from 0 for the better-flushed waters of Shinnecock Bay East up to over 90 percent for the more densely subwatersheds including the Forge River, Quantuck Canal/Moneybogue Bay, Quantuck Bay, Great South Bay East and Middle, Carmans River Lower, Patchogue Bay, Nicoll Bay, Connetquot River Upper and Great Cove along with a number of the poorly characterized water bodies as shown on **Table 7-6**. In general, the nitrogen load reduction targets are highest for the subwatersheds located in the densely populated poorly flushed areas of the estuary. The overall goal for nitrogen from sanitary wastewater for the Peconic Estuary watershed based on well characterized subwatersheds is 78 percent.

The 74 individual surface water bodies within the South Shore Estuary watershed were aggregated into six larger, administratively manageable wastewater management areas based on priority for nitrogen load reduction, nitrogen load reduction goals and the downstream receiving water body nitrogen load reduction priority and target nitrogen reduction. The six South Shore Estuary wastewater management areas are shown on **Figure 7-7**, described below and summarized on **Table 7-7**.

Table 7-7 Nitrogen Load Reduction Goals and Nitrogen Load Reductions Achievable through On-Site Wastewater Management

Management Area	Management Area Name	Management Area Reference Water Body HAB/DO Improvement Goal*	Management Area Reference Water body Overall Water Quality Improvement Goal*	Achievable Reduction through On-Site Wastewater Management
14	Shinnecock Bay Restoration and Protection Area I	28%	52%	44%
15	Shinnecock Bay Restoration and Protection Area II	0%	20%	42%
16	Moriches Bay Restoration Area I	76%	88%	48%
17	Moriches Bay Restoration Area II	18%	41%	48%
18	Great South Bay Restoration Area I	87%	93%	48%
19	Great South Bay Restoration Area II	2%	44%	27%

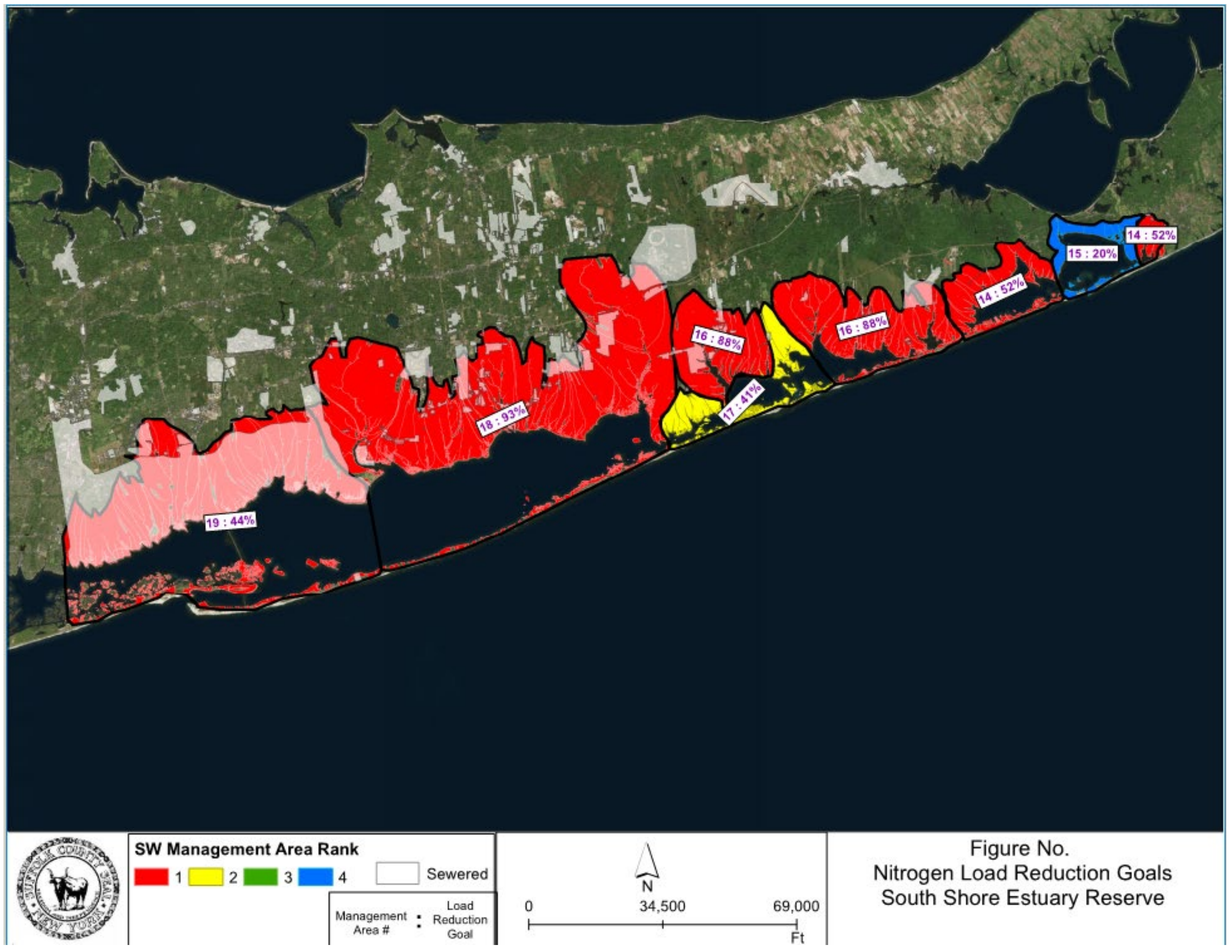


Figure 7-7 Priority Areas for Nitrogen Load Reduction

7.3.2.1 Wastewater Management Area 14 – Shinnecock Bay Restoration and Protection Area I

The Shinnecock Bay Restoration and Protection Area I Wastewater Management Area includes eight individual water bodies located within Shinnecock Bay of the SSER. Five of the water bodies are poorly characterized for water quality while the remaining three are well characterized. Wastewater Management Area 14 generally includes water bodies with the poorest water quality and highest sensitivity to nitrogen within Shinnecock Bay and its connected water bodies and includes five water bodies with an individual surface water rank of Priority Rank 1 and three with a Priority Rank of 2. Individual load reduction goals for ideal water quality range from 0 percent to 87 percent. It should be noted that the large range in load reduction goals is primarily due to the incorporation of Shinnecock Bay Central and "Penny Pond, Wells Smith and Gilbert Creeks," which have load reduction goals of three percent and 0 percent, respectively. Shinnecock Bay Central generally has good water quality for eastern sampling stations due to its proximity to the Shinnecock Inlet and poor water quality for western sampling stations and Penny Pond, Wells Smith and Gilbert Creeks are poorly characterized for water quality. Land use around the area includes a mix of low, medium, and high density residential, with the majority of parcels assigned as medium density residential. Water quality within Wastewater Management Area 14 water bodies is generally poor to fair and is characterized by the occurrence of frequent HABs, elevated chlorophyll-*a*, low dissolved oxygen and poor water clarity within the well characterized water bodies, with the exception of eastern Shinnecock Bay Central.

Combined, the wastewater management priority area rank is Priority Rank 1 with an overall ideal water quality goal of 52 percent.

7.3.2.2 Wastewater Management Area 15 – Shinnecock Bay Restoration and Protection Area II

The Shinnecock Bay Restoration and Protection Area II Wastewater Management Area includes five individual water bodies located within Eastern Shinnecock Bay. Three of the water bodies are poorly characterized for water quality while the remaining two are well characterized. Wastewater Management Area 15 generally receives the benefit of enhanced flushing through the close proximity to Shinnecock Inlet, which results in good water quality and moderate sensitivity to nitrogen. While the well characterized surface waters within this wastewater management area currently exhibit good water quality, select individual load reduction goals for many of the same waters are elevated, suggesting that these water bodies may be vulnerable to water quality degradation in the future. Three of the water bodies in this management area have an individual surface water priority rank of Priority Rank 4 and the remaining two have a priority rank of Priority Rank 3. Individual load reduction goals for ideal water quality range between 0 and 56 percent. Land use around the area is diverse and primarily includes a mix of low, medium, and high density residential with the majority of parcels assigned as medium density residential.

Combined, the wastewater management priority area rank is Priority Rank 4 with an overall ideal water quality goal of 20 percent.

7.3.2.3 Wastewater Management Area 16 Moriches Bay Restoration and Protection Area I

The Moriches Bay Restoration and Protection Area I Wastewater Management Area includes 15 individual water bodies located within Moriches Bay, Quantuck Bay, the Forge River, and their connecting water bodies of the SSER. Nine of the water bodies are poorly characterized for water quality while the remaining six are well characterized. Wastewater Management Area 16 generally includes water bodies with the poorest water quality and highest sensitivity to nitrogen within the Moriches Bay region and its connected water bodies and includes 11 water bodies with an individual surface water rank of Priority Rank 1 and four with an individual rank of Priority Rank 2. Individual load reduction goals for overall water quality range from 31 percent to 93 percent with the majority of the water bodies having a load reduction goal of greater than 80 percent. Land use around the area is intense and includes a mix of low, medium, and high density residential, along with agricultural use in select subwatersheds, with the majority of parcels assigned as medium density residential. With high predicted nitrogen loads combined with poor flushing due to the barrier beaches, water quality within Wastewater Management Area 16 water bodies is poor and is characterized by the occurrence of frequent HABs, elevated chlorophyll-*a*, low dissolved oxygen and poor water clarity within the well characterized water bodies.

Combined, the wastewater management priority area rank is Priority Rank 1 with an overall ideal water quality goal of 88 percent.

7.3.2.4 Wastewater Management Area 17 – Moriches Bay Restoration and Protection Area II

The Moriches Bay Restoration and Protection Area II Wastewater Management Area includes seven individual water bodies located within western Moriches Bay, Narrow Bay, and their connecting water bodies. Four of the water bodies are poorly characterized for water quality, while the remaining three are well characterized. Wastewater Management Area 17 generally receives the benefit of enhanced flushing through the close proximity to Moriches Inlet, which results in good water quality and moderate sensitivity to nitrogen. Because of the geometry associated with the contributing areas of subwatersheds adjacent to Narrow Bay, Narrow Bay's subwatershed generally receives a lower overall nitrogen load per unit volume than nearby water bodies resulting in a lower priority rank and load reduction goal (e.g., when compared to the unsewered areas of Great South Bay and Moriches Bay East). The majority of the water bodies in this management area have an individual surface water priority rank of Priority Rank 2 with one water body receiving Priority Rank 3 (Hart's Cove). Individual load reduction goals for ideal water quality range between 0 and 86 percent; however, the majority of the load reduction goals are 69 percent or lower. Land use around the area includes primarily a mix of low, medium, and high density residential with the majority of parcels assigned as medium density residential. In addition, there are agricultural land use parcels in Harts Cove.

Combined, the wastewater management priority area rank is Priority Rank 2 with an overall ideal water quality goal of 41 percent.

7.3.2.5 Wastewater Management Area 18 – Great South Bay Restoration Area I

The Great South Bay Restoration Area I Wastewater Management Area includes 22 individual water bodies located within and connected to the generally unsewered sections of Great South Bay. Sixteen of the water bodies are poorly characterized for water quality while the remaining six are well characterized. The poorly characterized water bodies generally represent the freshwater/tidal stream systems that drain into Great South Bay, while the well characterized water bodies represent the larger embayments. The water bodies within Wastewater Management Area 18 represent some of the most impacted surface waters in Suffolk County due to the intense unsewered residential land use combined with extremely poor flushing due to the presence of the barrier islands. Not surprisingly, all water bodies within this management area received individual surface water priority ranks of Priority Rank 1. Individual load reduction goals for ideal water quality range from 78 percent to 97 percent. Land use around the area is intense and includes a mix of primarily medium and high density residential. Water quality in Wastewater Management Area 18 is poor and is characterized by the occurrence of frequent HABs, elevated chlorophyll-*a*, low dissolved oxygen and poor water clarity within the well characterized water bodies.

Combined, the wastewater management priority area rank is Priority Rank 1 with an overall ideal water quality goal of 93 percent, which represents the highest overall regional load reduction goal in the County.

7.3.2.6 Wastewater Management Area 19 – Great South Bay Restoration Area II

The Great South Bay Restoration Area II Wastewater Management Area includes 16 individual water bodies located within and connected to the sewered sections of Great South Bay contributing area. Twelve of the water bodies are poorly characterized for water quality, while the remaining four are well characterized. The poorly characterized water bodies generally represent the freshwater/tidal stream systems that drain into Great South Bay while the well characterized water bodies represent the larger embayments. Wastewater Management Area 19 receives the benefit of the Southwest Sewer District [SWSD], which has resulted in incremental water quality benefits when compared to the unsewered sections of Great South Bay, and comparatively lower load reduction goals. However, the combination of legacy nitrogen (e.g., nitrogen that continues to seep into the Bay from groundwater that is older than the SWSD), nitrogen contributions from unsewered areas north of the SWSD, poor flushing associated with the barrier islands, and mixing of nitrogen from the unsewered eastern Great South Bay, continue to result in overall poor water quality within this management area. All water bodies in this management area have an individual priority rank of Priority Rank 1. Individual load reduction goals for overall water quality range between 0 and 86 percent; however, it should be noted that the load reduction goal range for ideal water quality for the well characterized embayments is from 39 to 53 percent. Land use around the area is intense and includes a mix of primarily medium and high density residential. While water quality in the sewered portions of Great South Bay show incremental benefits when compared to the unsewered areas, water quality in Wastewater Management Area 19 is still considered poor and is characterized by the occurrence of frequent HABs, elevated chlorophyll-*a*, low dissolved oxygen and poor water clarity within the well characterized water bodies.

Combined, the wastewater management priority area rank is Priority Rank 1 with an overall ideal water quality goal of 44 percent.

Table 7-7 shows that only Wastewater Management Areas 15 and 17 would achieve both the HAB/DO water quality goals and the overall water quality goals with centralized sewering and I/A OWTS implementation; additional nitrogen load reductions achievable from wastewater management in these areas will be provided by SWP implementation. I/A OWTS installations throughout Wastewater Management Areas 14 and 19 will reduce nitrogen loading sufficiently to achieve the HAB/DO water quality goals. SWP implementation in Wastewater Management Areas 16 and 18 will support continued progress towards achievement of water quality improvement.

7.4 South Shore Estuary Watershed Wastewater Planning

The following subsections provides recommendations for wastewater management planning specific to the South Shore Estuary subwatersheds.

7.4.1 Overall Wastewater Management Strategy

As described in Section 4.4, the recommended wastewater management program includes four phases. While the primary means of wastewater management will focus on the use of I/A OWTS, sewering and clustering are also important elements of the overall wastewater management strategy. During the Phase I ramp-up period from 2019 to 2023, I/A OWTS installations will continue to be implemented based on voluntary upgrades at a Countywide rate of 1,000 per year; this will include I/A OWTS installations in the South Shore Estuary watershed. I/A OWTS will be installed at all parcels within the 0 to 2-year groundwater contributing area to the Estuary and its subwatersheds and within the Phase II Wastewater Management Areas including Wastewater Management Area 14 – Shinnecock Bay Restoration and Protection Area I, Wastewater Management Area 16 - Moriches Bay Restoration and Protection Area I, Wastewater Management Area 18 – Great South Bay Restoration Area I and Wastewater Management Area 19 – Great South Bay Restoration Area II from 2024 to 2054.

Figures 7-8, 7-9 and **7-10** summarize the number of I/A OWTS installations per SWP implementation phase and the number of pounds of nitrogen reduced per SWP phase and the cost per phase, respectively. This information is also provided in **Table 7-8**.

Table 7-8 Nitrogen Load Reduction Provided by I/A OWTS Implementation in South Shore Estuary Subwatersheds

Area	Parcels Implementing I/A OWTS	Nitrogen Removed Daily (pounds)	Cost ($)
0 to 2-year Contributing Area	25,335	1,089	$615,916,098
Phase II Area (includes 0 to 2-year contributing area)	88,911	4,247	$1,948,000,000
Phase III Area	5,348	263	$127,421,000
Total	94,259	4,510	$2,075,421,000

The vast majority of the South Shore Estuary subwatersheds are located within the Phase II area. Almost 89,000 I/A OWTS would be installed during Phase II in the densely developed South Shore Estuary watershed including over 25,000 parcels located within the 0 to 2-year groundwater contributing area. The nitrogen load to the South Shore Estuary watershed will be reduced by over 4,200 pounds per day when Phase II is completed, including almost 1,089 pounds per day from the 0 to 2-year groundwater contributing area.

During Phase III, I/A OWTS will be installed on the remaining 5,348 priority parcels, removing an additional 263 pounds per day.

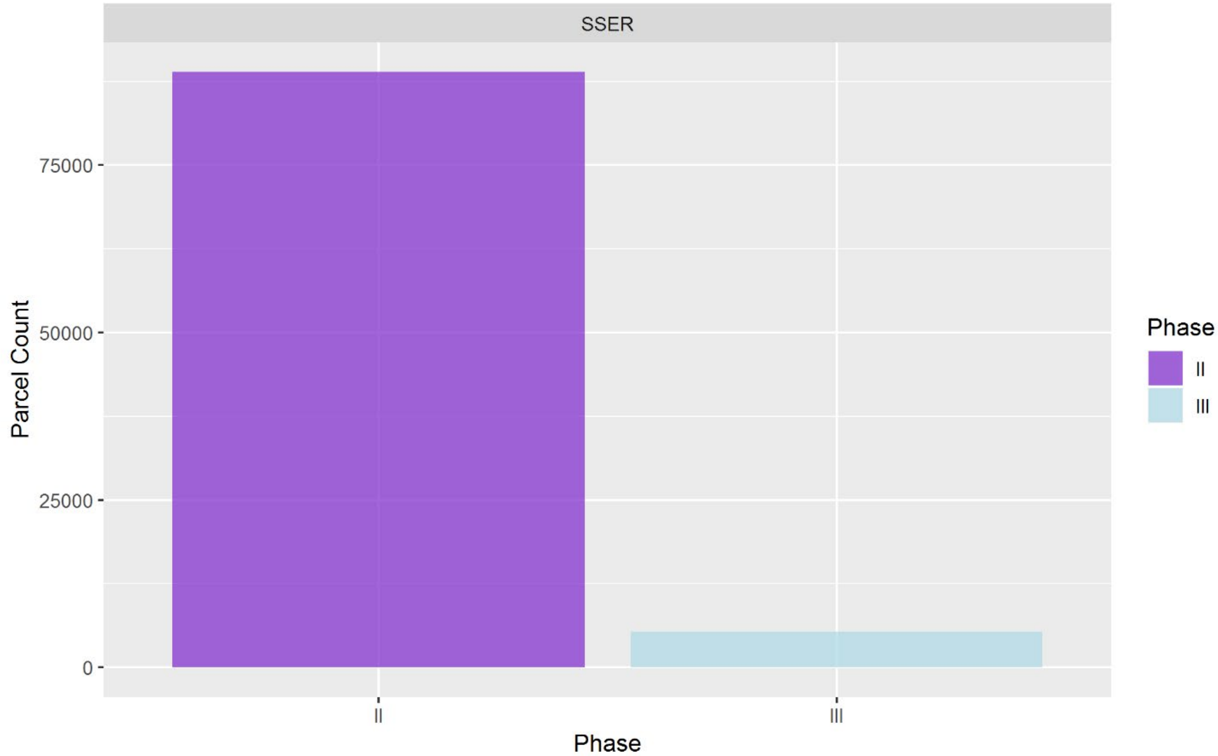


Figure 7-8 Number of I/A OWTS Installed in the South Shore Estuary Watershed by Phase

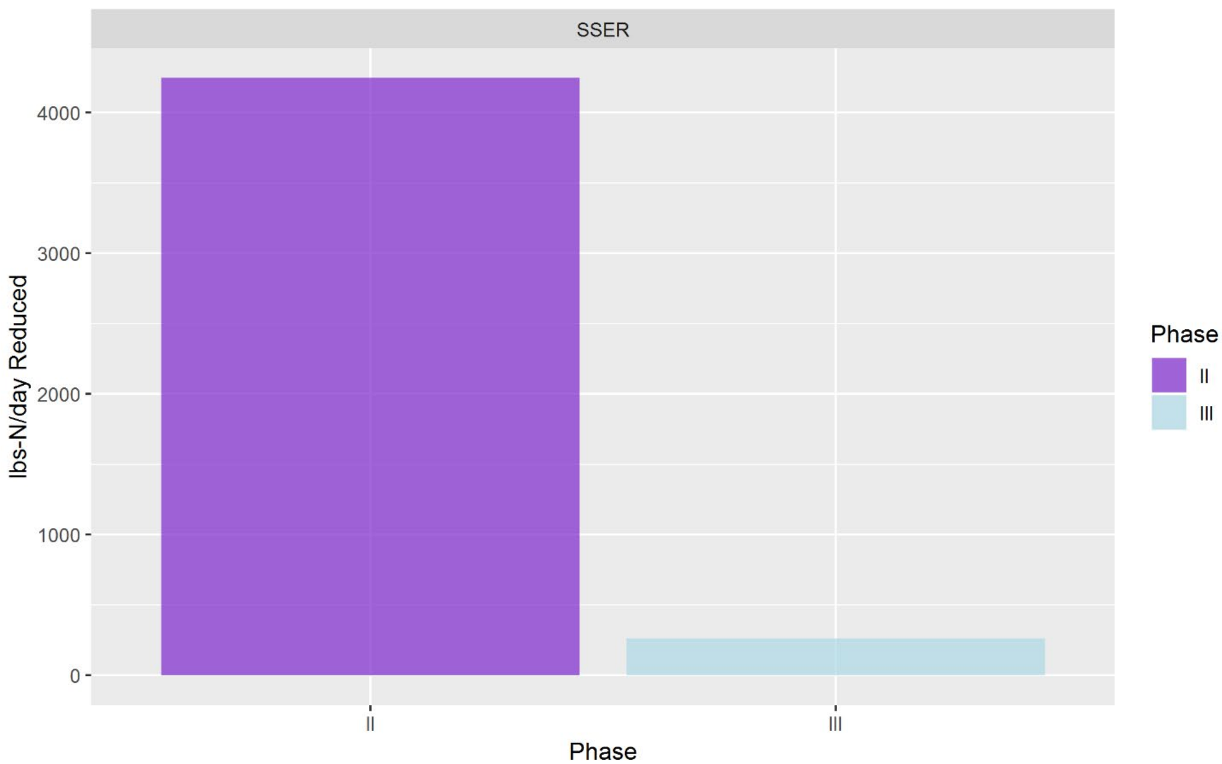


Figure 7-9 Pounds of Nitrogen Removed by I/A OWTS Installation in the South Shore Estuary Watershed by Phase

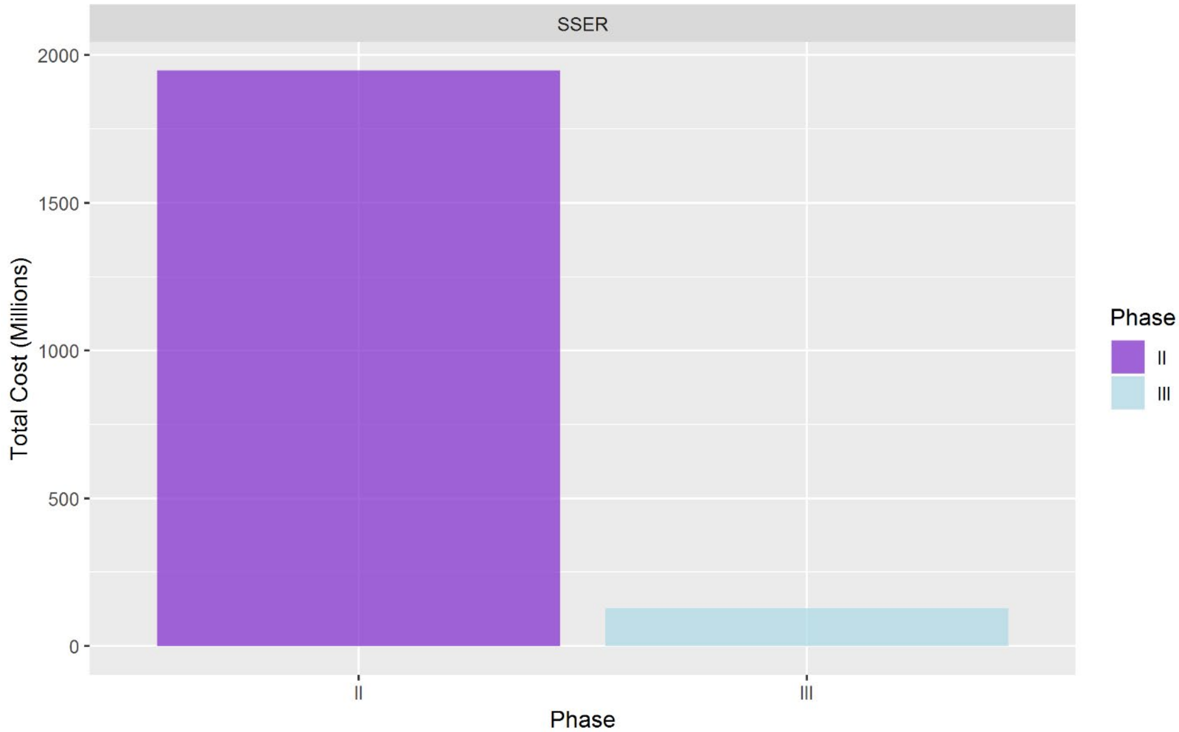


Figure 7-10 Estimated I/A OWTS Implementation Cost in the South Shore Estuary Watershed by SWP Phase

7.4.2 Sewering/Clustering Recommendations for the South Shore Estuary Reserve Watershed

The following subsections provide initial recommendations for sewering and clustering for the South Shore Estuary Reserve subwatersheds. Recommendations were generated using the three-step approach documented in Section 4.5 which included:

- Inventory of existing sewering proposals in Suffolk County and documentation of current status;
- A parcel-specific scoring analysis, referred to as the "Wastewater Management Response Evaluation," to identify parcels where sewering and/or clustering may represent the preferred means of wastewater management; and,
- Development of three sewer implementation scenarios based upon a range of potential funding availability and the findings of Steps 1 and 2 above.

Individual sewer and clustering projects would require project-specific Feasibility Study to develop cost estimates and assess overall project feasibility. In addition, project-specific SEQRA evaluations would be required to assess and mitigate project-specific environmental concerns. Finally, it should be noted that the evaluation and findings presented herein are intended to be an initial planning tool to support recommendations for stable recurring revenue source needs and present initial findings regarding areas that may benefit from sewering or clustering. The findings are not intended to be binding in any way.

7.4.2.1 Inventory of Existing Sewer Proposals in the South Shore Estuary Reserve Watershed

Review of the inventory and status table of all known existing County, Town, and Village sewer proposals identified 14 existing sewer expansion proposals located in the South Shore Estuary Reserve watershed that have not been deemed infeasible through existing Feasibility Study including:

- Carlls River Expansion: funded portions including West Babylon, Wyandanch, North Babylon;
- Forge River Watershed Sewer District Phases I & II (Mastic/Shirley;
- Patchogue / Patchogue River Expansion Project (Patchogue);
- Sayville Extension: funded portions including Oakdale Phase 1a / Connetquot River (Oakdale);
- Carlls River Expansion: unfunded portions including areas in West Islip, North Babylon, West Babylon, Deer Park, and Wyandanch;
- Forge River Watershed Sewer District Phases III & IV (Mastic/Mastic Beach);
- Sayville Extension: unfunded portions including Oakdale, W. Sayville, Sayville, and Bayport;
- Bellport Village/N. Bellport;
- MacArthur Industrial Sewer District;
- Westhampton Downtown - Village of Westhampton Beach (Phase 1 of 4);
- Wyandanch Commercial District Expansion - Town of Babylon;
- Patchogue Expansion - Village of Patchogue; and,
- Southampton Downtown - Village of Southampton

A summary of the proposals for County led proposals is provided in **Table 4-6** located in Section 4.5. A summary of Town/Village led proposals is provided in **Table 4-7** located in Section 4.5. A map showing the location of all sewer proposals and estimated District boundaries is provided below on **Figure 7-11**. Please note that for the purposes of this evaluation, projects that were deemed infeasible through feasibility study or projects that were identified as having no plan to move forward by Towns/Villages were omitted from the map.

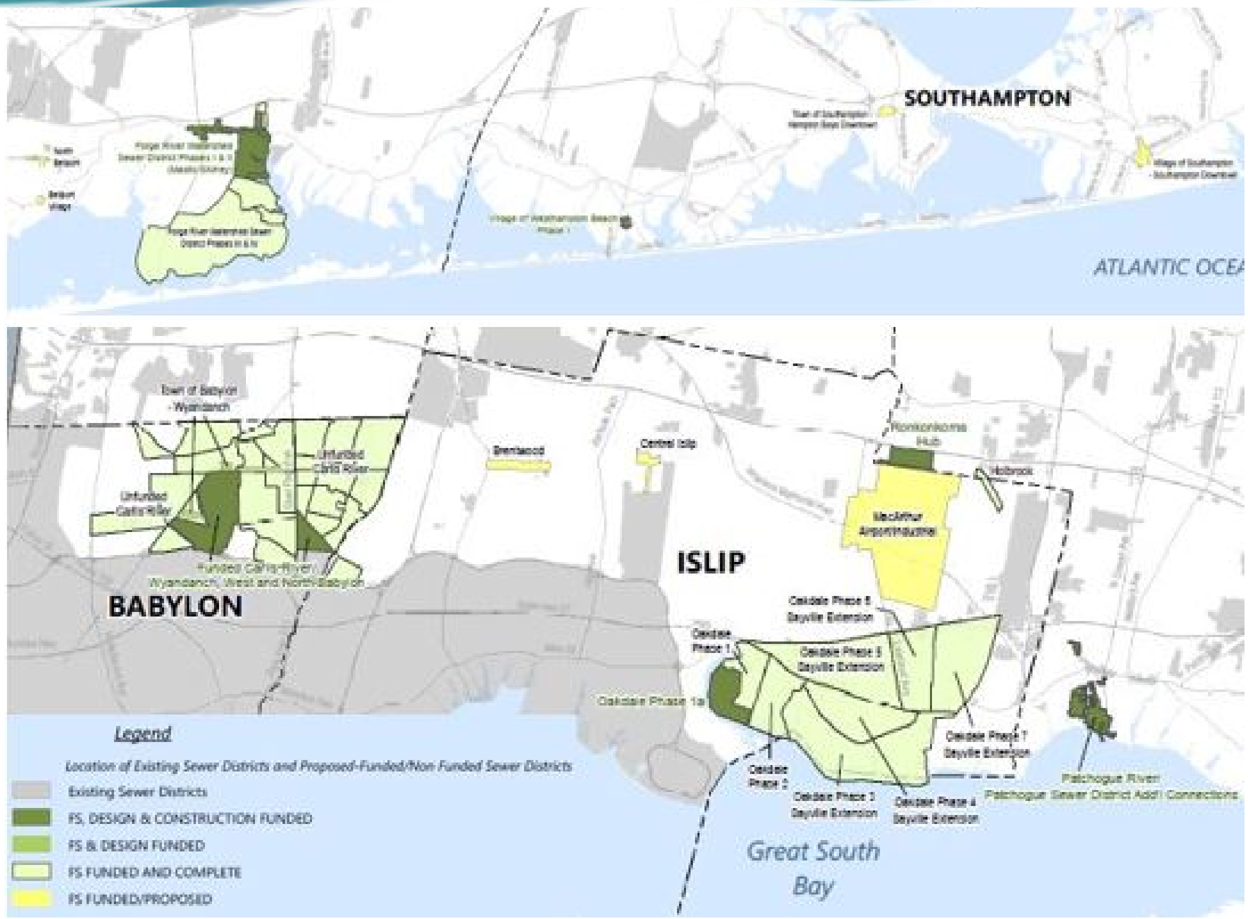


Figure 7-11 Location of Existing Sewer Proposals for South Shore Estuary Reserve

7.4.2.2 Wastewater Management Response Evaluation Findings for the South Shore Estuary Reserve

To provide an initial planning tool that identifies parcels that might benefit from sewering or clustering, the Suffolk County Department of Economic Planning and Development completed a geospatial, parcel-specific scoring analysis that expanded upon the methodology used by the Maryland Department of Environment for the Chesapeake Bay Program (TetraTech, 2011). While clustering was not explicitly evaluated during this analysis, parcels recommended for sewering through the scoring analysis that are not within close proximity to an existing common collection system; or, are in proximity to an existing STP with no expansion capacity, should be considered as clustering candidates if a suitable lot is identified for siting of the clustered treatment system.

A summary of the scoring analysis criteria, methodology, and results are summarized in Section 4.5 of this SC SWP. An example of the output for the South Shore Estuary Reserve watershed region is provided below on **Figure 7-12**.

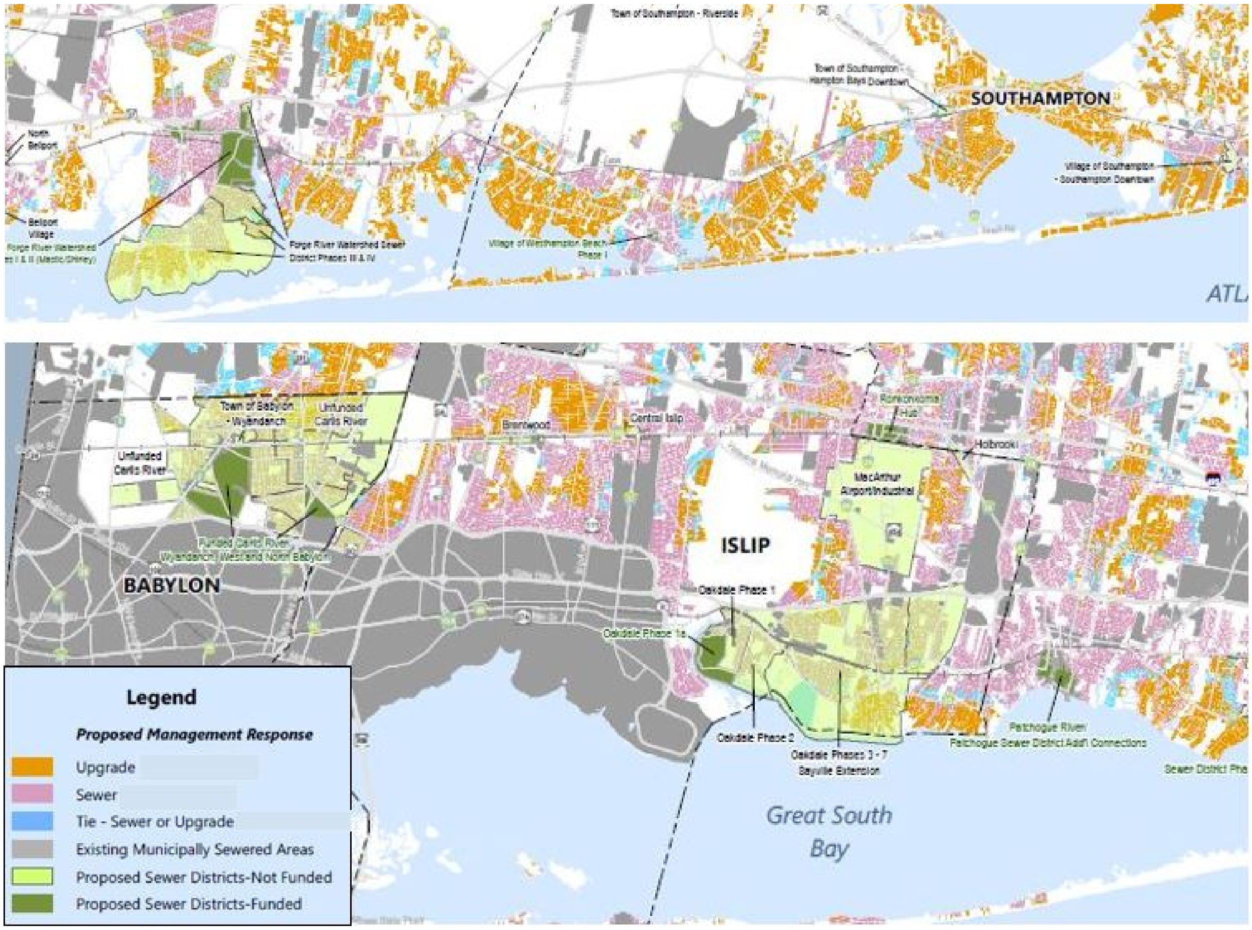


Figure 7-12 Wastewater Management Response Evaluation Map Output for South Shore Estuary Reserve

As shown on **Figure 7-12**, contrary to the findings for the other two major estuary watersheds, the majority of the parcels in the South Shore Estuary Reserve watershed scored in favor of sewering, particularly for western Suffolk County. These findings are not unfounded as the many water bodies in the South Shore Estuary Reserve are surrounded by medium to high density residential development and have poor flushing due to the presence of the barrier islands. Combined, these factors have resulted in most water bodies being ranked as ecological Priority Rank 1 with extremely high load reduction goals. Water bodies in the eastern South Shore Estuary Reserve that are surrounded with less intense development and have flushing benefit from nearby inlets generally scored in favor of I/A OWTS.

It should be reiterated that the intent of the Wastewater Management Response Evaluation is to serve as an initial planning tool for the development of initial recommendations pertaining to wastewater management methods in Suffolk County. As discussed previously within this SWP, individual sewer and clustering projects would require project-specific Feasibility Study to develop cost estimates and assess overall project feasibility. In addition, project-specific SEQRA evaluations would be required to assess and mitigate project-specific environmental concerns.

7.4.2.3 Sewer Implementation Scenario Findings for South Shore Estuary Reserve Sewer Proposals

The final step completed under the sewering evaluation was to develop and evaluate a range of possible sewer expansion scenarios that built upon the existing sewer proposal inventory table and considered potential revenue streams, relative geographic priority rank as identified in the SWP priority areas, and the results of the parcel-specific sewer scoring analysis. The analysis incorporated existing sewer proposals identified in the sewer project inventory table that have already been deemed feasible through project-specific feasibility and which the project sponsor/lead is actively pursuing. These projects include all medium to light green shaded projects on **Tables 4-6** and **4-7** located in Section 4.5 (note that dark green projects on these tables are excluded from the analysis since they already have construction funding identified and are anticipated to move forward). Projects with incomplete or draft feasibility study, or projects where the project sponsor/lead is no longer interested in pursuing the project, were omitted from the analysis. These projects include all yellow and red shaded projects on **Tables 4-6** and **4-7** located in Section 4.5. The analysis then evaluated three possible sewer expansion scenarios that were built upon a range of estimated revenue streams. Scenario 1 represented the lowest revenue assumption for the stable and recurring revenue source of $75 million dollars per year and Scenario 3 represents the highest revenue assumption of $93.7 million dollars per year. In addition, the analysis assumed that sewer expansion projects would be implemented through five, 10-year projects, which would be constructed over a period of 50 years. Each 10-year project would include the construction of several sewer expansion proposals simultaneously. Finally, it should be noted that three of the proposed projects located in the South Shore Estuary Reserve watershed were considered "large projects" that were further divided into smaller project sub-phases for the purposes of the scenario evaluations. These include the Forge River Phases III and IV, the Sayville Extension, and the Carll's River Extension. In general, sub-phase implementation preference was given for areas located within highest priority areas of the SWP.

A detailed summary of the evaluation methodology and its findings is presented in Section 4.5 of the SWP. A summary of the sewer implementation scenario findings for the South Shore Estuary Reserve watershed is included below in **Table 7-9**.

As shown in **Table 7-9**, the results of the sewer implementation scenario evaluation were generally as expected: an increase in the annual funding available through the stable and recurring revenue source increases the total number of projects that can be executed and accelerates the start date of many of the projects. Under Scenario 1, the scenario evaluation findings indicate that at an assumed stable and recurring revenue source of $75 million dollars per year, insufficient funding would be available for an estimated 13 proposed sewer projects. Under Scenario 3, all South Shore Estuary Reserve sewer proposals can be implemented, and at an accelerated timeframe, when compared to Scenario 1. The results of the sewering evaluation underscore the obvious conclusion: more funding available to offset the cost of individual projects results in more projects being completed and at an accelerated timeframe. It should be reiterated that the sewer evaluation was completed as an initial planning study and that the priority implementation order of individual projects was assumed for the sole purposes of this initial analysis.

Table 7-9 Summary of Sewer Implementation Scenario Evaluation Findings for the South Shore Estuary

	Scenario 1	Scenario 2	Scenario 3
Target Implementation Times	Projects that can be completed	Projects that can be completed	Projects that can be completed
2024 - 2033	Carlls River 108-1 Carlls River 108-2	Carlls River 108-1 Carlls River 108-2	Carlls River 108-1 Carlls River 108-2 Sayville Extension – Phase 1b Sayville Extension – Phase 2 Carlls River 110-1 Wyandanch – Town of Babylon*
2034 - 2043	Sayville Extension – Phase 1b Sayville Extension – Phase 2	Sayville Extension – Phase 1b Sayville Extension – Phase 2 Forge River - Phase 3 Carlls River 110-1 Wyandanch – Town of Babylon* Patchogue Expansion – Village of Patchogue*	Forge River - Phase 3 Carlls River 108-3 Sayville Extension – Phase 3
2044 - 2053	Forge River - Phase 3 Carlls River 110-1 Wyandanch – Town of Babylon*	Sayville Extension – Phase 3 Carlls River 110-4 Sayville Extension – Phase 4	Carlls River 110-4 Sayville Extension – Phase 4 Patchogue Expansion – Village of Patchogue* Sayville Extension – Phase 7
2054-2063	Carlls River 108-3 Sayville Extension – Phase 3 Carlls River 110-4 Sayville Extension – Phase 4 Patchogue Expansion – Village of Patchogue *	Carlls River 108-3 Forge River – Phase 4	Forge River – Phase 4 Sayville Extension – Phase 5
2064-2073	Sayville Extension – Phase 7 Carlls River – 108-4 Carlls River - 110-5 Carlls River - 110-6 Carlls River - 110-7 Carlls River - 110-8 Carlls River – 108-15 Carlls River – 108-16 Carlls River – 110-9 Carlls River – 107-1 Carlls River - 108-9 Sayville Extension – Phase 5	Sayville Extension – Phase 7 Carlls River – 108-4 Carlls River - 110-5 Carlls River - 110-6 Carlls River - 110-7 Carlls River - 110-8 Carlls River – 108-15 Carlls River – 108-16 Carlls River – 110-9 Sayville Extension – Phase 5 Sayville Extension – Phase 6 Carlls River – 107-1 Carlls River - 108-9 Carlls River 108-12 Carlls River 108-5 Carlls River 108-6 Carlls River 108-7 Carlls River 110-3 Carlls River 110-10 Carlls River 110-11	Sayville Extension – Phase 6 Carlls River – 108-4 Carlls River - 110-5 Carlls River - 110-6 Carlls River - 110-7 Carlls River - 110-8 Carlls River – 108-15 Carlls River – 108-16 Carlls River – 110-9 Carlls River – 107-1 Carlls River - 108-9 Carlls River 108-12 Carlls River 108-5 Carlls River 108-6 Carlls River 108-7 Carlls River 110-3 Carlls River 110-10 Carlls River 110-11 Carlls River 108-10 Carlls River 107-2 Carlls River 108-13 Carlls River 108-14
Remaining Projects; Insufficient Financing Available	Forge River – Phase 4 Sayville Extension – Phase 6 Carlls River 108-12 Carlls River 108-5 Carlls River 108-6 Carlls River 108-7 Carlls River 110-3 Carlls River 110-10 Carlls River 110-11 Carlls River 108-10 Carlls River 107-2 Carlls River 108-13 Carlls River 108-14	Carlls River 108-10 Carlls River 107-2 Carlls River 108-13 Carlls River 108-14	None

7.4.2.4 Preliminary Identification of Other Areas for Sewer Expansion or Clustering in the South Shore Estuary Reserve Watershed

The previous evaluations focused on presenting potential sewer implementation scenarios using existing sewering proposals and an assumed range of revenue sources. While this represents a logical first step, the initial evaluations completed within this SWP can also be used to identify locations where new sewer expansion projects might be beneficial beyond those already proposed and inventoried herein. A summary of additional areas that might benefit from sewer expansion, new STPs, or clustering in the South Shore Estuary Reserve watershed is provided below.

7.4.2.4.1 Potential Sewer Expansion Locations

The following areas were preliminarily identified as possibly benefitting from additional sewer expansion beyond the projects already presented within this SWP:

- Residential neighborhoods located east of the proposed Sayville Extension project including the hamlets of Bayport, Bluepoint, and Patchogue. As shown on **Figure 7-12**, these parcels scored in favor of sewering due to their proximity to existing sewer districts and their ecological rank of Priority Rank 1. In addition, the unsewered portions of the Great South Bay have some of the highest load reduction goals in Suffolk County and require nitrogen load reductions above the reduction that could be achieved through the use of I/A OWTS alone.

- Residential neighborhoods located west of Forge River Phase I and II. These neighborhoods appear to contribute groundwater to either the Forge River or to Great South Bay, East and could potentially benefit from sewering given their proximity to the pending Forge River sewer project. Both of these water bodies have been identified as Priority Rank 1, have some of the highest load reduction goals in Suffolk County, and have been identified as requiring nitrogen load reductions above the reduction that could be achieved through the use of I/A OWTS alone and the existing Forge River Phase I and II sewer projects.

- Finally, **Figure 7-12** shows various residential neighborhoods that are not situated directly adjacent to an existing sewer district but scored in favor of sewering as part of this preliminary scoring exercise. These parcels would have scored in favor of sewering due to a combination of small lot size, high ecological priority rank, and/or vulnerability to sea level rise. These parcels could potentially benefit from small clustered systems and/or connection to a new STP.

It should be noted that all of the areas identified above are solely for preliminary screening and discussion purposes only. The viability of each area to connect to existing or new sewer districts and/or use clustering will vary significantly based upon a variety of known and unknown factors including available capacity at adjacent sewer districts (both hydraulically and for compliance with mass loading restrictions per existing TMDL[s]). Ultimately, each area would require project-specific feasibility study to determine implementability, cost feasibility, and overall viability as a wastewater management option.

7.4.3 Environmental Benefits

Implementation of I/A OWTS throughout the six South Shore Estuary Wastewater Management Areas will result in significant progress towards achievement of overall nitrogen load reduction goals as shown on **Figures 7-13** and **7-14. Figure 7-13** shows that I/A OWTS implementation will be successful in reducing the unit nitrogen load * residence time to the same unit nitrogen load * residence time that characterizes the water bodies meeting the HAB/DO targets for four of the South Shore Estuary Wastewater Management Areas. While significant progress in water quality improvement will be provided for Wastewater Management Areas 16 and 18, additional nitrogen load reductions would be required to achieve the desired endpoints. **Figure 7-14** shows that for two of the six South Shore Estuary wastewater management areas, I/A OWTS implementation will be successful in achieving the same unit nitrogen load * residence time as was described in Section 2.1.9 for the reference water bodies that completely achieve water quality goals.

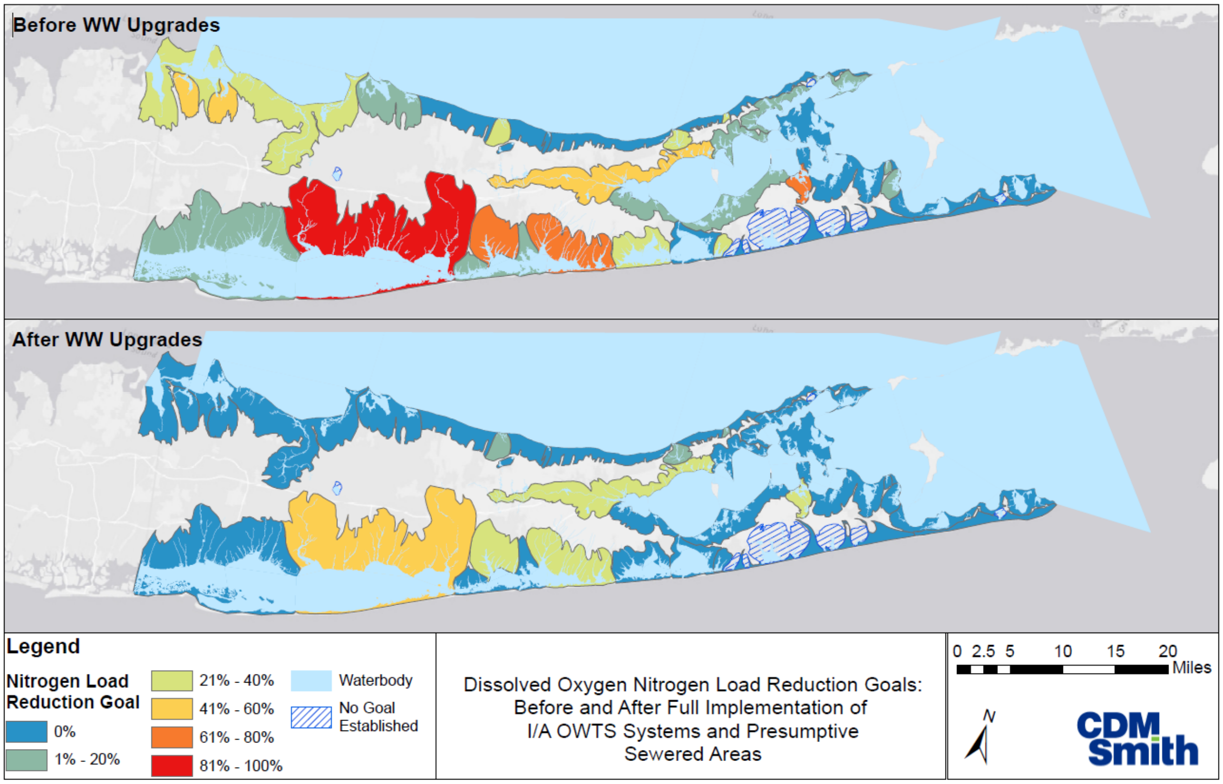
7.4.4 Water Bodies Requiring Additional Nitrogen Load Reduction

Only 35 percent of the overall nitrogen load reduction goal for Wastewater Management Area 13 Shinnecock Bay Restoration and Protection Area I, 50 percent of the overall nitrogen load reduction goal for Wastewater Management Area 18 Great South Bay Restoration Area II, 56 percent of the nitrogen load reduction goal for Wastewater Management Area 19 – Great South Bay Restoration Area II and 69 percent of the nitrogen load reduction goal for Wastewater Management Area 14 Shinnecock Bay Restoration and Protection Area II will be achieved as shown by **Figure 7-15**. Additional nitrogen load reductions will be needed in these areas.

However, 100 percent of the overall water quality nitrogen load reduction goal will be achieved for Wastewater Management Area 15 Moriches Bay Restoration Area I and Wastewater Management Area 17, Great South Bay Restoration Area I, providing substantial anticipated water quality improvement and/or protection to these areas which include 27 of the South Shore Estuary subwatersheds.

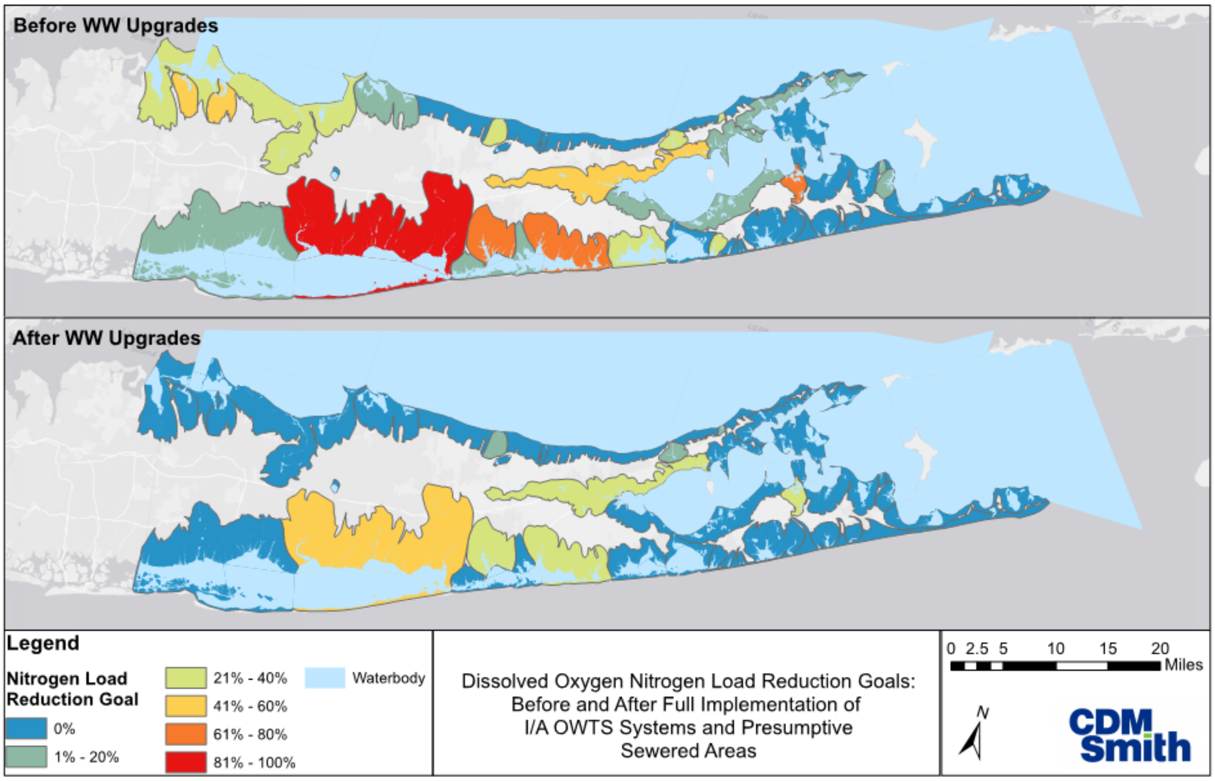
While significant water quality benefits are anticipated to result from wastewater management in the South Shore Estuary Reserve watershed, based on the reference water body approach, additional nitrogen load reductions would be required to achieve ideal water quality in many of the subwatersheds. **Table 7-10** identifies the 57 subwatersheds where additional nitrogen load reductions would be required. Water quality in 39 of the water bodies were not well characterized; additional characterization would help to refine the nitrogen load reductions required.

This SWP is one aspect of a Countywide program to reduce the total nitrogen mass load to groundwater and surface water within the County. Suffolk County remains dedicated to tracking the implementation of the program and to working with local jurisdictions and continuing coordination with related programs (e.g., estuary programs, LINAP, LICAP, Towns, Villages) to ensure the Countywide implementation strategy addressing nitrogen sources is advanced. As part of the adaptive management plant described in Section 8.4.11, other nitrogen removal or mitigation alternatives including sewering targeted areas, addition of pressurized shallow drainfields, hydromodification, nutrient bioextraction, permeable reactive barriers and/or fertilizer management can be studied and considered further.



Note: The upper panel in the figure shows the nitrogen load reductions required to achieve the same unit nitrogen load observed in Suffolk County waters with no hypoxic or HAB events. The lower panel shows the much lower nitrogen load reductions required to achieve the unit nitrogen loads after SWP implementation.

Figure 7-13 Progress Towards Achievement of Unit Nitrogen Loads Consistent with Water Bodies that Have Experienced No Dissolved Oxygen Hypoxic Events and No HAB Events in the Past 10 Years



Note: The upper panel in the figure shows the nitrogen load reductions required to achieve the same unit nitrogen load observed in Suffolk County waters exhibiting ideal water quality. The lower panel shows the much lower nitrogen load reductions required to achieve the unit nitrogen loads after SWP implementation.

Figure 7-14 Dissolved Oxygen Nitrogen Load Reduction Goals Attained by SWP Implementation

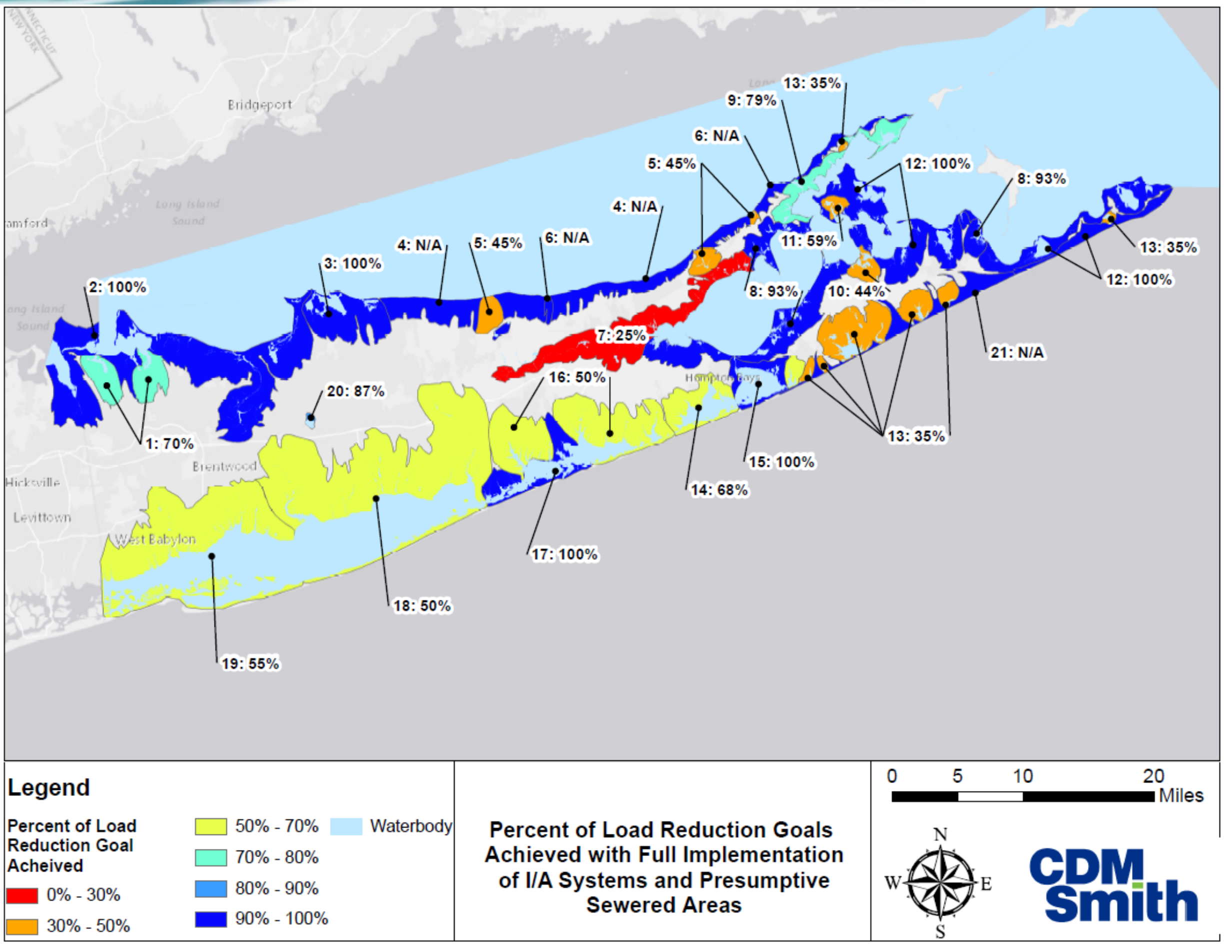


Figure 7-15 Overall Nitrogen Load Reduction Goals Attained by SWP Implementation

Table 7-10 South Shore Estuary Water Bodies Requiring Additional Nitrogen Load Reduction to Achieve Overall Water Quality Goals

	Management Area Name	Individual Water Bodies in Management Area	Individual Water Body Overall Water Quality Improvement Goal	Achievable Reduction through On-Site Wastewater Management
13	Shinnecock Bay Restoration and Protection Area I	**Shinnecock Bay West**	**71%**	**41%**
		Tiana Bay and Tidal Tribs	68%	50%
		Weesuck Creek and Tidal tribs	72%	39%
		Phillips Creek, Lower, and Tidal Tribs	80%	46%
		Heady and Taylor Creeks	87%	45%
14	Shinnecock Bay Restoration and Protection Area II	Old Fort Pond	56%	51%
15	Moriches Bay Restoration Area I	**Moriches Bay East**	**79%**	**43%**

	Management Area Name	Individual Water Bodies in Management Area	Individual Water Body Overall Water Quality Improvement Goal	Achievable Reduction through On-Site Wastewater Management
		Beaverdam Pond	89%	46%
		Speonk River	88%	48%
		Seatuck Cove and Tidal Tribs	**86%**	**39%**
		Terrell River	72%	40%
		Mud and Senix Creeks	89%	55%
		Orchard Neck Creek	92%	54%
		Forge River and Tidal Tribs	**93%**	**54%**
		Forge River Cove and Tidal Tribs	**69%**	**43%**
		Quantuck Canal/Moneybogue Bay	**91%**	**52%**
		Quantuck Bay	**93%**	**43%**
		Quantuck Creek and Old Ice Pond	80%	40%
		Aspatuck Creek and River	80%	52%
		Quogue Canal	93%	44%
16	Moriches Bay Restoration Area II	**Moriches Bay West**	**37%**	**9%**
		Narrow Bay	**69%**	**49%**
		Pattersquash Creek	82%	59%
17	Great South Bay Restoration Area I	**Great South Bay, East**	**95%**	**31%**
		Bellport Bay	**89%**	**44%**
		Beaverdam Creek	91%	51%
		Carmans River Lower, and Tribs	**95%**	**39%**
		Carmans River Upper, and Tribs	55%	39%
		Howell's Creek	87%	52%
		Dunton Lake, Upper, and Tribs and Hedges Creek	94%	57%
		Abets Creek	91%	53%
		Mud Creek, Robinson Pond, and Tidal Tribs	87%	48%
		Swan River, Swan Lake, and Tidal Tribs	96%	55%
		Patchogue River	93%	54%
		Patchogue Bay	**91%**	**43%**
		Tuthills Creek	94%	52%
		Corey Lake and Creek, and Tribs	92%	52%
		Stillman Creek	97%	56%
		Brown Creek	96%	57%
		Green Creek, Upper, and Tribs	94%	57%

	Management Area Name	Individual Water Bodies in Management Area	Individual Water Body Overall Water Quality Improvement Goal	Achievable Reduction through On-Site Wastewater Management
		Nicoll Bay	**92%**	**50%**
		Connetquot River, Lower, and Tribs	**92%**	**45%**
		Grand Canal	86%	54%
		Connetquot River, Upper, and Tribs	78%	53%
18	Great South Bay Restoration Area II	**Great South Bay, Middle**	**53%**	**6%**
		Great Cove	**42%**	**8%**
		Champlin Creek	86%	29%
		Pardees, Orowoc Lakes, Creek, and Tidal Tribs	83%	43%
		Awixa Creek	79%	32%
		Penataquit Creek	83%	36%
		Lawrence Creek, O-co-nee and Lawrence Lakes	51%	15%
		Brightwaters Canal, Nosreka, Mirror, and Cascade Lakes	59%	16%
		Carlls River	86%	52%
		Sampawams Creek	80%	44%
		Great South Bay, West	**39%**	**6%**
		Santapogue Creek	56%	10%
		Neguntatogue Creek	19%	11%

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Section 7 Tables

Table 7-1 Subwatersheds Contributing to the South Shore Estuary Reserve Area

South Shore Estuary Reserve Subwatersheds	SWP PWL Number
Abets Creek	1701-0327-AC
Amityville Creek	1701-0087+0372
Aspatuck Creek and River	1701-0303-AC
Awixa Creek	1701-0093+0338
Beaverdam Creek	1701-0324+0104
Beaverdam Pond	1701-0307+0306
Bellport Bay	1701-0320+0325
Belmont Lake	1701-0021+0089
Brightwaters Canal	1701-0338-BC+0342
Brown Creek	1701-0097+0333
Carlls River	1701-0089+0346+0345+0344+0372
Carmans River Lower, and Tribs	1701-0321-rev
Carmans River Upper, and Tribs	1701-0102-rev+0322+0323
Champlin Creek	1701-0019+0338+0340
Connetquot River, Lower, and Tribs	1701-0337
Connetquot River, Upper, and Tribs	1701-0095+0339
Corey Lake and Creek, and Tribs	1701-0329+0327-CL
Dunton Lake, Upper, and Tribs	1701-0330-HC+0327
Far Pond	1701-0295-FP
Forge River and Tidal Tribs	1701-0316-FR+0312+0026
Forge River Cove and Tidal Tribs	1701-0316-FRC+0312
Grand Canal	1701-0337-GC
Great Cove	1701-0376+0338
Great South Bay, East	1701-0039-rev+0333
Great South Bay, Middle	1701-0040-rev
Great South Bay, West	1701-0173+0372
Green Creek, Upper, and Tribs	1701-0096+0333
Halsey Neck Pond	1701-0355
Harts Cove	1701-0309-HC
Heady and Taylor Creeks and Tribs	1701-0294
Howell's Creek	1701-0327-HC
Lawrence Creek/Lakes, O-co-nee	1701-0338-LC
Middle Pond	1701-0295-MP
Moriches Bay East	1701-0305-rev+0306
Moriches Bay West	1701-0038-rev
Mud and Senix Creeks	1701-0312-MSC
Mud Creek, Robinson Pond, and Tribs	1701-0101+0331+0327
Narrow Bay	1701-0318+0319
Neguntatogue Creek	1701-0088+0372
Nicoll Bay	1701-0375+0333
Ogden Pond	1701-0302

Table 7-1 Subwatersheds Contributing to the South Shore Estuary Reserve Area

South Shore Estuary Reserve Subwatersheds	SWP PWL Number
Old Fort Pond	1701-0295-OFP
Orchard Neck Creek	1701-0312-ONC
Pardees, Orowoc Lakes, Creek, & Tribs	1701-0094+0341+0338
Patchogue Bay	1701-0326
Patchogue River	1701-0099+0018+0055+0327
Pattersquash Creek	1701-0319-PC
Penataquit Creek	1701-0092+0338
Penniman Creek and Tidal Tribs	1701-0300
Penny Pond, Wells, Smith, and Gilbert Creeks	1701-0298-rev+0033
Phillips Creek, Lower, and Tidal Tribs	1701-0299
Quantuck Bay	1701-0042+0303
Quantuck Canal/Moneybogue Bay	1701-0371
Quantuck Creek and Old Ice Pond	1701-0303-QC+0304
Quogue Canal	1701-0301
Sampawams Creek	1701-0090+0372+0343
Sans Souci Lakes	1701-0336+0335
Santapogue Creek	1701-0016+0372
Seatuck Cove and Tidal Tribs	1701-0309-SC+0306+0311
Sheepen Creek	1701-0319-SC
Shinnecock Bay - Bennet Cove (Cormorant Cove)	1701-0033-BC+0252+0296
Shinnecock Bay Central	1701-0033-C
Shinnecock Bay East	1701-0033-E
Shinnecock Bay West	1701-0033-W
Speonk River	1701-0306-SR
Stillman Creek	1701-0329-SC
Swan River, Swan Lake, and Tidal Tribs	1701-0100+0332+0329+0327
Terrell River	1701-0103+0313+0314
Tiana Bay and Tidal Tribs	1701-0112
Tuthill Cove	1701-0309-TC
Tuthills Creek	1701-0098+0327+0329+0334
Unchachogue/Johns Neck Creeks	1701-0319-UC
Weesuck Creek and Tidal Tribs	1701-0111-rev
Willets Creek	1701-0091+0175+0372

Table 7-2 Groundwater Baseflow Contributions to South Shore Subwatersheds

Water Body	SWP PWL ID	0 to 2 Years	0 to 10 Years	0 to 25 Years	0 to 50 Years	0 to 100 Years	0 to 200 Years
Abets Creek	1701-0327-AC	27.48%	64.18%	87.39%	89.72%	90.67%	100.00%
Amityville Creek	1701-0087+0372	39.01%	80.46%	92.73%	92.89%	96.27%	100.00%
Aspatuck Creek and River	1701-0303-AC	24.07%	56.67%	77.38%	85.98%	90.56%	100.00%
Awixa Creek	1701-0093+0338	30.88%	68.45%	78.93%	79.13%	91.50%	100.00%
Beaverdam Pond	1701-0307+0306	22.52%	50.20%	73.04%	81.99%	88.83%	100.00%
Beaverdam/Motts Creeks	1701-0324+0104	24.84%	60.21%	83.25%	91.01%	94.46%	100.00%
Bellport Bay	1701-0320	33.24%	71.59%	93.66%	96.44%	97.58%	100.00%
Belmont Lake	1701-0021	40.08%	85.96%	100.00%	100.00%	100.00%	100.00%
Brightwaters Canal, Nosreka, Mirror, and Cascade Lakes	1701-0338-BC+0342	21.53%	45.30%	64.66%	73.38%	86.96%	100.00%
Brown Creek	1701-0097+0333	24.16%	58.26%	85.01%	93.84%	95.39%	100.00%
Carlls River	1701-0089+0346+0345+0344+0372	29.93%	61.54%	82.65%	89.94%	95.57%	100.00%
Carmans River Lower, and Tribs	1701-0321	28.99%	64.98%	86.92%	93.90%	96.50%	100.00%
Carmans River Upper, and Tribs	1701-0102+0322+0323	17.64%	48.27%	73.00%	84.10%	89.71%	100.00%
Champlin Creek	1701-0019+0338+0340	32.18%	73.81%	90.28%	91.55%	94.25%	100.00%
Connetquot River, Lower, and Tribs	1701-0337	26.40%	62.80%	84.19%	89.63%	93.99%	100.00%
Connetquot River, Upper, and Tribs	1701-0095+0339	19.64%	41.44%	64.38%	83.75%	94.72%	100.00%
Corey Lake and Creek, and Tribs	1701-0327-CL	27.33%	64.46%	93.96%	98.84%	98.88%	100.00%
Dunton Lake, Upper, and Tribs and Hedges Creek	1701-0330+0327	26.96%	61.99%	87.91%	95.04%	96.03%	100.00%
Far Pond	1701-0295-FP	41.27%	83.81%	99.20%	100.00%	100.00%	100.00%
Forge River and Tidal Tribs	1701-0316-FR+0312	18.73%	48.41%	73.38%	85.68%	91.42%	100.00%

Table 7-2 Groundwater Baseflow Contributions to South Shore Subwatersheds

Water Body	SWP PWL ID	0 to 2 Years	0 to 10 Years	0 to 25 Years	0 to 50 Years	0 to 100 Years	0 to 200 Years
Forge River Cove and Tidal Tribs	1701-0316-FRC+0312	38.40%	72.18%	84.58%	93.26%	97.00%	100.00%
Grand Canal	1701-0337-GC	37.34%	60.46%	67.29%	82.26%	85.30%	100.00%
Great Cove	1701-0376	36.85%	64.69%	81.36%	85.59%	90.07%	100.00%
Great South Bay, East	1701-0039	52.32%	72.72%	95.10%	98.42%	98.86%	100.00%
Great South Bay, Middle	1701-0040	88.26%	91.36%	94.12%	96.87%	99.50%	100.00%
Great South Bay, West	1701-0173	48.31%	78.44%	86.35%	87.73%	92.64%	100.00%
Green Creek, Upper, and Tribs	1701-0096	27.46%	67.70%	94.80%	99.91%	99.93%	100.00%
Halsey Neck Pond	1701-0355	45.56%	75.46%	91.62%	99.30%	99.30%	100.00%
Harts Cove	1701-0309-HC	17.61%	49.91%	77.68%	92.83%	94.12%	100.00%
Heady and Taylor Creeks and Tribs	1701-0294	29.18%	62.36%	85.44%	95.84%	99.13%	100.00%
Howell's Creek	1701-0327-HC	21.72%	61.97%	87.60%	95.76%	96.33%	100.00%
Lawrence Creek, O-co-nee and Lawrence Lakes	1701-0372-LC	26.04%	50.30%	70.17%	74.17%	79.80%	100.00%
Middle Pond	1701-0295-MP	51.52%	83.92%	99.03%	100.00%	100.00%	100.00%
Moriches Bay East	1701-0305	37.86%	73.75%	90.04%	94.83%	96.34%	100.00%
Moriches Bay West	1701-0038	83.72%	92.58%	98.26%	99.91%	100.00%	100.00%
Mud and Senix Creeks	1701-0316-MSC	23.95%	58.80%	84.68%	94.98%	95.40%	100.00%
Mud Creek, Robinson Pond, and Tidal Tribs	1701-0101+0331+0327	30.40%	70.09%	87.97%	89.65%	93.92%	100.00%
Narrow Bay	1701-0318	46.03%	73.82%	88.94%	96.97%	100.00%	100.00%
Neguntatogue Creek	1701-0088+0372	37.28%	77.58%	87.01%	87.01%	96.76%	100.00%
Nicoll Bay	1701-0375	30.65%	55.39%	70.93%	83.75%	88.12%	100.00%
Ogden Pond	1701-0302	20.08%	54.63%	78.70%	92.50%	97.84%	100.00%
Old Fort Pond	1701-0295-OFP	27.81%	64.65%	86.41%	95.41%	99.60%	100.00%
Orchard Neck Creek	1701-0316-ONC	23.53%	62.40%	90.12%	94.13%	96.31%	100.00%

Table 7-2 Groundwater Baseflow Contributions to South Shore Subwatersheds

Water Body	SWP PWL ID	0 to 2 Years	0 to 10 Years	0 to 25 Years	0 to 50 Years	0 to 100 Years	0 to 200 Years
Pardees, Orowoc Lakes, Creek, and Tidal Tribs	1701-0094-0341+0338	35.81%	74.24%	86.56%	89.79%	95.15%	100.00%
Patchogue Bay	1701-0326	32.28%	68.48%	88.33%	95.62%	96.85%	100.00%
Patchogue River	1701-0099+0018+0055+0327	21.86%	47.75%	72.23%	79.74%	88.73%	100.00%
Pattersquash Creek	1701-0319-PC	27.74%	69.73%	92.17%	99.79%	100.00%	100.00%
Penataquit Creek	1701-0092+0338	35.96%	73.15%	86.74%	87.43%	90.04%	100.00%
Penniman Creek and Tidal Tribs	1701-0300	23.59%	64.03%	86.35%	93.72%	96.97%	100.00%
Penny Pond, Wells, Smith, and Gilbert Creeks	1701-0298+GC	36.76%	67.89%	84.60%	94.67%	97.32%	100.00%
Phillips Creek, Lower, and Tidal Tribs	1701-0299	23.25%	53.09%	76.55%	83.64%	90.33%	100.00%
Quantuck Bay	1701-0042	38.28%	73.34%	92.79%	96.90%	98.46%	100.00%
Quantuck Canal/Moneybogue Bay	1701-0371	44.34%	76.59%	94.17%	96.65%	97.08%	100.00%
Quantuck Creek and Old Ice Pond	1701-0303-QC+0304	21.00%	51.21%	74.68%	82.88%	89.45%	100.00%
Quogue Canal	1701-0301	42.84%	70.11%	87.72%	96.23%	98.93%	100.00%
Sampawams Creek	1701-0090+0372	32.58%	67.19%	89.24%	93.12%	97.82%	100.00%
Sans Souci Lakes	1701-0336+0335	38.88%	94.33%	100.00%	100.00%	100.00%	100.00%
Santapogue Creek	1701-0016+0372	28.20%	62.88%	76.39%	78.52%	88.33%	100.00%
Seatuck Cove and Tidal Tribs	1701-0309-SC	17.24%	51.32%	79.83%	89.20%	94.26%	100.00%
Sheepen Creek	1701-0319-SC	36.93%	76.10%	92.07%	99.99%	100.00%	100.00%
Shinnecock Bay - Bennet Cove (Cormorant Cove)	1701-0033-BC+0252+0296	34.39%	66.05%	85.32%	93.31%	97.36%	100.00%
Shinnecock Bay Central	1701-0033-C	77.94%	92.93%	97.40%	98.75%	99.98%	100.00%
Shinnecock Bay East	1701-0033-E	43.62%	71.66%	89.82%	96.42%	97.83%	100.00%

Table 7-2 Groundwater Baseflow Contributions to South Shore Subwatersheds

Water Body	SWP PWL ID	0 to 2 Years	0 to 10 Years	0 to 25 Years	0 to 50 Years	0 to 100 Years	0 to 200 Years
Shinnecock Bay West	1701-0033-W	39.07%	69.04%	83.70%	90.13%	94.11%	100.00%
Speonk River	1701-0306-SR	19.18%	56.34%	85.33%	97.75%	98.12%	100.00%
Stillman Creek	1701-0329-SC	26.31%	70.09%	94.91%	99.91%	99.95%	100.00%
Swan River, Swan Lake, and Tidal Tribs	1701-0100+0327+0332	24.79%	58.38%	82.48%	87.89%	94.49%	100.00%
Terrell River	1701-0103+0313+0314	19.56%	54.41%	80.75%	96.78%	97.54%	100.00%
Tiana Bay and Tidal Tribs	1701-0112	24.28%	54.68%	77.96%	87.49%	92.72%	100.00%
Tuthill Cove	1701-0309-TC	24.22%	59.56%	81.33%	95.98%	97.76%	100.00%
Tuthills Creek	1701-0098+0327+0329+0334	25.89%	62.50%	91.07%	93.66%	94.71%	100.00%
Unchachogue/ Johns Neck Creeks	1701-0319-UC	36.01%	74.42%	92.05%	99.35%	100.00%	100.00%
Weesuck Creek and Tidal Tribs	1701-0111	21.05%	50.74%	77.29%	85.81%	92.43%	100.00%
Willets Creek	1701-0091+0175+0372	38.38%	71.88%	83.08%	85.44%	93.20%	100.00%
Average		32.85%	65.97%	85.31%	91.82%	95.26%	100.00%

Table 7-3 Nitrogen Load Components for South Shore Estuary Reserve Subwatersheds (page 1 of 5)

PWL ID	Subwatershed	On Site Sanitary Wastewater (lbs/day)	Fertilizer (lbs/day)	Pets (lbs/day)	Atmospheric Deposition to Subwatershed (lbs/day)	STP Discharge to GW (lbs/day)	Total Nitrogen Load from GW (lbs/day)	STP Discharge to Surface Water (lbs/day)	Atmospheric Deposition to Surface Water (lbs/day)	Total Nitrogen Load (lbs/day)
1701-0327-AC	Abets Creek	75.1	18.8	4.3	3.2	11.1	112.6	0.0	0.05	112.7
1701-0087+0372	Amityville Creek	5.3	13.1	5.6	2.9	0.0	27.0	0.0	0.75	27.7
1701-0303-AC	Aspatuck Creek and River	57.0	18.3	2.5	3.1	0.0	80.9	0.0	0.85	81.8
1701-0093+0338	Awixa Creek	41.0	13.3	4.8	2.6	0.0	61.7	0.0	4.21	65.9
1701-0307+0306	Beaverdam Pond	43.7	21.8	2	5.0	0.0	72.5	0.0	1.34	73.8
1701-0324+0104	Beaverdam Creeks	93.7	25.7	4.5	8.2	1.1	133.1	0.0	0.35	133.4
1701-0320+0325	Bellport Bay	176.5	35.2	7.8	6.4	29.1	255.0	0.0	31.16	286.2
1701-0021+0089	Belmont Lake	87.8	9.5	3.7	1.9	0.0	102.9	0.0	0.38	103.3
1701-0338-BC+0342	Brightwaters Canal, Nosreka, Mirror, and Cascade Lakes	59.3	26.3	8	4.3	0.0	97.9	0.0	0.25	98.2
1701-0097+0333	Brown Creek	403.3	57.8	15.7	11.0	8.9	496.7	0.0	1.43	498.1
1701-0089+0346+0345 +0344+0372	Carlls River	409.2	76.0	42.2	15.7	2.6	545.7	0.0	1.71	547.4
1701-0321-rev	Carmans River Lower, and Tribs	446.7	111.0	16.7	23.7	16.8	614.9	0.0	2.69	617.6
1701-0102-rev+0322+0323	Carmans River Upper, and Tribs	319.1	189.2	17.3	35.3	23.2	584.1	0.0	0.87	585.0
1701-0019+0338+0340	Champlin Creek	80.4	52.3	15.1	8.5	0.0	156.2	0.0	4.21	160.4
1701-0337	Connetquot River, Lower, and Tribs	198.6	58.1	16.6	10.3	0.0	283.6	0.0	5.46	289.0
1701-0095+0339	Connetquot River, Upper, and Tribs	1041.9	225.0	42	42.5	47.7	1399.1	0.0	0.18	1399.3

Table 7-3 Nitrogen Load Components to the South Shore Estuary Subwatersheds

PWL ID	Subwatershed	On Site Sanitary Wastewater (lbs/day)	Fertilizer (lbs/day)	Pets (lbs/day)	Atmospheric Deposition to Subwatershed (lbs/day)	STP Discharge to GW (lbs/day)	Total Nitrogen Load from GW (lbs/day)	STP Discharge to Surface Water (lbs/day)	Atmospheric Deposition to Surface Water (lbs/day)	Total Nitrogen Load (lbs/day)
1701-0329+0327-CL	Corey Lake and Creek, and Tribs	53.1	11.1	3.2	2.3	0.2	69.8	0.0	2.38	72.2
1701-0330-HC+0327	Dunton Lake, Upper, and Tribs and Hedges Creek	61.4	10.1	3.4	2.4	0.0	77.2	0.0	0.20	77.4
1701-0295-FP	Far Pond	6.6	2.4	0.3	0.4	0.0	9.7	0.0	0.21	9.9
1701-0316-FR+0312+0026	Forge River and Tidal Tribs	605.9	126.4	27.8	28.4	6.3	794.8	0.0	6.13	801.0
1701-0316-FRC+0312	Forge River Cove and Tidal Tribs	29.3	8.4	1.2	1.1	0.0	40.0	0.0	8.51	48.5
1701-0337-GC	Grand Canal	73.2	16.6	4.1	2.8	0.7	97.4	0.0	0.17	97.6
1701-0376+0338	Great Cove	158.8	152.7	27.5	24.9	0.0	363.9	0.0	42.83	406.7
1701-0039-rev+0333	Great South Bay, East	356.1	92.8	17.8	14.5	5.1	486.3	0.0	321.47	807.7
1701-0040-rev	Great South Bay, Middle	26.3	27.7	5.7	5.1	0.0	64.7	9.9	200.96	275.6
1701-0173+0372	Great South Bay, West	48.3	117.7	64.7	25.4	0.0	256.1	0.0	138.40	394.5
1701-0096+0333	Green Creek, Upper, and Tribs	148.2	23.4	6	4.8	0.1	182.4	0.0	1.43	183.8
1701-0355	Halsey Neck Pond	3.3	2.2	0.2	0.5	0.0	6.2	0.0	0.11	6.3
1701-0309-HC	Harts Cove	72.6	35.6	3.3	6.6	0.0	118.2	0.0	4.52	122.7
1701-0294	Heady and Taylor Creeks and Tribs	91.8	33.3	4.4	5.8	0.4	135.7	0.0	2.88	138.6
1701-0327-HC	Howell's Creek	63.8	17.4	3.6	2.3	0.0	87.1	0.0	0.07	87.2
1701-0338-LC	Lawrence Creek, O-co-nee and Lawrence Lakes	30.6	15.5	5.5	2.7	0.0	54.2	0.0	0.26	54.5
1701-0295-MP	Middle Pond	12.9	3.1	0.6	0.5	0.0	17.0	0.0	0.52	17.5
1701-0305-rev+0306	Moriches Bay East	156.0	61.3	7.4	10.3	1.1	236.1	0.0	26.15	262.3

Table 7-3 Nitrogen Load Components to the South Shore Estuary Subwatersheds

PWL ID	Subwatershed	On Site Sanitary Wastewater (lbs/day)	Fertilizer (lbs/day)	Pets (lbs/day)	Atmospheric Deposition to Subwatershed (lbs/day)	STP Discharge to GW (lbs/day)	Total Nitrogen Load from GW (lbs/day)	STP Discharge to Surface Water (lbs/day)	Atmospheric Deposition to Surface Water (lbs/day)	Total Nitrogen Load (lbs/day)
1701-0038-rev	Moriches Bay West	9.6	15.3	0.5	2.1	0.0	27.5	0.0	48.60	76.1
1701-0312-MSC	Mud and Senix Creeks	133.1	29.3	5.4	6.1	0.4	174.4	0.0	1.04	175.4
1701-0101+0331+0327	Mud Creek, Robinson Pond, and Tidal Tribs	75.9	22.9	3.7	4.9	3.5	110.9	0.0	0.11	111.0
1701-0318+0319	Narrow Bay	130.6	28.0	6.3	4.1	0.0	168.9	0.0	12.53	181.5
1701-0088+0372	Neguntatogue Creek	5.7	13.7	12.5	4.0	0.0	35.9	0.0	0.70	36.6
1701-0375+0333	Nicoll Bay	157.5	30.6	4.6	6.0	1.4	200.1	0.0	13.63	213.7
1701-0302	Ogden Pond	7.7	3.4	0.4	0.6	0.0	12.1	0.0	0.15	12.3
1701-0295-OFP	Old Fort Pond	28.9	8.5	1.1	2.2	0.0	40.7	0.0	0.94	41.7
1701-0312-ONC	Orchard Neck Creek	73.6	17.9	3.5	3.3	0.0	98.2	0.0	0.27	98.5
1701-0094+0341+0338	Pardees, Orowoc Lakes, Creek, and Tidal Tribs	156.8	52.0	18.1	9.4	0.0	236.3	0.0	0.19	236.4
1701-0326	Patchogue Bay	186.8	32.0	8.8	4.7	49.9	282.2	0.0	25.94	308.1
1701-0099+0018+0055+0327	Patchogue River	554.5	80.8	27.6	14.5	60.5	737.8	31.9	1.50	771.2
1701-0319-PC	Pattersquash Creek	112.4	14.4	5.3	2.4	0.0	134.5	0.0	0.65	135.2
1701-0092+0338	Penataquit Creek	97.2	35.6	14.3	8.6	0.0	155.6	0.0	0.87	156.5
1701-0300	Penniman Creek and Tidal Tribs	15.5	8.9	0.8	1.6	0.0	26.8	0.0	0.63	27.5
1701-0298-rev+0033	Penny Pond, Wells, Smith, and Gilbert Creeks	85.7	20.1	4.1	2.6	0.0	112.5	0.0	3.54	116.0

Table 7-3 Nitrogen Load Components to South Shore Estuary Subwatersheds

PWL ID	Subwatershed	On Site Sanitary Wastewater (lbs/day)	Fertilizer (lbs/day)	Pets (lbs/day)	Atmospheric Deposition to Subwatershed (lbs/day)	STP Discharge to GW (lbs/day)	Total Nitrogen Load from GW (lbs/day)	STP Discharge to Surface Water (lbs/day)	Atmospheric Deposition to Surface Water (lbs/day)	Total Nitrogen Load (lbs/day)
1701-0299	Phillips Creek, Lower, and Tidal Tribs	45.8	21.4	2.3	4.0	0.0	73.5	0.0	0.50	74.0
1701-0042+0303	Quantuck Bay	17.1	6.3	0.8	1.2	0.0	25.3	0.0	3.09	28.4
1701-0371	Quantuck Canal/Moneybogue Bay	38.5	10.6	1.3	1.7	0.0	52.1	0.0	1.26	53.3
1701-0303-QC+0304	Quantuck Creek and Old Ice Pond	42.5	26.5	1.8	7.3	0.0	78.1	0.0	1.92	80.0
1701-0301	Quogue Canal	16.5	6.5	0.9	1.0	0.0	25.0	0.0	0.23	25.2
1701-0090+0372+0343	Sampawams Creek	133.3	35.0	21.5	8.1	0.0	197.9	0.0	0.76	198.7
1701-0336+0335	Sans Souci Lakes	40.6	9.4	1.7	1.5	0.2	53.5	0.0	0.51	54.0
1701-0016+0372	Santapogue Creek	18.3	29.1	17.5	7.8	0.0	72.7	0.0	0.69	73.4
1701-0309-SC+0306+0311	Seatuck Cove and Tidal Tribs	202.3	131.9	10.6	22.6	1.5	369.0	0.0	6.30	375.3
1701-0319-SC	Sheepan Creek	23.2	2.5	1.1	0.5	0.0	27.3	0.0	0.22	27.5
1701-0033-BC+0252+0296	Shinnecock Bay - Bennet Cove (Cormorant Cove)	91.1	20.2	4	2.9	0.0	118.2	0.0	4.39	122.6
1701-0033-C	Shinnecock Bay Central	4.9	6.7	0.2	0.9	0.0	12.7	0.0	20.47	33.1
1701-0033-E	Shinnecock Bay East	88.2	25.7	4.2	4.5	0.0	122.6	0.0	53.82	176.4
1701-0033-W	Shinnecock Bay West	71.7	29.6	3.7	4.6	0.2	109.8	0.0	15.44	125.2
1701-0306-SR	Speonk River	36.3	12.3	1.4	4.1	0.0	54.1	0.0	0.74	54.9
1701-0329-SC	Stillman Creek	35.7	5.5	1.5	1.1	1.3	45.1	0.0	0.04	45.1
1701-0100+0332+0329+0327	Swan River, Swan Lake, and Tidal Tribs	319.0	62.8	14.3	11.2	3.8	411.1	0.0	2.38	413.5

Table 7-3 Nitrogen Load Components to South Shore Estuary Subwatersheds

PWL ID	Subwatershed	On Site Sanitary Wastewater (lbs/day)	Fertilizer (lbs/day)	Pets (lbs/day)	Atmospheric Deposition to Subwatershed (lbs/day)	STP Discharge to GW (lbs/day)	Total Nitrogen Load from GW (lbs/day)	STP Discharge to Surface Water (lbs/day)	Atmospheric Deposition to Surface Water (lbs/day)	Total Nitrogen Load (lbs/day)
1701-0103+0313+0314	Terrell River	37.9	20.5	1.8	4.0	0.6	64.8	0.0	0.94	65.7
1701-0112	Tiana Bay and Tidal Tribs	135.5	41.0	6.1	5.7	0.1	188.4	0.0	7.16	195.6
1701-0309-TC	Tuthill Cove	29.9	11.1	1.3	2.5	0.0	44.8	0.0	2.15	47.0
1701-0098+0327+0329+0334	Tuthills Creek	167.7	36.9	11.5	7.1	3.5	226.8	0.0	0.45	227.3
1701-0319-UC	Unchachogue/Johns Neck Creeks	135.9	14.0	6.4	2.4	0.0	158.6	0.0	1.01	159.6
1701-0111-rev	Weesuck Creek and Tidal Tribs	37.4	31.8	1.8	4.6	0.0	75.6	0.0	0.73	76.3
1701-0091+0175+0372	Willets Creek	43.5	28.1	11.9	5.1	0.0	88.7	0.0	4.80	93.5

Table 7-4 SSER Nitrogen Load Priority Areas

South Shore Estuary Reserve Subwatersheds	SWP PWL Number	Priority for Nitrogen Load Reduction
Abets Creek	1701-0327-AC	1
Amityville Creek	1701-0087+0372	1
Aspatuck Creek and River	1701-0303-AC	1
Awixa Creek	1701-0093+0338	1
Beaverdam Creek	1701-0324+0104	1
Beaverdam Pond	1701-0307+0306	1
Bellport Bay	1701-0320+0325	1
Belmont Lake	1701-0021+0089	1
Brightwaters Canal	1701-0338-BC+0342	1
Brown Creek	1701-0097+0333	1
Carlls River	1701-0089+0346+0345+0344+0372	1
Carmans River Lower, and Tribs	1701-0321-rev	1
Carmans River Upper, and Tribs	1701-0102-rev+0322+0323	1
Champlin Creek	1701-0019+0338+0340	1
Connetquot River, Lower, and Tribs	1701-0337	1
Connetquot River, Upper, and Tribs	1701-0095+0339	1
Corey Lake and Creek, and Tribs	1701-0329+0327-CL	1
Dunton Lake, Upper, and Tribs	1701-0330-HC+0327	1
Far Pond	1701-0295-FP	4
Forge River and Tidal Tribs	1701-0316-FR+0312+0026	1
Forge River Cove and Tidal Tribs	1701-0316-FRC+0312	2
Grand Canal	1701-0337-GC	1
Great Cove	1701-0376+0338	1
Great South Bay, East	1701-0039-rev+0333	1
Great South Bay, Middle	1701-0040-rev	1
Great South Bay, West	1701-0173+0372	1
Green Creek, Upper, and Tribs	1701-0096+0333	1
Halsey Neck Pond	1701-0355	1
Harts Cove	1701-0309-HC	3
Heady and Taylor Creeks and Tribs	1701-0294	1
Howell's Creek	1701-0327-HC	1
Lawrence Creek/Lakes, O-co-nee	1701-0338-LC	1
Middle Pond	1701-0295-MP	3
Moriches Bay East	1701-0305-rev+0306	1
Moriches Bay West	1701-0038-rev	2
Mud and Senix Creeks	1701-0312-MSC	2
Mud Creek, Robinson Pond, and Tribs	1701-0101+0331+0327	1

Table 7-4 SSER Nitrogen Load Priority Areas

South Shore Estuary Reserve Subwatersheds	SWP PWL Number	Priority for Nitrogen Load Reduction
Narrow Bay	1701-0318+0319	2
Neguntatogue Creek	1701-0088+0372	1
Nicoll Bay	1701-0375+0333	1
Ogden Pond	1701-0302	1
Old Fort Pond	1701-0295-OFP	3
Orchard Neck Creek	1701-0312-ONC	2
Pardees, Orowoc Lakes, Creek, & Tribs	1701-0094+0341+0338	1
Patchogue Bay	1701-0326	1
Patchogue River	1701-0099+0018+0055+0327	1
Pattersquash Creek	1701-0319-PC	2
Penataquit Creek	1701-0092+0338	1
Penniman Creek and Tidal Tribs	1701-0300	1
Penny Pond, Wells, Smith, and Gilbert Creeks	1701-0298-rev+0033	2
Phillips Creek, Lower, and Tidal Tribs	1701-0299	1
Quantuck Bay	1701-0042+0303	1
Quantuck Canal/Moneybogue Bay	1701-0371	1
Quantuck Creek and Old Ice Pond	1701-0303-QC+0304	1
Quogue Canal	1701-0301	1
Sampawams Creek	1701-0090+0372+0343	1
Sans Souci Lakes	1701-0336+0335	1
Santapogue Creek	1701-0016+0372	1
Seatuck Cove and Tidal Tribs	1701-0309-SC+0306+0311	1
Sheepen Creek	1701-0319-SC	2
Shinnecock Bay - Bennet Cove (Cormorant Cove)	1701-0033-BC+0252+0296	4
Shinnecock Bay Central	1701-0033-C	2
Shinnecock Bay East	1701-0033-E	4
Shinnecock Bay West	1701-0033-W	1
Speonk River	1701-0306-SR	1
Stillman Creek	1701-0329-SC	1
Swan River, Swan Lake, and Tidal Tribs	1701-0100+0332+0329+0327	1
Terrell River	1701-0103+0313+0314	2
Tiana Bay and Tidal Tribs	1701-0112	2
Tuthill Cove	1701-0309-TC	2
Tuthills Creek	1701-0098+0327+0329+0334	1
Unchachogue/Johns Neck Creeks	1701-0319-UC	2
Weesuck Creek and Tidal Tribs	1701-0111-rev	1
Willets Creek	1701-0091+0175+0372	1

Table 7-6 South Shore Estuary Subwatersheds Nitrogen Load Reduction Goals

	Management Area Name	Individual Water Bodies in Management Area	Individual Water Body HAB/DO Improvement Goal	Individual Water Body Overall Water Quality Improvement Goal	Achievable Reduction through On-Site Wastewater Management	Reduction Goal for Protection of Down Gradient Water Bodies
13	Shinnecock Bay Restoration and Protection Area I	**Shinnecock Bay West**	**42%**	**71%**	**41%**	**3%**
		Shinnecock Bay Central	**0%**	**3%**	**11%**	**0%**
		Penny Pond, Wells, Smith, and Gilberts Creeks	0%	0%	52%	3%
		Tiana Bay and Tidal Tribs	36%	68%	50%	3%
		Weesuck Creek and Tidal tribs	44%	72%	39%	71%
		Phillips Creek, Lower, and Tidal Tribs	60%	80%	46%	71%
		Penniman Creek and Tidal Tribs	**0%**	**30%**	**41%**	**71%**
		Heady and Taylor Creeks	74%	87%	45%	0%
14	Shinnecock Bay Restoration and Protection Area II	**Shinnecock Bay East**	**0%**	**0%**	**31%**	**N/A**
		Shinnecock Bay - Bennet Cove (Cormorant Cove)	**0%**	**50%**	**52%**	**0%**
		Old Fort Pond	12%	56%	51%	0%
		Middle Pond	3%	52%	52%	0%
		Far Pond	0%	19%	48%	0%
15	Moriches Bay Restoration Area I	**Moriches Bay East**	**57%**	**79%**	**43%**	**N/A**
		Beaverdam Pond	77%	89%	46%	79%
		Speonk River	76%	88%	48%	79%
		Seatuck Cove and Tidal Tribs	**71%**	**86%**	**39%**	**37%**
		Terrell River	44%	72%	40%	37%
		Mud and Senix Creeks	79%	89%	55%	69%
		Orchard Neck Creek	83%	92%	54%	69%
		Forge River and Tidal Tribs	**86%**	**93%**	**54%**	**69%**
		Forge River Cove and Tidal Tribs	**38%**	**69%**	**43%**	**37%**
		Quantuck Canal/Moneybogue Bay	**82%**	**91%**	**52%**	**93%**
		Quantuck Bay	**85%**	**93%**	**43%**	**93%**
		Quantuck Creek and Old Ice Pond	61%	80%	40%	93%

Table 7-6 South Shore Estuary Subwatersheds Nitrogen Load Reduction Goals

	Management Area Name	Individual Water Bodies in Management Area	Individual Water Body HAB/DO Improvement Goal	Individual Water Body Overall Water Quality Improvement Goal	Achievable Reduction through On-Site Wastewater Management	Reduction Goal for Protection of Down Gradient Water Bodies
		Aspatuck Creek and River	61%	80%	52%	93%
		Quogue Canal	86%	93%	44%	37%
		Ogden Pond	0%	31%	40%	93%
16	Moriches Bay Restoration Area II	**Moriches Bay West**	**0%**	**37%**	**9%**	**N/A**
		Harts Cove	**0%**	**0%**	**44%**	**37%**
		Tuthill Cove	0%	40%	46%	37%
		Narrow Bay	**38%**	**69%**	**49%**	**37%**
		Pattersquash Creek	65%	82%	59%	69%
		Sheepen Creek	7%	54%	59%	69%
		Unchachogue/Johns Neck Creeks	0%	18%	60%	69%
17	Great South Bay Restoration Area I	**Great South Bay, East**	**91%**	**95%**	**31%**	**N/A**
		Bellport Bay	**79%**	**89%**	**44%**	**95%**
		Beaverdam Creek	82%	91%	51%	95%
		Carmans River Lower, and Tribs	**90%**	**95%**	**39%**	**95%**
		Carmans River Upper, and Tribs	N/A	55%	39%	95%
		Howell's Creek	74%	87%	52%	95%
		Dunton Lake, Upper, and Tribs and Hedges Creek	88%	94%	57%	95%
		Abets Creek	83%	91%	53%	95%
		Mud Creek, Robinson Pond, and Tidal Tribs	75%	87%	48%	95%
		Swan River, Swan Lake, and Tidal Tribs	92%	96%	55%	95%
		Patchogue River	86%	93%	54%	95%
		Patchogue Bay	**81%**	**91%**	**43%**	**95%**
		Tuthills Creek	88%	94%	52%	95%
		Corey Lake and Creek, and Tribs	84%	92%	52%	95%
		Stillman Creek	94%	97%	56%	95%
		Brown Creek	91%	96%	57%	95%
		Sans Souci Lakes	N/A	N/A	53%	96%
		Green Creek, Upper, and Tribs	88%	94%	57%	95%

Table 7-6 South Shore Estuary Subwatersheds Nitrogen Load Reduction Goals

	Management Area Name	Individual Water Bodies in Management Area	Individual Water Body HAB/DO Improvement Goal	Individual Water Body Overall Water Quality Improvement Goal	Achievable Reduction through On-Site Wastewater Management	Reduction Goal for Protection of Down Gradient Water Bodies
		Nicoll Bay	**83%**	**92%**	**50%**	**95%**
		Connetquot River, Lower, and Tribs	**84%**	**92%**	**45%**	**95%**
		Grand Canal	71%	86%	54%	95%
		Connetquot River, Upper, and Tribs	N/A	78%	53%	95%
18	Great South Bay Restoration Area II	**Great South Bay, Middle**	**6%**	**53%**	**6%**	**N/A**
		Great Cove	**0%**	**42%**	**8%**	**53%**
		Champlin Creek	72%	86%	29%	53%
		Pardees, Orowoc Lakes, Creek, and Tidal Tribs	67%	83%	43%	53%
		Awixa Creek	57%	79%	32%	53%
		Penataquit Creek	67%	83%	36%	53%
		Lawrence Creek, O-co-nee and Lawrence Lakes	3%	51%	15%	53%
		Brightwaters Canal, Nosreka, Mirror, and Cascade Lakes	18%	59%	16%	53%
		Carlls River	72%	86%	52%	39%
		Belmont Lake	N/A	N/A	60%	86%
		Sampawams Creek	59%	80%	44%	39%
		Great South Bay, West	**0%**	**39%**	**6%**	**N/A**
		Willets Creek	0%	0%	7%	39%
		Santapogue Creek	0%	56%	10%	39%
		Neguntatogue Creek	0%	19%	11%	39%
		Amityville Creek	0%	0%	14%	39%

Section 8

Subwatershed Wastewater Plan Implementation

The recommendations provided within this SWP represent the first step of a long-term Countywide wastewater upgrade program that considered and balanced priority areas, program objectives, and other fundamental factors such as funding mechanisms and implementation timeframes. To ensure the long-term success of the program, there are several additional considerations that need to be considered and monitored as part of an adaptive management strategy. The following subsections summarize the primary recommendations set forth within this SWP, provide a detailed recommended road map of how to implement the SWP, and provide recommendations for other administrative and technical considerations.

8.1 Summary of Primary Program Recommendations

The recommended wastewater alternative (e.g., Alternative 4) was selected as the most balanced approach that achieved the proposed ecological endpoints (with the potential for associated human health benefits) in accordance with the program schedule objectives; accommodated industry and RME growth; and has an annual revenue requirement consistent with the stable and recurring revenue source identified in this SWP. A general summary of the major program elements, including an overview of each program phase, objectives, schedule and cost is provided on **Table 8-1**.

Table 8-1 Countywide Wastewater Upgrade Program Conceptual Timeline Summary

Program Phase	Program Phase Objectives	Approximate Cost
I Program Ramp Up 9,000 WWT Upgrades (5,000 retrofit; 4,000 new construction)	-Continue voluntary upgrade incentive programs -Ramp up RME and Industry Capacity -Establish Countywide Water Quality Management District -Establish Stable Recurring Revenue Source	$12-20M/year* 5 Years (2019-2023)
II Upgrades in Near Shore and Highest Priority Areas 207,000 WWT Upgrades (177,000 retrofit; 30,000 new construction)	-Continue Program Ramp Up (RME and Industry Capacity) -Address all highest priority areas including: *Upgrades in all near shore 0-2 year contributing areas. *Upgrades in surface water priority area rank 1. * Upgrades in groundwater/drinking priority area rank 1.	Alternative 4A: $65M-$69M/year Alternative 4B: $65M-$101M/year Alternative 4C: $71M-$140M/year 30 Years (2024-2053) [95% complete]
III Upgrades in All Other Priority Areas 296,000 WWT Upgrades (253,000 retrofit; 43,000 new construction)	-Upgrades in all remaining priority areas. *Remaining parcels in surface water priority area ranks 2,3 and 4. *Groundwater/drinking water priority area rank 2	Alternative 4A: $67M/year Alternative 4B: $102M/year Alternative 4C: $141M/year 15 Years (2054-2068)

Program Phase	Program Phase Objectives	Approximate Cost
IV Upgrades in Remaining Areas (Central Suffolk) 427,000 WWT Upgrades (384,000 retrofit; 43,000 new construction)	-Upgrades in all remaining areas (primarily central Suffolk County)	Annual Cost Target $67M/year Timeframe = TBD
*** WWT upgrades represent cumulative installations of either I/A OWTS, sewering, or clustering ** Actual annual cost during Phase I will depend on funding availability from existing programs through County and NYS Septic Improvement Programs and Town Community Preservation Funds * Retrofit = upgrade of existing onsite disposal system		

As shown in **Table 8-1** and **Figure 8-1**, and described in Section 4, the Program consists of four primary phases. The phases are intended to build upon each other through an aggressive, but achievable, timeline that allows for:

- Establishment of critical administrative elements such as a Countywide Water Quality Management District (WQMD) and stable recurring revenue source before initiating required wastewater upgrades;
- A steady, but controlled, annual upgrade target rate that can accommodate industry and RME (Responsible Management Entity) readiness; and
- The program timeline goals for the protection of human health and the environment.

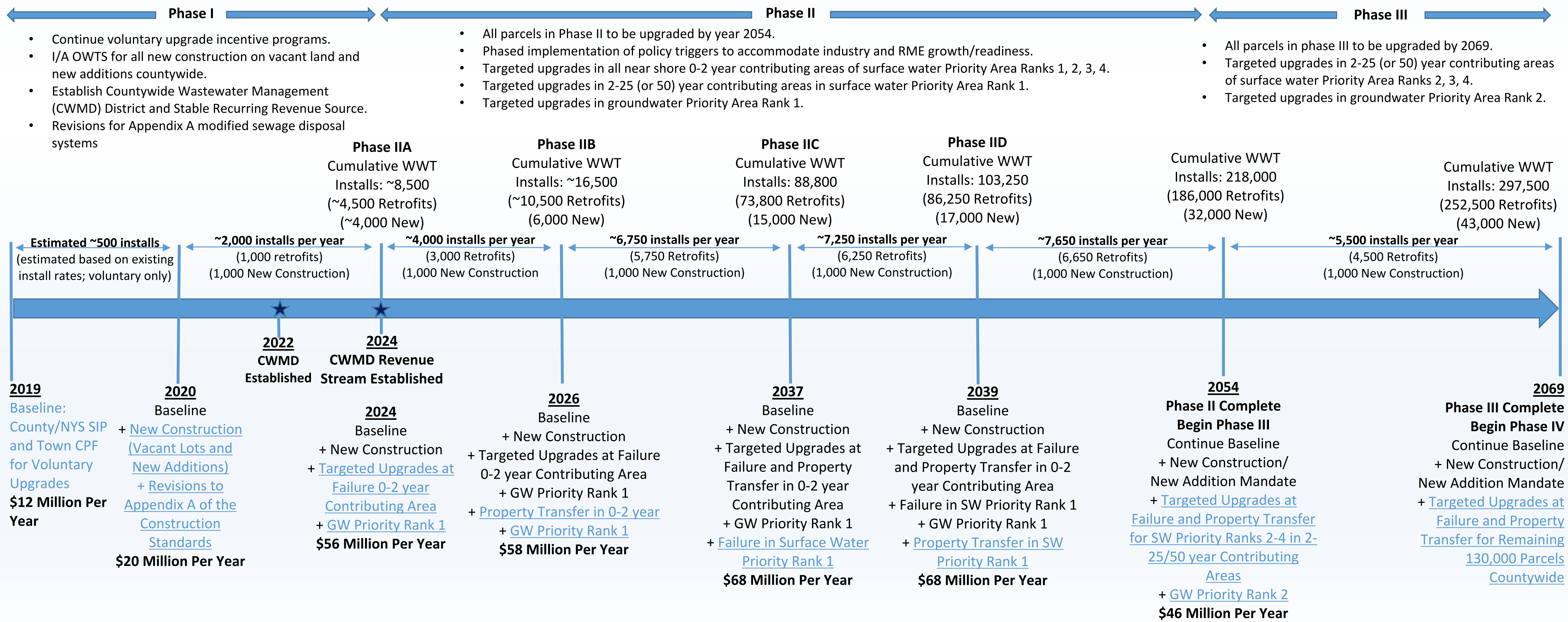
It should be noted that the Program recommendations are intended to be a guide that builds upon the information, data, and assumptions defined within this SWP. As discussed in Section 8.4.11, Adaptive Management Plan, it is recommended that the Program be reviewed periodically and adjusted based upon the availability of new data obtained through Program implementation and/or other data sources generated through the LINAP or related initiatives. The proposed timeline is one possible timeline and may be modified and refined based upon factors such as the actual amount of financial resources available once a stable and recurring revenue source is procured. If the Countywide Water Quality Management District and the revenue source are established faster than anticipated under Phase I, then implementation may move faster, which will accelerate the resulting water quality improvements. If additional funding is procured, implementation may move faster. If implementation moves more slowly than identified above, this will be identified via the Adaptive Management Plan (Section 8.4.11) which may trigger re-evaluation of the program.

Overall implementation of the program recommendations must accommodate several programmatic structure considerations. While the recommended program incorporates and accommodates most of these considerations, a detailed discussion of each is provided in the following section along with recommendations to overcome hurdles that have been preliminarily identified as potential obstacles to program administration.

8.1.1 Recommended Sanitary Code Changes for I/A OWTS Upgrades

Recommendations for Sanitary Code changes that would facilitate upgrades to I/A OWTS were generated through the Article 6 Work Group. The Article 6 Work Group is composed of County

Figure 8-1 Subwatersheds Wastewater Plan Conceptual Program Timeline



Notes
1. Blue Font = new requirement set forth in that particular year; Black Font = preexisting requirement(s) set forth in previous years(s).
2. Retrofits include upgrade of existing OSDS only (no new construction or building addition). New Construction = new construction on vacant land for purposes of this figure.
3. Upgrade rates shown are estimated using the best available data and are rounded for simplification.
4. All dollar values shown are estimated capital costs in current dollars (no inflation) for grants to offset costs to property owners through a stable and recurring revenue source and/or existing funding mechanisms (SIP, CPF, etc.)
5. WWT = Wastewater Treatment via individual I/A OWTS, Sanitary Sewer Connection, or Clustering. All costs based upon use of I/A OWTS; however, select parcels may benefit more from connection to existing sewer districts, connection to a new STP, or through the use of clustered/decentralized systems. Final recommendations for targeted sewer expansion areas and/or clustered systems to be provided once a stable and recurring revenue source and Countywide Wastewater Management District have been established.
6. Revision to Appendix A of the Construction Standards in 2020 includes revised setbacks based on land use and increase in allowable flow up to 30,000 gpd.
7. 2019-2023: assumes a $12 to $20 Million annual incentive allotment from State and County SIP and Town CPF programs to fund voluntary upgrades and upgrades at new construction with a building addition. Funding range to account for uncertainty in funding availability wherein $12 million represents minimum available to maintain County/NYS SIP programs and $20 million represents the maximum funding need to fund existing voluntary plus building addition upgrades.
8. 2024-2069: assumes $12 Million annual incentive allotment to fund 600 voluntary upgrades within priority areas and failures outside of mandated area.

Legislators, County staff, staff from various Towns/Villages, and non-governmental organizations. Since the inception of the Work Group in October 2016, there have been 15 meetings of the group to discuss policy changes, specific language included in Article 6 amendments, and implementation of enacted policy changes, etc.

The proposed recommendations agreed upon by the Work Group and evaluated as part of the recommendations for a Countywide wastewater upgrade program include the following:

- New Construction – All new construction on vacant land and building additions that require upgrade of an existing sanitary system would be required to upgrade to I/A OWTS.
- Property Transfer – All property transfers occurring within priority areas would be required to upgrade to I/A OWTS unless the property has already installed an I/A OWTS or will access advanced wastewater treatment through connection to an existing sewage treatment plant (STP) or a proposed STP or clustered system that has been approved by the RME.
- System Failure – All sanitary systems located within priority areas and meeting the definition of failure as defined in §760 603(17) of Article 6 of the Suffolk County Sanitary Code effective January 1, 2019 would be required to upgrade to I/A OWTS, unless the property has already installed an I/A OWTS or will access advanced wastewater treatment through connection to an existing STP or a proposed STP or clustered system which has been approved by the RME.

A summary of the key elements and rationale supporting these recommendations is provided below.

8.1.1.1 New Construction

As discussed within this SWP, Suffolk County sits atop a sole source drinking water aquifer with observed increasing nitrogen concentration trends in almost all of our groundwater, drinking water, and surface water resources. While some water resources in the County may exhibit acceptable water quality today, predicted load reduction goals coupled with the observation of increasing nitrogen trends suggest that these water bodies may be subject to the same fate as the impaired waters if initial action is not taken immediately.

Requirements for wastewater upgrades at New Construction represents the most logical first step in implementing a Countywide wastewater management program to prevent additional impacts from future development. In short, the use of advanced wastewater treatment through I/A OWTS should become the minimum conforming system requirement in Suffolk County.

The Countywide buildout evaluation discussed in Section 2.1.5.3 estimates that with no I/A OWTS implementation, nitrogen loading to approximately 163 water bodies in Suffolk County would increase and approximately 57 of the water bodies are estimated to see a nitrogen load increase of greater than 10 percent. The data indicate that requiring upgrades at New Construction to I/A OWTS can mitigate potential increases of total nitrogen loads above current conditions and therefore represents a critical component of the overall wastewater management strategy in Suffolk County. In addition, water bodies with the highest predicted buildout potential may benefit from additional strategies to mitigate new nitrogen loads such as revisions to local zoning, increase in the Article 6 minimum lot size, and/or revisions to existing TDR programs. This is discussed further in Section 8.4.7.

Adjacent proximal jurisdictions that have already implemented a requirement for I/A OWTS at New Construction include Rhode Island and Maryland. Rhode Island is the first jurisdiction in the northeast to implement a requirement for nitrogen removing septic systems on new construction. Rhode Island requires I/A OWTS on all applications for new building construction, alterations, and repairs in state-defined Critical Resource Areas (CRAs). CRAs are defined as the Salt Pond Area watershed, the Narrow River area watershed, and watersheds for all drinking water supply wells. Maryland also requires I/A OWTS for new construction in the designated critical area which is defined as land within 1,000 feet of tidal waters or all sites with a flow of 5,000 gallons per day or greater.

Requirements for New Construction should be subdivided into two categories for the purposes of wastewater management:

1) New Construction on vacant land; and

2) New Construction with a building addition.

It should be noted that New Construction with a building addition should also be subdivided into additional subcategories of "minor" building addition versus "major" renovation.

Countywide I/A OWTS annual upgrade rates for New Construction on both vacant land and with a building addition were estimated using the SCDHS Office of Wastewater Management (OWM) permit tracking database "Blacksmith". Specifically, all final approvals of constructed works were queried between the years 2013 through 2016 for both residential and commercial parcels. A summary of the data is provided below in **Table 8-2**.

Table 8-2 Summary of New Construction Final Approvals between Years 2013 and 2016 in Suffolk County

SCDHS Wastewater Management Approval Type	2013	2014	2015	2016	Average
Residential Final Approval Issued(1) for New Single-Family Dwelling with Onsite Wastewater Disposal System	699	849	861	1012	**855**
Residential Final Approval Issued for Addition/Accessory Bldg/Accessory Apartment with Onsite Wastewater Disposal System	367	348	335	423	**368**
Commercial Final Approvals Issued for New Other-than-Single-Family Building with Onsite Wastewater Disposal System(2)	61	69	54	62	**61**
Commercial Final Approvals Issued for Addition or Change of Use to Existing Building with Onsite Wastewater Disposal System(2)	123	140	108	124	**124**

(1) "Final Approval Issued" means applications that have been constructed.
(2) Assumes 1/3 of Other-Than-Single-Family-Dwelling applications are for construction of new commercial buildings and 2/3 applications are for additions/change of use to existing commercial buildings.

As shown in **Table 8-2**, an average of 855 final approvals were issued for newly constructed residential homes between the years 2013 through 2016; an average of 368 final approvals were issued for residential building additions and accessory apartments; an average 61 final approvals were issued for newly constructed commercial buildings; and, an average of 124 final approvals were issued for existing commercial buildings with a building addition or change of use. The average number of final approvals was used to estimate the annual revenue needs to offset wastewater upgrade costs for construction of a new addition to an existing building and were taken into consideration for industry ramp-up.

8.1.1.2 Property Transfer

Property transfer represents a unique and significant opportunity to facilitate wastewater upgrades in Suffolk County. First, based upon data provided by the New York Association of Realtors, there were an average of 15,616 property transfers per year between the years 2015 and 2018, which represent approximately 3.39 percent of the 459,398 homes (U.S Census Bureau, 2017 American Community Survey) in Suffolk County (**Table 8-3**). As discussed further within this report, this denotes the highest potential annual upgrade rate of the potential Sanitary Code policy options that have been recommended through the Article 6 Work Group and explored further within this SWP. Second, property transfer typically involves the transaction of significant monetary resources wherein the cost for a wastewater upgrade would, for most property transactions, represent a fraction of the overall transaction value. For example, the average residential property sold price for Suffolk County from January 2017 to January 2019 was $360,588; so the cost of an I/A OWTS installation would represent 5.5 percent of the sale cost (MLS LI, http://links.mlsstratus.com/actrep/2019/January/Suffolk.pdf). In addition, because most transactions involve financing through mortgages, the cost of wastewater upgrades can be distributed over the lifetime of the mortgage, which can significantly reduce the initial cost burden to property owners; however, property values in Suffolk County can vary dramatically geographically; as such, areas with low property values or those with limited financial means may warrant special consideration as discussed below. Finally, adding a requirement for septic system inspection on property transfer can be a plausible mechanism to promote I/A OWTS upgrades during the ramp-up period prior to requiring I/A OWTS upgrades. The New York State Property Condition Disclosure Act requires completion of a standard form disclosure statement that covers mechanical systems and services. However, there is no specific requirement or procedure to report septic system and cesspool inspections. The adoption of a consumer protection ordinance requiring inspection of wastewater systems in residential property transactions by certified inspectors and engineers will standardize reporting and assist the County in building a database of failed and substandard systems.

Table 8-3 Number of Homes Sold in Suffolk County, NY

Number of Homes Sold in Suffolk County, New York				
	2015	***2016***	***2017***	***2018***
January	784	977	1,121	1,190
February	747	980	1,023	959
March	858	1,002	1,201	1,107
April	898	1,038	1,090	1,052
May	977	1,123	1,399	1,349
June	1,220	1,510	1,624	1,582

Number of Homes Sold in Suffolk County, New York				
July	1,469	1,547	1,553	1,568
August	1,470	1,813	1,885	1,768
September	1,294	1,445	1,593	1,420
October	1,294	1,346	1,495	1,619
November	1,166	1,409	1,472	1,391
December	1,344	1,463	1,443	1,417
Total	**13,438**	**15,653**	**16,899**	**16,472**
Average Number of Homes Sold (2015 through 2018)				15,616

Source: New York State Association of Realtors

I/A OWTS upgrade on property transfer has precedence in Rhode Island, where the Cesspool Phase-out Act requires that any cesspool serving a property subject to sale or transfer with a closing date on or after January 1, 2016 must be removed from service within one year of the closing date. The cesspool must be replaced with a code compliant conventional septic system or an I/A OWTS if the property is within a State defined CRA.

Many jurisdictions have mandated septic system inspections on property transfers. Legislation in these jurisdictions is designed to protect potential homebuyers and to identify systems in need of repair or upgrade to prevent system failures. In many instances, if a failed or substandard system is identified it must be upgraded to a code-compliant system in order to receive mortgage financing. States where towns or counties operate with some form of property transfer inspection law are Massachusetts, Rhode Island, New York, Ohio, Arizona, Washington, Oregon, Wisconsin, Minnesota, California, Michigan and Iowa. The State of Massachusetts requires that onsite wastewater disposal systems are upgraded to I/A OWTS upon property transfer in the Nitrogen Sensitive Area under Title 5 MassDEP guidelines and this is when the majority of upgrades occur.

In New York, there is precedence for inspection of septic systems on property transfer in both Erie County and Wyoming County. If the system fails inspection, a code-compliant system must be installed before a certificate of occupancy can be issued for the property.

Finally, while the upgrade of an existing OSDS to an I/A OWTS will typically represent a fraction of the overall transaction price, it must be acknowledged that there are some transactions where the average transaction value is significantly lower than the countywide average. Specific examples include geographic property value variability and certain transaction types, such as the purchase of foreclosed properties. These transactions may warrant special consideration or exemption when developing the Sanitary Code amendments to facilitate upgrades at property transfer and/or may warrant the allocation of grant funding or low-cost loans for prospective property owners.

8.1.1.3 System Failure

Similar to property transfer, system failure represents a unique and important opportunity to facilitate wastewater upgrades. In March of 2017, SCDHS surveyed 20 percent of the 380 licensed liquid waste contractors and determined that 2,057 septic systems and cesspools required modification and / or repair each year. When extrapolated to the entire liquid waste industry, it is estimated that an average of 8,100 or 2.25 percent of all properties within Suffolk County with an OSDS experience system failure each year. If upgrades were required at system failure, it would represent the second highest amount of wastewater upgrades per year of the evaluated policy options. The framework for requiring upgrades to the minimum conforming system has already been established in Suffolk County through the recent amendment of Article 6 of the Suffolk County Sanitary Code that requires any replacement or retrofit of an existing sewage disposal system, where no new construction is proposed, to comply with the SCDHS standards in effect at the time of the replacement or retrofit. Therefore, if a property owner has a cesspool and needs to replace it or add an overflow cesspool, they would also be required to install a septic tank preceding the cesspools and the cesspools would have to be constructed with pre-cast concrete.

Table 8-4 Estimated Onsite Treatment System Failure Rates in Surveyed States

State	Estimated system failure rate (percentage)	Failure definition
Alabama	20	Not given
Arizona	0.5	Surfacing, backup, surface or ground water contamination
California	1–4	Surfacing, backup, surface or ground water contamination
Florida	1–2	Surfacing, backup, surface or ground water contamination
Georgia	1.7	Public hazard
Hawaii	15–35	Improper construction, overflow
Idaho	20	Backup, surface or ground water contamination
Kansas	10–15	Surfacing, nuisance conditions (for installations after 1980)
Louisiana	50	Not given
Maryland	1	Surfacing, surface or ground water contamination
Massachusetts	25	Public health
Minnesota	50–70	Cesspool, surfacing, inadequate soil layer, leaking
Missouri	30–50	Backup, surface or ground water contamination
Nebraska	40	Nonconforming system, water quality
New Hampshire	<5	Surfacing, backup
New Mexico	20	Surfacing
New York	4	Backup, surface or ground water contamination
North Carolina	15–20	Not given
North Dakota	28	Backup, surfacing
Ohio	25–30	Backup, surfacing
Oklahoma	5–10	Backup, surfacing, discharge off property
Rhode Island	25	Not given
South Carolina	6–7	Backup, surface or ground water contamination
Texas	10–15	Surfacing, surface or ground water contamination
Utah	0.5	Surfacing, backup, exceed discharge standards
Washington	33	Public health hazard
West Virginia	60	Backup, surface or ground water contamination
Wyoming	0.4	Backup, surfacing, ground water contamination

[a] Failure rates are estimated and vary with the definition of failure.

Per §760-603(17) of Article 6 of the Suffolk County Sanitary Code effective January 1, 2019, a failed system is currently defined as follows but may be subject to future revisions:

"Any Cesspool or Individual Sewerage System that does not adequately treat and/or disperse wastewater so as to create a public or private nuisance or threat to public health or environmental quality, as evidenced by and including, but not limited to, one or more of the following conditions:

1. Continued failure to accept wastewater into the building sewer;

2. Continued discharge of wastewater to a basement, subsurface drain, stormwater collection, conveyance or treatment device, or watercourse unless expressly permitted by the Department;

3. Wastewater rising to the surface of the ground over or near any part of an OWTS or seeping from the Absorption Area at any change in grade, bank or road cut;

4. Where pumping of the Cesspool, septic tank, I/A OWTS, or Leaching Structure is required four or more times per year due to the infiltration of groundwater into the system, a collapsed Leaching Structure, or clogged Absorption Area which does not allow effluent to infiltrate the surrounding soils. This condition excludes grease trap maintenance or commercially reasonable, regular/scheduled preventative maintenance of a Cesspool, septic tank, I/A OWTS, or Leaching Structure. The Department may promulgate Standards pursuant to this Article defining commercially reasonable, regular/scheduled preventative maintenance;

5. Where groundwater seeps into a septic tank, Cesspool, pump tank/basin, distribution box/manhole, or Leaching Structure after it is pumped;

6. Any structural damage or deterioration that has caused structural damage to the Individual Sewerage System, as determined by a New York State Licensed Design Professional or a contractor/Developer holding an active Liquid Waste License pursuant to Suffolk County Code Chapter 563, Article VII (Septic Industry Businesses) through the Suffolk County Department of Labor, Licensing and Consumer Affairs. A determination of structural damage or deterioration that causes structural damage by a New York State Licensed Design Professional (registered architect or licensed professional engineer) shall supersede a Liquid Waste License holder's determination."

Consistent with the recommendations for new construction and building upon the recent code amendments, upgrade to I/A OWTS at system failure could represent upgrade to the new minimum conforming system in Suffolk County.

Requiring sanitary upgrades at system failure has precedence in many United States jurisdictions as many States require failed systems be replaced with a permitted code-compliant septic system. Regionally, Massachusetts, Rhode Island and Maryland have taken this requirement a step further and currently require the use of I/A OWTS upon system failure in defined critical areas. Massachusetts requires failing systems be upgraded to I/A OWTS within the Nitrogen Sensitive Area under Title 5 MassDEP guidelines, and local towns can have additional requirements for when installation of an I/A OWTS is necessary.

8.1.2 Article 6 Sanitary Code Changes and Construction Standards for Appendix A Systems

SCDHS has standards for the approval and construction of sewage treatment facilities that are capable of reducing effluent wastewater to 10 mg/L or less of nitrogen. These standards are included in Appendix A and Appendix B of the "Standards for Approval of Plans and Construction for Sewage Disposal Systems for Other Than Single-Family Residences". Appendix A systems include packaged STPs approved by the SCDHS for flows of less than or equal to 15,000 gallons per day (gpd). Appendix B systems include systems with flows greater than 15,000 gpd and may include packaged or conventional treatment plants. Appendix A systems represent an important tool in the toolbox of wastewater management because they generally have reduced aboveground footprints, are less costly, and can accommodate reduced setbacks when compared to Appendix B systems. For comparative purposes, Appendix B systems typically require a minimum lot size of four acres to meet the required setbacks while Appendix A systems require a minimum lot size of 0.6 acres to meet the required setbacks. In 2017, there were 45 Appendix A systems sited in Suffolk County. The average effluent total nitrogen concentration of the systems in steady-state was 6.1 mg/L. It should also be noted that of the 88 odor complaints received between 2009 and 2019, only two complaints were for Appendix A systems.

Based upon input from industry professionals and other stakeholders, in many cases, Appendix A systems represent the only viable wastewater management strategy where a shared wastewater collection and treatment plant is required. Specific examples could include locations where the use of I/A OWTS is not feasible (e.g., micro lots, high groundwater, site limitations, etc.), for upgrade/replacement of the 1980's failed passive denitrification systems, small downtown hamlets where land availability for siting an STP is limited, and for existing residential developments where land availability for siting an STP is limited (e.g., single family residential neighborhoods, apartments, condominiums, and townhouses). While the existing "Standards for Approval of Plans and Construction for Sewage Disposal Systems for Other Than Single-Family Residences" requirements provides provisions for reduced setbacks, the existing setbacks still preclude using Appendix A systems to cluster existing residential, commercial, or mixed-use projects in many cases. In addition, the flow limitation of 15,000 gpd can prevent property owners from pursuing advanced wastewater treatment because Appendix B systems can be cost prohibitive. Finally, while the existing permitting and oversight process for STPs in Suffolk County assures project quality control and provides a mechanism for long-term management of the system, it is generally not a viable and cost-effective approach for smaller clustering projects, such as Appendix A projects.

In summary, Appendix A systems represent an important wastewater management method in Suffolk County but their use is currently limited by existing flow limitations, setback requirements, and the administrative and financial burden associated with installing STPs in Suffolk County. Recommendations for revisions to "Appendix A of the Standards for Approval of Plans and Construction for Sewage Disposal Systems for Other Than Single-Family Residences" and Article 6 of the Suffolk County Sanitary Code are provided below along with initial recommendations on the development of an administrative structure that would reduce the administrative and cost burden associated with the regulatory oversight of Appendix A systems in Suffolk County. Finally, the recommendations provided herein pertain to changes in the Sanitary Code and commercial standards only. Individual projects will still require consideration of siting requirements as described in Section 8.1.2.3 and require project-specific SEQRA compliance to evaluate all potential environmental impacts associated with the project.

8.1.2.1 Appendix A System Setback Requirements

An evaluation of the setback requirements for Appendix A systems was completed that considered:

- Historical framework for Appendix A setback establishment;
- Comparison to setbacks for proximate jurisdictions;
- Comparison to current setbacks for I/A OWTS under Article 19; and,
- Potential nuisances associated with reduced setbacks and mitigation options.

The findings of the evaluation are provided below.

8.1.2.1.1 Historical Framework

The original framework for Appendix A systems was set forth in the 1984 Appendix A "Standards for Construction of Modified Sewage Disposal Systems". As discussed in Subsection 1.1.6 of the SWP, the original Modified Sewage Disposal Systems included passive denitrification systems comprised of a buried aerobic sand filter for nitrification followed by an upflow denitrification filter that was charged with sulfur and limestone. Since the overall maintenance requirements and potential nuisances associated with the passive denitrification systems were anticipated to be the same as a conventional OSDS, the setback requirements for the original Appendix A Modified Sewage Disposal Systems were consistent with the setbacks required for conventional OSDS. Unfortunately, these systems failed due to a combination of factors and their use was revoked by the NYSDEC in 1991.

In 1995, the SCDHS revised the Appendix A standards by permitting the use of the Cromaglass system. In addition, the Appendix A standard was modified to require increased setbacks for Modified Sewage Disposal Systems. The increased setbacks were established based on NYSDEC requirements for the design of intermediate sized wastewater treatment plants (NYSDEC 2014). In 2003, Suffolk County issued draft revisions to the Appendix A standards which permitted reduced setbacks if engineering controls for odors and aerosols were employed. The revisions were adopted and have remained in effect since 2005.

In summary, historical setbacks for Modified Sewage Disposal Systems as defined in Appendix A of the Standards for Construction of Modified Sewage Disposal Systems have varied based upon individual technology requirements.

8.1.2.1.2 Comparison to Setbacks in Proximate Jurisdictions

Suffolk County contacted eight proximal jurisdictions to evaluate regional setback requirements for STPs. A summary of the regional setback requirements is provided in **Table 8-5**. In summary, while individual requirements vary by locality, most jurisdictions allow minimal setbacks as long as engineering controls are utilized to mitigate any potential hazards and nuisances. In some locations, the setbacks are reduced for below-ground treatment units but not for above-ground treatment units. In most locations, setbacks are maximized to the extent practical for residential and recreational land uses.

Table 8-5 Sewage Treatment Plant Setback Requirements in Other Jurisdictions

Municipality/ Agency	STP Flow Regulated	Required Setback to Property Lines	Required Setback to Habitable Bldgs	Recommended Setback	Codes/ Standards/ Regulations	Contact Information
New Jersey Department of Environmental Protection	All Treatment Works	None (see note 1)	None (See note 1)	500 ft to property line w/o engineering controls (controls may be required at the discretion of the municipality) (1)	NJPDES Rules N.J.A.C. 7:14A	Tracy Shevlin, PE Div Water Quality South Contact Person (609) 633-1169
Connecticut Department of Environmental Protection	Municipal Wastewater	None	None	300 ft habitable buildings w/o engineering controls (controls may be required at the discretion of the municipality) (2)	New England Interstate Water Pollution Control Commission TR16 – guides for the Design of Wastewater Treatment Works (2)	Rowland Denny Bureau of Water Protection & Land Reuse Engineer (860) 424-3704
Rhode Island Department of Environmental Management	Greater Than 5,000 GPD	None	None	300 ft habitable buildings w/o engineering controls for processing units in conventional treatment plants and sludge processing facilities.	New England Interstate Water Pollution Control Commission TR16 – guides for the Design of Wastewater Treatment Works	Bill Patenaude Office of Water Resources – Permitting (401) 222-3961 ext 7264
Massachusetts Department of Environmental Management	10,000 GPD to 150,000 GPD	Treatment Plant: 50 ft Pump Station: 25 ft Subsurface Tank: 10 ft Leaching Facility: 25 ft Sewer / Force Main: 10ft	Treatment Plant: 50 ft Pump Station: 25 ft Subsurface Tank: 10 ft Leaching Facility: 25 ft Sewer / Force Main: 10ft	N/A	MADEP - Guidelines for the Design, Construction, Operation, and Maintenance of Small Wastewater Treatment Facilities with land Disposal	David Ferris The Bureau of Resource Protection Innovative & Alternative Technologies (617) 654-6514
Maryland Department of the Environment	All Wastewater Treatment facilities	None (3)	None (3)	None (3)	State: Environment Article, Title; Comar 26.03.12	Dr. Ta Shon Yu Water Quality Infrastructure Program Contact (410) 537-3758
Georgia Environmental Protection Division	10,000 GPD to 150,000 GPD	10 ft below ground unit 150 ft above ground unit (4)	10 ft below ground unit 300 ft above ground unit (4)	N/A	GA EPD – Large Community Design Guidance	Mark Beebe Engineering & Tech Support – Wastewater (404) 675-6232

Municipality/ Agency	STP Flow Regulated	Required Setback to Property Lines	Required Setback to Habitable Bldgs	Recommended Setback	Codes/ Standards/ Regulations	Contact Information
Florida Department of Environmental Management	Greater than 10,000 GPD Commercial projects Greater than 5,000 GPD	None	None	None (5)	FL – Chapter 62-600 Domestic Wastewater Facilities	Sharon Sawicki Domestic Wastewater Program Administrator (850) 245-8606
Pennsylvania Department of Environmental Protection	Greater than 10,000 GPD	None	None	250 Ft to occupied dwellings or recreational areas w/o engineering controls (controls may be required at the discretion of the municipality) (6)	PA DEP: Domestic Wastewater Facilities Manual	Donna Smith Sewage Planning Specialist Bureau of Water Quality Protection (814) 332-6942

(1) (2) (5) (6) Recommend maximizing the distance to residential parcels to the extent practicable.

8.1.2.1.3 Comparison to Article 19 of the Suffolk County Sanitary Code

Article 19 of the Suffolk County Sanitary Code was adopted by the Suffolk County legislature in 2016. For the first time, Article 19 permitted the use of I/A OWTS in Suffolk County. As documented previously in this SWP, I/A OWTS include prepackaged individual onsite treatment systems capable of reducing total nitrogen (TN) to less than 19 mg/l. I/A OWTS use the same unit biological processes typically used in STPs to reduce TN but on a smaller scale. In addition, I/A OWTS are typically buried below grade, minimizing the potential for direct exposure to raw sewage if a leak were to occur. Finally, because the effluent TN requirement for I/A OWTS is less stringent (19 mg/L) when compared to STPs (10 mg/L), maintenance requirements, including pump out frequency, are typically less intense for I/A OWTS.

The setback requirements for I/A OWTS approved under Article 19 are consistent with those required for conventional systems as defined in the Standards for Approval of Plans and Construction for Sewage Disposal Systems for Single-Family Residences and the Standards for Approval of Plans and Construction for Sewage Disposal Systems for Other Than Single-Family Residences (e.g., commercial standards). A summary of I/A OWTS setback requirements for single-family residential and for other than single-family residential projects is provided below in **Tables 8-6** and **8-7**, respectively.

Table 8-6 Setback Requirements for I/A OWTS on Single-Family Residential Properties

Table of Minimum Horizontal Separation Distances From:	Septic Tank, I/A OWTS Pump Station, or Manhole	Leaching Structure/System (including expansion)	Sewer Line, Force Main
Building with Cellar/Basement	10 ft.	10 ft.	5 ft.

Table of Minimum Horizontal Separation Distances From:	Septic Tank, I/A OWTS Pump Station, or Manhole	Leaching Structure/System (including expansion)	Sewer Line, Force Main
Building on Slab	5 ft.	10 ft.	5 ft.
Porches, decks, house overhangs, cantilevers, etc.	5 ft.	5 ft.	5 ft.
Water Service Line/Laterals/Mains [1]	10 ft.	10 ft.	10 ft.
Underground Utilities	5 ft.	5 ft.	5 ft.
Surface Waters [2]	75 ft.	100 ft.	50 ft.
Public Water Well	200 ft.	200 ft.	50 ft.
Private Well [3]	75 ft.	100/150 ft.	50 ft.
Non-Potable Water Well	50 ft.	50 ft.	50 ft.
Road Storm Drains/Stormwater Recharge Basin [4]	20 ft.	20 ft.	10 ft.
On-site Drywells/Drainage Structures [4]	10 ft	10 ft	10ft
Catch Basins (non-leaching)/Drainage Pipe [5]	5 ft.	10 ft.	5 ft.
Leaching Pool	8 ft.	8 ft.	5 ft.
Septic Tank, Pump Station, or Manhole[6,8]	5 ft.	8 ft.	5 ft.
Property Lines	5 ft.	5 ft.	5 ft.
Swimming Pool	20 ft.	20 ft.	5 ft.
Retaining Wall (water proof) [7]	10 ft.	10 ft.	5 ft.
Fuel Storage Tanks (below ground)	10 ft.	10 ft.	10 ft.
Bluffs	65 ft.	65 ft.	65 ft.

Table 8-7 Setback Requirements for I/A OWTS on Commercial Properties

Table of Minimum Horizontal Separation Distances From:	Septic Tank, I/A OWTS, Pump Station, Grease Trap, or Manhole	Leaching Structure [3]	Sewer Line, Force Main
Building with Cellar	10 ft.	10 ft.	5 ft.
Building on Slab	5 ft.	10 ft.	5 ft.
Water Service Line/Laterals/Mains [5]	10 ft.	10 ft.	10 ft. [4]
Underground Utilities	5 ft.	5 ft.	5 ft.
Surface Water/Regulated Wetlands	75 ft.	100 ft.	50 ft.
Public Water Well [2]	200 ft.	200 ft.	50 ft.
Private Well [1]	100 ft.	150 ft.	50 ft.
Storm Drain/Stormwater Recharge Basin [5]	20 ft.	20 ft.	10 ft.
Catch Basins (non-leaching)/Drainage Pipe[6]	5 ft.	10 ft.	5 ft.
Leaching Structure[8]	8 ft.	8 ft.	10 ft. [7]
Septic Tank, Pump Station, Grease Trap, or Manhole[9]	5 ft.	8 ft.	5 ft.

Table of Minimum Horizontal Separation Distances From:	Septic Tank, I/A OWTS, Pump Station, Grease Trap, or Manhole	Leaching Structure [3]	Sewer Line, Force Main
Property Lines	5 ft.	10 ft.	5 ft.
Swimming Pool	20 ft.	20 ft.	5 ft.
Retaining Wall (water proof)	10 ft.	10 ft.	5 ft.
Fuel Storage Tanks (below ground)	20 ft.	20 ft.	10 ft.
Top of Embankment or Steep Slope (15 % slope or greater)	25 ft.	25 ft.	25 ft.
Bluffs	65 ft.	65 ft.	65 ft.

8.1.2.1.4 Potential Nuisances and Mitigation

Impacts that could potentially result from operation of an Appendix A system should be considered when evaluating potential set-backs. Potential impacts of Appendix A operation and associated mitigating measures are identified below:

- Odors and aerosol emissions –can be mitigated by subsurface tankage and by incorporation of odor control into the design as currently required in the standards to qualify for reduced setbacks;

- Noise – can be mitigated by incorporating sound attenuation into the system design as currently required in the standards to qualify for reduced setbacks. To continue to realize this benefit, the requirements for sound attenuation currently provided in the standards will be required to be met at the most stringent setback on the revised recommended setbacks (for example, at 10 feet for commercially zoned projects); and

- Increased water table – while the depth to groundwater and permeability testing are required for system designs, water table mounding evaluations should be completed to assess the potential for offsite impacts (e.g., flooding), particularly for coastal areas and where setback reductions are proposed.

- Growth inducement – while the recommended revisions to the requirements for Appendix A systems are intended to make the Appendix A systems more flexible for use as a wastewater management tool to address wastewater nitrogen loading from unique areas such as downtown hamlets, it is recognized that the proposed increase of the design flow may allow for a parcel or lot to meet its development potential under current zoning. This would be specific to a parcel where development was limited by sanitary wastewater treatment availability such as could potentially exist in an existing downtown area. As a program enhancement and to ensure that all future Appendix A projects result in a net nitrogen reduction benefit, all new Appendix A systems located within sensitive areas will be required to achieve a minimum 10 percent reduction of nitrogen from current 'as-of-right' Article 6 standards. It is recommended that SCDHS General Guidance Memorandum #28 – "Guidelines for Siting Proposed or Expanded Sewage Treatment Plants" be updated with the recommendations below and be incorporated into the Standards for Approval of Plans and Construction for Sewage Disposal Systems for Other Than Single-Family Residences as an appendix. It is recommended that the memorandum be revised to require an overall effluent nitrogen load of at least 10 percent lower than required as-of-right per the Article 6 density requirements for all proposed Appendix A systems to be installed within the 0 to 25-year travel time to surface waters for eastern Suffolk, within the 0 to 50- year travel time to surface waters for western Suffolk, and within the 0 to 50-year travel time to public supply wells.

8.1.2.1.5 Recommended Setbacks

Revisions to the recommended setbacks have been established in consideration of the setback requirements and engineering mitigation options described above. In general, the revised setbacks considered the following guiding principles:

1. Existing, readily available, engineering controls are available to mitigate potential nuisances associated with reduced setbacks;
2. Precedence exists for reduced setbacks for STPs and I/A OWTS within proximate jurisdictions. In general, most proximate jurisdictions allow minimal setbacks when appropriate engineering controls are provided;
3. Reduced setbacks should consider existing property use and adjacent property use; and,
4. Reduced setbacks should consider direct exposure risks to the public, and more specifically, whether treatment tanks are above ground or below ground.

The revised proposed setbacks are summarized on **Table 8-8**.

Table 8-8 Proposed Setback Requirements for Appendix A Systems

Recommended Setbacks for Appendix A STPs						
		Distance to Structure and Neighboring Property Line:				
Property Use Served By Appendix A STP	**STP Structure**	**Habitable Structure (feet)**	**Non-Habitable Structure (feet)**	**Residential Property Line (feet)**	**Mixed Use Property Line (feet)**	**Commercial Property Line (feet)**
Residential Use i.e. Single-Family, Condos, Townhouses, Apartments, Co-Ops	**Enclosed STP w/below grade tanks + Odor Control (Less Than or Equal to 15,000/30,000 gpd – Appendix A)**	75	50	75	25	10
Commercial	**Enclosed STP w/below grade tanks + Odor Control (Less Than or Equal to 15,000/30,000 gpd – Appendix A)**	10	10	75	25	10

Recommended Setbacks for Appendix A STPs						
		Distance to Structure and Neighboring Property Line:				
Mixed Use w/ more than 25% of the site commercial use	**Enclosed STP w/below grade tanks + Odor Control (Less Than or Equal to 15,000/30,000 gpd – Appendix A)**	25	10	75	25	10
All Uses	**Enclosed STP w/above grade tanks w/o Odor Control (Less Than or Equal to 15,000/30,000 gpd – Appendix A)**	200	100	150	150	150
All Uses	**Enclosed STP w/above grade tanks w/Odor Control (Less Than or Equal to 15,000/30,000 gpd – Appendix A)**	75	50	75	75	75
All Uses	**Leaching Structures**	10	10	10	10	10

As shown in **Table 8-8** proposed setbacks are provided for a variety of property use scenarios. For proposed Appendix A systems with below grade tanks, reduced setbacks are permitted. The proposed reduction in setback is related to the land use of both the subject property and neighboring properties. Properties designated as residential land use have the most stringent setback requirements while properties designated as commercial land use have the lowest setbacks. Projects that propose to use above-grade tanks and do not provide odor control would be subject to the same setback requirements as defined in the existing Appendix A standards. Likewise, properties with above grade tanks and odor control would be subject to the same reduced setback requirements as defined in the existing Appendix A standards.

Finally, the proposed setbacks for leaching structures have been reduced to be consistent with the current requirements for I/A OWTS.

8.1.2.2 Recommendations for Appendix A Flow Requirements

Suffolk County has not reviewed the standards for Appendix A systems relative to flow requirements since 2005. The existing flow limitation of 15,000 gpd for Appendix A systems was set forth in the Appendix A standards for Modified Sewage Disposal Systems based upon the anticipated and demonstrated flow capacity of the failed passive denitrification systems of the 1980s and the first Appendix A "prepackaged" CROMAFLOW system capacity. Since 1994, the pre-packaged STP industry has significantly evolved and expanded, including the introduction of a variety of prepackaged STP technologies that are capable of handling higher flows. To acknowledge and accommodate current technology ability and provide a mechanism for expanded use of Appendix A systems in Suffolk County, it is recommended that Article 6 of the Suffolk County Sanitary Code be modified to facilitate a technology-specific means whereby individual Appendix

A technologies can be approved for use up to 30,000 gallons per day. New York State does not require treatment to reduce nitrogen to less than 10 mg/L for flows less than 30,000 gpd, however design flows, treatment requirements and setbacks are regulated in Suffolk County through the Sanitary Code and Construction Standards. In order for individual technologies to be approved for use up to 30,000 gallons per day, individual manufacturers would be required to provide an engineering report, or similar document, that demonstrates:

- The technology's ability to reduce total nitrogen to 10 mg/l or less at 30,000 gpd; and,
- The technology's acceptable operational flow range of the system up to 30,000 gpd;

When combined with the recommendations for reduced setbacks, the increased flow allowance should significantly expand the universe of projects that can use Appendix A systems within Suffolk County which would provide benefit towards achievement of the environmental goals set forth in the SWP. Consistent with the adaptive management philosophy of the overall recommendations in the SWP, the performance of the reduced setbacks and technologies approved for flows up to 30,000 gpd should continue to be routinely monitored by the SCDHS and reported in annual reports. Adjustments should be made to the standards for Appendix A systems, as necessary, based upon the findings of the annual reviews.

8.1.2.3 Appendix A Siting Considerations

The recommendations provided for Appendix A systems are intended to facilitate the expanded use of Appendix A systems as a wastewater management method to meet the wastewater management priority areas and load reduction goals recommended in the SWP. In order to meet these objectives, siting requirements for proposed or expanded STPs, as provided in SCDHS General Guidance Memorandum #28, must be implemented. As described in the guidance memorandum, siting of proposed or expanded STPs must consider the potential impacts to existing or planned drinking water supplies, and surface water features such as wetlands, lakes, streams and embayments. Potential impacts to neighboring properties that may occur as a result of elevated groundwater levels or flooding may also be evaluated as required. Specific siting requirements towards fulfillment of the surface water protection and restoration goals of the SWP include the following:

> *"The siting of STP discharges within 0 to 25-year groundwater contributing areas to sensitive surface waters should be minimized to the extent feasible. However, when an STP is located within this travel time, the applicant shall provide an advanced treatment process that consistently reduces the total nitrogen concentration to the maximum practical extent. Also, the SPDES permit conditions issued for these systems shall require the nitrogen discharge goal be significantly lower than 10 mg/l.*
>
> 1. *For STP discharges within 0-to 25-year groundwater contributing areas to sensitive surface waters, the applicant shall demonstrate that the nitrogen mass loading is significantly reduced by the proposed project, as compared with the mass loading that can occur with a development that complies with the density requirements of Article 6 of the Suffolk County Sanitary Code. A total nitrogen concentration of 50 mg/l may be used when calculating the equivalent mass loadings"*

In essence, these requirements ensure that individual projects result in a significant load reduction when compared to the nitrogen load permitted under Article 6 of the Suffolk County Sanitary Code. While there is an existing mechanism in-place that ensures the proposed revisions continue to maintain the same environmental benefit as the existing sanitary code and construction standards, it is recommended that this guidance memorandum be codified by incorporation into the Standards for Approval of Plans and Construction for Sewage Disposal Systems for Other Than Single-Family Residences as an appendix.

Other options that can be considered by policymakers to further ensure that the proposed revisions to Appendix A systems have the intended environmental benefit outcome include:

- Codifying the STP siting requirements set forth in the guidance memorandum into Article 6 of the Suffolk County Sanitary Code. Evaluation of sites to be developed or expanded with Appendix A systems to ensure TN mass loading (at 10mg/L) is less than or equal to Article 6 density equivalent with onsite sewage disposal systems;
- Codifying or amending the guidance memorandum to include additional nitrogen load offsets; and/or;
- Codifying or amending the guidance memorandum to require treatment down to 5 to 7 mg/l total nitrogen.

Finally, the recommendations of the SWP included expansion of the inland priority area boundary for western Suffolk County surface water bodies to the 50-year groundwater contributing area. Based upon the recommended expansion in priority area, General Memorandum #28 should be revised to clarify which surface waters have priority areas to the 50-year groundwater contributing area, and which surface water bodies have priority areas to the 25-year groundwater contributing area. General Memorandum #28 should be expanded and revised to match the environmentally sensitive areas identified in the SWP.

8.1.2.4 Initial Recommendations for Streamlining Approvals for Clustered Systems

8.1.2.4.1 Background

The permitting, approval(s) to construct, and the long-term management for sewering/clustering of existing parcels to a new common treatment system typically involves a complicated process that can involve multi-jurisdictional review of construction plans, the need for sewer agency agreements, the potential need for creation of a District, and additional significant financial burden associated with multiple permit fees and financial assurance requirements. While the process assures project quality control and provides a mechanism for long-term management of the system, it is not a viable and cost-effective approach for smaller clustering projects, particularly for existing homeowners or business owners who wish to provide advanced wastewater treatment but do not have the required space or financial means to do so.

For example, all new wastewater proposals that involve the connection of multiple property owners to a common treatment plant require the execution of a sewer agency agreement with the Suffolk County Department of Public Works (SCDPW). The execution of the sewer agency agreement establishes a long-term mechanism for the continued administrative and financial obligations associated with the operation of the system, in the event that the property owners fail to maintain the system properly due to financial or other reasons. Projects requiring sewer agency agreements ultimately must meet both SCDHS and SCDPW design and construction standards, must obtain construction permits from both agencies (including the payment of associated permit fees for both agencies), and may require financial assurance for both agencies. While this process has proven largely successful, the additional financial and administrative burden is not practical or realistic for smaller projects that might benefit from a clustering approach using Appendix A systems or I/A OWTS; particularly for existing small commercial districts or small residential clustering projects. Finally, some projects with multiple property owners require the establishment of a new sewer district, if deemed necessary by the Sewer Infrastructure Committee.

Ultimately, the existing process in place for the permitting, construction, and long-term maintenance of sewage treatment plants in Suffolk County essentially precludes the use of clustering in areas that may warrant the use of this approach (e.g., in areas that cannot accommodate I/A OWTS or connection to existing municipal treatment facilities).

8.1.2.4.2 Initial Recommendations

The identification of alternatives to streamline and facilitate the use of clustering in Suffolk County is a critical component of the overall wastewater management strategy. Clustering provides an attractive wastewater management option where the use of I/A OWTS or connection to existing sewer districts is not feasible. Suffolk County has partnered with the Long Island Nitrogen Action Plan (LINAP) Project Management Team and the Long Island Regional Planning Council to develop the scope of services for a Countywide Water Quality Management District (WQMD) Feasibility Study (FS) that will assess the financial implications and clarify the process for the establishment and management of a WQMD. The WQMD FS will also evaluate and provide recommendation for the establishment of a stable and recurring revenue source and will evaluate other potential benefits of establishing a WQMD, such as the potential for streamlining approvals, oversight, and funding options for “clustered” systems in Suffolk County (e.g., the clustering of two or more properties to a common I/A OWTS or other advanced wastewater systems).

Specific recommendations that may be provided in the WQMD FS that may facilitate streamlined approvals of clustered Appendix A and I/A OWTS may include:

- Assignment of one set of design standards (e.g., SCDHS or SCDPW, but not both);
- Assignment of a single lead agency for review and permitting; and,
- Recommendations for operation and maintenance (O&M) financial assurance and overall O&M responsibility such as:
  - Establishment of a WQMD;
  - Use of local Town/Village led Districts; and,
  - Identification of maintenance provider options (e.g., SCDPW, Town/Village, master contracts with private maintenance firms, etc.).

8.1.3 Countywide Water Quality Management District

A key recommendation of both the IBM Smarter Cities Challenge report and the Comprehensive Water Resources Management Plan was the establishment of a WQMD. The potential advantages of establishing a WQMD include the establishment of a single entity to provide the administrative organizational structure to manage sewage treatment infrastructure and to oversee the widespread installation of I/A OWTS technologies in areas where sewering is not a practical or a cost-effective alternative. As envisioned, the WQMD would manage sewer and I/A OWTS services separately in a tiered system through which sewered parcels would comprise one tier, and non-sewered (IA/OWTS) parcels, another.

Suffolk County has partnered with the Long Island Nitrogen Action Plan (LINAP) Project Management Team and the Long Island Regional Planning Council to develop the scope of services for a WQMD Feasibility Study (FS) which will assess the financial implications and clarify the process for the establishment and management of a WQMD. The WQMD FS will also evaluate and provide recommendations for the establishment of a stable and recurring revenue source and will evaluate other potential benefits of establishing a WQMD, such as the potential for streamlining approvals, oversight, and funding options for "clustered" systems in Suffolk County (e.g., the clustering of two or more properties to a common I/A OWTS or other advanced wastewater systems).

Specific recommendations set forth in the WQMD FS could require supplemental State Environmental Quality Review Act (SEQRA) evaluation, depending on the scope and nature of the recommendations.

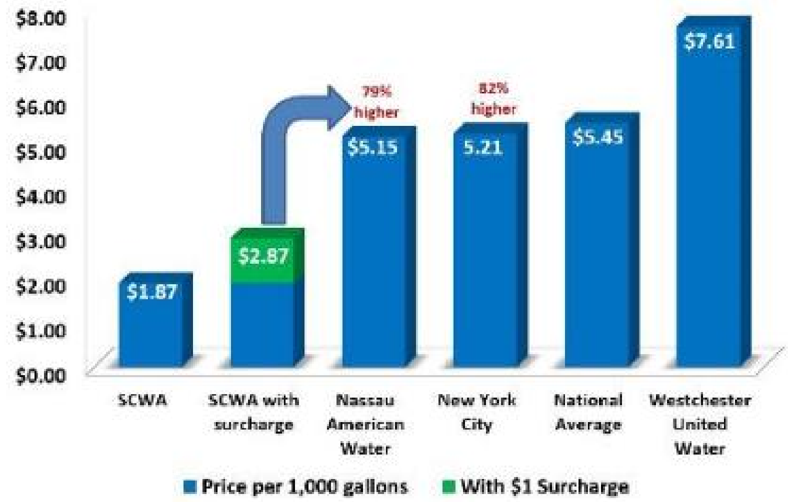
8.1.4 Stable Recurring Revenue Source

Identification and procurement of a stable recurring revenue source is paramount for implementation of the recommendations provided within this Plan. The recommendations provided in the SWP will not be advanced unless a stable, recurring revenue source is established that makes the cost of wastewater upgrades affordable to the residents of Suffolk County. While there are numerous successful models of revenue programs focused on funding wastewater management infrastructure nationally and locally, two example models were evaluated as part of this SWP to identify a range of potential annual revenue streams that could be used to offset the cost of wastewater infrastructure upgrades. The two example models evaluated include: 1) an Aquifer Protection Fee applied as a surcharge on individual public water supply bills; and 2) a Bay Restoration Fee model applied to each parcel's property tax bill and modeled on the Chesapeake Bay Restoration Fund which has been successful in the State of Maryland.

As discussed further within Section 8, the annual amount of funding realized from the stable and recurring source directly impacts the methods of wastewater management that can be pursued (e.g., I/A OWTS versus sewering/clustering) as well the speed at which the program can move forward. A short summary documenting the primary aspects of each program and estimated revenue projections for parallel programs in Suffolk County is provided below.

8.1.4.1 Aquifer Protection Fee

Suffolk County's sole drinking water source emanates from the USEPA designated sole source aquifer that sits below each and every residence in Suffolk County. Most locations in the County are fortunate to have one of the largest and most prolific aquifers in the world due to the unique hydrogeologic setting of Long Island. The result of our abundant water source is that water can be supplied at a fraction of the cost of drinking water when compared to rates nationally. Specifically, the average cost of drinking water per 1,000 gallons in Suffolk County is almost 3 times lower than the national average and 2.5 times lower than Nassau County's average rate. The concept of the Aquifer Protection Fee is simple, a small incremental surcharge would be applied to individual water bills for customers on public water supply to provide a funding source to protect our drinking water and surface waters.



The fee would be based upon water usage and would be collected from those parcels utilizing a public water supply. The fee would be included on the water bill and would be collected by the supplier and remitted to the County. Although it is assumed that an administrative fee would be provided to the water supplier, for purposes of the revenue projections included below that fee has not been deducted.

8.1.4.1.1 Revenue Projections

Based upon records from the SCDHS Office of Water Resources there are 12 public water suppliers that are monitored by the SCDHS. Two of the suppliers are federal entities and have been excluded from the analysis. Total pumpage data per supplier was provided for the years 2010 through 2014. A five-year average pumpage rate per supplier was calculated. The average was then adjusted by a 10 percent volume loss rate, based on Suffolk County Water Authority (SCWA) experience that, on average, a 10 percent volume loss is experienced between the pumped rate and the usage rate.

As shown in **Table 8-9** the projected annual revenue stream under the Aquifer Protection Fee model ranges from an estimated $75,000,000 assuming a $1/1000 gallons used surcharge up to $117,187,500 assuming a $1.50/1000 gallons surcharge. Including a $1/1000-gallon fee, the average cost for public drinking water in Suffolk County is still projected to be nearly 80 percent lower than the cost of drinking water in Nassau County, and nearly two times lower than the cost of water in New York City and the national average. It should also be noted that most jurisdictions locally and nationally have an additional wastewater treatment fee collected above and beyond the cost of water supply, whereas 74 percent of Suffolk County residents currently do not pay any fee for disposal, management, and treatment of their wastewater.

Table 8-9 Potential Revenue(s) from an Aquifer Protection Fee

	Fee Basis		
	$1.00/1000 gal	$1.25/1000 gal	$1.50/1000 gal
Estimated Revenue Stream	$75,000,000	$93,750,000	$117,187,500
Estimated Cost Per Household	$96	$120	$150

8.1.4.2 Bay Restoration Fund

Suffolk County has considered how other jurisdictions approach a stable occurring revenue source to fund wastewater upgrades. Maryland established the Bay Restoration Fund in 2004 to create a specific fund to address poor water quality in the Chesapeake Bay due to nutrient enrichment. According to the Code of Maryland 26.04.02.01, OSDS are required to be upgraded to I/A OWTS (referred to as nitrogen removing best available technology or BAT in Maryland) within the Chesapeake Bay and Atlantic Coastal Bay Critical Areas under the following circumstances:

- New construction;
- Any replacement of a system; or,
- Renovation, repair and change of use of a new or existing residence or other building.

The Chesapeake Bay and Atlantic Coastal Bay Critical Areas are land areas within 1,000 feet of tidal waters. Local jurisdictions have the authority to require an I/A OWTS outside the Critical Area in order to protect public health or the waters of the state.

The Onsite Disposal Systems Fund, part of the Bay Restoration Fund program, became effective July 1, 2012, where a $60 annual fee is collected from each user served by an onsite system. The fee is applied through various means including, but not limited to, individual water bills and property tax bills. The total program annual budget is $24 to $27 million per year, and 60 percent of the funds are used for septic system upgrades and the remaining 40 percent are used for cover crops. The Wastewater Treatment Plants Fund, which also became effective in 2012, is a $5 monthly fee collected from each home served by a wastewater treatment plant. Commercial and industrial users are charged at a rate of $5 per month per equivalent dwelling unit. Fees from wastewater treatment plant users generate an estimated $100 million/year. To expedite the implementation of the program, Maryland issues bonds backed in full or in part by funds generated under this program. As of 2018, the overall Bay Restoration Fund has collected over $1.2 billion dollars in revenues, as shown by **Table 8-10**.

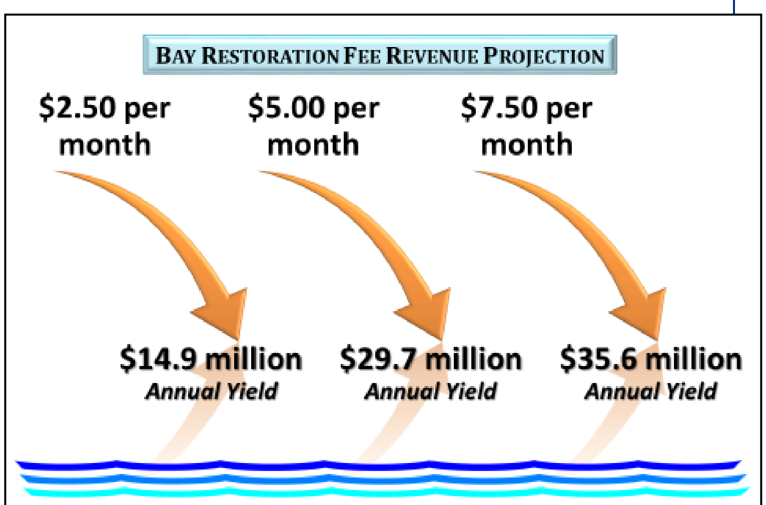
Table 8-10 Maryland Bay Restoration Fund

	2008	2015**	2018
Maryland Department of Environment Wastewater Treatment Fund	$152.03 Million	$ 620 Million	$970 Million
Maryland Department of the Environment Septic System Upgrade Fund	$18.35 Million	$83 Million	$135 Million
Maryland Department of Agriculture Cover Crop Program Fund	$12.33 Million	$64 Million	$99 Million
Total BRF	$ 182.61 Million	$ 767 Million	$1.204 Billion

The Bay Restoration Fund's Onsite Disposal Systems Fund awards approximately 1,000 grants per year for I/A OWTS technology. Grant funding may be used for the cost attributable to upgrading an existing OSDS to Best Available Technology (BAT) for nitrogen removal. For new construction, funding can be used for the cost differential between a conventional OSDS and the I/A OWTS. In accordance with Maryland State Law, the Bay Restoration Fund prioritizes upgrades as follows:

- Failing OSDS in the critical areas;
- Failing OSDS outside the critical areas;
- Non-conforming OSDS in the critical areas;
- Non-conforming OSDS outside the critical areas;
- Other OSDS in the critical areas, including new construction; and,

Other OSDS outside the critical areas, including new construction



8.1.4.2.1 Revenue Projections

Based upon 2014 land use records and an estimated 496,666 developed tax lots in Suffolk County, the projected annual revenue stream under the Bay Restoration Fund model ranges from an estimated $14,900,000 assuming a $30 per year fee up to $44,700,000 assuming a $90 per year fee. While the Bay Restoration Model is attractive because it distributes costs across all parcels in Suffolk County evenly, the estimated revenue streams may be insufficient to drive a countywide wastewater program forward in accordance with the overall goals and objectives discussed within this SWP.

8.1.4.3 Other Funding Sources

There are a variety of existing County and Town funding sources that currently support water quality restoration, including nitrogen mitigation. Two of the primary existing funding sources include proceeds from the Suffolk County ¼% sales tax fund and the East End Town CPF programs. A brief summary of existing programs is provided below.

8.1.4.3.1 Community Preservation Funds

The Community Preservation Fund (CPF) was initially established by voter referendum in 1998, when voters in East Hampton, Riverhead, Shelter Island, Southampton and Southold approved a real estate transfer tax of 2 percent on each transaction occurring in these towns. On November 8, 2016, voters in the five East End Towns extended the CPF to 2050 and also added the opportunity for each Town to invest up to 20 percent of the funds toward water quality improvement projects, which includes funding for the I/A OWTS rebate programs. As of 2017, the CPF programs had already collected over $1.2 billion in revenue (**Table 8-11**), with the majority of funds being collected from the Town of Southampton and the Town of East Hampton. Total annual CPF proceeds collected during the last 10 years ranged between $40 million per year in 2009 up to $98 million per year in 2014.To date, the CPF has protected over 10,000 acres through land acquisition in the five East End Towns. Given the demonstrated success of the program and estimated annual revenue needs to implement a countywide wastewater upgrade program, the CPF represents a tremendous opportunity to offset costs for wastewater upgrades in the five east end towns.

8.1.4.3.2 Suffolk County 1/4% Fund

The Suffolk County 1/4% fund is a 0.25 percent sales tax that funds various projects in Suffolk County including the Drinking Water Protection Program for Environmental Protection (WQPRP, also known as Fund 477) and the Open Space and Farmland Protection Program. The WQPRP provides funding to protect and restore water resources throughout the County. This includes both surface and ground water. The Open Space and Farmland Protection Programs purchase Open Space for the purposes of land preservation and water quality protection and includes the purchase of development rights (PDR) program to preserve farmland.

In 2017 Suffolk County received approximately $1.39 billion in sales tax revenue. Assuming 0.25 percent of this revenue goes towards the 1/4% Fund as shown on **Figure 8-2** and assuming 11.75 percent and 31.1 percent of the 1/4% Fund goes towards the WQPRP and Open Space and Farmland Protection, respectively, approximately $40 million was obtained toward implementation of the WQPRP in 2017 and approximately $108 million was obtained toward implementation of the Open Space and Farmland Preservation Programs. It should be noted that not all funding is available for individual projects as some funding is used to pay off debt service and other operating expenses. Nonetheless, these funding sources sustain critical programs towards the protection of groundwater and surface water quality in Suffolk County and should continue to be maintained.

Table 8-11 Community Preservation Fund Revenue Collected

Community Preservation Fund Revenue Collected								
Year*	East Hampton	Riverhead	Shelter Island	Southampton	Southold	Dual Town	Total	% change from prior year
1999	$3,092,940	$421,383	$335,010	$8,282,117	$1,025,621	$0	**$13,157,071**	(partial year)
2000	$9,935,509	$1,258,811	$700,504	$19,920,004	$2,291,543	$0	**$34,106,371**	(n/a)
2001	$7,844,319	$2,410,355	$534,239	$15,345,427	$2,765,762	$0	**$28,900,102**	-15%
2002	$10,926,139	$2,693,518	$908,813	$22,299,221	$3,499,812	$0	**$40,327,503**	40%
2003	$11,245,881	$3,707,333	$1,030,646	$26,257,545	$4,352,692	$0	**$46,594,098**	16%
2004	$19,736,640	$4,153,513	$1,663,060	$42,265,802	$5,793,880	$0	**$73,612,895**	58%
2005	$25,445,355	$5,537,874	$2,014,368	$50,619,156	$6,928,467	$0	**$90,545,220**	23%
2006	$19,422,143	$6,070,360	$2,161,867	$49,635,380	$5,638,504	$86,819	**$83,015,073**	-8%
2007	$29,933,154	$4,298,119	$2,234,347	$53,310,752	$5,841,578	$30,000	**$95,647,950**	15%
2008	$14,477,685	$2,763,545	$1,237,489	$32,737,452	$5,134,269	$0	**$56,350,440**	-41%
2009	$10,128,100	$1,620,698	$838,250	$24,768,073	$2,881,477	$0	**$40,236,599**	-29%
2010	$17,700,099	$2,284,907	$1,349,001	$33,763,820	$3,617,777	$0	**$58,715,604**	46%
2011	$13,698,232	$1,925,301	$820,790	$38,428,621	$3,291,305	$0	**$58,164,248**	-1%
2012	$20,943,231	$2,170,315	$1,215,848	$35,279,920	$3,548,684	$0	**$63,157,998**	9%
2013	$23,794,792	$2,384,072	$2,018,447	$51,058,238	$4,664,770	$0	**$83,920,319**	33%
2014	$28,385,389	$3,138,223	$1,889,943	$59,346,673	$5,615,433	$0	**$98,375,660**	17%
2015	$27,418,514	$2,833,743	$1,889,241	$53,540,291	$5,709,200	$0	**$91,390,990**	-7%
2016	$22,808,913	$3,078,678	$1,724,649	$47,186,092	$5,837,323	$0	**$80,635,656**	-12%
2017	$24,726,070	$3,274,583	$1,874,606	$51,477,453	$6,479,802	$0	**$87,832,514**	9%
Totals	**$341,663,105**	**$56,025,330**	**$26,441,119**	**$715,522,038**	**$84,917,900**	**$116,819**	**$1,224,686,311**	
* PARTIAL YEAR in 1999, TAX WENT INTO EFFECT 04/99								

Source: https://www.scnylegislature.us/DocumentCenter/View/47459/05112018-Review-of-the-Proposed-Capital-Program-2019-2021-Capital-Budget-2019-PDF

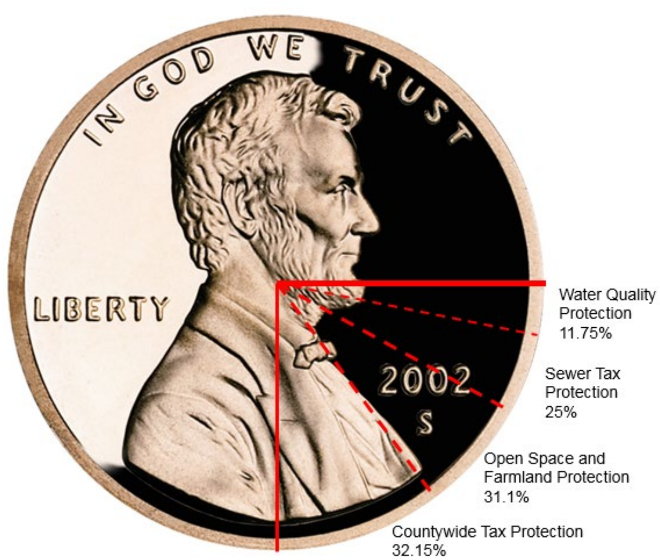


Figure 8-2 Summary of Suffolk County ¼ % Sales Tax Program Distributions

8.1.5 Recommendations for Sewering

As discussed throughout the SWP, three primary wastewater management tools were identified as part of an overall Countywide wastewater upgrade program including the use of advanced onsite treatment systems (e.g., I/A OWTS), sewer expansion, and decentralized/clustered systems. While the SWP has confirmed that the use of onsite treatment systems is the most cost-effective approach to reduce nitrogen for most parcels in Suffolk County, Suffolk County completed an initial planning exercise to identify locations that may benefit more from sewering or clustering/decentralized systems.

The SWP includes the sewering projects that have been funded and listed on **Table 8-12**.

Table 8-12 Sewering Project included in the SWP

Sewering Projects Included in the SWP
Carlls River (funded portions) within West Babylon, Wyandanch, and North Babylon (areas 108-8, 108-11, 110-2)
Forge River Watershed Sewer District Phases I & II (Mastic/Shirley)
Patchogue/Patchogue River
Oakdale Phase IA/Connetquot River
Kings Park Business District
Ronkonkoma Hub
Calverton/EPCAL – Town of Riverhead
Westhampton Downtown – Village of Westhampton Beach (Phase I of 4)

Recognizing that centralized sewering or cluster systems could be the most appropriate option for additional areas in Suffolk County where additional nitrogen load reduction would benefit water quality or for challenging sites with high groundwater tables the County completed a parcel-specific evaluation to identify the most appropriate wastewater management approach:

- Inventory of existing sewering proposals in Suffolk County and documentation of current status;
- A parcel-specific scoring analysis, referred to as the "Wastewater Management Response Evaluation," to identify parcels where sewering and/or clustering may represent the preferred means of wastewater management; and,
- Development and evaluation f of three sewer implementation scenarios based upon a range of potential funding availability.

The first step completed under the sewering evaluation was to develop an inventory and status table of all known existing County, Town, and Village sewer proposals evaluated over approximately the past two decades, as previously identified on **Tables 4-5** and **4-6**. Overall, the County identified 21 County led proposals and 15 Town/Village led projects.

Projects with the highest likelihood of moving forward include projects that have been deemed feasible via project specific feasibility study and have both design and construction funding procured. For the purposes of modeling the Countywide Recommended Wastewater Scenario in the SWP, it was presumed that all parcels within the proposed district boundaries for these projects will be connected to the proposed treatment facility. The sewering evaluation identified individual parcels where sewer connections could be the preferred approach to wastewater management based on parcel size, proximity to an existing connection system, environmental criteria and future sea level rise.

The results of the Wastewater Management Response Evaluation are presented on **Figure 8-3** and summarized on **Table 8-13**.

Table 8-13 Summary of Wastewater Management Evaluation Results

Phase	Number of Parcels		
	Upgrade	Sewer	Tie
II	72,843	85,898	8,833
III	33,539	19,628	3,420
IV	46,933	76,242	10,148
Parcel totals	153,315	181,768	22,401

The preliminary assessment concluded that sewering could be the preferred option for over half of the unsewered parcels in the County, including all of the proposed sewering projects. Parcels located within subwatersheds with the highest wastewater upgrade Priority Rank scored the highest for sewering while parcels located within subwatersheds with lower wastewater upgrade Priority Rank and/or located in areas with no existing sewer district scored highest for upgrades to I/A OWTS.

Three revenue scenarios were developed to evaluate how various revenue assumptions impact the quantity of sewer expansion projects that can be funded through the stable and recurring revenue source and how they impact the timing in which projects can be implemented. A summary of the scenario evaluation findings is provided below in **Table 8-14**. In short, the sewer scenario evaluation established the logical conclusion that an increase in the annual funding available through the stable and recurring revenue source increases the total number of projects that can be executed and accelerates the start date of many of the projects.

Individual sewer and clustering projects would require project-specific Feasibility Study to develop cost estimates and assess overall project feasibility, including consideration of available capacity at adjacent sewage treatment plants, impact on TMDLs, cost, etc. In addition, project-specific SEQRA evaluations would be required to assess and mitigate project-specific environmental concerns. Finally, it should be noted that the evaluation and findings presented herein are intended to be an initial planning tool to support recommendations for stable recurring revenue source needs and present initial findings regarding areas that may benefit from sewering or clustering.

8.1.6 Detailed Implementation Plan Recommendations

The following subsections provide expanded, detailed, recommendations for implementation of the overall Program for each of the phases identified within this SWP.

8.1.6.1 Phase I – Program Ramp Up

The primary objectives of Phase I are to establish the basic programmatic infrastructure necessary to implement a countywide wastewater upgrade program, to require the installation of I/A OWTS

Table 8-14 Summary of Sewer Implementation Scenario Evaluation

	Scenario 1		Scenario 2		Scenario 3	
Target Implementation Times	Projects that can be completed	Amount of Connections	Projects that can be completed	Amount of Connections	Projects that can be completed	Amount of Connections
2024 - 2033	Carlls River 108-1 Carlls River 108-2 Smithtown Business District	1,864	Carlls River 108-1 Carlls River 108-2 Smithtown Business District	1,864	Carlls River 108-1 Carlls River 108-2 Smithtown Business District Sayville Extension – Phase 1b Sayville Extension – Phase 2 Huntington Station Carlls River 110-1 Wyandanch – Town of Babylon* Northport Expansion – Village of Northport*	4,074
2034 - 2043	Sayville Extension – Phase 1b Sayville Extension – Phase 2 Huntington Station	1,452	Sayville Extension – Phase 1b Sayville Extension – Phase 2 Huntington Station Forge River - Phase 3 Carlls River 110-1 Wyandanch – Town of Babylon* Northport Expansion – Village of Northport* Patchogue Expansion – Village of Patchogue*	3,778	Forge River - Phase 3 Carlls River 108-3 Sayville Extension – Phase 3	4,663
2044 - 2053	Forge River - Phase 3 Carlls River 110-1 Wyandanch – Town of Babylon*	2,175	Sayville Extension – Phase 3 Carlls River 110-4 Sayville Extension – Phase 4 Riverside – Town of Southampton*	4,119	Carlls River 110-4 Sayville Extension – Phase 4 Patchogue Expansion – Village of Patchogue* Riverside – Town of Southampton* Sayville Extension – Phase 7	4,372
2054-2063	Carlls River 108-3 Sayville Extension – Phase 3 Northport Expansion – Village of Northport* Carlls River 110-4 Sayville Extension – Phase 4 Patchogue Expansion – Village of Patchogue *	5,732	Carlls River 108-3 Forge River – Phase 4	7,930	Port Jefferson Station Forge River – Phase 4 Sayville Extension – Phase 5	7,789
2064-2073	Riverside – Town of Southampton* Sayville Extension – Phase 7 Carlls River – 108-4 Carlls River - 110-5 Carlls River - 110-6 Carlls River - 110-7 Carlls River - 110-8 Carlls River – 108-15 Carlls River – 108-16 Carlls River – 110-9 Carlls River – 107-1 Carlls River - 108-9 Port Jefferson Station Sayville Extension – Phase 5	8,917	Sayville Extension – Phase 7 Carlls River – 108-4 Carlls River - 110-5 Carlls River - 110-6 Carlls River - 110-7 Carlls River - 110-8 Carlls River – 108-15 Carlls River – 108-16 Carlls River – 110-9 Port Jefferson Station Sayville Extension – Phase 5 Sayville Extension – Phase 6 Carlls River – 107-1 Carlls River - 108-9 Holbrook Carlls River 108-12 Carlls River 108-5 Carlls River 108-6 Carlls River 108-7 Carlls River 110-3 Carlls River 110-10 Carlls River 110-11	12,978	Sayville Extension – Phase 6 Carlls River – 108-4 Carlls River - 110-5 Carlls River - 110-6 Carlls River - 110-7 Carlls River - 110-8 Carlls River – 108-15 Carlls River – 108-16 Carlls River – 110-9 Carlls River – 107-1 Carlls River - 108-9 Holbrook Carlls River 108-12 Carlls River 108-5 Carlls River 108-6 Carlls River 108-7 Carlls River 110-3 Carlls River 110-10 Carlls River 110-11 Carlls River 108-10 Carlls River 107-2 Carlls River 108-13 Carlls River 108-14	12,606
Remaining Projects; Insufficient Financing Available	Forge River – Phase 4 Sayville Extension – Phase 6 Holbrook Carlls River 108-12 Carlls River 108-5 Carlls River 108-6 Carlls River 108-7 Carlls River 110-3 Carlls River 110-10 Carlls River 110-11 Carlls River 108-10 Carlls River 107-2 Carlls River 108-13 Carlls River 108-14	13,364	Carlls River 108-10 Carlls River 107-2 Carlls River 108-13 Carlls River 108-14	2,835	None	

SUFFOLK COUNTY, NEW YORK

Phase	Number of Parcels		
	Upgrade	Sewer	Tie
II	72,843	85,898	8,833
III	33,539	19,628	3,420
IV	46,933	76,242	10,148
Parcel totals	153,315	181,768	22,401

Figure 8-3

WASTEWATER MANAGEMENT EVALUATION RESPONSE

Proposed Management Response for Residential Parcels

Map is subject to revision. This map is not to be used for surveying, conveyance of land, or other precise purposes.

for all new construction in Suffolk County, and to revise Appendix A of the Standards for Approval of Plans and Construction for Sewage Disposal Systems for Other Than Single Family Residences to make the use of Appendix A STPs more flexible in Suffolk County. In addition, Phase I should be used to continue wastewater upgrades through the existing County and New York State Septic Improvement Program (SIP) programs, existing County Assessment Stabilization Reserve Fund (ASRF) and Water Quality Protection and Restoration Program (WQPRP) funding, existing Town Community Preservation Fund (CPF) programs, and existing Suffolk County Coastal Resiliency Initiative (SCCRI) sewer projects. Continuation of these programs will advance wastewater upgrades and progress toward the environmental goals of the SWP as well as providing a continuing means for RME and industry growth and readiness. Through continuation of the existing upgrade programs and triggers, it is estimated that up to 5,000 wastewater treatment upgrades of existing OSDS will be implemented during Phase I with a net nitrogen reduction of up to 252,000 lbs.

Building on the objectives described above, Phase I has been subdivided into the following implementation sub-tasks as described below:

1.) Completion of a Countywide Water Quality Management District Feasibility Study (WQMD FS) to establish recommendations for the administrative structure of the Countywide Water Quality Management District and provide recommendations for the establishment of a stable and recurring revenue source;

2.) Establishment of the WQMD using the data and recommendations obtained from the WQMD FS;

3.) Establishment of the stable and recurring revenue source using the findings of the WQMD FS;

4.) Amendment of Article 6 of the Suffolk County Sanitary Code to require the installation of I/A OWTS for all new construction;

5.) Amendment of Appendix A of the Standards for Approval of Plans and Construction for Sewage Disposal Systems for Other Than Single Family Residences to permit reduced setbacks and an increase in allowable design flow to 30,000 gpd for Appendix A STPs including revising the language to require sound attenuation – such that a maximum noise level of 50 dbA must be met at the most conservative (minimum) setback for the project and revising the commercial standards to include the STP guidance memorandum as an appendix so that all future Appendix A systems located within environmentally sensitive areas will result in a new nitrogen reduction benefit.

6.) Continue to reduce nitrogen from wastewater sources in Suffolk County through the implementation of existing voluntary incentive programs for the installation of I/A OWTS and Town/Village required upgrades to I/A OWTS. Modify existing New York State and County SIP grant guidelines to align with the priority needs and recommendations provided within this SWP;

7.) Continue industry and RME ramp up, including hiring approximately 18 staff, to accommodate the up to 3,000 upgrades per year estimated under Phase IIA;

8.) Complete buildout nitrogen load travel time analysis and work with County and Town/Village planners and the Article 6 Workgroup to develop policy recommendations for upzoning;

9.) Preparation of a SWP Adaptive Management and Monitoring Plan(s); and,

10.) Completion of a SWP Addendum including revaluation of parcel-specific recommended upgrade methodology (e.g., advanced onsite treatment versus sewering/clustered).

A description of each these steps is provided below.

8.1.6.1.1 Sub-Task 1: Completion of a Countywide Water Quality Management District Feasibility Study (WQMD FS)

As discussed previously, Suffolk County has partnered with the LINAP Project Management Team and the Long Island Regional Planning Council to develop this scope of services for a WQMD FS which will assess the financial implications and clarify the process for the establishment and management of a WQMD. The WQMD FS will also evaluate and provide recommendations for the establishment of a stable and recurring revenue source and will evaluate other potential benefits of establishing a WQMD, such as the potential for streamlining approvals, oversight, and funding options for "clustered" systems in Suffolk County (e.g., the clustering of two or more properties to a common I/A OWTS or other advanced wastewater systems).

8.1.6.1.2 Sub-Task 2: Establishment of a Countywide Water Quality Management District

While contingent on the findings of the WQMD FS, the establishment of a WQMD will likely be recommended to provide the administrative organizational structure to manage sewage treatment infrastructure and to oversee the widespread installation of I/A OWTS technologies in areas where sewering is not a practical or a cost-effective alternative. As envisioned, the WQMD would manage sewer and I/A OWTS services separately in a tiered system through which sewered parcels would comprise one tier, and non-sewered (IA/OWTS) parcels, another. The WQMD could also provide the means to administer and manage the stable recurring revenue source that would be used to offset the costs associated with the Program.

8.1.6.1.3 Sub-Task 3: Establishment of a Stable and Recurring Revenue Source

As discussed previously, income from a stable and recurring revenue source is essential for the offsetting costs associated with the recommendations provided within this SWP. The stable and recurring revenue source will serve several needs, including, but not limited to:

- Providing wastewater treatment upgrade incentives to property owners;
- Providing funds for administration of the Countywide wastewater management program (e.g., RME and WQMD);
- Providing funds for individual sewer connections to existing sewer districts and/or to support cost offsets for new STPs; and,
- Providing funds for individual clustering projects.

While several revenue models have received initial evaluation for the purposes of this SWP, the WQMD FS will provide final recommendation(s) for the proposed revenue source.

8.1.6.1.4 Sub-Task 4: Amendment of Article 6 of the Suffolk County Sanitary Code for New Construction

It is recommended that revision to Article 6 of the Suffolk County Sanitary Code requiring the use of I/A OWTS for New Construction be pursued immediately. For the purposes of this SWP it is presumed that these revisions will be adopted by the year 2020. The use of I/A OWTS for New Construction is a critical element of the overall wastewater strategy in Suffolk County. Specifically, upgrades at New Construction will essentially ensure that the impact of nitrogen loads resulting from land use change do not impact the overall load reduction strategy within individual subwatersheds.

8.1.6.1.5 Sub-Task 5: Revision to Appendix A of the Standards for Approval of Plans and Construction for Sewage Disposal Systems for Other Than Single Family Residences

It is recommended that revision to Appendix A of the Standards for Approval of Plans and Construction for Sewage Disposal Systems for Other Than Single Family Residences be pursued immediately. For the purposes of this SWP it is presumed that these revisions will be adopted by the year 2020. As discussed in Section 8.1.2, revision of the Appendix A requirements to facilitate reduced setbacks and an increase in the permissible design flow to 30,000 gpd will enable these systems to be installed at sites with limited space for wastewater upgrades. The revision will be especially beneficial for existing downtown hamlets where wastewater upgrades are necessary for protection of the environment and to facilitate economic growth. Based upon a review of requirements for proximal jurisdictions, the implementation of reduced setbacks has existing precedence throughout the northeast so long as sufficient engineering controls are employed to mitigate any potential odor and noise nuisances.

Recognizing that the proposed increase of the design flow and reduced setbacks may allow for a parcel or lot to meet its development potential under current zoning in areas where development is limited by sanitary wastewater treatment availability such as could potentially exist in an existing downtown area, the Standards for Approval of Plans and Construction for Sewage Disposal Systems for Other Than Single-Family Residences will be revised to require an overall effluent nitrogen load of at least 10 percent lower than required as-of-right per the Article 6 density requirements for all proposed Appendix A systems to be installed within the 0 to 25-year travel time to surface waters for eastern Suffolk, within the 0 to 50-year travel time for surface waters to western Suffolk, or within the 0 to 50-year travel time to public supply wells. Since SCDHS General Guidance Memorandum #28 – "Guidelines for Siting Proposed or Expanded Sewage Treatment Plants" already contains a variety of related siting requirements, it is recommended that this memorandum be updated with the recommendations herein and be incorporated into Standards for Approval of Plans and Construction for Sewage Disposal Systems for Other Than Single-Family Residences as an appendix.

8.1.6.1.6 Sub-Task 6: Continuation of Existing Wastewater Upgrade Programs

Wastewater upgrades through existing grant programs and Town/Village mandates should continue to be promoted and leveraged during Phase I to reduce nitrogen loading to our water resources and to continue the growth of the I/A OWTS industry and RME in Suffolk County. For the purposes of this SWP, it is assumed that there will be an existing annual revenue stream of approximately $12,000,000 that would consist of a combination of New York State and County SIP Funding, Suffolk County WQPRP and ASRF funding, and/or Town CPF. To use the existing funding towards fulfillment of the recommendations provided in the SWP, it is recommended that the existing grant program funds be repurposed to:

1) Adopt the use of the priority areas established in the SWP; and,

2) Set funding priorities to property owners who are required to upgrade upon New Construction with a building addition.

Specifically, once the requirement for I/A OWTS upon all New Construction is instated, it is assumed that a portion of the existing annual revenue stream(s) will be made available to provide a 50 percent upgrade incentive to qualified property owners for new construction with addition or change of use. Approximately $5,000,000 in annual funding must be obligated to provide these incentives. The remaining $7,000,000 would target properties with cesspool failure and/or voluntary upgrades within the priority areas established in the SWP.

8.1.6.1.7 Sub-Task 7: Continue Industry and RME Ramp-Up

Continued ramp-up of the industry and RME is essential to accommodate the estimated upgrade rate of approximately 3,000 existing systems per year under Phase IIA. The incremental increase in the number of systems to be installed per year between Phases I and IIA is approximately 2,000 upgrades per year. Based upon current projections of industry capacity, it is anticipated that industry readiness will not be a concern. Approximately nine staff equivalents are needed for RME oversight and grant administration of the County and New York State SIP programs (~1,000 upgrades per year). Using this ratio, it anticipated that Suffolk County would need to hire up to 18 additional staff to accommodate the additional 2,000 upgrades per year. However, it is expected that RME operations and grant administrative procedures will become more efficient as the Countywide wastewater program matures and that the actual needs for additional staff could be reduced significantly. Based upon review of existing and historical civil service eligibility lists for the anticipated staffing titles needed to implement the program, it is expected that there is sufficient market/candidate capacity to fulfill the additional staff needs.

8.1.6.1.8 Sub-Task 8: Complete Build-out Nitrogen Travel Time Analysis and Work with County/Town/Villages and the Article 6 Work Group

Based upon stakeholder input, the nitrogen load travel time evaluation for future potential build-out Subwatersheds Wastewater Plan Adaptive Management and Monitoring Plan was developed and is summarized on **Table 8-11** (please see tables at the end of this section). Based upon each subwatershed's sensitivity to nitrogen loading, targeted nitrogen load reduction and potential build-out evaluation, Town and Village planners should work with the County and the Article 6 Work Group to develop policy recommendations for upzoning where appropriate.

8.1.6.1.9 Sub-Task 9: Subwatersheds Wastewater Plan Adaptive Management and Monitoring Plan

The implementation of an adaptive management strategy is a critical element to ensure the overall success of programs with extended timelines. Adaptive management incorporates a process of information gathering, periodic program reviews, and periodic changes to program recommendations that are built around new data collected during program implementation. Further description of the timeline and recommendations for addressing these parcels is provided in Section 8.4.11 below.

8.1.6.1.10 Sub-Task 10: Subwatersheds Wastewater Plan Addendum

A Subwatersheds Wastewater Plan Addendum should be prepared to develop wastewater management recommendations for program elements that were identified as data-gaps within this SWP. These include, but may not be limited to:

- Identify priority areas and recommendations for wastewater upgrades to existing commercial projects with design flows of greater than 1,000 gpd;
- Identify priority areas and recommendations for public schools;
- Incorporate, to the extent practical depending on information availability, updated recommendations for subwatersheds identified as requiring additional study;
- Incorporate recommendations for additional onsite treatment alternatives including experimental systems, I/A OWTS polishing units, and alternate leaching technologies;
- Refined recommendations for expanded sewering areas and/or clustered systems based upon anticipated revenue streams and other new data sources;
- Identify existing commercial parcels or areas that potentially have US EPA designated Large Capacity Cesspools; and,
- Refine the initial recommendations provided within this SWP for sea level rise by providing a detailed recommended framework for wastewater upgrades within sea level rise protection areas.

It is anticipated that most of the individual data-gap projects identified above will be fulfilled at a different pace. Accordingly, the progress and status of each data-gap should be evaluated during routine adaptive management reviews and the date to commence preparation of the SWP Addendum should be completed when deemed appropriate by the Adaptive Management Lead Agency. For example, if the SCDHS OWM file scanning project is complete which would fill data-gaps identified in the first, second and fourth bullets above, it may make sense to advance the SWP Addendum to provide recommendations for upgrades of large commercial projects and schools.

8.1.6.2 Phase II –Upgrades in Near Shore and All Priority Rank I Areas

It is recommended that Phase II (shown on **Figure 8-4**) be initiated immediately upon establishment of the stable and recurring revenue source and/or establishment of the WQMD, pending the findings of the WQMD FS. The primary objective of Phase II is to upgrade all unsewered parcels to advanced wastewater treatment in the highest priority areas of Suffolk County. This includes upgrades in all near shore areas within the 0 to 2-year groundwater contributing area to surface waters, all surface water Priority Rank 1 areas, and all groundwater/drinking water Priority Rank 1 areas.

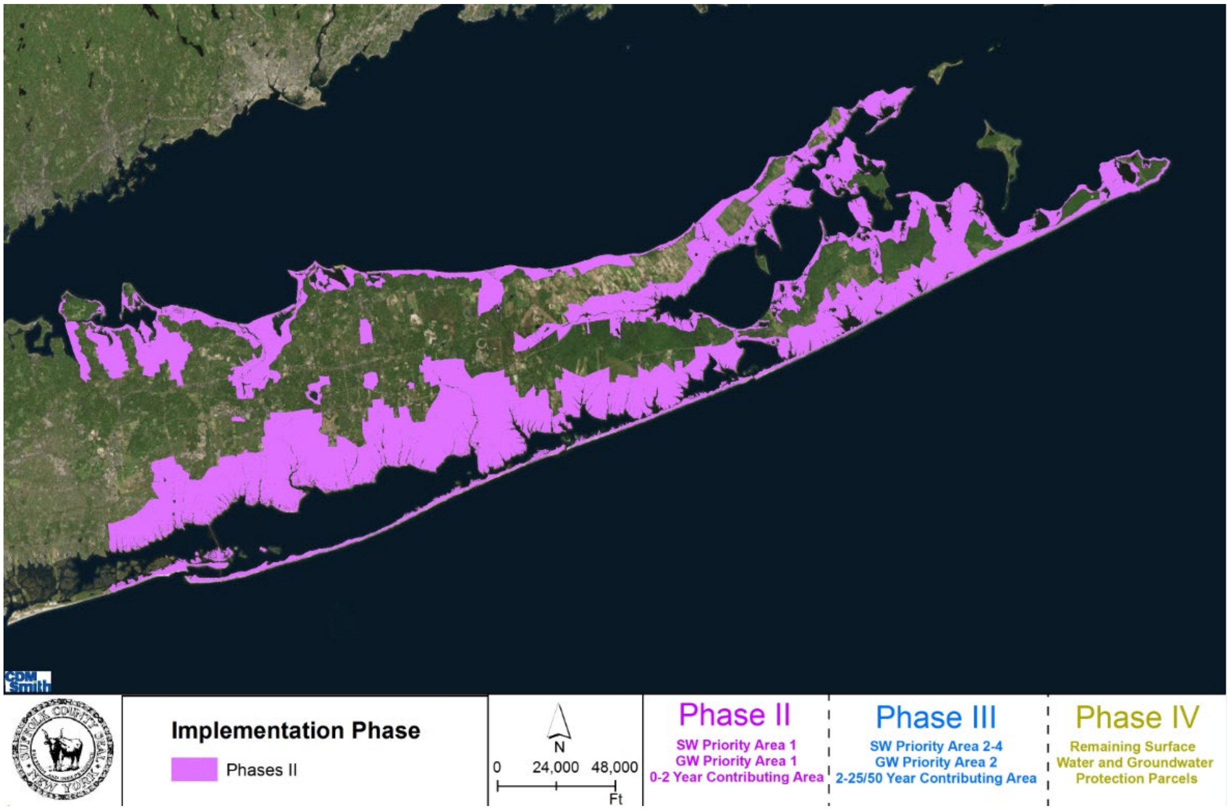


Figure 8-4 Phase II SWP Implementation Area

As discussed previously in this SWP, these areas were established as the highest priority areas for wastewater upgrades in Suffolk County due a variety of factors as described below:

- Installation of I/A OWTS in the 0 to 2-year contributing area results in the most immediate benefit in terms of reducing nitrogen loads to Suffolk County water bodies including 708 pounds per day from the Long Island Sound subwatersheds, 788 pounds per day from the Peconic Estuary subwatersheds and 1,236 pounds of nitrogen per day from the South Shore Estuary Reserve subwatersheds;
- Installation of I/A OWTS in the 0 to 2-year contributing area provides the most cost-effective removal of nitrogen loading as shown by **Figure 8-5**;
- Reducing nitrogen concentrations to below NYSDEC groundwater criteria and New York State Department of Health (NYSDOH) drinking water standards within supply wells where concentrations in untreated groundwater currently exceed 10 mg/l and the predominant source of nitrogen is from sanitary wastewater;
- May reduce the concentration of CECs (e.g., some of which can be degraded biologically through existing wastewater technologies); and
- Provides additional nitrogen removal for the protection of surface water bodies in eastern Suffolk groundwater/drinking water priority areas that overlap surface water contributing areas.

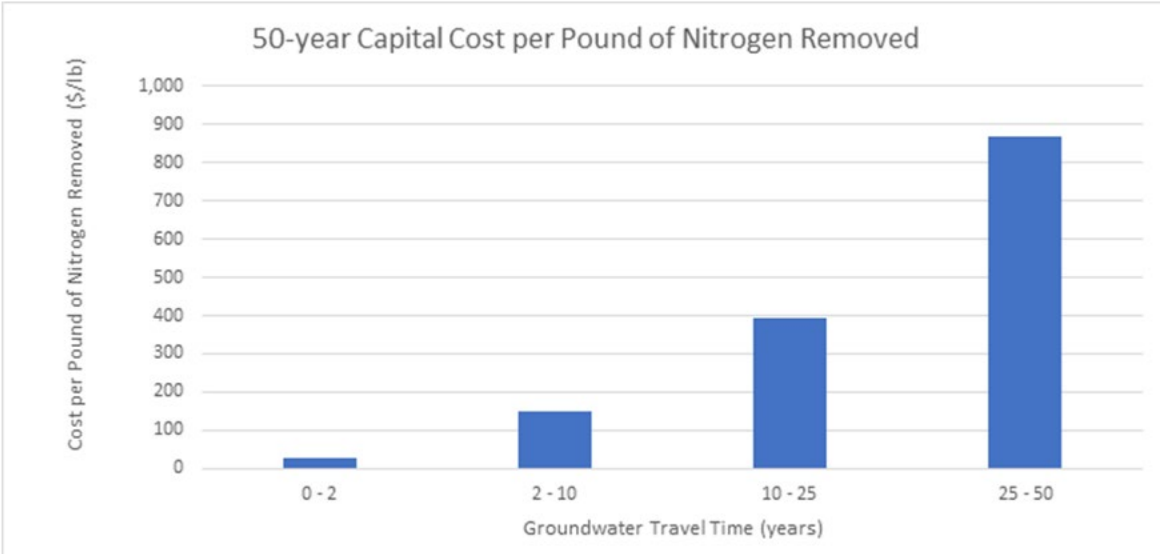


Figure 8-5 50-Year Capital Cost Per Pound of Nitrogen Removed by I/A OWTS Implementation in Each Groundwater Travel Time Interval

Phase II consists of four sub-phases to accommodate industry and RME growth. The sub-phases include the phasing-in of specific geographic target areas and policy triggers to achieve manageable incremental increases in the annual number of WWT upgrades per year. A summary of each sub-phase, their respective policy recommendations, and expected outcomes is provided below in **Table 8-15**.

Table 8-15 Summary of Phase II Policy Recommendations and Expected Outcomes

Program Phase/Start Year	Program Phase Policy Recommendations	Expected Outcomes
IIA 2024 – 2025	-Continue voluntary upgrade incentive programs -Continue requirement for upgrades on all New Constructions **-Upgrades at system failure in all 0-2-year surface water contributing areas** **-Upgrades at system failure in all groundwater/drinking water Priority Rank 1 areas**	3,188 upgrades/year* 11,873 cumulative upgrades** Total Funding Need = Alt. 4A = ~65M/year Alt. 4B = ~65M/year Alt. 4C = ~71M/year
IIB 2026 – 2036	-Continue voluntary upgrade incentive programs -Continue requirement for upgrades on all New Constructions -Continue upgrades at system failure in all 0-2-year surface water contributing areas -Continue upgrades at system failure in all groundwater/drinking water Priority Rank 1 areas **-Upgrades at property transfer in all 0-2-year surface water contributing areas** **-Upgrades at property transfer in all groundwater/drinking water Priority Rank 1 areas**	6,082 upgrades/year* 78,778 cumulative upgrades** Total Funding Need = Alt. 4A = ~65M/year Alt. 4B = ~98M/year Alt. 4C = ~137M/year

Program Phase/Start Year	Program Phase Policy Recommendations	Expected Outcomes
IIC 2037 – 2038	-Continue voluntary upgrade incentive programs -Continue requirement for upgrades on all New Constructions -Continue upgrades at system failure in all 0-2 year surface water contributing areas -Continue upgrades at system failure in all groundwater/drinking water Priority Rank 1 areas -Continue upgrades at property transfer in all 0-2 year surface water contributing areas -Continue upgrades at property transfer in all groundwater/drinking water Priority Rank 1 areas **- Upgrades at system failure in all Priority Rank 1 surface water contributing areas**	4,409 upgrades/year* 87,595 cumulative upgrades** Total Funding Need = Alt. 4A = ~66M/year Alt. 4B = ~80M/year Alt. 4C = ~96M/year
IID 2039 - 2053	-Continue voluntary upgrade incentive programs -Continue requirement for upgrades on all New Constructions -Continue upgrades at system failure in all 0-2 year surface water contributing areas -Continue upgrades at system failure in all groundwater/drinking water Priority Rank 1 areas -Continue upgrades at property transfer in all 0-2 year surface water contributing areas -Continue upgrades at property transfer in all groundwater/drinking water Priority Rank 1 areas - Continue upgrades at system failure in all Priority Rank 1 surface water contributing areas -**Upgrades at property transfer in all Priority Rank 1 surface water contributing areas**	6,431 upgrades/year* 177,634 cumulative upgrades** Total Funding Need = Alt. 4A = ~66M/year Alt. 4B = ~100M/year Alt. 4C = ~140M/year

* Retrofits of existing on-site systems
** Includes upgrades from previous phase(s)
*** Represents 95% completion level and assumes that 5% of parcels will fall under the definition of a hardship or infeasible for upgrades
Bold = New policy recommendation for the current phase

As shown in **Table 8-15**, each program sub-phase builds upon the previous sub-phase by incorporating additional geographic target areas and upgrade triggers. Text shown in **bold** font represents the new geographic target area and associated policy triggers for each sub-phase. Voluntary upgrades and upgrades at new construction would be continued throughout all program phases. A short description of each sub-phase is provided below.

8.1.6.2.1 Sub-Phase IIA

Sub-phase IIA incorporates the new requirement of upgrades upon system failure in all near shore areas and in all groundwater/drinking water Priority Rank 1 areas. Incorporation of these requirements results in the upgrade of approximately 3,188 existing systems per year, which represents an incremental increase of 2,188 systems per year when compared to the estimated number of upgrades during Phase I. As described previously, it is anticipated that there is sufficient industry and RME staff growth capacity to meet the demand of the additional installations during Phase IIA. To accommodate the additional industry and RME capacity needed for Phase IIB, an estimated 25 additional RME and program administration staff will need to be hired during Phase IIA.

8.1.6.2.2 Sub-Phase IIB

Sub-phase IIB incorporates the new requirement of upgrades upon property transfer in all near shore areas and in all groundwater/drinking water Priority Rank 1 areas. Incorporation of these requirements results in the upgrade of approximately 6,082 existing systems per year, which represents an incremental increase of 2,894 systems per year when compared to the estimated number of upgrades during Phase IIA. While this increase exceeds the optimal target of 2,500 systems per year, it is anticipated that there is sufficient industry and RME staff growth capacity to meet the demand of the additional installations during Phase IIB. No necessary additional RME capacity is anticipated for Phase IIC.

8.1.6.2.3 Sub-Phase IIC

Sub-phase IIC incorporates the new requirement of upgrades upon system failure in the remainder of surface water Priority Rank 1 areas (travel times 2-25 years or 2-50 years). Incorporation of these requirements results in the upgrade of approximately 4,409 existing systems per year, which represents a decline of about 1,600 systems per year when compared to the estimated number of upgrades during Phase IIB.

8.1.6.2.4 Sub-Phase IID

Sub-phase IID incorporates the new requirement of upgrades upon property transfer in the remainder of surface water Priority Rank 1 areas (travel times 2-25 years or 2-50 years). Incorporation of this requirement results in the upgrade of approximately 6,431 existing systems per year, which represents an incremental increase of 2,022 systems per year when compared to the estimated number of upgrades during Phase IIC but only 349 more systems per year than that of Phase IIB. As described previously, it is anticipated that there is sufficient industry and RME staff capacity to meet the demand of the additional installations during Phase IID. No additional RME and program administration staff will need to be hired during Phase IID to accommodate the additional industry and RME capacity needed for Phase III.

8.1.6.2.5 Phase II Summary

In summary, it is estimated that approximately 177,634 I/A OWTS upgrades will be completed by the end of Phase II with a net nitrogen reduction of up to 4,000,000 lbs.

8.1.6.3 Phase III –Upgrades in All Remaining Surface Water Priority Areas and Groundwater/Drinking Water Priority Rank 2 Areas

Phase III, shown by **Figure 8-6**, will be initiated approximately 30 years after the start of Phase II, or sooner, if the annual revenue stream can accommodate the additional upgrades targeted for Phase III. The primary objective of Phase III is to upgrade all remaining surface water priority areas Countywide as well as parcels within groundwater/drinking water Priority Rank 2 areas.

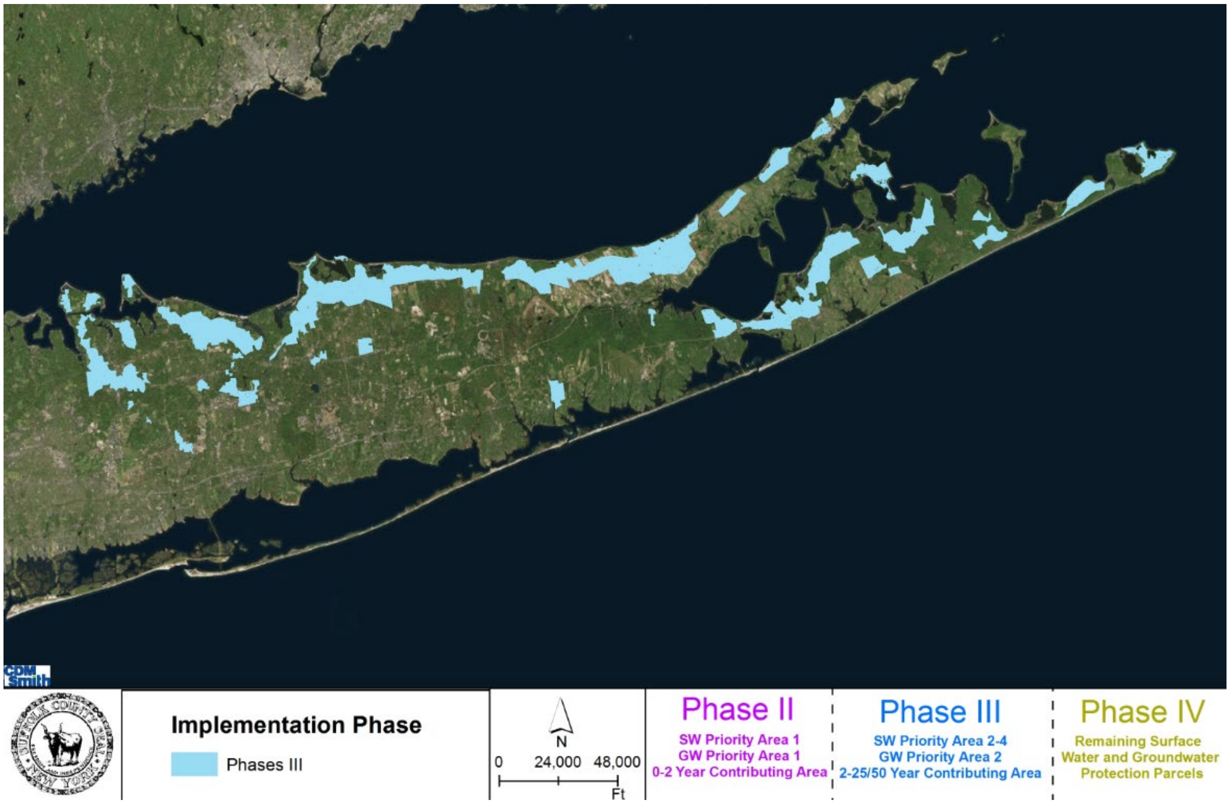


Figure 8-6 Phase III SWP Implementation Areas

It should be noted that an estimated 15 percent of parcels for upgrade in Phase III will have already been upgraded through the voluntary upgrade program and through the upgrades required for new construction with building additions. Phase III would continue utilizing all sanitary code upgrade triggers simultaneously and the total parcel pool calculated for Phase III accommodates the completion of the phase as a single 15-year phase without the need for sub-phases (e.g., as required in Phase II to accommodate industry or RME capacity). Phase III will result in addition of 75,349 I/A OWTS upgrades and will result in an approximate nitrogen load reduction of 1.2 million lbs. and significant progress towards achievement of the nitrogen load reductions required to achieve the ideal water quality conditions defined by the reference water bodies, as shown by **Figure 8-7.**

A summary of the program policy recommendations and expected outcomes of phase III is provided in **Table 8-16**.

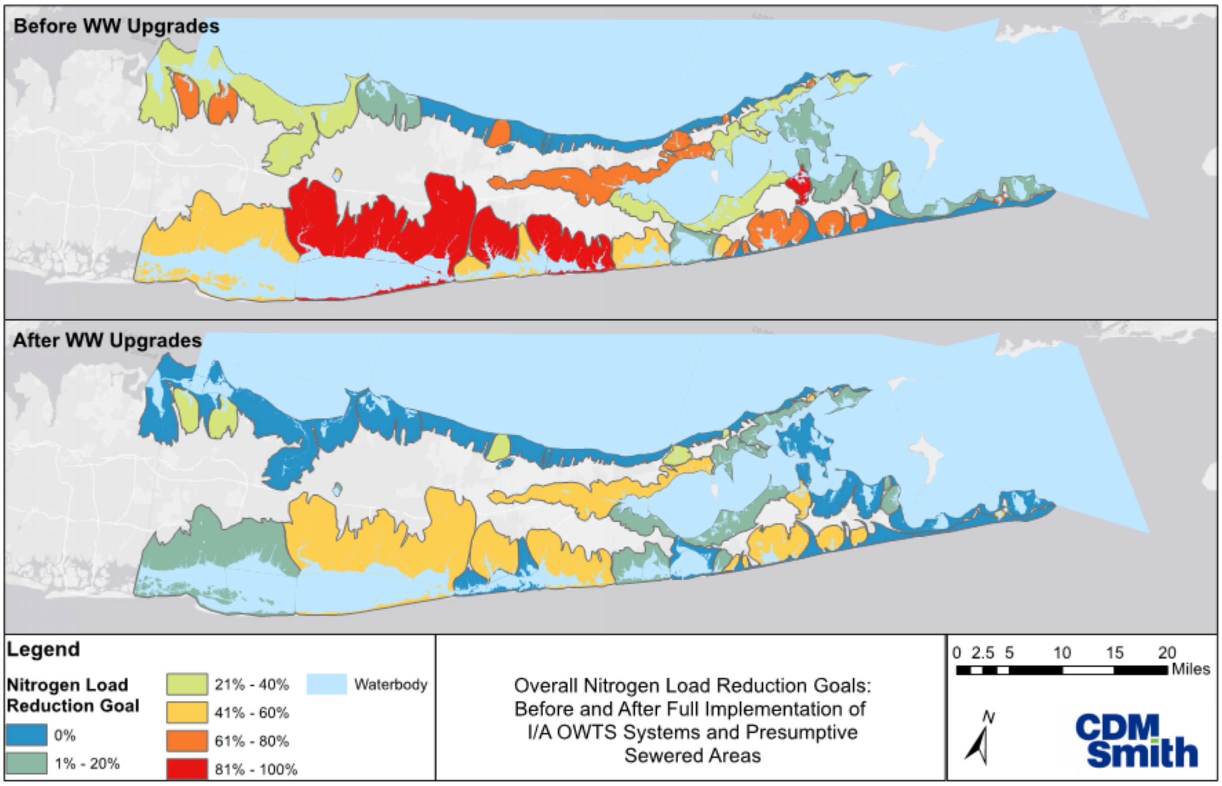


Figure 8-7 Comparison of Nitrogen Loads before and after I/A OWTS Implementation

Note: The upper panel in the figure shows the nitrogen load reductions required to achieve the same unit nitrogen load observed in Suffolk County waters exhibiting ideal water quality. The lower panel shows the much lower nitrogen load reductions required to achieve the unit nitrogen loads after SWP implementation.

Table 8-16 Summary of Phase III Policy Recommendations and Expected Outcomes

Program Phase/Start Year	Program Phase Policy Recommendations	Expected Outcomes
III	-Continue voluntary upgrade incentive programs -Continue requirement for upgrades on all New Constructions -Upgrades at system failure in all 0-2-year surface water contributing areas, if necessary -Upgrades at system failure in all groundwater/drinking water Priority Rank 1 areas, if necessary **- Mandatory upgrades at system failure and property transfer in the 2 to 25/50 year surface water contributing area for Priority Ranks 2 through 4** **-Mandatory upgrades at system failure and property transfer in groundwater/drinking water Priority Rank 2**	5,500 upgrades/year* 252,500 cumulative upgrades** Total Funding Need = Alt. 4A = ~67M/year Alt. 4B = ~102M/year Alt. 4C = ~141M/year

* Retrofits of existing on-site systems
** Includes upgrades from previous phase(s)
*** Represents 95% completion level and assumes that 5% of parcels will fall under the definition of a hardship or infeasible for upgrades
Bold = New policy recommendation for the current phase

8.1.6.4 Phase IV – Upgrades in All Remaining Groundwater/Drinking Water (Priority Rank III)

Phase IV, shown on **Figure 8-8**, will be initiated approximately 15 years after the start of Phase III, or sooner, if the annual revenue stream can accommodate the additional upgrades targeted for Phase IV. The primary objective of Phase IV is to upgrade all remaining groundwater/drinking water parcels in Suffolk County (e.g., groundwater/drinking water Priority Rank 3). Because of the significant parcel pool estimated within groundwater/drinking water Priority Rank 3 (approximately 430,000 parcels), it is anticipated that the Article 6 upgrade triggers utilized in Phase IV would need to be phased in, similar to the process used in Phase II, to accommodate an upgrade rate consistent with the industry, RME, and annual funding spending capacity.

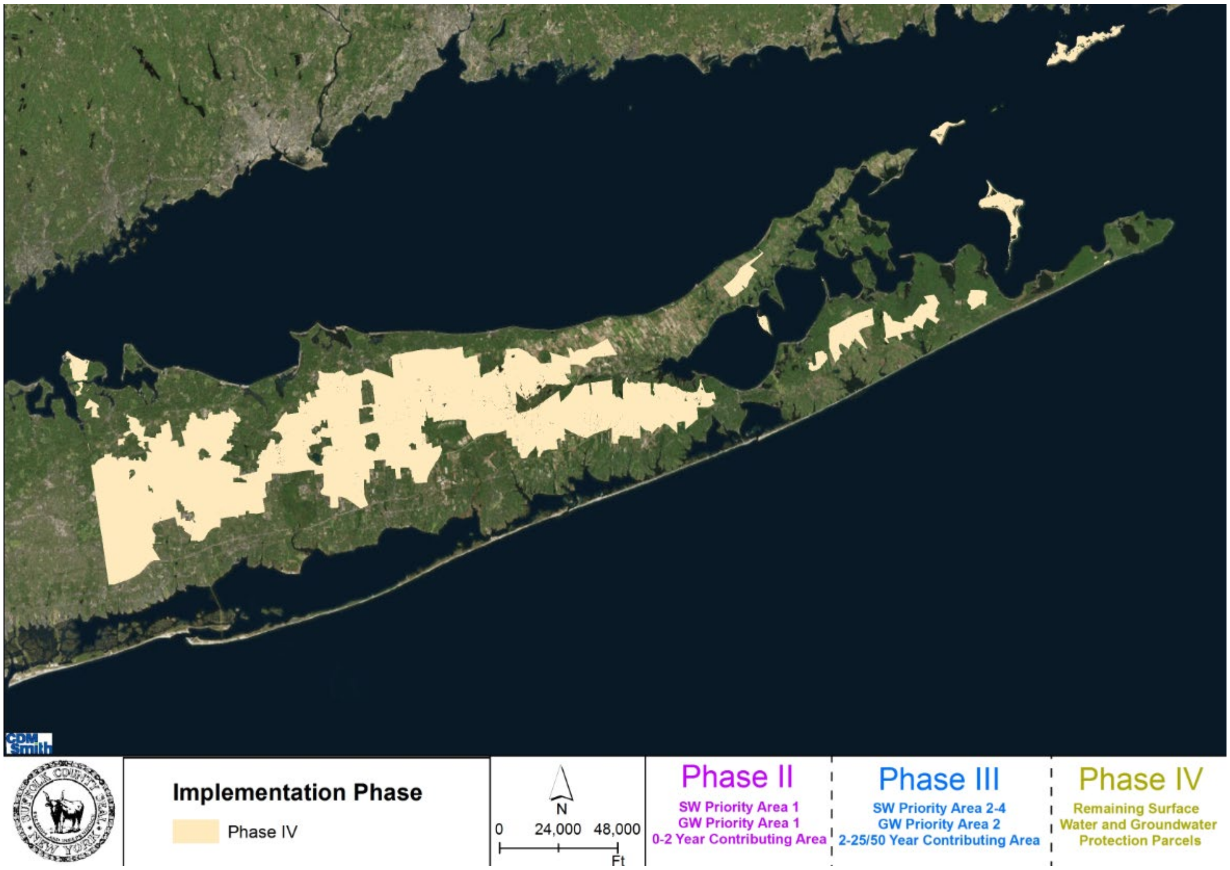


Figure 8-8 Phase IV SWP Implementation Areas

Because of the uncertainty in making recommendations for a program phase that will begin an estimated 45 years after establishment of a stable and recurring revenue source (Phase I), specific recommendations for how to phase individual parcels within Phase IV are not provided within this SWP. Policy recommendations for Phase IV should be made through a future SWP Addendum or Annual Report pursuant to the Adaptive Management Plan described in Section 8.4.11 below. It should be noted that many of the parcels located within Phase IV are in areas with very long travel times (e.g., hundreds of years).

Phase IV will result in an additional of 2.3 million lbs of nitrogen removal through wastewater management. As shown on **Figure 8-9** below, the predicted groundwater concentration in the Upper Glacial aquifer with Priority Rank 3 areas decreases significantly when compared to baseline conditions such that the nitrogen concentrations in much of the shallow upper glacial aquifer is reduced to less than 10 mg/L.

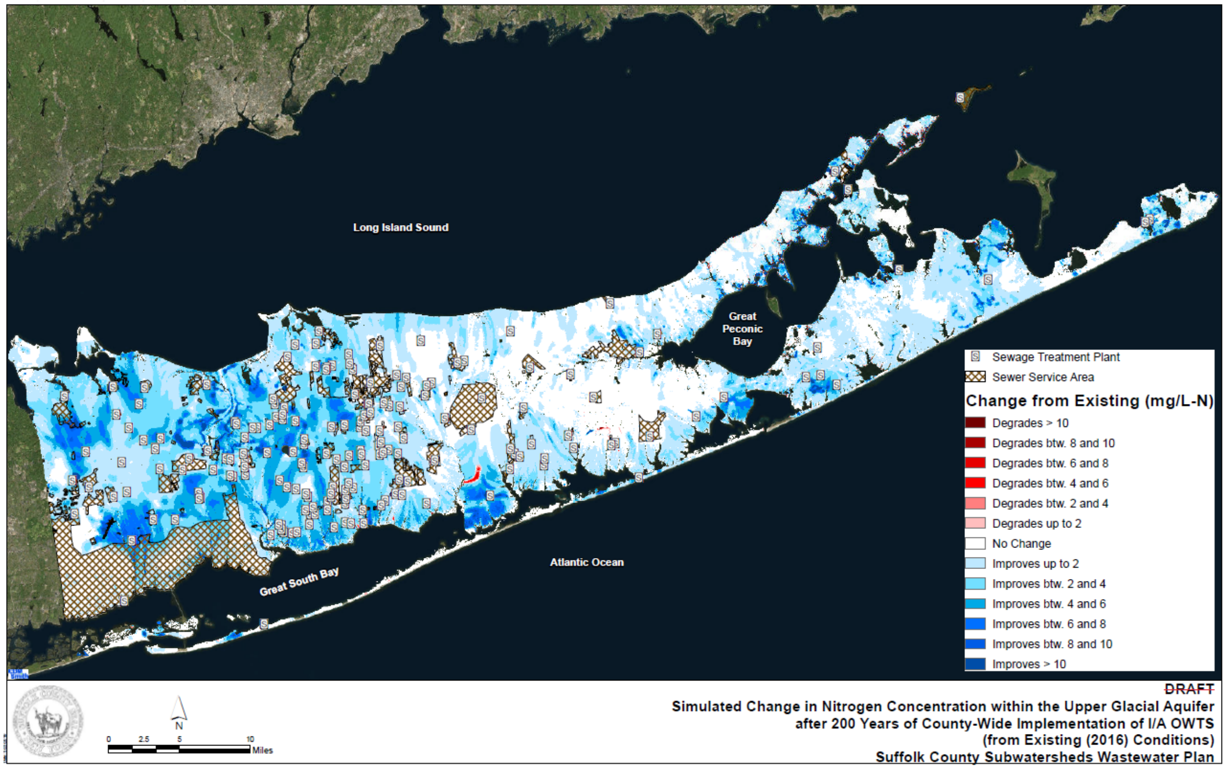


Figure 8-9 Simulated Reductions in Shallow Upper Glacial Nitrogen Concentrations after I/A OWTS Implementation

8.2 Program Ramp-up Considerations

Program ramp-up considerations include ensuring that manufacturing, design, installers, and program administration capacity for a Countywide wastewater upgrade program meets or exceeds the program needs at each phase of the program. The following sections discuss ramp-up considerations and provide recommendations on how to overcome potential ramp-up obstacles.

8.2.1 Estimated Upgrade Rates for Wastewater Treatment

As described previously, estimated upgrade rates were generated for the various Sanitary Code policy triggers discussed in Section 8.1.1. The upgrade rates were then used to balance ramp-up of the program. It should be noted that upgrade rates were generated using the best available data; however, and as with any estimate, actual rates will likely vary based upon geographic location and future economic and housing market conditions. Upgrade rates should continuously be evaluated as part of an overall adaptive management strategy described in Section 8.4.11 of this SWP. In addition, the number of upgrades per year is dependent on the number of existing systems requiring upgrade within a specific geographic target area. For example, if the geographic target area for upgrades has 100,000 existing OSDS, it can be estimated that 3,400 upgrades per year will be required at property transfer (100,000 x 0.034 = 3,400). Therefore, upgrade rates are not only dependent on the selected policy options requiring upgrade, but are also dependent on the number of parcels requiring upgrade. An example of potential annual upgrade rates at various trigger mechanisms and geographic target areas is provided below in **Table 8-17**.

Table 8-17 Example Number of Upgrades Based on Triggers and Geographic Target Areas.

Geographic Target Area	Amount of Existing Parcels	Amount of Upgrades under System Failure Mandate (2.25%)	Amount of Upgrades under Property Transfer Mandate (3.39%)
Phase II (0-2 Year Contributing Area for all Priority Ranks, Priority Rank 1, & Groundwater Priority Rank 1)	171,081	3,849	5,815
Phase III (Priority Ranks 2-4's 2-25/50 Year Contributing Area & Groundwater Priority Rank 2)	67,699	1,523	2,301
Groundwater Priority Rank 1	39,068	879	1,328
Groundwater Priority Rank 2	32,778	738	1,114

While upgrade rates for property transfer are readily available through sales data, the estimated rates for system failure should be refined based upon actual data that will be obtained through SCDHS's new "SHIP" database which will track the number and location of failures that occur in Suffolk County beginning in 2019.

8.2.2 Industry and Market Readiness

Implementation of a Countywide wastewater upgrade program must account for the current and future capacities of the manufacturing, design professional, and installation contractor industries. In short, the required upgrade rates under future triggers proposed through the Suffolk County Sanitary Code must be in close proximity to the then-current industry capacity for a Countywide upgrade program to be successful.

A summary of the current and projected industry capacity of the various industry sectors (e.g., manufacturing, design, installation and O&M) based upon existing data obtained from the Suffolk County SIP and SCDHS OWM database is provided below. In general, based on manufacturing and I/A OWTS technology trends, I/A OWTS installation and maintenance training, and design professional capacity, there is currently industry and market readiness to meet the existing need of 1,000 installations per year, and ramp-up could enable an annual incremental increase of 2,500 installations per year, which will eventually provide for a maximum of 7,500 installations annually.

8.2.2.1 Manufacturing Capacity

There is currently an I/A OWTS manufacturing capacity for existing provisionally approved technologies in Suffolk County of 470 systems per month or 5,640 per year, which exceeds the current demand of approximately 1,000 systems per year and provides ample room for program growth. Approval of additional I/A OWTS technologies is expected as the piloting of I/A OWTS technologies continues in Suffolk County. For example, based on current data trends, it is anticipated that an additional four I/A OWTS technologies will obtain provisional approval status by 2020, which would increase the manufacturing capacity to 710 per month or 8,520 per year. In addition, existing approved manufacturers have committed to increasing capacity, as necessary, as the market demand increases.

In summary, it is not anticipated that manufacturing capacity will be a limiting factor for program ramp-up based upon the existing available capacity of more than 1,000 per year and the expectation that capacity will increase as new technologies' provisional approval status and local market demand increases through program growth.

8.2.2.2 Installation and Maintenance Capacity

Contractors wishing to install and maintain I/A OWTS in Suffolk County must take the appropriate I/A OWTS training class(s) and obtain their respective liquid waste license endorsement(s). Based upon the licensed contractors currently participating in the SC SIP, there is industry capacity to install and maintain 135 I/A OWTS per month or 1,620 per year which exceeds the current demand of 1,000 systems per year and provides marginal room for program growth. However, these existing capacity estimates are based upon the sole capacity of the nine contractors actively participating in the Suffolk County SIP. As of 2019, there are 51 licensed contractors who have endorsement 9 (I/A OWTS Installer) and 41 who have endorsement 10 (I/A OWTS Maintenance Provider) on their liquid waste licenses. There are 276 contractors that have participated in the SCDHS OWM 105 Innovative and Alternative Onsite Wastewater Treatment Class, a requirement for the liquid waste license endorsement to install I/A OWTS. Assuming an installation capacity of 5 to 12 I/A OWTS per month for each installer, and assuming that these contractors receive the appropriate endorsements, there is an estimated maximum capacity of 16,000 to 39,000 installations per year. In addition, there are a total of 380 liquid waste contractors in Suffolk County currently, so maximum capacity could increase to greater than these estimates.

In summary, it is not anticipated that the installation and maintenance capacity will be a limiting factor for program ramp-up based upon the existing available capacity of more than 1,000/year and the expectation that capacity will significantly increase as additional contractors receive the appropriate endorsements and local market demand increases through program growth.

8.2.2.3 Design Capacity

There are currently 14 design professionals willingly participating in the SC SIP with a monthly design capacity of approximately five I/A OWTS each, which could result in a capacity to design only 70 I/A OWTS per month or 840 per year, which is less than the current demand of 1,000 systems per year. Due to this, design professionals (Professional Engineers and Registered Architects) likely represent the highest challenge toward ensuring overall industry readiness for implementation of a Countywide wastewater upgrade program. However, similar to the liquid waste industry (e.g., installation contractors), there appear to be a substantial number of existing design professionals in Suffolk County that are not actively participating in the design of I/A OWTS but who could do so and without any additional licensing or requirements necessary. Specifically, OWM records indicate that approximately 500 design professionals have submitted plans to the OWM over the last 10 years alone. Assuming that each design professional can generate 60 designs per year, the maximum annual capacity of design professionals in Suffolk County is estimated to be 30,000. Ultimately, if I/A OWTS become the new standard onsite wastewater management method in Suffolk County, design professionals will adjust their training and familiarity with I/A OWTS design accordingly to accommodate the industry and to obtain their share of the design market. If the design industry fails to keep pace with demand, the following other options can be pursued:

- Modify New York State Education Department definition of Design Professional to include Land Surveyors. Current New York State law requires that all I/A OWTS be designed by a New York State Professional Engineer or Licensed Architect; whereas conventional systems installed on residential properties can typically be designed by Land Surveyors. The proposed change would include both retrofits of existing structures and new construction. There are approximately 141 licensed land surveyors in Suffolk County that could potentially design I/A OWTS. This option could increase design capacity to 705 per month.
- Amend the New York State Education Law to allow County Health Departments to develop a liquid waste endorsement that allows installers to design pre-manufactured I/A OWTS provided there is an adequate training program developed. The proposed change would include system repairs and retrofit of existing systems only (e.g., would not include new construction). There are approximately 380 licensed liquid waste contractors in Suffolk County that could potentially design I/A OWTS. This option could increase design capacity to 1,900 per month.
- Establish a streamlined process where a system is installed under a Design Professional's supervision, but the paperwork documenting design and construction in accordance with County standards is filed with the County after installation is completed. The proposed change would include system repairs and retrofit of existing systems only (e.g., would not include new construction).

In summary, the design professional industry likely represents the largest challenge towards overall industry readiness of a full-scale program. However, existing capacity appears to be dependent on the willingness of individuals in the industry to design I/A OWTS, but it is expected that the capacity will increase as additional design professionals become more familiar with I/A OWTS. Further, as additional local jurisdictions continue to pass new mandates for the use of I/A OWTS, and as the Suffolk County phased wastewater upgrade program matures, the design professional industry will naturally evolve to accommodate the new market demand. Finally, if the design professional industry cannot keep up with market demand, there are several alternate design models available to support an increase in countywide design capacity. It should be noted that any changes to the New York State Education Law would require a change to state law and would be subject to separate project-specific SEQRA, if the revisions required environmental review under NYS SEQRA regulations.

8.2.3 Responsible Management Entity Readiness

Another element that must be balanced when establishing recommendations for a Countywide wastewater upgrade program is the readiness and capacity of the Responsible Management Entity (RME). As defined in Article 19 of the Suffolk County Sanitary Code, the RME is responsible for overseeing the long-term operation, maintenance, and management of all I/A OWTS.

Using data obtained from the Suffolk County SIP, it is estimated that approximately seven staff equivalents will be needed to process and oversee the design and construction of every 1,000 I/A OWTS installations. Similarly, SCDHS was able to identify, interview, hire, and train approximately

15 staff within two years as part of the ramp-up process for SC SIP. It is anticipated that staffing demand for a Countywide wastewater upgrade program would become more efficient (e.g., less staff will be needed per 1,000 installations) as staff become more familiar with I/A OWTS and as opportunities for program optimization/efficiency are identified through lessons learned during implementation. In addition to staffing, the following other considerations should be evaluated to optimize program efficiency and reduce program oversight demand.

Currently, the SCDHS Division of Environmental Quality serves as the RME. The RME has the authority and responsibility to enforce the requirements of Article 19 and associated Standards. This includes tracking the status of O&M contracts, registrations, and contractor sampling and issuing Notice of Violations and fines if not resolved. The RME also has authority to revoke or suspend a technology's approval in the event of non-performance or non-compliance. Licensed contractors in violation of the Standards can also be fined and referral made to the RME of Labor, Licensing, and Consumer Affairs. A detailed summary of the current RME structure and responsibilities is provided in **Table 8-18**. Phase I of the recommended wastewater upgrade program would allow for the continued growth and expansion of RME capacity. It is anticipated that the overall structure of the RME would remain similar, but would be expanded to meet the demand/capacity of the program as it matures.

8.2.3.1 Streamlined Approval for Failure (Compliance with Current NYS Design Professional Requirements)

Under this model, streamlined SCDHS OWM approvals of design would be provided for all wastewater upgrades triggered by system failure. This model could result in significant RME staff efficiency as the time for overall review, permitting, and administration would be significantly reduced. A design professional would need to notify SCDHS of failure and the need to replace or retrofit the system. Proof of system failure would need to be submitted, similar to the requirements currently implemented under the Septic Improvement Program. Proof of system failure can be a photograph of collapse, letter from septic hauler stating the need to pump-out more than four times per year, or an engineer's certification that the system has failed. In some instances, SCDHS may visit the site to help layout the system with the installer and design professional; this would be limited to difficult sites. The designer and liquid waste professional would layout where system components are to be installed and the liquid waste professional would install the system. The design professional would then certify the installation. The contractor would use the Suffolk County Septic Hauler Information Portal (SHIP) to upload installer certification with a sketch of the system and design professional certification. SCDHS would send a letter to the design professional and installer acknowledging receipt and acceptance of the filing. This option is in compliance with New York State Education Department requirements and may be implemented with a change to SCDHS Residential Construction Standards.

Table 8-18
SUFFOLK COUNTY'S RECLAIM OUR WATER INITIATIVE
RESPONSIBLE MANAGEMENT ENTITY OPERATION & ORGANIZATION
AS ESTABLISHED IN ARTICLE 19 OF THE SUFFOLK COUNTY SANITARY CODE

ROW Reclaim Our Water

RME COMPONENT	ADMINISTRATION	TECHNOLOGY	TRACKING / DATA MANAGEMENT	PROMOTING I/A OWTS	ENFORCEMENT & COMPLIANCE	PUBLIC OUTREACH	INDUSTRY LICENSING, TRAINING, & OUTREACH	INTEGRATION WITH SUBWATERSHEDS PLAN
INVOLVED DEPARTMENTS	Health Department Administration, Office of Ecology	Office of Ecology, Office of Wastewater Management	Department of IT Office of Ecology, Office of Wastewater Management	Office of Ecology, Office of Wastewater Management, Health Department Contracts Unit, Suffolk County Department of Law	Office of Ecology, Office of Wastewater Management. Department of Labor, Licensing, and Consumer Affairs	Office of Ecology	Office of Ecology, Office of Wastewater Management. Department of Labor, Licensing, and Consumer Affairs	Office of Ecology
DUTIES & RESPONSIBILITIES	SCUPE program administration, supervision, coordination. Oversight of RME operation and organization. Coordinate RFPs, procurement, and contracts for RME initiatives. Manages budgets and finance related to SCUPE, SIP, and RME Expenditures	Field sampling, performance tracking and compliance, evaluation and review of technologies for approval in Suffolk County. Interface with Consumer Affairs on training and continuing education requirements. Oversee and track registration, O&M contracts, and services events for all installed I/A OWTS. Trouble shoot performance and maintenance issues and oversee corrective action plans to improve performance. Prepare data evaluation of demonstration, piloting, provisional and general use systems and request corrective action plans or suspend approval in accordance with Dept. Standards	Coordination with IT on the creation, organization, and implementation of EHIMS integrated data management system. Future operation of RME web-based portal for reporting of performance data, O&M, and homeowner registrations. Tracking and organization of system performance, number of systems, O&M, and property owner registrations.	Septic Improvement Program and State Septic System Replacement Program administration. Goal of issuing 1,000 grants per year. Staff process application intake, grant issuance, and issuance of grant agreements. Coordination with OWM plan approval and system installation. Processing Grant payments to vendors, designers, and property owners. Promote I/A OWTS by streamlining permitting and installations in instances of catastrophic failure.	Plan review, site visits with designers and installers, field inspections, and compliance with Department Standards. System sampling and monitoring. Enforcement of Construction Standards, I/A OWTS Standards, O&M, Performance, and Property Owner Registrations. Ability to issue NOV's, orders on consent, fines, and cross coordination with Department of Labor, Licensing, and Consumer Affairs for potential suspension of LW license.	ReclaimOurWater.info website created to distribute information to residents. The website contains information on the Septic Improvement Program, I/A OWTS Technologies, news and upcoming events, I/A performance data, Annual technology reports, links to the Sanitary Code and Department Standards related to I/A OWTS.	Ecology staff hold industry training and stakeholders meetings on changes in regulations, conventional septic system installations, I/A OWTS tours, overview class and other continuing education opportunities in accordance with the Liquid Waste Licensing Law adopted by the Suffolk County Legislature in December of 2015, which became effective in June 2016. Staff also interface and act as a liaison	Staff will make adjustments to the I/A OWTS and RME Programs based on the recommendations of the Subwatersheds Wastewater Plan. For example, the priority areas currently identified as part of the Septic Improvement Program will be changed to reflect findings of the SWP. In addition, Staff will revise standards to allow for Nitrogen and Phosphorous polishing units as recommended in the SWP, and adjust I/A OWTS performance standards as needed to meet recommended load reduction goals.

8.2.3.2 Alternate Model for Streamlined Approval for Failure (If Installer or Land Surveyor Is Permitted to Design the System)

This model is similar to the previous model and includes streamlined SCDHS OWM approvals for all wastewater upgrades triggered by system failure. However, in this scenario, the liquid waste professional or land surveyor would notify SCDHS of the failure and need to replace or retrofit the system. As with the above scenario, proof of system failure would need to be submitted to SCDHS and a SCDHS representative may visit difficult sites to assist the liquid waste professional or land surveyor in laying out system components. The system would then be installed by the liquid waste installer and the installer certification and sketch of the system would be submitted electronically through the SHIP portal to SCDHS. SCDHS would send a letter to the installer and/or land surveyor acknowledging receipt and acceptance of the filing. This option would require a change to New York State Education Law before SCDHS could amend the Residential Construction Standards.

It is potentially worthwhile to explore using the processes above for any replacement or retrofit when no new construction is proposed (including additions). This process could be used when stamped approved plans with bedroom count is not required. It should also be noted that systems requiring a retaining wall would still need to be designed by a New York State Licensed Professional Engineer or Architect.

8.2.3.3 Responsible Management Entity User Portal and Database

Development and integration of an overall wastewater management user portal and database is essential to the efficient operation of a countywide wastewater upgrade program. SCDHS Division of Environmental Quality (DEQ) is currently replacing and integrating several existing databases within the Department with a new unified and fully integrated database called the Environmental Health Information Management System (EHIMS). EHIMS will function as the central nervous systems for RME program administration and related monitoring and enforcement activities.

Specific functionality of EHIMS includes maintaining all aspects of I/A OWTS permitting, approval, inspection, and maintenance requirements including, but not limited to:

- Tracking of all permitting, inspections, and approvals;
- Tracking all Department cross coordination activities required for I/A OWTS permit approval including coordinated review status with the Office of Water Resources, Office of Pollution Control, Office of Ecology;
- Incorporation of an online portal for applicant submittals and status tracking;
- Development and linking of an electronic plan review module;
- Incorporation of an inspection and environmental data collection module from PCs, tablets, cell phones, data collection buoys, and other electronic data collection devices;
- Tracking of all operation, maintenance, and sampling activities for different service providers and I/A OWTS technologies;
- Ability for contractors to submit inspection, pumping, and maintenance reports via website login;

- Tracking of all I/A OWTS performance monitoring data along with geodatabase referencing;
- Linking all records to tax parcels through GIS-based mapping; including the eventual documentation of grandfathered and passive failed denitrification sites; and,
- Identification of non-compliant systems and/or service providers for enforcement needs.

The EHIMS Inspector App would be used by inspectors in the field to view scheduled inspectors, view checklists, input comments, attach site photos, and more from a mobile device (**Figure 8-10**).

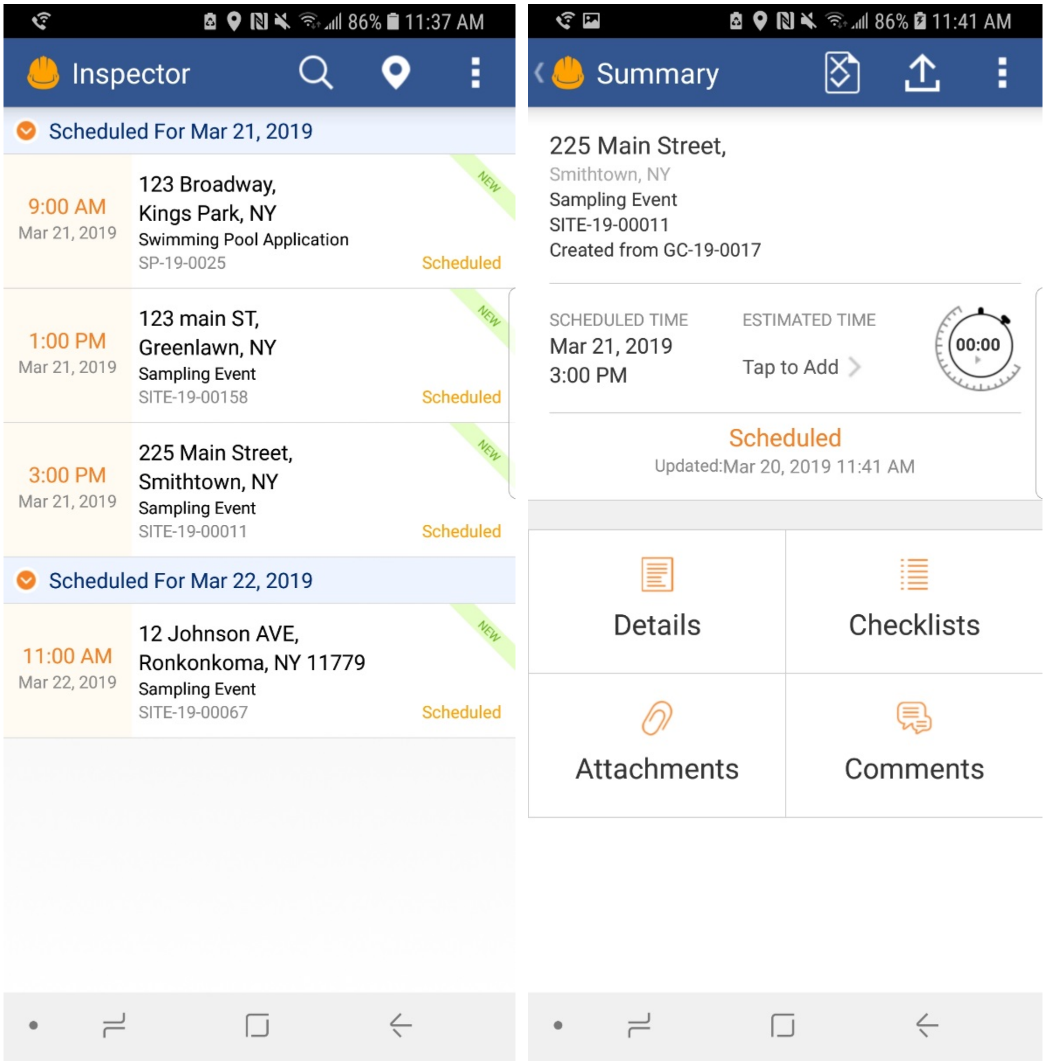


Figure 8-10 Screenshot of the EHIMS Inspector App

In addition to the functionality described above, EHIMS will further support implementation of the recommended wastewater upgrade program and related identification of priority areas through:

- Integrating a GIS-based portal where all scanned records of grandfathered commercial, SPDES, and failed denitrification systems will be graphically presented by tax map number;

- Integration of the SWP wastewater management priority area map (or equivalent) for the linking of tax lots to priority area designation; and,
- Tracking system installation location and number of upgrades by priority area to track program progress and load reductions, and identify areas falling behind presumed upgrade target rates; and,
- Finally, EHIMS will fully support implementation of long-term nitrogen water quality monitoring for tracking the long-term success of the program through integrating and maintaining existing water quality databases within the Office of Water Resources and Office of Ecology and providing GIS-based integration ability for linking sampling locations to their respective sampling IDs.

The EHIMS Back Office Portal is where all documentation related to applications is managed, including GIS, fees, contacts, inspections, and related application (**Figure 8-11**). The EHIMS citizen portal allows the public to apply for permits, track the status of applications and schedule inspections (**Figure 8-12**).

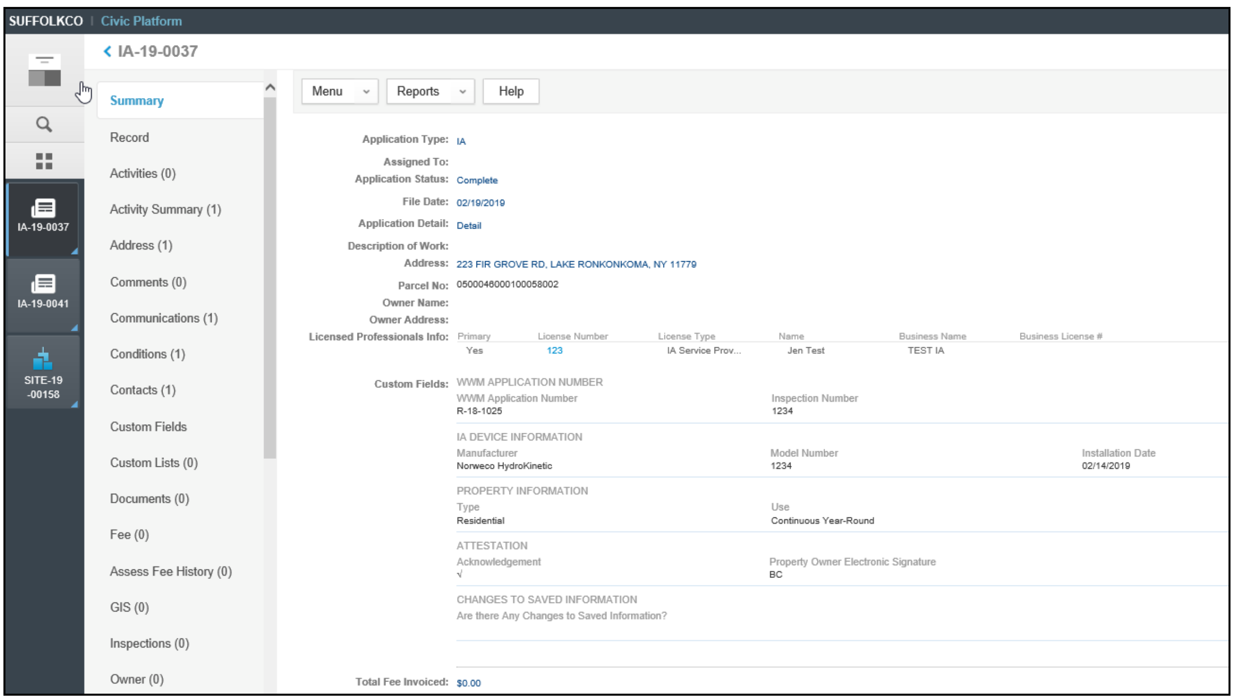


Figure 8-11 EHIMS Back Office Portal Screen

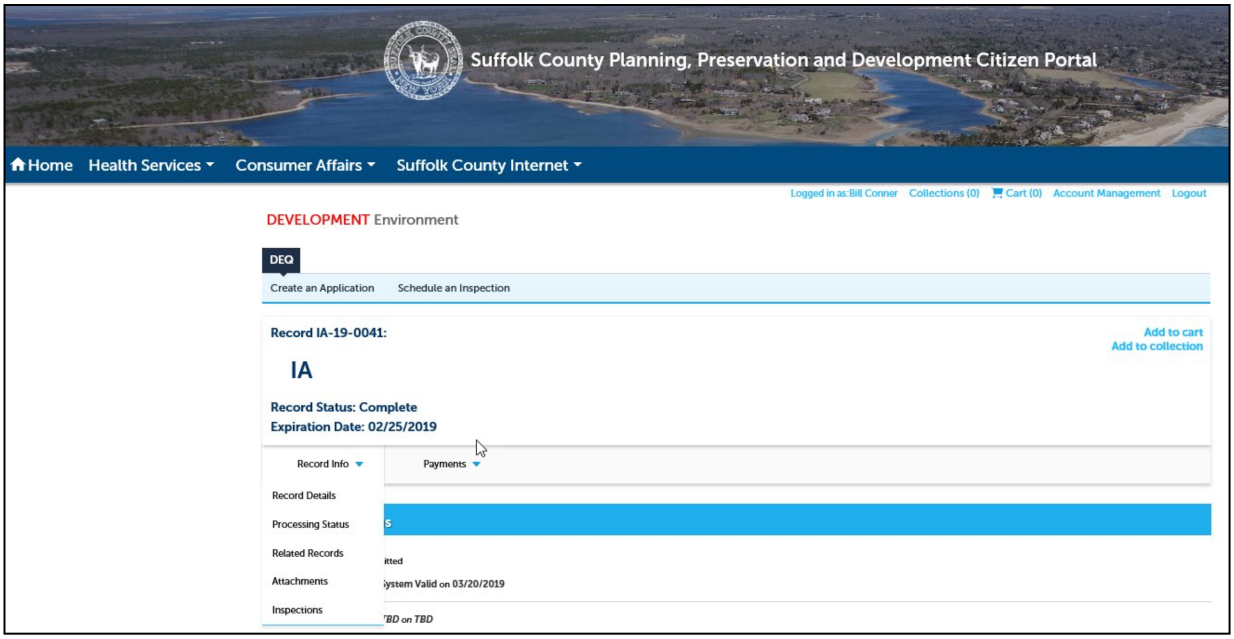


Figure 8-12 EHIMS Citizen Portal Screen Shot as Public User Would See it

8.2.3.4 I/A OWTS Operation and Maintenance Considerations

Ensuring long-term maintenance of I/A OWTS is paramount to achieve the recommended load reduction goals provided in the SWP and ultimately the overall success of the program. Article 19 of the Suffolk County Sanitary Code as well as the construction standards for residential and commercial wastewater construction permits set forth rigorous requirements for Operation & Maintenance. Article 19 requires all I/A OWTS be included with a 3-year warranty, that maintenance be conducted at a minimum of once per year, and that homeowners complete a registration form for their I/A OWTS that must be renewed every 3-years or within 60 days of Property Transfer. The County has additional quality control measures and sampling requirements to ensure that all installed I/A OWTS of specific technologies maintain effluent nitrogen concentration averages below or equal to Department Standards of 19 mg/L total nitrogen. Current sanitary code and Septic Improvement Program (SIP) provisions that ensure performance of I/A OWTS include:

- Article 19 of the Suffolk County Sanitary Code and Related Construction Standards:

    1. The establishment of a Responsible Management Entity (RME), currently the SCDHS, that is required to ensure the operation, maintenance, management, and monitoring of all I/A OWTS in Suffolk County (see **Table 8-18** for a detailed summary of RME responsibilities);

    2. The most comprehensive and rigorous I/A OWTS technology approval process in the United States ensures that individual technologies demonstrate performance that meets or exceeds the 19 mg/L total nitrogen standard (e.g., nitrogen concentration is less than or equal to 19 mg/L) before being allowed for widespread use in the county;

3. Detailed procedures documenting the corrective actions to be taken if individual technologies do not continue to meet the minimum performance standards along with the ability to remove individual technologies from the program if non-compliance is not corrected; and

4. An active operation and maintenance contract must be in-place between the property owner and a licensed liquid waste professional endorsed to perform operation and maintenance in Suffolk County, which contract must be registered with the RME.

- Suffolk County Septic Improvement Program:

1. The first three years of operation and maintenance is included in the price for installation of the I/A OWTS.

2. Suffolk County grant agreement requires property owners to review and sign-off on operation and maintenance requirements.

In addition, Suffolk County has one of the most robust I/A OWTS industry training programs in the United States to ensure that design, installation, and maintenance professionals are adequately trained to design, install, and maintain I/A OWTS for optimal performance. Training is coordinated with the Long Island Liquid Wastewater Association and as of January 2020, more than 300 individuals have completed the I/A OWTS training program. Section 1.1.6.4.2 of the SWP provides a brief overview of the I/A OWTS training program in Suffolk County. Finally, Suffolk County just completed development of a first of its kind database (the "Environmental Health Information Management System" or "EHIMS" – see Section 8.2.3.3) which includes all necessary provisions to track performance and long-term maintenance of a full scale countywide wastewater upgrade program and will serve as a singular interface for permitting, design review, and registration of systems. The establishment of the new database is an historic step forward in the use of technology to facilitate the role of the RME.

While the existing provisions are adequate for ensuring performance of I/A OWTS under the existing voluntary and Town/Village I/A OWTS mandates, an alternate model may be more appropriate for full-scale implementation of the SWP recommendations, which could eventually include the installation of more than 200,000 I/A OWTS countywide. One alternate model to ensure maintenance is completed would be similar to how a zoned garbage pickup area operates. In the "garbage" model, a municipality contracts with a private carter to complete garbage pickups within a designated geographic zone. In this case, the County would contract with on-site system maintenance contractors to complete a cycle of required maintenance for a given service area within a certain amount of time. The advantage would be that the maintenance contractors would be cost competitive in order to win zones and the County would have more certainty that the maintenance was being performed. Property owners are likely to benefit as well with reduced costs from the County aggregating the maintenance work. The success of such a program would be dependent upon the ability of the County to keep administrative costs low, while ensuring strong contractor oversight. If the zones are too small for instance, the administrative cost becomes more burdensome for the County. As such, the County might need to attract a large national service provider or might potentially drive consolidation in the local marketplace if such a service provider does not exist. In addition, requirements for the use of public prevailing wage rates would need to be considered as these rates could result in the maintenance cost increasing above what an individual homeowner would pay under private contract.

Based upon the potential benefits of the District managed zone model, it is recommended that a detailed evaluation and comparison analysis be completed by the County to evaluate zoned I/A OWTS maintenance service models and to ultimately implement a maintenance procurement approach that is most feasible and offers the greatest benefits to the County and property owners in terms of administrative efficiency and cost effectiveness.

Another long-term maintenance consideration that needs to be managed is the performance of I/A OWTS under extended power outages. While most I/A OWTS technologies function as conventional OSDS during power outages and/or provide storage volume for wastewater during power outages, some technologies do require electricity to pump the treated effluent to the gravity leaching field. In addition, pressurized shallow drainfields (PSDs) require power to operate irrespective of the I/A OWTS technology installed. The construction standards for I/A OWTS currently recommend that all design professionals consider the incorporation of a generator outlet on the control panel of technologies that do not operate under gravity during power outages. Currently, this is solely a recommendation and the decision is ultimately the design professional’s responsibility to select the most appropriate technology for a given site application and planning for power outages must be considered. While this approach has been effective under the voluntary programs and Town/Village programs, a more deliberate requirement to accommodate power failures may be appropriate for full-scale implementation of the SWP recommendations wherein over 200,000 I/A OWTS may be installed. As such, it is recommended that Suffolk County consider revisions to the construction standards for I/A OWTS that mandate the installation of generator receptacles for all I/A OWTS that do not operate under gravity discharge and all PSDs. Alternatively, a requirement mandating a sufficient storage volume to accommodate long-term power outages could be considered.

8.3 Wastewater Management Methods

The SWP recommendations include three primary wastewater management tools:

- I/A OWTS (including the potential use of alternative leaching methods),
- Sewer expansion, and
- Decentralized/clustered systems.

The cost/benefit evaluations included in this SWP have confirmed that the use of I/A OWTS represents the most cost-effective approach to reduce nitrogen from sanitary wastewater for most parcels in Suffolk County, however, as described in Section 4.5, the parcel-specific geo-referenced scoring evaluation completed by Suffolk County concluded that some locations may benefit more from sewering or clustering/decentralized systems. These areas include locations within close proximity to new or proposed STPs, small parcels, particularly those with high groundwater tables, and parcels located in subwatersheds with high environmental priority rank.

The SWP recommendations include sewering for all parcels within the presumptive sewered areas (areas shaded dark green) on **Tables 1-18** and **4-6**, and initially, implementation of I/A OWTS in priority areas throughout the County. This approach should be revisited as part of the Adaptive Management Plan described below in Section 8.4.11.

The ability to implement additional potential sewer expansion projects will be determined based largely upon future funding availability. In addition, the administrative and technical hurdles associated with private clustered/decentralized sewering projects, particularly with existing project approval requirements and issues that arise when multiple property owners wish to connect to a common treatment system (e.g., overall responsibility for long-term maintenance) should be addressed for decentralized/clustered systems to become implementable approaches for parcels that may benefit more from connection to a clustered/decentralized system. Therefore, in addition to the proposed sewering projects, it is recommended that during the Phase I period, I/A OWTS continue to be installed in all priority areas as part of the County and Town programs.

As the stable and recurring revenue source for wastewater upgrades is established, and the additional data collection and evaluation programs are implemented:

- Reevaluate the initial sewer evaluation provided herein after identification of a stable and recurring revenue source and determination of actual funding availability to offset the costs for sewer expansion and/or clustering;
- Using information obtained in the updated sewer evaluation, identify locations where the preferred upgrade option is sewering and consider identifying these as I/A OWTS exemption areas or similar designation. The exemption areas designation should also consider the anticipated implementation timeframe for individual sewer projects. Projects that are estimated to be completed after expected useful life of an I/A OWTS will still benefit from implementation of I/A OWTS; and
- Continue to reevaluate locations identified as sewering or clustered/decentralized candidates as part of the SWP Adaptive Management Plan.

8.4 Other Program Recommendations

Implementation of a Countywide wastewater upgrade program requires a holistic approach that acknowledges the unique nature of Suffolk County's diverse landscape and wastewater management challenges. While the recommendations discussed thus far address the majority of parcels in Suffolk County, there are several situations that warrant special consideration and will likely require follow up study through a SWP Addendum and/or future study through the LINAP or project partners such as the Stony Brook University Center for Clean Water Technology. The following subsections discuss other wastewater management recommendations and considerations for Suffolk County including the implementation of an Adaptive Management Plan to facilitate continuous review of the program and provide an overall mechanism to ensure the programs long-term success.

8.4.1 Recommendations for "Other than Single Family Residential" Parcels in Suffolk County

As described in Section 1.1.6 (Wastewater Management in Suffolk County), properties defined as "Other than Single Family Residential" in Suffolk County represent a unique and diverse challenge to wastewater management. The diversity of the land use in this category includes, but is not limited to:

- Traditional commercial uses such as retail stores, offices, restaurants, etc.;
- Multi-family residential uses such as apartment buildings, condominiums, townhouses, etc.;
- Industrial uses such as warehouses and manufacturing plants;
- Parks and recreational facilities such as County/State beaches, campgrounds, and other parks; and,
- Government buildings, hospitals, firehouses, libraries, police stations, schools.

These other than single family residential land uses are also referred to as commercial sites. Commercial sites developed with one or more of the uses stated above and an onsite sewage disposal system after the enactment of Article 6 normally meet the density requirements. Commercial sites connected to sewers (either onsite or off site) are not required to meet the density requirements of Article 6.

It is recommended that commercial sites with design flows of less than 1,000 gpd be subject to the same policy recommendations and grant incentives described within this SWP as the upgrade cost project complexity for smaller commercial projects is typically more manageable than large scale projects with design flows of greater than 1,000 gpd. Conversely, the cost and overall job complexity associated with providing advanced wastewater treatment at parcels with design flows of greater than 1,000 gpd may be significant and warrant special consideration. Unfortunately, many of these large flow parcels include existing developed commercial sites that significantly exceed the density requirements since they were constructed prior to the enactment of Article 6. There are also commercial sites where passive denitrification systems were installed between 1985 and 1994, and these sites were permitted to exceed Article 6 density requirements based on anticipation that the denitrification system would have the ability to reduce total nitrogen in the sanitary wastewater to 10 mg/L or less. Regrettably, many, if not all, of these systems lost the ability to reduce total nitrogen as described in Section 8.1.2.1.1. Finally, public schools are not required to comply with Article 6 since they are regulated by the NYSDEC. SCDHS does review the construction of sewage disposal systems for public schools for conformance with SCDHS standards but as an agent for the NYSDEC. Commercial sites exceeding allowable density represent a unique but critical element to the overall wastewater upgrade strategy in Suffolk County. Therefore, there are three categories of existing developed commercial parcels that are not connected to sewers and that may exceed Article 6 density requirements in Suffolk County:

- Grandfathered properties that predate the 1984 density requirements set forth in Article 6;
- Failed sulfur/limestone passive denitrification systems installed between 1985 and 1994; and,
- Public Schools.

In addition to exceeding density, these sites typically have additional challenges as many do not meet current setback requirements and/or have other site constraints and significant utility infrastructure. Site constraints and existing design flows may result in significant individual project cost to upgrade and maintain I/A OWTS with nitrogen removal.

Unfortunately, the locations of most of the sites exceeding density are unknown and therefore their relative priority rank, relative to the findings within this SWP, could not be established. A short description of the unique features for each of the over-density categories is provided below followed by recommendations for an overall strategy on how to address them.

8.4.1.1 Description of Other than Single Family Parcels Exceeding Density

A brief description of the three categories/groups of commercial parcels exceeding density in Suffolk County is provided below.

8.4.1.1.1 Commercial Grandfathered Properties

Existing commercial sites developed prior to the enactment of Article 6 with an onsite sewage disposal system and that exceed the discharge (density) requirements of Article 6 are known as "grandfathered" properties. Instead of their design sanitary flow being limited by lot area per Article 6 it is limited by the pre-existing uses, which can considerably exceed Article 6 density requirements.

The Suffolk County Legislature and Suffolk County Board of Health approved amendments to Article 6 addressing some grandfathered commercial properties which went into effect on January 1, 2018. Under the amendments, certain grandfathered commercial sites would be required to install improved wastewater treatment with nitrogen removing capabilities known as an innovative and alternative onsite wastewater treatment system (I/A OWTS) at the time of application to the Office of Wastewater Management for approval of their sanitary and water supply to maintain their grandfathered sanitary flow. Such applications are required when there is new construction, including additions to or changes of use of existing buildings. The I/A OWTS will provide increased protection of water resources, as compared to an onsite sewage disposal system consisting of a septic tank and leaching structure only.

8.4.1.1.2 Failed Passive Denitrification Systems

After the commercial density requirements went into effect in 1984, the SCDHS approved passive denitrification systems as a form of treatment that allowed commercial properties to exceed Article 6 density as long as the total flow generated was less than 15,000 gallons per day. Originally these systems were truly passive treatment systems. Later, in an effort to increase performance, pumps were added to the system to optimize the dosing of the treatment works. The system had five main components. The pretreatment unit consisted of a standard septic tank and grease trap. It was followed by a dosing siphon or pump station that distributed flow to the downstream treatment units.

The treatment process was carried out in two separate treatment units. The first unit consisted of a buried aerobic sand filter where nitrification would take place. The sewage was introduced to the top of the filter by a distribution manifold. As the sewage filtered down through the media, oxygen would be pulled down into the unit and mixed the sewage and the in-situ bacteria that attached to the sand. Both carbonaceous satisfaction and nitrification would occur in the filter before liquid was captured in an underdrain collection system.

The next treatment step consisted of an upflow denitrification filter that was charged with sulfur and limestone. The limestone acted to buffer the solution and the sulfur acted as the food source for the sulfur fixing bacteria that performed the denitrification process. The overflow from the denitrification filter was passed on to the final step which was effluent recharge via leaching pools.

Passive denitrification systems were installed between 1985 and 1994. There are approximately 450 of these systems installed throughout Suffolk County. This technology was thought to be advantageous because it provided developers with the ability to exceed density with a much smaller footprint and significantly lower operating cost than a traditional decentralized onsite wastewater treatment plant. Unfortunately, permission to install these systems was ultimately suspended by the NYSDEC due to the fact the technology could not consistently meet the groundwater nitrogen discharge limit of 10 mg/L due to clogging of both the sand media and denitrification filter.

Over time, most of these systems failed hydraulically and were bypassed to conventional treatment systems. The systems originally operated under a State Pollution Discharge Elimination System (SPDES) permit requiring that they met the groundwater nitrogen discharge limit of 10 mg/L. When the systems were discontinued from use, the SPDES permits were modified to drop the effluent limitations and place the permittee on notice that additional treatment may be required in the future.

8.4.1.1.3 Public Schools

SCDHS reviews and approves sanitary facilities for public schools as an agent for NYSDEC. NYSDEC has jurisdiction over the type of sanitary system and amount of wastewater flow permitted to be discharged for a public school parcel.

8.4.1.2 Recommendations for Commercial Parcels with Design Flows Greater Than 1,000 gpd

As described previously, large flow (>1,000 gpd) commercial parcels represent a unique challenge in Suffolk County for several reasons. Most notably, there is simply no definition or quantification of the problem due to the lack of geospatial location information, design flows of individual projects, their potential relative impacts to our water resources, and the overall cost implication associated with wastewater upgrades to both property owners and possible funding sources. Therefore, development of policy recommendations for large flow commercial parcels requires a four-step approach including:

- *Obtain Data to Quantify the Problem*
    - Scan/index all County wastewater permits indexed to specific tax lot numbers with particular focus on indexing failed passive denitrification systems, SPDES grandfathered sites, and exempt sites, including individual public schools. Existing funding is available through the NYSDEC-funded SCUPE grant. In addition, generate a geospatial layer that defines the location of all exempt sites through independent search, as most exempt sites likely do not have filing with the SCDHS OWM.

- *Quantify and Organize the Data*

  Using the SWP priority area map(s) as a base map:

  - Map individual parcels in a GIS based application;
  - Identify the number of parcels within specific Wastewater Management Areas;
  - Quantify the total mass from all over-density parcels contributing to each subwatershed and Wastewater Management Area;
  - Identify and quantify parcels with significant site constraints;
  - Quantify flow distribution of projects Countywide (e.g., # of projects <1,000 gpd, 1,000 gpd – 5,000 gpd, 5,000 to 10,000 gpd, etc.). Pair data with sites with significant constraints; and,
  - Quantify the number of parcels and locations where large capacity cesspools may exist that do not meet USEPA injection well requirements. This would include all commercial parcels with no SCDHS OWM filing and parcels with filings constructed before the requirement of a septic tank.

- *Preparation of a SWP Addendum*

  Using data obtained through Steps 1 and 2, the SWP addendum recommended for development during Phase I of the recommended wastewater alternative should be prepared to identify priority ranking for specific parcels, to reevaluate load reduction goals within subwatersheds with significant commercial wastewater loads, to provide recommendations for funding, and to provide recommendations for revisions to the Suffolk County Sanitary Code and/or commercial design and construction standards. Recommendations shall consider:

  - Total mass contributing to high priority areas for wastewater upgrades (proximity to surface waters and priority rank);
  - Implications to existing load reduction goals;
  - Potential for non-compliance with USEPA injection well requirements; and,
  - Thresholds for additional funding of higher flows including, but not limited to, establishing income criteria for large flow commercial parcels.

- *Revisions to the Suffolk County Sanitary Code and/or Commercial Design and Construction Standards*

  The SWP addendum should be prepared as soon as possible such that the recommendations can be incorporated into the final revenue allocation structure of the stable and recurring revenue source or other existing grant programs. Recommended revisions to the Suffolk County Sanitary Code and/or Commercial Design and Construction Standards should be developed and implemented shortly thereafter and should consider funding availability. Similar to incentives for residential and small flow (less than 1,000 gpd) commercial projects, a lack of funding to offset costs to property owners with limited means could significantly impact the financial well-being of these property owners.

8.4.1.3 Evaluation of Commercial Wastewater Flow Design Standards

Over the past two decades, changes in various factors that impact wastewater flow rates and loading rates typically used for designing STPs have occurred. The use of low-flow plumbing fixtures, changes in population density per household, and changes in both commercial development type and water use requirements for individual commercial uses are all examples of factors that could impact design flow rates. To evaluate this and provide a mechanism to optimize the use of STPs as a means of wastewater management in Suffolk County, it is recommended that existing commercial design flow rates be evaluated for accuracy. In some cases, existing design flow rates may overestimate actual design flows, possibly resulting in under use of an STP's treatment capacity (and ability to potentially connect other/adjacent unconnected parcels with no nitrogen treatment). In other cases, it is possible that design flow rates are too low, which could potentially result in less efficient treatment efficiency of the system.

Evaluation of existing design capacity will require a systematic approach with considerations for both existing STPs and new/proposed STPs. As a fundamental and logical first step of the strategy, it is recommended that data be collected from existing STPs to evaluate and document actual flow rates, concentrations, and ultimately nitrogen loading (and other contaminant loading) under a variety of uses. Once this data is obtained, a holistic evaluation and comparison can be completed against existing design standards to see where possible revisions or optimizations to the standards can be made. Finally, it is recommended that the results of the evaluation and any recommended revisions to the commercial standards be shared for comment with the Article 6 Workgroup and be presented in an SWP Annual Report as part of the Adaptive Management and Long-Term Monitoring Plan.

It should be noted that any revisions to the construction standards for modified design flow rates may require supplemental or project-specific SEQRA review before being advanced.

8.4.2 Upgrade Requirements for Home Elevation

There are an estimated 4,000 houses that have been identified for elevation through the United States Army Corps of Engineers (ACOE) Fire Island Inlet to Montauk Point (FIMP) allocations. These homes represent another unique opportunity for leveraging existing programs to support installation of I/A OWTS in high priority areas. There are several benefits to requiring upgrades in these areas, which include, but are not limited to:

- Potential for cost offset of wastewater upgrades through FIMP allocations;
- Upgrades to 4,000 houses which will result in the removal of approximately 84,000 pounds of nitrogen per year within the highest priority areas of Suffolk County; and,
- Leveraging wastewater upgrades to challenging sites (e.g., small lots with high groundwater) during a site-wide construction project will result in significantly lower cost when compared to retrofitting an already built/constructed site.

It is recommended that policymakers work with ACOE and FIMP staff immediately to pursue this unique opportunity. It is currently estimated that these upgrades will occur between the years 2022 through 2026 based upon initial discussion with ACOE and FIMP personnel.

8.4.3 - Scavenger Plant Capacity

Assuming that each of the approximately 430,000 I/A OWTS that will ultimately be installed to reduce nitrogen loading from sanitary wastewater is pumped out every four years, and approximately 300 gallons of waste is removed, approximately 0.1 MGD of scavenger waste treatment capacity would be required to accept the pumped waste.

As described in Section 1.1.6.9, there is currently an existing 1.46 MGD of municipal scavenger wastewater treatment capacity (e.g., Suffolk County's Bergen Point WWTP and the Towns of Huntington and Riverhead) and an additional 0.5 MGD of private scavenger waste treatment capacity. The existing capacity exceeds the anticipated demand for I/A OWTS maintenance. If future demand increases, the County could consider re-evaluation of Suffolk County Department of Public Works' (SCDPW) 2001 proposed 100,000 to 200,000 gpd scavenger waste treatment facility on County property in Yaphank to provide better access for waste generated in the eastern part of the County.

8.4.4 Recommendations for Contaminants of Emerging Concern

There are literally thousands of references on the environmental occurrence, fate and transport of various contaminants of concern (CECs) that may be present in air, soil, water and food, and that can also be introduced to groundwater from wastewater (Wells et al., 2008, 2009, 2010; Bell, et al., 2011, da Silva et al., 2012, 2013, 2014). These CECs include groups of compounds such as pharmaceutically active compounds, personal care and consumer product additives, etc. and have been the subject of thousands of studies on their removal in various wastewater treatment processes (Wells et al., 2008, 2009, 2010; Bell, et al., 2011, 2012, 2013; Keen et al. 2014). **Table 8-19** illustrates the types of compounds that have been reported in treated wastewater effluents in many of these previous studies.

It is acknowledged that a comprehensive strategy to address CECs must consider all sources of the contaminants, and a holistic approach that includes monitoring, research, and provision of actionable information regarding use and disposal of household products and PPCPs (e.g., identification of safer alternatives) to limit exposure. The 2015 Comp Plan provides additional information.

The discussion in the SWP focuses on CECs in wastewater. Removal mechanisms for CECs have been evaluated for the two primary methods of wastewater management in Suffolk County including onsite wastewater management methods (which includes OSDS, I/A OWTS, and leaching) and centralized treatment at STPs.

Research findings point to three major themes that should be considered when evaluating the treatability of these compounds. First, the compounds that are being detected include polar, poorly degradable compounds that occur frequently in wastewater effluents (Reemtsma, 2006). The occurrence of many of the CECs can be attributed to the fact that they are difficult to remove because they are very hydrophilic (tendency to mix with or dissolve in water) at the pH at which most treatment occurs, i.e., between pH 7 and pH 8; therefore, developing an understanding of appropriate measures of hydrophobicity/hydrophilicity of CECs is critical in understanding their removals by various treatment processes (Wells, 2006; 2007).

Secondly, there are significant differences in CEC removal among treatment processes, depending upon the mechanism of treatment. It is of note that the addition of advanced nutrient reduction and tertiary filtration to biological treatment systems is correlated with additional pharmaceutical and personal care product (PPCP) removal.

Finally, research reports on CECs only provide information about the parameters measured. As analytical technologies continue to advance and more chemicals enter commerce, it is a certainty that new chemicals will be discovered in water, and at even lower concentrations. According to Chemical Abstracts Services, more than 88 million organic and inorganic chemicals have been registered, more than 65 million chemical products are available commercially, and approximately 15,000 new chemicals are added per day (www.cas.org).

Table 8-19 CEC Classes and Examples of Compounds in These Categories

Category	Compound(s)
Pharmaceuticals	Trimethoprim, Fluoxetine, Carbamazepine, Diltiazem, Cotinine, Caffeine, Acetaminophen, Gemfibrozil, Ibuprofen, Naproxen, Sulfamethoxazole, Primidone, Atenolol, Furosemide, Metoprolol, Meprobamate, Ofloxacin, Valsartan, Hydrochlorothiazide, Oxycodone, Sertraline, Verapamil, Tetracycline, Roxythromycin, Nor-Floxacin, Ciprofloxacin, Sulfamerazine, Diclofenac
Sterols and Hormones	Coprostanol, cholesterol, β-sitosterol, β-stigmastanol, androstenedione, estrone, 17-α-ethynyl estradiol, 17-β estradiol
Flame retardants	Tris[2-chloroethyl]phosphate (TCEP), Hexabromocyclododecane (HBCD)
Perfluorinated compounds	Perfluorooctanesulfonic acid (PFOS), Perfluorooctanoic acid (PFOA), Perfluorononanoic acid (PFNA), Perfluorohexanesulfonic acid (PFHxS), Perfluoroheptanoic acid (PFHpA), Perfluorobutanesulfonic acid (PFBS)
Nonylphenols	Nonylphenol Diethoxylate, Nonylphenol Monoethoxylate, para-tert-Octylphenol, p-Nonylphenol
Disinfection byproducts (DBPs)	Trihalomethanes (THMs), Haloacetic acids (HAAs), Chloride, Bromate, Bromide, Chlorate, *n*-Nitrosodimethylamine (NDMA)
Volatile organic compounds (VOCs)	Methyl tert-butyl ether (MTBE), m- & p-Xylene, o-Xylene, 1,2,4-Trimethylbenzene, Naphthalene, Isopropylbenzene, Benzene, Ethylbenzene, Carbon tetrachloride, Toluene, 1,4-Dioxane, tert-Butyl alcohol, Acetone (2-propanone), and Tetrachloroethene (perc), 1,1,1,2-Tetrachloroethane and 1,1,2,2-Tetrachloroethane
Pesticides, herbicides, fungicides	Atrazine, Benzo(a)pyrene, Metolachlor, Simazine, Bentazon, 2,4-D, MCPA, Pentachlorophenol (PCP), Carbaryl, N,N-Diethyl-meta-toluamide (DEET), Chlordane
Consumer products and manufacturing additives	Bisphenol A (BPA), Triclosan, Triphenyl phosphate, Salicylic acid, Camphor, Anthraquinone, p-Cresol, 1, 4-dioxane, Benzophenone, DEHP, epoxy resins (alkylphenols),
Contrast media	Iopromide
Wastewater tracer	Sucralose
Musks	Nonbiodegradable musk, musk ketone (nito-musk)

8.4.4.1 On-site Wastewater Management Methods

There are a wide variety of onsite wastewater management methods that can be implemented in Suffolk County, each of which has a different capability of removing CECs from wastewater. For the purposes of discussion herein, these methods have been broken down into four primary groups:

1. Leaching pool only (e.g., “cesspools”; leaching pools predating the requirement of a septic tank);
2. Conventional OSDS (septic tank followed by a leaching pool);
3. I/A OWTS that employ biological treatment processes; and,
4. Shallow narrow drainfields.

As discussed previously, the various CECs in wastewater host a variety of chemical structures. Some compounds can be degraded aerobically and may be degraded beneath existing cesspools and within the aquifer. Other compounds require anaerobic conditions for degradation which could occur within a septic tank, within I/A OWTS, or within shallow narrow drainfields; and yet other compounds require both aerobic conditions and anaerobic conditions to fully degrade CECs to innocuous end products. Compounds requiring both aerobic and anaerobic conditions would likely require the use of an I/A OWTS for full degradation. Finally, and as described earlier, some compounds such as 1,4-dioxane and PFAS are hydrophilic and extremely stable. These compounds may not be broken down through biological or physical removal processes and typically require chemical processes such as advanced oxidation.

In summary, each compound is unique and there currently is not a one size fits all treatment technology that will address all potential CECs. Further discussion of the performance of OWTS on CECs is provided below.

8.4.4.2 Summary of CEC Treatment Performance with Onsite Wastewater Management

Though there have been a considerable number of studies validating the presence of CECs in groundwater, there have been considerably fewer studies that have investigated the level of treatment that onsite wastewater systems provide with respect to CECs (CEC removal efficiency) (Schaider et al. 2013). An important note when discussing the treatment provided by onsite systems is the high variability of CEC concentrations (can differ by orders of magnitude) from sample to sample and from site to site, likely due to inconsistent and sporadic timing and frequency of the use of personal care products, pharmaceuticals, and other organic wastewater contaminants (Heufelder 2012; Carrara et al. 2008; Conn et al. 2010). While the concentrations of CECs in the influent to centralized wastewater treatment plants reflect a homogenized stream of wastewater from multiple sources, OWTSs can capture concentrations indicating that a single discharge event has occurred (Heufelder 2012). The variability of influent water quality, complicated further by the vast range of site-specific conditions and soil characteristics, makes field studies and resulting recommendations for OWTS design difficult to generalize; therefore it should be noted that research and knowledge gaps on this topic are still prevalent and in need of further exploration.

This literature review provides a summary of available information on the performance of various OWTSs with respect to CEC removal efficiency and transformation. **Table 8-20** summarizes broad conclusions with respect to OWTSs and CEC removal.

Table 8-20 General CEC Removal Conclusions from Literature for Onsite Management Methods

Citation	Study Conclusions with Respect to CEC Removal & Treatment in OWTS
Wilcox et al. (2009); Stanford and Weinberg (2010)	Minimal CEC removal in anaerobic conditions of the septic tank
Swartz et al. (2006)	Minimal CEC removal in anaerobic groundwater, suggests significant aerobic biodegradation
Conn and Siegrist (2009), Heufelder (2012)	Significant CEC removal through sorption and aerobic biodegradation processes
Hinkle et al. (2005), Stanford and Weinberg (2010)	Significant CEC removal with advanced onsite treatment septic systems (trickling/packed bed filter, sequencing batch reactor, rotating biological reactor, aeration, forced aeration/attached growth media, aeration with carbon source, packed bed filter with carbon source, packed bed filter, trench with packed bed filter and carbon, attached growth media)
Heufelder (2012)	Significant CEC removal when leach fields were modified by hydraulic loading rates, vertical separation to groundwater, and horizontal setback distances from receiving water bodies.
Drewes et al. (2011)	Findings suggest that removal of DEET, diclofenac, ibuprofen, and meprobamate required at least one week of travel time to achieve 90% removal rates. Chlorinated flame retardants such as TCEP, TCPP, TDCPP were not well removed after 6 days, and antiepileptic compounds such as primidone, Dilantin, carbamazepine, sulfamethoxazole, and atrazine were not well removed after 5 days in either oxic or anoxic conditions.
Schaider et al. (2013)	High variability across removal efficiencies for various leach fields. Sulfamethoxazole had higher leach field effluent concentration than septic tank effluent concentration. Triclosan is well removed in septic treatment processes, but degradation products are persistent in the environment.
Berto et al. (2008)	Antimicrobials in hospital wastewater treated with an aerobic septic system could be degraded.
Garcia et al. (2013)	Aerobic on-site septic effluent was not statistically different than WWTP effluent. Anaerobic on-site septic effluent was of poorer quality than both ATS and WWTP effluent.
Teerlink et al. (2012)	Hydraulic loading was inversely related to CEC attenuation. Longer residence time may allow the microbial community to evolve to better transform CECs. Aerobic conditions facilitated better removal of acetaminophen and cimetidine than anaerobic conditions.
Roberts et al. (2014)	Direct relationship between organic carbon fraction and soil-water partitioning coefficient may exist, making estimation of CEC sorption to soil more accurate and useful.
Rosario et al. (2014)	Current horizontal setback distances from septic tanks to receiving surface waters are not enough to provide complete CEC attenuation.
Du et al. (2013)	Removal of CECs by aerobic on-site treatment systems was comparable to WWTP removal.
Subedi et al. (2014)	Advanced on-site wastewater systems in the vicinity of Skaneateles Lake in central New York incorporating synthetic media such as textile filter, peat fiber and textile/peat along with drip irrigation and bottomless and filters successfully reduced nitrogen concentrations. Significant concentrations of sulfamethoxazole were found subsequent to textile/peat treatment in

Citation	Study Conclusions with Respect to CEC Removal & Treatment in OWTS
	comparison with effluent concentrations from the other systems. Concentrations of atenolol were found to be tenfold lower when treated with the biofilter treatment unit. The textile/peat filter was found to be the most effective advanced OWTS in terms of removing total coliform, E. coli, enterococci, and all of the measured PPCPs, however, effluent from the textile/peat filter had PFOS concentrations 2 to 4 times higher than the other advanced OWTSs.

The studies referenced in **Table 8-20** provide valuable information regarding the treatment of CECs in onsite wastewater systems and the mechanisms by which treatment can likely be enhanced to better protect the integrity of the surrounding environment and human health. Upon review of available literature, conclusions have been compiled regarding attenuation of CECs with respect to removal mechanisms. Specifically, there are a suite of design parameters that ideally should be optimized to facilitate increased removal. Removal mechanisms and design parameters in OWTSs are discussed below.

8.4.4.2.1 Suffolk County Performance Data on CEC Removal in Experimental Systems

The Stony Brook University Center for Clean Water Technology (CCWT) has been completing sampling of experimental OWTS for CECs. Samples have been collected from the constructed wetland system at Sylvester Manor and from Nitrogen Reducing Biofilters (NRBs) that are currently being tested at Massachusetts Alternative Septic System Test Center (MASSTC) and various other sites throughout Suffolk County. Samples collected from the effluent of Sylvester Manor were analyzed for PPCPs during September and October 2017. In this system, fewer than 36 compounds tested were detected in any sample due to the limited diversity of influent sources at this location. Nearly all compounds detected were significantly removed by the treatment system, as shown in **Table 8-21.**

Table 8-21 Sylvester Manor Percent Removals of Organic Wastewater Constituents (OWCs)

OWC	Removal (%)
Acetaminophen	95%
DEET	88%
Paraxanthine (human metabolite of caffeine)	96%
Nicotine	66%
Cotinine (human metabolite of nicotine)	55%
Ciprofloxacin	92%

NRBs take advantage of naturally occurring soil microbes to achieve contaminant removal and generally consist of an aerobic sand layer placed over an anaerobic layer of sand and lignocellulose. Since NRBs are passive systems in which water flows by gravity, are constructed with locally available material, and do not require aeration, installation, operation and maintenance costs are minimized. **Table 8-22** below shows preliminary removals of select CECs through the various types of NRBs currently under development by the Center. These data confirm that, consistent with existing literature, biologically based systems that rely on both aerobic and anaerobic processes can have a significant treatment benefit on select CECs.

Table 8-22 Removal Efficiency of Select CECs through Nitrogen Biofilters

	LINED NRB Influent (ng/L)	LINED NRB Effluent (ng/L)	Removal LINED NRB (%)	WOODCHIP BOX Influent (ng/L)	WOODCHIP BOX Effluent (ng/L)	Removal WOODCHIP BOX (%)	UNLINED Influent (ng/L)	UNLINED Effluent (ng/L)	Removal UNLINED NRB (%)
Acetaminophen	98,000	<MDL (61)	>99	67,000 ± 6,000	<MDL (64)	>99	99,000	<MDL (55)	>99
Atenolol	480	19	96	480 ± 10	45 ± 0.8	90	450	<MDL (17)	96
Caffeine	40,000	<MDL (56)	>99	36,000 ± 2,000	<MDL (58)	>99	40,000	<MDL (50)	>99
Cotinine	1,800	<MDL (39)	98	1,800 ± 70	<MDL (40)	98	1,700	<MDL (35)	98
DEET	22,000	70	>99	22,000 ± 1,000	35 ± 2	>99	20,000	14	>99
Diphenhydramine	400	<MDL (19)	95	360 ± 30	<MDL (20)	95	340	<MDL (17)	95
Metoprolol	420	76	82	440 ± 7	160 ± 1	63	390	<MDL (8.2)	98
Nicotine	1,100	<MDL (20)	98	1,400 ± 70	<MDL (20)	99	1,200	<MDL (18)	98
Paraxanthine	17,000	<MDL (51)	>99	12,000 ± 700	<MDL (53)	>99	11,000	<MDL (46)	>99
Sulfamethoxazole	1,400	120	92	1,500 ± 60	22 ± 1	99	1,400	35	97
Trimethoprim	300	<MDL (17)	94	340 ± 9	<MDL (18)	95	330	<MDL (15)	95

Source: SBU CCWT

8.4.4.3 Wastewater Treatment Plants

The CECs present in onsite wastewater effluent are also present in wastewater from municipal sewer systems. The following section provides a summary of the mechanisms by which CECs can be attenuated in centralized wastewater treatment plants employing conventional treatment processes. A detailed discussion of the removal mechanisms can be found in Section 8.1.2.3 of the Comp Plan. Treatability and removal of CECs in OWTS differs from centralized systems partly because centralized WWTPs receive a homogenized stream of wastewater from multiple sources. However, lessons learned from review of centralized WWTPs may also help identify treatment options for "next generation" I/A OWTS. That is, unit treatment processes that demonstrate high CEC removal efficacy may warrant further evaluation at the I/A OWTS scale. Finally, it is important to note that unit processes that are already part of conventional WWTPs provide a certain level of CEC removal, even though the plants themselves were not initially designed to treat for these constituents (Rojas et al. 2013). CEC removals at centralized WWTPs are summarized on **Table 8-23.**

In general, existing literature documents that biological treatment with activated sludge, as well as chlorine and ozone disinfection have been shown to reduce and remove many contaminants of emerging concern. However, improvements are still necessary to improve the removal efficiency of some pharmaceuticals. In addition, hydrophilic compounds such as PFOS, PFOA, and 1-4 dioxane are recalcitrant to traditional wastewater treatment processes and will likely require an alternate method of treatment such as advanced oxidation or other alternate treatment options as described below.

Table 8-23 General Conclusions from Literature Regarding CEC Removal and Treatment in WWTPs

Treatment Process	Citation	Compounds Removed & Removal Efficiencies
Secondary Treatment	Rojas et al. (2013)	Antibiotics: < 50% to > 70%. Caffeine: up to 100% Pharmaceuticals Acetaminophen: up to 100%. Carbamazepine: < 50% Diclofenac: < 20%. Hormonal Compounds Estrogen and estrogen mimics: > 75%. Musks: > 65%. Musk ketone: > 90%. Plastic additives: average to high. Compounds such as PFOS and PFOA: close to zero
Chlorine	Snyder, et al. (2008), Stackleberg, et al. (2008), Westerhoff, et al. (2005), Huber, et al. (2005), Boyd, et al. (2004)	Chlorine is the most widely used disinfectant in wastewater treatment today. Pharmaceutical removal efficiency varies depending on the compound. Acetaminophen, Caffeine and Erythromycin: high Fluoxetine and Sulfamethoxazole: low Carbamazepine, Diclofenac and Ibuprofen: mixed results
Ozone	Andreozzi, et al. (2004), Bahr, et al (2007), Buffle, et al. (2006), Huber, et al. (2005), Ikehata, et al. (2006), Lei, et al. (2007), Menapace, et al. (2008), Petrovic, et al. (2003), Snyder, Wert, et al. (2006),	Ozone treatment is useful for bacteria and viruses, but its oxidative power also makes it a good candidate for removal of pharmaceutical compounds. Pharmaceutical removal efficiency varies depending on the compound. Carbamazepine, Fluoxetine, Diclofenac and Sulfamethoxazole: high Caffeine and Erythromycin: mixed results

8.4.4.4 Alternate Treatment Options

As discussed above, while traditional WWTP processes can remove many CECs, there is incomplete removal of some PPCPs and there appears to be little, if any, treatment benefit to hydrophilic compounds such PFOS, PFOA, and 1,4 dioxane. A short summary of alternate treatment options that may warrant further evaluation as an additional process to existing WWTPs is provided below. In many cases, these processes are currently primarily used for potable water treatment, groundwater remediation projects, or other water treatment processes.

8.4.4.4.1 Sorption

Two types of activated carbon: powdered activated carbon (PAC) and granular activated carbon (GAC) are used for wastewater treatment (NRC, 2012). Activated carbon can be used to enhance adsorption of contaminants, such as organic wastewater chemicals, on a solid phase material and remove them from the water. PAC is most commonly utilized in the activated sludge process to increase solids contact, whereas GAC is a common component in pressure and gravity filters (NRC, 2012).

8.4.4.4.2 Biofiltration

Biofiltration is a process that relies upon the growth of microbial communities on filter media to facilitate microbial degradation of organic matter (Kandasamy et al. 2002). A biofilter can be any type of filter that has developed a biological film on the filter media; examples include trickling filters, GAC filters, and sand filters (Kandasamy et al. 2002). The microbial community transforms organic material into both energy and cell mass. Operating parameters such as the pH, temperature, and hydraulic loading rates can impact the performance of the microbial community (Kandasamy et al. 2002).

8.4.4.4.3 Ion Exchange

Ion exchange incorporates a solid phase material to substitute ions in the aqueous phase for an ion in the solid phase (Asano et al. 2007). The most common application of this process is in water softening, where the hardness of the water is reduced by removing magnesium and calcium ions from the water and replacing them with sodium ions from the solid phase exchange material such as polymeric resin, kaolinite, or montmorillonite (Asano et al. 2007). Essentially, the exchange materials have fixed charge functional groups attached to the material itself; oppositely charged ions, known as counter ions, uphold the electroneutrality of the exchange material and the aqueous solution, allowing removal of select ions from the water by replacement (Asano et al. 2007). Ion exchange can be used to remove a variety of constituents such as barium, radium, arsenic, perchlorate, chromate, Na+, Cl^-, SO_4^{2-}, NH_4^+ and importantly for systems that discharge to groundwater for the purposes of indirect potable reuse, NO_3^- (Asano et al. 2007).

8.4.4.4.4 Advanced Oxidation Processes

AOPs rely on the generation of highly reactive hydroxyl radicals (·OH). These reactive species are the strongest oxidants that can be applied in water and can virtually oxidize any compound present in the water matrix, often at a diffusion-controlled reaction speed. Consequently, ·OH reacts unselectively once formed and contaminants will be quickly and efficiently fragmented and converted into small inorganic molecules. Hydroxyl radicals are produced with the help of one or more primary oxidants (e.g. ozone, hydrogen peroxide, oxygen) and/or energy sources (e.g. ultraviolet light) or catalysts (e.g. titanium dioxide). Precise, pre-programmed dosages, sequences and combinations of these reagents are applied in order to obtain a maximum •OH yield. In general, when applied in properly optimized conditions, AOPs can reduce the concentration of contaminants from several-hundred ppm to less than 5 ppb and therefore significantly reduce COD and TOC, which earned it the credit of "water treatment processes of the 21st century".[3]

The AOP procedure is particularly useful for cleaning biologically toxic or non-degradable materials such as 1,4 dioxane and PFAS. Contaminants are converted to a large extent into stable inorganic compounds such as water, carbon dioxide and salts, i.e. they undergo mineralization. A goal of the wastewater purification by means of AOP procedures is the reduction of the chemical contaminants and the toxicity to such an extent that the cleaned wastewater may be reintroduced into receiving streams or, at least, into a conventional sewage treatment.

While AOP technology can remove the most recalcitrant of compounds, their use is generally limited to large scale water and wastewater treatment applications such as the treatment of public water supply wells and as tertiary treatment at STPs. Compared to other technologies, the capital and operation and maintenance costs associated with AOP processes are significant. While there are commercially available AOP systems for residential treatment of pool water, these systems typically rely on ozone generation only, which may have insufficient oxidation potential to completely degrade 1,4 dioxane and PFAS. Generally, AOP technologies that are capable of removing these compounds are not suitable for use at individual homes as they require the use of dangerous chemicals (e.g., hydrogen peroxide) and have very high maintenance needs.

8.4.4.5 Recommendations for Suffolk County

In Suffolk County, CECs are of specific concern because the County sits atop a sole source aquifer which provides drinking water to all of the County's residents. In addition, an estimated 74 percent of the county is unsewered, relying on outdated conventional OSDS that provides minimal treatment of wastewater.

As discussed in previous sections, biologically mediated treatment technologies have been shown to have significant removal rates for select CECs in wastewater, depending on the specific technology evaluated. Nonetheless, it is clear that research gaps inevitably exist, particularly with respect to how each specific system performs on individual CECs. In addition, it is clear that existing readily available onsite wastewater technologies do not currently exist for the removal of biologically recalcitrant CECs such as 1,4 dioxane and PFAS. Further investigation, evaluation, and technology development is, without doubt, a crucial component of making educated decisions about the long-term selection and implementation of processes to provide treatment for these compounds.

Thus, the following four step approach is recommended to evaluate CEC performance of existing technologies and identify needs for the development of new technologies:

1. Continue to develop an integrated monitoring strategy building upon current collaboration efforts with SCDHS, SBU, USGS, and the NYSDEC to evaluate the efficacy of existing I/A OWTS (including shallow narrow drainfields and polishing units) and WWTPs on the removal of CECs. Identify recalcitrant compounds that require the development of alternate treatment technologies;

2. Establish initial recommendations and guidelines for technology selection and system design of existing I/A OWTS to optimize the removal of readily degradable CECs;

3. Develop new technologies to enhance removal of recalcitrant CECs; and,

4. Complete cost-benefit for the removal of recalcitrant CECs under various technologies. In addition, compare and contrast the benefit of providing treatment on public water supply versus wastewater upgrades published through a follow up study (e.g., CCWT, LINAP, or other initiative).

In addition to the above, as Suffolk County's wastewater and groundwater systems are directly connected, all efforts should be coordinated with the Long Island Commission for Aquifer Protection and the recommendations in the LICAP Groundwater Resources Management Plan to leverage the findings of each program and ensure optimal allocation of funds committed to similar objectives.

8.4.4.5.1 I/A OWTS and WWTP Performance Monitoring

Performance monitoring of CEC removal efficiency is currently being completed for some CECs at experimental I/A OWTS sites and at a subset of the WWTPs in Suffolk County by both SCDHS and SBU CCWT. In addition, the SCDHS is currently evaluating options to expand the existing CEC monitoring framework at WWTPs including an expansion of the CEC analyte list and expansion of the number of facilities tested. It is recommended that these programs continue to be pursued and that an integrated CEC wastewater performance monitoring plan be developed to evaluate CEC removal at centralized WWTPs in Suffolk County, at existing and future provisionally approved I/A OWTS technologies, as well as existing or future experimental technologies.

Performance monitoring data should be used to:

- Identify technologies with the highest efficacy on the widest range of CECs;
- Adjust operating parameters of existing technologies to optimize removal of CECs; and,
- Identify compounds that are recalcitrant to treatment through existing technology.

Performance monitoring data and related recommendations should continue to be included in the I/A OWTS and STP Annual Reports currently prepared by the SCDHS. The monitoring program should leverage existing resources from both the SCDHS, SBU CCWT, and potentially other related project partners to optimize program efficiency and leverage the sharing of information and lessons learned.

8.4.4.5.2 Develop New Technologies

The development of new cost-effective technologies that are suitable at both the onsite wastewater treatment level and at centralized WWTPs likely represents the largest challenge in the treatment of CECs from wastewater sources.

The New York State Center for Clean Water Technology (CCWT) was established with the goal of developing and commercializing technology that will be efficient, reliable, and affordable at removing nitrogen and other contaminants from onsite wastewater. The CCWT has already developed and tested Nitrogen Removing Biofilters (NRBs) as a technology potentially capable of meeting this goal and is actively developing the next generation of NRBs with the objective of identifying the optimal configurations for Long Island. In full-scale pilot studies investigated by the CCWT, these systems have demonstrated an ability to consistently achieve high percentages of total nitrogen removal (up to 90 percent), as well as efficient attenuation of pathogens, pharmaceuticals and personal care products.

Through grant funding obtained from the New York State Department of Health (NYSDOH) and other sources, the CCWT will be evaluating novel treatment methods for the removal of 1,4 dioxane and PFAS from drinking water. While the work plans for these studies are still being finalized and are focused on the treatment of drinking water, the findings of the research could lead to additional recommendations or insights into removal mechanisms for wastewater treatment in Suffolk County. The CCWT's evaluation of removal technologies for 1,4-dioxane and PFAS are anticipated to include (but subject to final work plan approval):

- Novel biological treatment approaches for the removal of 1,4-dioxane and its intermediates from drinking water;
- AOP for the removal of 1,4-dioxane and related byproducts and PFOS from drinking water;
- Evaluating the efficiency of existing treatment approaches (GAC, ion-exchange treatment, advanced oxidation processes) in removing PFOS, PFOA and more specifically, short-chain PFAS;
- Novel biomaterials for removal of PFAS;

- Evaluating treatment technology combinations for the removal of PFOS (e.g. GAC plus ion exchange [IX]; AOP followed by GAC; GAC/IX followed by RO etc.);
- Membrane processes typically employed for point-of-use treatment (reverse osmosis); and,
- Zeolite filtration: zeolite filtration involves the use of zeolite clays to chemically or physically remove contaminants from water or wastewater. While initial efforts may target the development of an advanced nitrogen removing zeolite filter for wastewater, the efficacy of removing CECs should be evaluated during technology testing and development.

It is anticipated that the evaluation and testing of these technologies will be completed over the next few years. Given the Center's research capabilities and anticipated research activities, it is recommended that new wastewater technologies continue to be developed and tested through the CCWT or similar programs to develop cost-efficient solutions for onsite I/A OWTS and that can leverage and be added to existing treatment plants.

8.4.4.5.3 Cost-Benefit/Feasibility Study for CECs

Building upon the findings of Recommendations 1 through 3 above, a Feasibility Study or similar document should be prepared to evaluate the cost-benefit of removing recalcitrant CECs under a variety of alternatives. Alternatives should include, but not be limited to:

- I/A OWTS for wastewater treatment on individual parcels (presuming new technology is developed);
- Advanced treatment for individual drinking water supplies (presuming new technology is developed); and,
- Advanced treatment for public water supply wells.

The findings of the Feasibility Study should be used to support decisions relative to the optimal management strategy of CECs in Suffolk County (e.g., wellhead treatment versus wastewater treatment, or both) as well as guide technology selection that balances the protection of human health and cost effectiveness. The FS methodology, development, and findings should be executed in a collaborative process that involves multiple agencies in programs including, but not limited to, the NYSDOH, NYSDEC, Suffolk County, and the LICAP.

8.4.5 Initial Recommendations for Sea Level Rise

The 2015 Comp Plan included an evaluation of the impact of sea level rise projections indicating that sea level is projected to rise between 24 and 34 inches by the end of the century with a 95 percent uncertainty range of 36 to 45 inches (Zhang et al, 2014) as shown by **Figure 8-13**. Sea level rise has significant implications regarding on-site wastewater treatment systems for parcels within low-lying coastal areas. Suffolk County Standards for On-Site Wastewater Disposal Systems identify the minimum separation distance from the bottom of a leaching pool system to the highest groundwater elevation recorded at the site of 3 feet to ensure adequate treatment in the unsaturated zone prior to discharge to groundwater. In some instances, the minimum separation distance may be reduced to 2 feet for alternative treatment systems, as approved by SCDHS. As per the Standards, for a single-family household with 4 or fewer bedrooms, a minimum depth to water

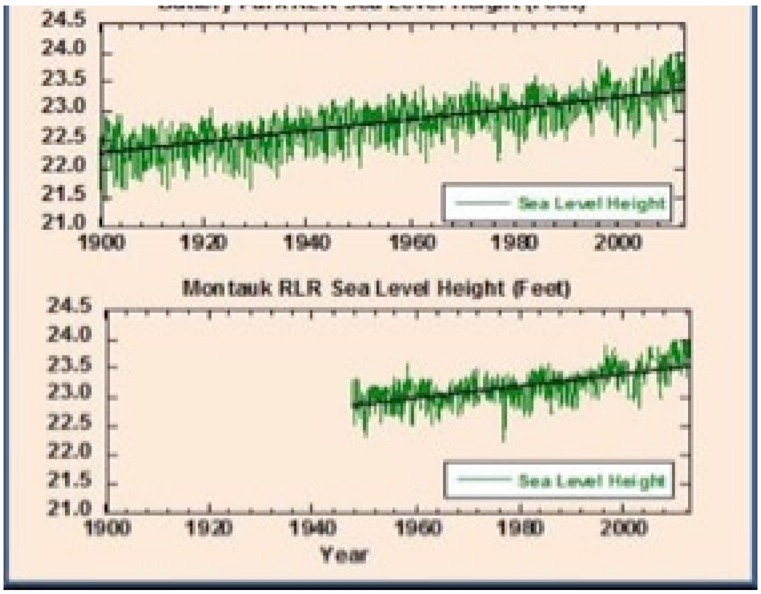


Figure 8-13 Monthly Sea Level Height over Time (Relative to the Revised Local Reference (RLR); from Zhang et al, 2014)

of 9 feet is required or an alternative system must be designed. For larger residences (5 to 6 bedrooms), the minimum depth to water is 11 feet due to the increased wastewater flow.

The 2015 Comp Plan documented the results of modeling evaluations of the potential impacts of sea level rise on both the water table elevation and salt water intrusion. The results concluded that the sea level rise conditions simulated may result in water table increases of more than 3 feet in coastal areas. This rise in the water table may result in a reduced treatment capability for systems installed within the 9-foot depth to groundwater range or may in fact cause flooding in older systems installed prior to the development of the 1995 Standards. This would result in a direct discharge of sanitary effluent to the groundwater with minimal or no treatment from travel through the unsaturated zone.

For example, the projected 34-inch sea level rise is simulated to result in an increased groundwater elevation of approximately 3 feet on the North Fork. From a wastewater treatment perspective, this increase results in risk of reduced treatment by septic systems, particularly on the peninsulas and Orient Point. Simulated depth to water maps for baseline, 2035 and 2100 conditions are shown on **Figure 8-14**. The model results for the North Fork provide a good opportunity for use as a planning tool and can highlight the areas on the North Fork that could be prioritized for sewering or the installation of alternative systems. However, when evaluating on a larger scale, impacts are more apparent. As shown on **Figure 8-15**, developed parcels near Jamesport and Aquebogue currently have a depth to groundwater greater than 10 feet or between 5 and 10 feet. However, as sea level rises, those parcels ultimately become at risk for reduced wastewater treatment as the depth to water at many of these parcels is less than or equal to 5 feet by 2100.

These estimates were based on mid-range estimates of sea level rise resulting from climate change models incorporating the greenhouse gas emissions resulting from "business as usual" and reasonable assumptions regarding precipitation and recharge. It is not reasonable to expect that sea level rise can be accurately predicted to the turn of the century, as estimates of climate change and sea level rise continue to be re-evaluated and updated as new information becomes available. Nonetheless, the information presented in this section is helpful in identifying the areas of potential concern, as well as the order of magnitude of change that could be expected in the decades to come.

Possible policy options/mitigation strategies that could be included as part of an overall sea level rise protection strategy for wastewater management include:

- Increase minimum separation distance to groundwater in sea level rise "protection areas" based on the objective of maintaining a minimum 3-foot separation distance based on the projected groundwater table elevation in Year 2100;
- Clustering/sewering of parcels in sea level protection areas and relocating the recharge of collected/treated wastewater outside of the sea level rise protection area;
- Purchasing parcels in the sea level protection area through Open Space; and,
- Providing incentives to property owners for making parcels in the sea level rise protection areas TDR sending parcels.

Ultimately, accommodating wastewater upgrades for sea level rise will likely require significant financial resources (e.g., retaining walls for small properties with I/A OWTS to increase separation distance, sewer expansion, purchase of land, etc.). To ensure that financial resources are not depleted prior to obtaining the best available information, the final sea level rise strategy for wastewater management must consider final recommendations and identification for sewer expansion as well as a possible Countywide strategy for addressing sea level rise. Because additional information is needed, it should be considered in the SWP Adaptive Management Plan and it should be reevaluated as part of routine project reviews and the availability of new data.

Additional data that would prompt a new review would include:

- Clarification on possible sewer expansion areas based upon the actual availability of funding from a stable and recurring revenue source to offset costs to sewer expansion projects (e.g., see Section 4.5, Wastewater Management Methods which describes the recommended process for finalizing sewer expansion areas);
- New information regarding development of regional or local sea level rise management plans, should such information become available; and,
- New information and data regarding sea level rise projections.

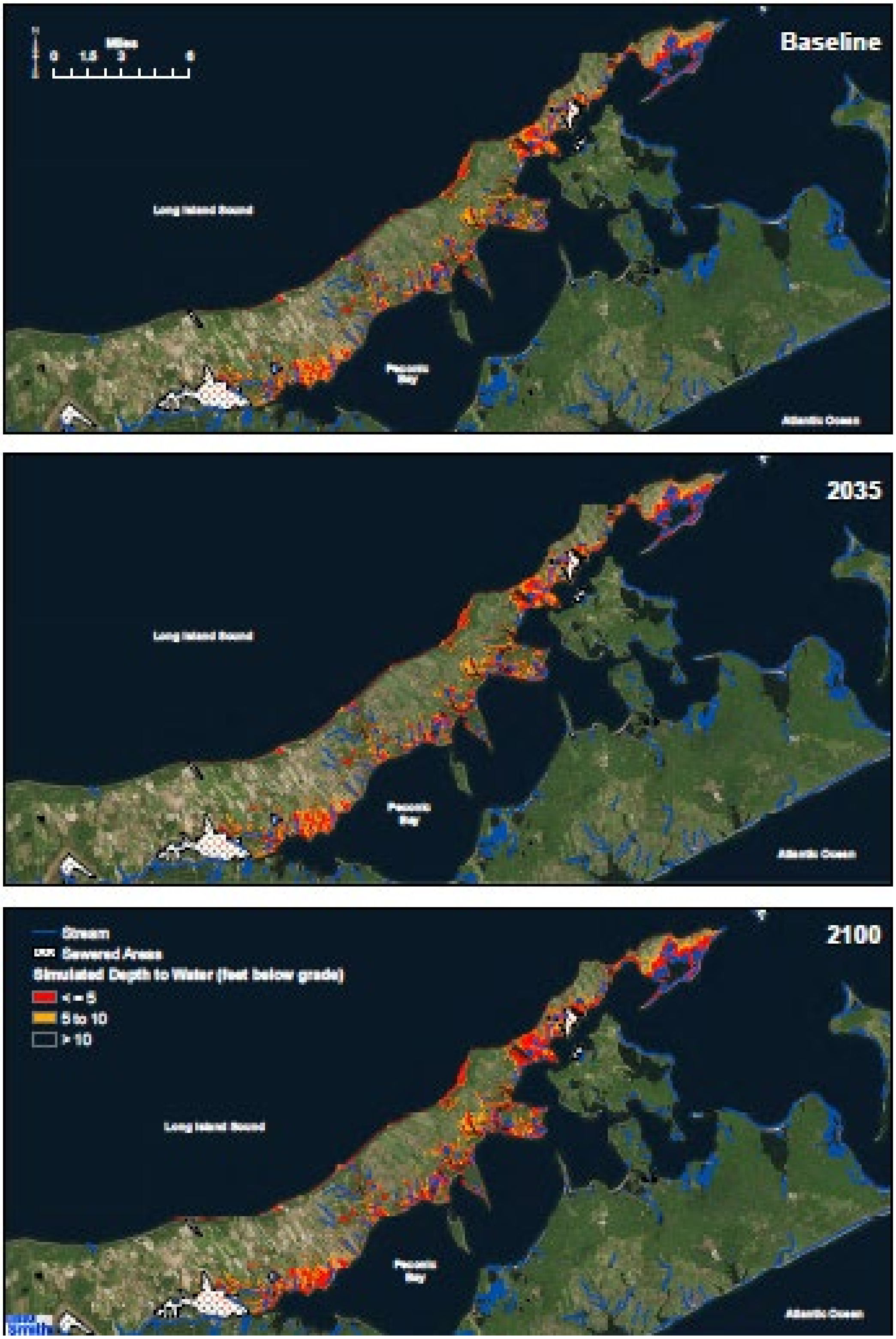


Figure 8-14 Model-Simulated Increase in Water Table Elevation Resulting from Projected 39-inch Sea Level Rise (Source 2015 Comp Plan)

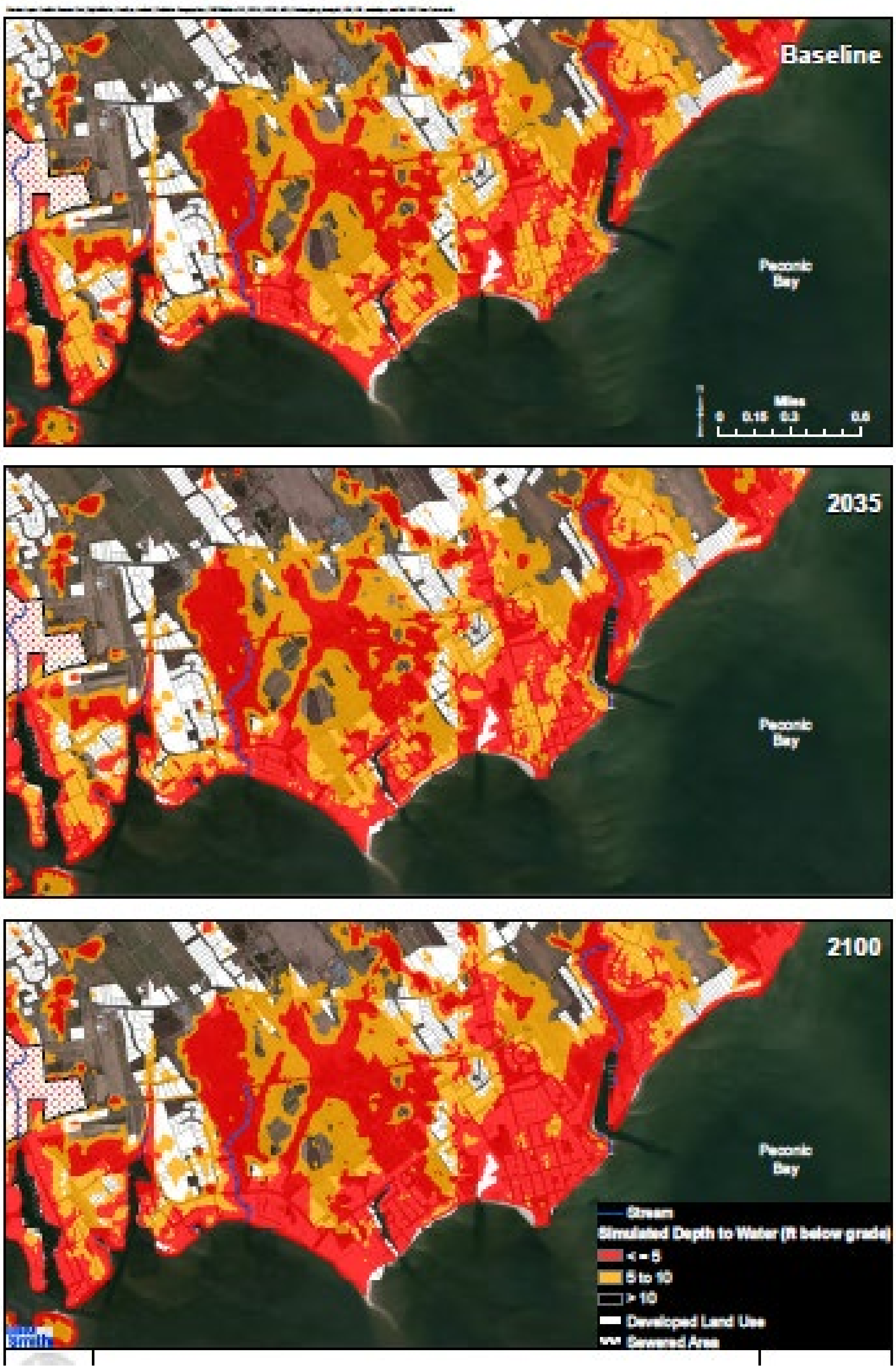


Figure 8-15 Simulated Impacts of Sea Level Rise on the North Fork Water Table (Source: 2015 Comp Plan)

Since the groundwater modeling assessment of the impacts of projected sea level rise on the groundwater table, updated sea level rise projections have been developed. New York State has adopted regulations establishing science-based sea-level rise projections. https://www.dec.ny.gov/regulations/103877.html. **Table 8-24** summarizes the updated New York State sea level rise projections for the Long Island Region; the medium/high-medium projections are the same order of magnitude as those used for the groundwater modeling simulation.

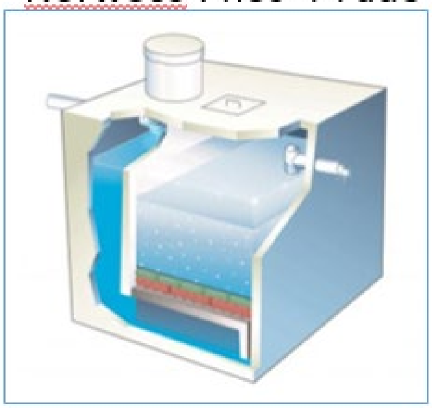
Table 8-24 New York State Sea Level Rise Projections for the Long Island Region

Time Interval	Low Projection	Low-Medium Projection	Medium Projection	High-Medium Projection	High Projection
2020s	2 inches	4 inches	6 inches	8 inches	10 inches
2050s	8 inches	11 inches	16 inches	21 inches	30 inches
2080s	13 inches	18 inches	29 inches	39 inches	58 inches
2100	15 inches	21 inches	34 inches	47 inches	72 inches

8.4.6 Initial Recommendations for Phosphorus

Compared to other wastewater constituents, phosphorus is not very mobile, and in many cases, it can be effectively retained in the shallow soils below drainfields. Although some phosphorus is removed in the septic tank as it becomes part of settled solids at the bottom of the tank, the amount of phosphorus reduction achieved is determined after wastewater leaves the septic tank. No data could be found on the removal of phosphorus using I/A OWTS technologies that are currently being tested in Suffolk County. However, a brief literature review confirmed that there are I/A OWTS polishing filters designed for the removal for phosphorus such as the Norweco Phos-4-Fade® phosphorus removal filter and Ecoflo DpEC self-cleaning phosphorus removal systems. It is recommended that phosphorus data be collected as part of the SCDHS I/A OWTS testing program to determine how much, if any, phosphorus is removed in the I/A OWTS technologies approved for use in Suffolk County. In addition, consideration should be given to testing readily available phosphorus polishing filters in subwatersheds that may be sensitive to phosphorus from wastewater sources.

Norweco Phos-4-Fade®



Research has demonstrated the effectiveness of phosphorus removal from wastewater as it is chemically bound to soil particles in the shallow portion of the soil by plant uptake and beneficial bacteria living in unsaturated soil (Wen et al., 2011. Lombardo, 2006. Minnesota Pollution Control Agency, 2006. Pipeline, 2013.24.1). Specifically, Holden et al. in "Nitrogen and Phosphorus Treatment and Leaching from Shallow Narrow Drainfield", studied pressure-dosed shallow narrow drainfields (referred to as pressurized shallow drainfields in the SWP) for their effectiveness of phosphorus removal. For all five Rhode Island sites, the average removal of total phosphorus (TP) was 40 percent to 100 percent with the use of the shallow narrow drainfield. The reductions can be attributed to both plant uptake, due to the grass roots absorbing moisture and nutrients from the wastewater effluent flowing through the drainfield, and the biogeochemical composition of the soil providing further reduction of phosphorus. However, coarse-grained soils such as sandy and gravelly soils are less effective than heavy soils like those with peat. When there are marginal soils it is recommended to utilize timed dosing of septic tank effluent into a pressurized shallow drainfield to equalize flow over the entire drainfield. This would eliminate localized, saturated ponding conditions that often occur after surge flows in conventional gravity-flow systems. This is another reason why localized testing of phosphorus treatment is recommended. Another suggestion has been the use of shallow dispersal options, especially the use of drip distribution systems in which the effluent is dispersed within the root zone of plants, which can then biologically take up phosphorus. Phosphorus treatment technology would be beneficial for onsite wastewater disposal systems within the contributing areas of freshwater streams, lakes and ponds, particularly those that have documented eutrophication.

Photo: GeoMat Pressurized Shallow Drainfield Installation

8.4.7 Recommendations for Subwatersheds with Buildout Potential

Two analyses were completed to identify subwatersheds that could be prone to increased nitrogen loading from buildout and to provide initial recommendations for alternate strategies to manage these potential nitrogen loads. The evaluations included:

1. The predicted nitrogen loads under a hypothetical full buildout analysis were compared to baseline (current) loading conditions for all subwatersheds (see Section 2.1.5.3 and **Table 2-20**); and,

2. The Comp Water Plan recommended extending the protections afforded to Groundwater Management Zones (GWMZs) III, V and VI to GWMZ IV for the protection of groundwater in coastal areas. As shown on **Figures 2-56** and **3-8**, GWMZ IV is primarily located within the five East Towns including East Hampton, Riverhead, Shelter Island, Southampton and Southold. A nitrogen load reduction analysis was completed using the full build-out parcel

data set and comparing the nitrogen load reductions that could be realized from upzoning to the reduction goal needs of each subwatershed in GWMZ 4. This analysis included:

- Estimation of the potential benefits of modifying Article 6 of the County's Sanitary Code to require a minimum of 40,000 square feet for residential development in GMZ IV by comparing the nitrogen load from full build-out at the current allowable density (1/2 acre) to the nitrogen load resulting from build-out at a minimum parcel size of 1 acre;
- Summarizing the results on a subwatershed-specific basis, and
- Comparing the resulting nitrogen load reductions to the subwatershed-specific nitrogen load reduction goals.

The Countywide buildout analysis found that:

- The overall nitrogen loading to Suffolk County subwatersheds is projected to increase by only 2.9 percent should all of the potential build-out be completed. Despite the overall modest increase in predicted buildout nitrogen load on a Countywide basis, some subwatersheds do present with increased potential buildout loads that warrant mitigation.
- Ninety-seven subwatersheds are predicted to have a zero to ten percent increase in nitrogen load at buildout when compared to baseline conditions. Mitigation of nitrogen through wastewater management alone (e.g., requiring a nitrogen removing sanitary system) is sufficient to address nitrogen loads for these water bodies.
- Nitrogen loads are predicted to increase between ten and 20 percent in forty-six subwatersheds at buildout when compared to baseline conditions. Mitigation of nitrogen through wastewater management alone (e.g., requiring a nitrogen removing sanitary system) is likely sufficient to address nitrogen loads for many of these water bodies; however, policymakers should consider coupling wastewater management mitigation with other mitigating measures such as purchasing open space, revising local zoning, increasing minimum Article 6 lot size, and/or TDR programs.
- Thirteen subwatersheds are predicted to have a greater than 20 percent increase in nitrogen load at buildout when compared to baseline conditions. Mitigation of nitrogen through wastewater management alone (e.g., requiring a nitrogen removing sanitary system) may be insufficient for some of these water bodies. As such, policymakers should consider coupling wastewater management mitigation with other mitigating measures such as purchasing open space, revising local zoning, increasing minimum Article 6 lot size, and/or TDR programs.

The GWMZ IV analysis found that:

- Increasing the minimum Article 6 lot size in GWMZ IV would reduce nitrogen loading by just over 70,000 pounds when compared to use of the existing Article 6 sanitary density;
- The total reduction benefit through increasing the minimum lot size was less than five percent of the total nitrogen load reduction goal for GMWZ IV under current conditions;

however, the potential benefit was relatively significant in a subset of the 100 subwatersheds evaluated. Specifically, Acabonack Harbor, Fort Pond, Georgica Pond, Goose Creek, Great South Bay (Middle), Hashamomuck Pond, Long Island Sound (Central and East), Mecox Bay, Noyac Bay, Quantuck Creek, Southold Bay, and Tiana Bay would benefit from increasing the minimum lot size as the potential increase in nitrogen load from buildout could inhibit the ability of these subwatershed to achieve their respective load reduction goals for ideal water quality. Furthermore, subwatersheds that overlap groundwater/drinking water Priority Rank 1 water bodies should be considered for additional protection of private supply wells.

Based upon the findings above, policymakers should consider the following options to mitigate the potential future buildout loads:

- Require I/A OWTS or other comparable wastewater treatment for all subwatersheds and all Priority Rank 1 drinking water areas;
- For subwatersheds where the predicted nitrogen load at buildout is greater than 20 percent of the predicted nitrogen load under current conditions and for water bodies with no additional nitrogen capacity (e.g., where predicted loads exceed the recommended nitrogen thresholds to meet water quality endpoints), policymakers should consider coupling wastewater management mitigation with other mitigating measures such as:
    - Revision to Article 6 of the Suffolk County Sanitary Code to require a minimum of 40,000 square foot lot size in all of GWMZ IV;
    - Revision to Article 6 of the Suffolk County Sanitary Code to identify special groundwater protection areas in select subwatersheds where a minimum of 40,000 square foot lot size would be required;
    - Do not revise Article 6 of the Suffolk County Sanitary Code, but local Towns/Villages could incorporate revised zoning with a minimum lot size of one acre in select subwatersheds, as appropriate, based upon the findings presented in this SWP;
    - Purchase of land for Open Space; and/or,
    - Use of local TDRs to offset proposed development (e.g., consider requiring "net-zero" nitrogen loading in sensitive water bodies).

The policy options above are initial recommendations for policymakers to consider. It is recommended that these policy options be discussed with Town and Village planners under future Article 6 Workgroup meetings to develop a holistic approach that meets the environmental protection needs of the subwatersheds while maintaining local socio-economic viability.

8.4.8 Initial Recommendations for Pathogens

The removal of pathogenic organisms from wastewater effluent with the use of pressurized shallow drainfields is proven to be an effective method. Fecal coliforms in wastewater effluent can be removed up to 99 to 99.99 percent in soil infiltration systems that have suitable separation between the discharge zone and groundwater (USEPA, 1992). The greatest removal of pathogens from wastewater effluent occurs in the biological mat at the interface of the drainfield discharge and the soil; the majority of pathogens become physically clogged in this mat, and smaller viral and bacterial pathogens are primarily removed by physical attachment and chemical adhesion to the soil (Meschke, J.S. and Sobsey, M. D., 2015). It is recommended that pathogen data be collected as part of the SCDHS I/A OWTS testing program to determine the ability of local soil to remove pathogens. Potts et al. suggest that air in the soil or aeration provides removal of fecal coliforms in leachfield soil in "Effects of Aeration on Water Quality from Septic System Leachfields" (Potts et al., 2004). Pfluger et al. agreed in "Efficacy of Bacterial Reduction by Onsite Wastewater Treatments" that "aerobic treatment provides greater reduction of enteric bacteria than does a traditional septic tank alone" due to the presence of oxygen enabling the breakdown of pathogens (Pfluger et al., 2009).

Similar to data regarding phosphorus removal efficiency in I/A OWTS, no data could be found on the removal of pathogens using I/A OWTS technologies that are currently being tested in Suffolk County. However, the literature review did reveal that there are several commercially available UV-based tertiary treatment units for the removal of pathogens from I/A OWTS treated effluent. Example brand names included the EcoFlo DiUV self-cleaning disinfection system, the Illumi-Jet UV Disinfection Unit ®, and Polylok UV Disinfection Unit. As suggested, all of these units require pretreatment through an I/A OWTS to remove solids prior to disinfection. The literature review also suggested that I/A OWTS with recirculating textile filters break down organic matter more efficiently than anaerobic septic tanks, achieve quicker decomposition of organic solids, and reduce the concentration of pathogens in wastewater. A study by Solomon et al., demonstrated that an Orenco AX series, combined with a shallow, narrow drainfield can achieve a 3-log reduction in fecal coliform counts based on the National Onsite Demonstration Program in the Green Hill Pond watershed of Rhode Island (Solomon et al., 2001).

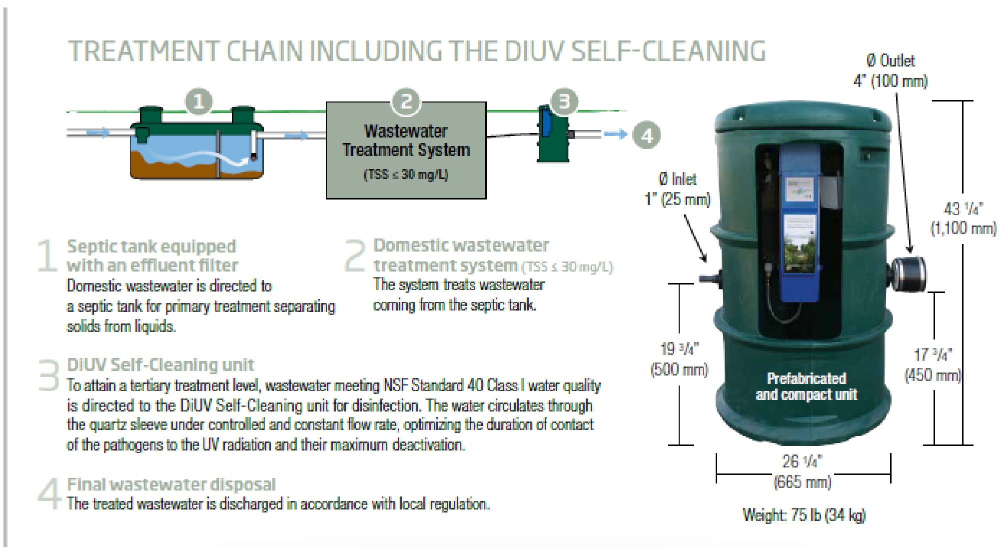
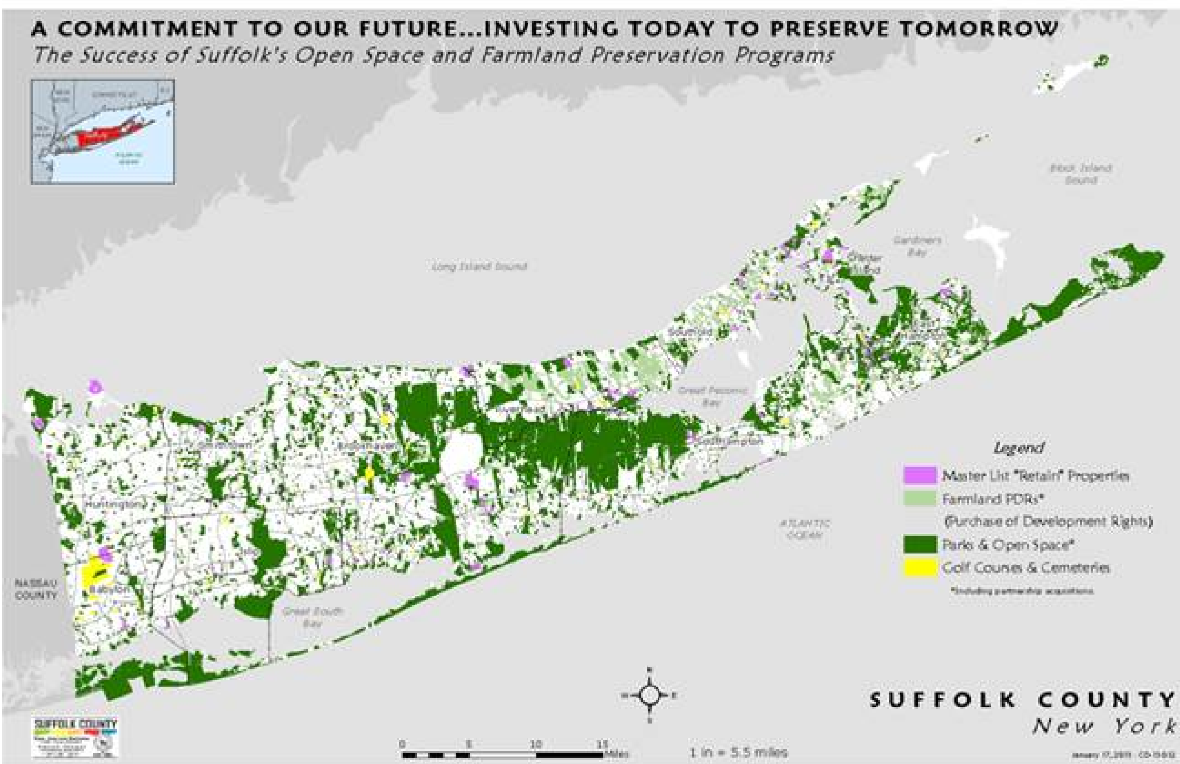


Photo: Infiltrator Pressurized Shallow Drainfield Installation

Finally, soil-based effluent discharge with the use of pressurized shallow drainfields after an I/A OWTS provides not only nutrient reduction but also pathogen removal with the use of natural processes in the most biologically active portion of the soil ecosystem. The shallower the effluent discharges into the soil and the greater the distance from the water table, the more oxygen is present which promotes better pathogen removal. Pathogen treatment would be beneficial for onsite wastewater disposal systems within the contributing areas of those water bodies indicated in Section 2.2.5, as subwatersheds with potential pathogen impacts from sanitary wastewater after additional DNA source tracking studies are conducted to determine if human wastewater is a contributor.

8.4.9 Recommendations for Open Space



Suffolk County's Open Space Land Acquisition Program is one of the most successful programs for land preservation in the country. The County has been at the fore-front of farmland preservation through the acquisition of development rights starting in the 1970s and open space preservation through the acquisition of environmentally sensitive lands starting on a grand scale in the 1980s. As a suburban county situated 50 miles east of Manhattan, New York City, the pressures of development have been and continue to be tremendous. Today, Suffolk County has a population of almost 1.5 million people, larger in population than 12 U. S. states. Being an area that has experienced rapid growth since the mid-20th Century, the importance to preserve and protect our environmentally sensitive lands, parklands and historic farmland uses has been a high priority to the citizens of this County over the last three decades. It is essential that we balance the needs of our large population with the need to protect those resources that sustain us, our groundwater and surface waters, our farming and tourism industries, and our recreational opportunities, in order to preserve the fundamental well-being of the residents of Suffolk County.

An integral part of Suffolk County's open space preservation program was the creation of Suffolk County's Comprehensive Master List that identified environmentally sensitive lands which included sites that possess but are not limited to such characteristics as: tidal and/or freshwater wetlands and their buffer areas; lands within the watershed of a stream or river corridor or lake system; lands within a Special Groundwater Protection Area (SGPA); lands consisting of natural vegetation including endangered, threatened and/or species of special concern; NYS Natural Heritage Program Elements; lands located adjacent to a water body and/or that contain a unique geological feature; and lands determined by the Planning Department to be necessary for maintaining the quality of surface and groundwater in Suffolk County. An important consideration was the identification of those sites that were located adjacent to other County holdings. A strong emphasis was placed on consolidation of County holdings where a majority of County ownership exists. Certain parcels located within old filed map areas, where Suffolk County has amassed numerous small sized parcels, primarily through tax lien procedures, were identified for acquisition to complement our park holdings in these areas. These sites were considered for their value as an environmentally sensitive area and/or as recreationally important parkland. Additionally, and equally important, the County continues to acquire lands within the Pine Barrens Core Area for environmental and groundwater protection along with New York State and the Towns of Brookhaven, Riverhead and Southampton. The County has utilized funds approved by County Legislative Resolutions and Countywide-approved referendums. To date, Suffolk County has acquired near to 45,000 acres for open space preservation and parkland use, some of which have been acquired in partnership with other local municipalities in support of the protection of environmentally sensitive lands and groundwater and surface water protection efforts.

The Suffolk County, New York State and Town programs alone have resulted in the acquisition of an estimated 121,854 acres of Open Space. Existing Open Space Preservation efforts have already mitigated nearly 3.65 million pounds of nitrogen per year from discharging to our sole source aquifer.

Tourism is a multi-billion dollar industry in the County. According to a study prepared for the State, traveler spending in the County totaled $3.2 billion in 2017, tourism supports 43,000 local jobs in the County and generates $394 million in local and state tax revenues annually. Twenty New York State parks are located in the County. According to the New York State Department of Parks and Recreation, the State parks on Long Island had 15.5 million attendees in 2016. The State parks located in the County that were most frequently visited in 2016 were Robert Moses State Park (with 4.3 million visitors), Sunken Meadow State Park (with 2.9 million visitors), Captree State Park (with 1.4 million visitors), Heckscher Park (with 1.0 million visitors) and Montauk State Park (with 1.0 million visitors). Many of the other State, County, Town and Village parks attract hundreds of thousands of visitors each year. Moreover, a beach in the County has again been ranked number one on a list of the top ten beaches in the United States in 2017 based on 50 factors rated by a professor at Florida International University. With 986 miles of shoreline, industries such as recreational boating, boat sales and service, marinas, and charter boat fishing are prominent in the County.

Open space preservation is a well-documented effective means of protecting ground and surface water resources (USEPA, AWWA, Trust for Public Land). Studies have established that open space preservation can also be the most cost-effective approach to protect source water quality for water supplies, as has been documented for New York City and Boston (AWWA, 2004). In a 2010 publication from the New York State Comptroller's Office (NYS Office of the State Comptroller, 2010), the following general conclusions were made regarding Open Space:

- Open space supports industries that generate billions of dollars in economic activity annually;
- Open space protection can be financially beneficial to local governments by reducing costs for public infrastructure and programs, lessening the need for property tax increases;
- Open space preservation can support regional economic growth; and
- Well-planned open space protection measures need not conflict with meeting other vital needs, such as economic development, municipal fiscal health and affordable housing.

Of the potential economic benefits from Open Space, the direct impact to recreation and tourism was significant. The following statistics and statements were provided in the 2010 publication:

"Similarly, New York's open spaces attract significant numbers of visitors, many of whom come from out-of-state. A 1987 study conducted by the President's Commission on Americans Outdoors cited natural beauty as the most important factor in attracting tourist visits.[18] New York's tourism industry generates approximately $43 billion annually.[19] While not all of this money is generated through tourism related to open space, there is evidence that open space is a significant attraction. For example, according to the Adirondack Regional Tourism Council, between seven and ten million tourists visit the Adirondack Park annually."

According to the County Department of Economic Development and Planning, there are more than 5,000 lodging rooms located in eastern Suffolk, ranging from luxurious boutique hotels and bed & breakfast inns to traditional motels. These lodging properties draw thousands of tourists to the County's east end throughout the year, but primarily in the summer months. The department estimates that the resident population in eastern Suffolk increases by more than 213,000 people during peak summer times due to tourism, which more than doubles the year-round population. Due to its proximity to New York City, the County is well situated to serve the vacation needs of this market. [LS1]

In summary, Open Space Preservation should continue to be a valuable nitrogen mitigation tool in Suffolk County as it will always provide the most cost beneficial approach in the long-term. Combined with the evaluation of upzoning, policymakers and Open Space land management specialists may want to add the following considerations for future Open Space Preservation purchases:

- Focus on geographic areas that will provide the greatest nitrogen removal benefit with particular focus on areas that have load reduction goals that exceed what can be achieved through wastewater alone; and,
- Focus on geographic areas that are connected to other open spaces to create larger blocks of preserved land.

8.4.10 Initial Recommendations for Transfer of Development Rights

Article 6 Sections 760-602, 760-608 and 760-610 of the Suffolk County Sanitary Code allow for the use of transfer of development rights (TDR) to conform with the standards established by the SCDHS and as a mechanism by which an unsewered parcel or project can exceed the allowable sanitary density. Transfer of development rights programs exist for many of the ten towns that make up Suffolk County.

SCDHS General Guidance Memorandum #27 dated May 5, 2014 provides guidelines for the use of TDR and Pine Barrens credits for sanitary density credit. Memorandum #27 provides information on methods, requirements and limitations on the use of TDRs. TDRs are used when an applicant wishes to transfer allowable sanitary density from one parcel ('sending') to another parcel (''receiving'') to allow for increased development on the 'receiving' parcel. The TDR standards protect groundwater, drinking water and surface water while offering developers flexibility.

The method to accomplish sanitary density transfer can be accomplished without the need for a variance from the SCDHS using TDR programs that have received prior approval by the Department. These TDR programs allow density transfer 'as-of-right' and include:

- Central Pine Barrens Comprehensive Land Use Plan
- Suffolk County Save Open Spacse (enacted 2004)
- Southold Township (adopted 2007)
- East Hampton Township (adopted 2007)
- Huntington Township (adopted 2008)
- Smithtown Township (adopted 2010)

In areas not identified in the above documents, there are no provisions in the Sanitary Code or in SCDHS standards that address the automatic use of TDR for sanitary density purposes. Developers do have the option of filing a variance application.

Article 6 of the Sanitary Code identifies the requirements for sewage facilities for single-family residential subdivision and developments including the use of TDRs within Groundwater Management Zones (750-608.B and C.). Similarly, Article 6 in subsections 760-610.D and E also identifies the requirements for sanitary facilities for development of other than single family residential parcels and addresses the conditions where TDR may be permitted. The use of TDR is permittable if in conformance with the standards established by the SCDHS.

As discussed previously, the primary objective of the Suffolk County Sanitary Code was to provide for the protection of the County's groundwater and drinking water resources. While there was limited acknowledgement/provision for the protection of surface waters in Article 6, it has become evident that the existing provisions in the Sanitary Code and wastewater management strategies are, generally, insufficient to adequately protect surface waters. Existing TDR guidelines and related codes are subject to the same limitations.

While a detailed Transfer of Development Rights plan was not in the scope of the SWP, the SWP process successfully provided tools which should be used to further refine TDR policies and plans. This may be done for new plans, as well as for pre-existing plans which are reviewed, reauthorized, or expanded.

Possible review principles for TDR programs may include, but not be limited to, the following. These are illustrative, and not exhaustive, and not intended to be definitive or binding; they should be explored for viability, given the balancing of environmental health goals with other social and economic needs, and SEQRA should be a platform for coordinating review in a transparent manner:

- Limit density transfer into "sensitive zones";
- Restrict transfers into a sensitive zone from outside the sensitive zone (e.g., no transfers into Priority Areas 1 and 2);
- Limit excess density transfer from areas with lower priority rank to areas with higher priority rank (groundwater or surface water; e.g., avoid transfers from Priority Area 4 to Priority Area 3, etc.).
- Load-based Transfer Restrictions
    - Limit receiving parcels to water bodies with nitrogen load capacity;
    - Cap maximum increase in total load through TDRs to water bodies with no nitrogen load capacity (e.g., 10%) including projected loads at buildout;
    - Identify locations of high priority commercial parcels with SWP Addendum and consider revision to Article 6 TDR requirements based upon addendum findings.
- Incentives
    - Consider incentives for transfer of development rights out of high priority areas and/or areas with high nitrogen load reduction goals.
- Tracking and Adaptive Management
    - Establishment of central Countywide TDR tracking database;
    - Periodic review of impact of sending and receiving parcels.

- Other
  - Evaluate mechanisms and means to make the use of TDRs in Suffolk County easier.

As shown above, the overarching initial guideline is to limit, to the extent practicable, the transfer of development rights from locations with acceptable water quality to locations with poor water quality. This becomes particularly important in areas with significant load reduction goals that have already been identified as not being able to meet load reduction goals through wastewater management alone. In addition, consideration should be given to promote or incentivize the sale of density rights from water bodies that have existing water quality degradation and/or high priority rank and load reduction goals. Finally, the establishment of a central TDR entry portal and database is recommended so that the existing location of TDRs (both sending and receiving parcels) can be tracked. This would enable monitoring of TDR trends in Suffolk County and would provide early warning for potential negative consequences associated with transferring excessive development rights into water bodies that are already highly susceptible to water quality degradation from excess nitrogen.

Consistent with previous recommendations in the SWP, the location of commercial parcels with the potential for significant nitrogen loads above existing density requirements (e.g., grandfathered parcels) is generally unknown and needs to be quantified before recommendations for large scale commercial projects (e.g., design flows of greater than 1,000 gpd) can be provided within this SWP. Because many TDR projects are focused on multi-residential and other commercial projects, it is recommended that final Countywide recommendations for potential TDR program modifications (e.g., updates to the Suffolk County Sanitary Code and/or guidance memorandum) be included as part of the SWP Addendum that is recommended for implementation in 2020.

8.4.11 Adaptive Management Plan

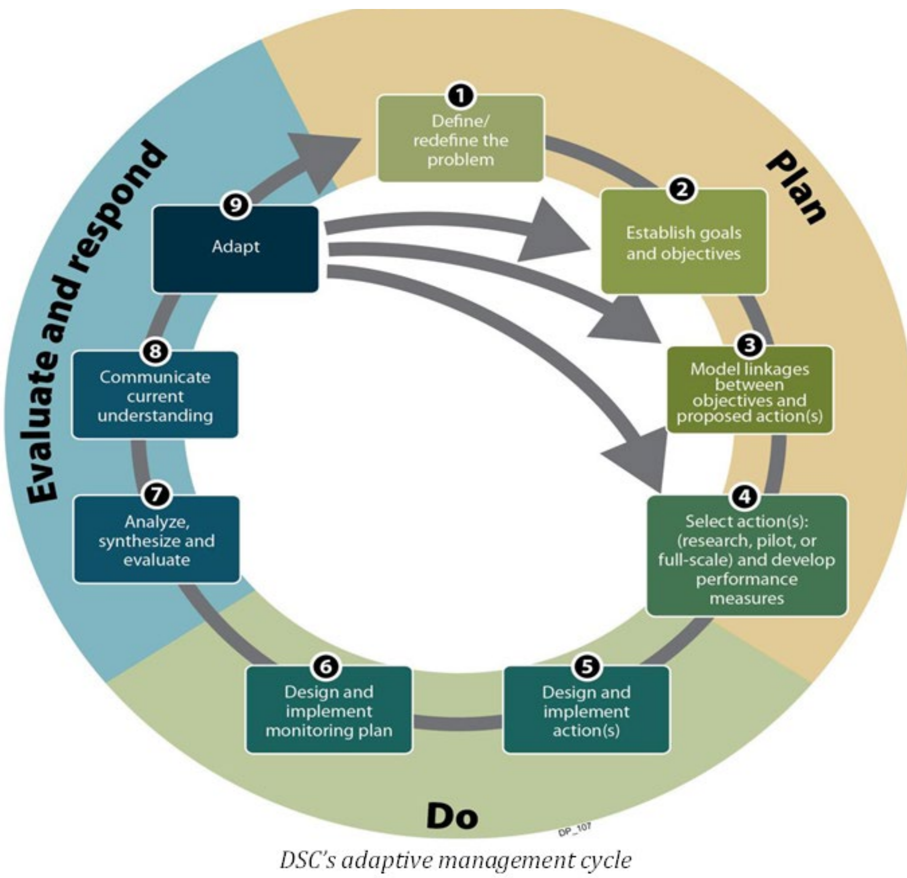
The Program defined within the SWP is intended be a guide that builds upon the best information available at the time of plan development. As with any extended program, the implementation of an adaptive management strategy is a critical element to ensure the overall success of the program. Adaptive management is a process of information gathering, review and analysis, and response that promotes flexible decision-making as shown by **Figure 8-16**. It is particularly appropriate for complex programs, for programs where the effects of an organization's decisions and actions play out over an extended period of time, and where an organization must meet multiple objectives – as in the case of the SWP.

If impacts from implementation of the SC SWP are identified during the review process, mitigation measures can be identified and implemented into the program as part of adaptive management. The County's adaptive management program includes the following five critical components:

1. Establishment of a program lead;
2. Establishment of clearly defined goals and objectives (performance measures);
3. Establishment of clearly defined program review intervals;
4. Establishment of a monitoring plan to track program progress; and,

5. A reporting mechanism that will:
   - Document progress;
   - Identify new data sources;
   - Identify corrective actions; and,
   - Identify recommendations to the Program.

In addition, the Adaptive Management Plan will provide the mechanisms to ensure that critical program elements are in-place prior to moving forward with individual program elements (e.g., industry readiness, design professional readiness, scavenger plant capacity). Finally, the Adaptive Management Plan will provide an additional location to publish defined SEQRA thresholds that would prompt requirements for supplemental Environmental Impact Statement (EIS) or project-specific EIS, essentially building on the list of thresholds identified in the Draft/Final Generic Environmental Impact Statement (GEIS).



Source: http://resources.ca.gov/ecorestore/what-is-california-ecorestore/

Figure 8-16 Example Adaptive Management Process as Utilized in the California EcoRestore Initiative

A summary of each of the primary Adaptive Management Plan elements is provided below.

8.4.11.1 Establishment of Lead Agency

The identification of a lead agency responsible for overall implementation of the Adaptive Management Plan is a fundamental requirement of any successful adaptive management strategy. The lead agency must have a detailed understanding of all program recommendations, have the expertise to properly evaluate the program, and have the authority to implement or initiate the recommendations of the Adaptive Management Plan. Building upon these principles, specific responsibilities for the lead agency of the SWP Adaptive Management Plan includes:

- Overall administration of the Adaptive Management Plan;
- Lead coordinator of periodic program reviews, including periodic reviews against defined SEQRA thresholds that would trigger supplemental or project-specific EIS;
- Lead coordinator of the program monitoring plan; and,
- Lead coordinator for preparation of annual status reports.

Based upon the unique position of the SCDHS Division of Environmental Quality (DEQ) as the SWP Project Manager, Article 19 RME, and its existing monitoring capabilities, it is recommended that the SCDHS DEQ be assigned as the lead agency for implementation of the SWP Adaptive Management Plan. However, consistent with the adaptive management philosophy, this recommendation should be reevaluated for consistency with the findings of the Countywide Water Quality Management District Feasibility Study and/or other future program administrative recommendations.

8.4.11.2 Program Goals and Objectives

For an Adaptive Management Plan to be successful, there needs to be clearly defined program goals and objectives for which to measure against. For the purposes of the SWP, the program goals and objectives are all recommendations set forth in the SWP.

8.4.11.3 Adaptive Management Review Frequency

The Adaptive Management Plan should include periodic project reviews that provide the formal mechanism for reviewing program data and progress against the defined program objectives. In the spirit of adaptive management, the review frequency may be periodically adjusted based upon the specific phase or needs of the program. In addition, supplemental program reviews (e.g. in addition to the pre-established program review period) should be completed as needed, based upon the needs of the program. This is particularly applicable in situations where new, unanticipated studies are released that provide new data that could significantly impact the recommendations and objectives of the program.

As discussed previously, the recommended Program in this SWP has four primary program phases. Based upon the initial timeline provided in this SWP, the following program review periods are recommended:

- Phase I – Annual;

- Phase II – Biannual;
- Phase III – Every five years; and,
- Phase IV – TBD

The program review periods recommended above were selected based upon the number and frequency of major recommendations during each program phase. For example, Phase I "Ramp-Up" includes several critical ramp-up recommendations that will be required before Phase II can begin. For that reason, annual reviews to check in on status and the availability of new data is warranted during that review period. During Phase II, major program changes occur on, at most, a biennial basis through the deliberate phased implementation of recommended upgrades within select geographic target areas and trigger mechanisms to accommodate industry growth.

Consistent with the adaptive management philosophy, the program review period frequency should be continually evaluated and adjusted, as needed, to fit the needs of the program. A review of the program review frequency should be included as part of each formal program review.

8.4.11.4 Adaptive Management and Monitoring Plan

The adaptive management recommendations within this SWP are intended to be a guide towards the development of a formal Adaptive Management and Monitoring Plan. The Adaptive Management and Monitoring Plan should incorporate the adaptive management recommendations provided herein along with a rigorous SWP Monitoring Plan. The SWP Monitoring Plan should define data collection needs and protocols, including quality assurance procedures. Data to be collected and analyzed as part of the SWP Monitoring Plan should include, but not be limited to:

- Supplemental surface water quality monitoring data to fill data gaps identified within this SWP;
- Routine groundwater and surface water quality monitoring data to track water quality during implementation of the Program;
- Monitoring of wastewater influent and effluent for evaluation of I/A OWTS and drainfield performance on nutrient removal (nitrogen and phosphorus);
- Monitoring of wastewater influent and effluent for evaluation of I/A OWTS and drainfield performance on the removal of CECs; and,
- Real time tracking of subwatershed specific nitrogen reductions achieved through wastewater management and comparison to their respective load reduction goals.

It should be noted that SCDHS DEQ currently has funding obligated from the NYSDEC SCUPE grant towards the preparation of an Adaptive Management and Monitoring Plan. It is anticipated that this work will be completed in 2019/2020.

To maximize data availability and overall program efficiency, it is recommended that a SWP Monitoring Plan Technical Committee be formed so that data collection needs and data availability can be coordinated with related initiatives and project partners. For example, routine data sharing efforts should be ongoing with the LINAP, SBU CCWT, major estuary programs, and local Town/Village initiatives.

Major storms (such as SuperStorm Sandy) and long-term climate trends will trigger re-evaluation of the program. If significant changes to the program are identified, supplemental review under SEQRA may be triggered.

Periodic review and monitoring plan findings should be documented annually in a dedicated SWP Annual Report as described below.

8.4.11.5 Adaptive Management Plan Reporting

A SWP Annual Report should be prepared to track the progress of the SWP recommendations, present data obtained through the Adaptive Management and Monitoring Plan, and offer additional recommendations based upon the findings of the report. The SWP Annual Report should leverage information documented in the I/A OWTS Annual reports currently required under Article 19 of the Suffolk County Sanitary Code. An initial recommended report outline is provided below:

- Progress towards SWP recommendations;
- Progress toward collecting and analyzing data that were identified as data gaps in the SWP;
- Evaluation of long-term groundwater and surface water data trends identified in the SWP;
- Update on the I/A OWTS technologies' nitrogen reduction performance in Suffolk County;
- Statistics of wastewater treatment upgrades, both through I/A OWTS retrofits and sewer connections;
- Update on the Appendix A systems (30,000 gpd) evaluated to confirm the intended objective of expanding usage as a nitrogen mass reduction tool;
- Review of stable recurring revenue source availability and upgrade rates and associated policy recommendations, if necessary, based upon actual funding availability and upgrade rates;
- Nitrogen Reductions Tracker – quantify percent reductions based on wastewater treatment upgrades and progress toward meeting nitrogen load reduction goals;
- Status on implementation of the recommendations for CECs in wastewater;
- Status on the implementation and management of other nitrogen reduction strategies being advanced as part of the overall Countywide nitrogen reduction program such as:
    - Recommendations for TDRs;
    - Recommendations for revisions to local zoning;
    - Recommendations for Article 6 minimum lot size;
    - Recommendations for Open Space

- Identification of new related initiatives, reports, and/or other data sources that could impact subwatershed delineations, load reduction goals, and policy recommendations such as:
  - New data obtained from related initiatives such as the USGS Peconic Estuary Transient Solute Transport Model findings;
  - New data on global warming including sea level rise, precipitation intensity, etc.;
  - Data obtained as recommended in Section 9 herein;
- Summary of proposed changes to the recommendations provided within the SWP including corrective actions, if necessary;
- Inclusion of corrective measures and reevaluation of the Management Area boundaries if appropriate, and
- Evaluation of SEQRA thresholds as identified in the SWP Final GEIS and Statement of Findings.

Finally, the annual report should incorporate the I/A OWTS Annual Report required under Article 19 as an appendix. The I/A OWTS Annual Report will include updates on the Suffolk County Reclaim Our Water Initiative, the Center for Clean Water Technology, I/A OWTS performance data in Suffolk County, I/A OWTS in other jurisdictions, new and emerging technologies, an evaluation of existing requirements, and any recommendations for streamlining and future research.

8.4.11.6 Program Coordination and Collaboration

The recommendations provided in the SWP may overlap with several parallel ongoing initiatives focused on restoring and maintaining water quality in Suffolk County. These include, but are not limited to:

- The LINAP;
- The Long Island Commission for Aquifer Protection;
- Individual estuary programs (e.g., LISS, PEP, and SSER); and,
- Town/Village initiatives.

The Adaptive Management Plan will include a recommended strategy to establish an integrated, collaborative framework for cross-coordination of programs to ensure that there is one vision, to reduce redundancies, and to maximize the efficiency of all programs.

8.4.12 Initial Recommendations for Legacy Nitrogen and Other Nitrogen Mitigation Measures

Additional nitrogen mitigation measures may be necessary in locations where wastewater management alone is insufficient to restore or protect water quality. There are two primary circumstances where additional mitigation measure may be appropriate:

- Legacy nitrogen that was discharged to the groundwater system prior to the current land use assignments used within this SWP. In some cases, nitrogen loading from historical land use might have been higher than under current conditions resulting in a groundwater nitrogen plume with concentrations higher than model estimates; and,

- In locations with significant nitrogen loading under existing conditions of which nitrogen load reductions from wastewater management alone will be insufficient to achieve water quality restoration.

The following section provides an initial cost-benefit analysis of alternate nitrogen mitigation strategies that can serve as a guide for project partners and other local initiatives such as the LINAP and Town CPF programs.

8.4.12.1 Fertilizer

Fertilizer is applied on a variety of land use types including for residential lawn maintenance, turf maintenance at parks and golf courses, and for agriculture. A comparison of the nitrogen load distribution for individual subwatersheds compared to their respective load reduction goals indicates that while the majority of subwatersheds would not benefit from additional reductions in fertilizer, there are geographic locations where fertilizer reductions would result in meaningful progression towards the achievement of water quality goals. Specific geographic areas that would benefit most from fertilizer management include:

- All south shore embayments and coastal ponds; and,

- Western Peconic Estuary water bodies that receive nitrogen loads from the North Fork where fertilizer from agricultural and residential land uses accounts for over 43 percent of the nitrogen load from groundwater as shown by **Figure 8-17**.

Suffolk County, the LINAP, Long Island Farm Bureau, Cornell Cooperative Extension of Suffolk County, Suffolk County Soil and Water Conservation District, and USDA Natural Resources and Conservation Service, and Long Island Sustainable Winegrowers have been active in identifying measures, recommendations, and best management practices to facilitate the reduction of nitrogen in groundwater from fertilizer as well as securing funding for implementation. Fertilizer use in landscapes and golf courses is also being addressed by groups such as LINAP, Cornell Cooperative Extension of Suffolk County, Long Island Golf Course Superintendents Association, Long Island Nursery and Landscape Association, and Nassau Suffolk Landscape Grounds Association. A brief overview of the historical and current initiatives is provided below.

8.4.12.1.1 Current Suffolk County Agricultural Stewardship

Farming and fishing are synonymous with Long Island and have been part of Suffolk County's coastal heritage since colonial times. In fact, there are Long Island farms today that have been providing food continually for over 350 years. Agriculture is a vital component of the County's rural character as visitors enjoy local restaurants, beaches, farm stands, and wineries. With over 35,000 acres of farmland on Long Island as of the 2017 agricultural census, Suffolk County remains one of the leading agricultural counties in New York with over $225 million dollars in annual sales. Suffolk County government has long supported the region's farmers and protection of farmland. In fact, the very first farmland preservation program in the United States was instituted in Suffolk

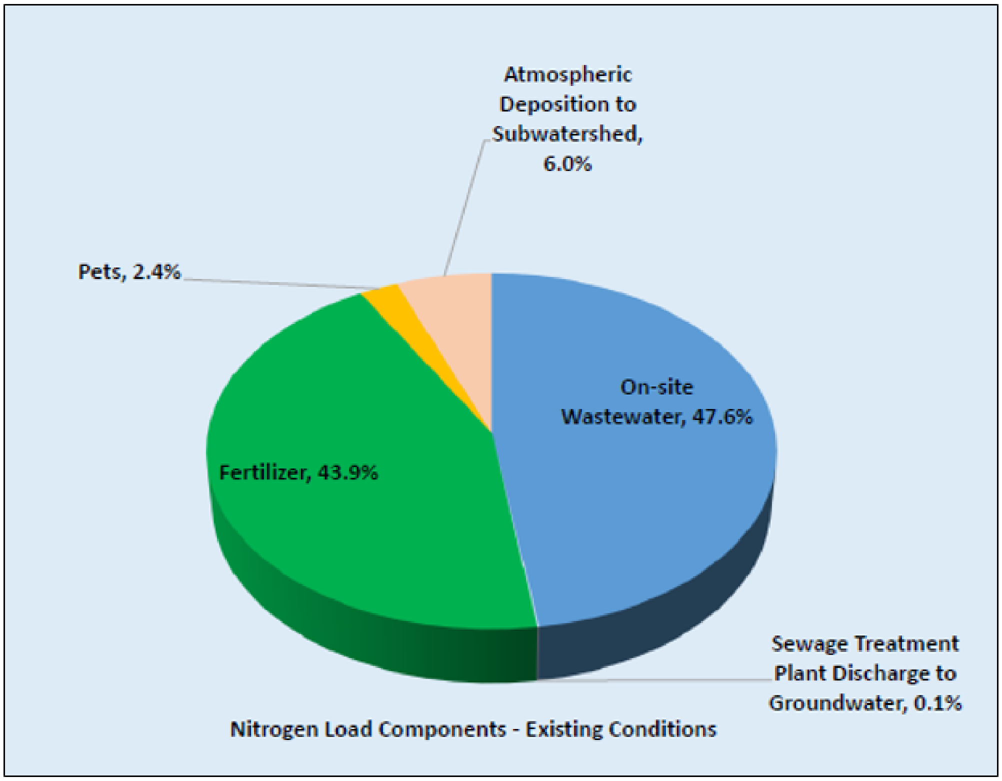


Figure 8-17 Fertilizer Contribution to Peconic Estuary Nitrogen Load from Groundwater

County in the 1970s and as of today over 20,000 acres of farmland have been preserved in perpetuity.

Suffolk County farmers grow a multitude of different types of crops including but not limited to vegetables, fruits, flowers, nursery stock, sod, grapes, shellfish and seafood, equine, dairy, livestock and a wide variety of specialty crops. Agriculture has evolved over the past few generations and today many farmers produce value added products from their crops and retail directly to consumers has taken the place of farmers selling wholesale crops to the market place. Farmers on Long Island also realize that they are part of Long Island's community and work hard to ensure the land and water resources are able to sustain the industry for future generations. Best management practices for agriculture have been introduced and farmers work hard to implement these practices on their farms.

Comprehensive agricultural stewardship requires the responsible planning and management of natural resources including water, plants, soils and wildlife on Suffolk County farmland. The agriculture industry in Suffolk County sees an opportunity to reduce nitrogen levels found in Suffolk County ground and surface waters further by strengthening existing Agricultural Stewardship programs, supporting new research and pilot projects, and expanding on-going monitoring efforts. Efforts to research and implement better management of nitrogen inputs for Long Island agriculture have been underway for well over 15 years. In 2004 A Strategy to Develop and Implement the Suffolk County Agricultural Stewardship Program was introduced, continuing the cooperation of numerous partnering organizations working towards the goals of better nitrogen management and leading to the creation of the Agricultural Stewardship Program at Cornell Cooperative Extension of Suffolk County and the cooperation of numerous partnering organizations.

The purpose of the 2016 Suffolk County Agricultural Stewardship Plan (available at: https://www.peconicestuary.org/wp-content/uploads/2017/06/AgriculturalStewardshipPlan.pdf) is to provide a framework, series of recommendations, and an associated budget to promote the long-term responsible management of farmland in Suffolk County, consistent with Suffolk County's Comprehensive Water Resources Management Plan and the County Executive's Reclaim Our Water initiative.

Goals for Suffolk County Agricultural Stewardship Plan - The mission of the Suffolk County Agricultural Stewardship Plan is to cooperatively develop a strategy to reduce nutrient and pesticide loading associated with farming to the groundwater and surface waters of Suffolk County while maintaining a strong, viable agricultural industry. The individual goals of the program include:

- At least 85 percent of the farmers in Suffolk County should enroll in Tiers III-V in the Agricultural Environmental Management (AEM) program and adopt best management practices (BMPs) to prevent or minimize non-point or point contamination from agricultural inputs. BMPs will include methods of reducing pesticide and nitrogen use and/or maximizing the efficiency of these agricultural inputs by improved timing, formulations, new products, new technologies, water and soil management and use of new crops/varieties, to limit leaching and run-off;
- Secure approximately $10.2 million in cost-share funding needed to write and implement 90 Nutrient Management Plans over the next ten years. When appropriate, funding sources should prioritize parcels impacting the Long Island Sound and Peconic Estuary;
- Secure approximately $6.6 million in cost-share funding needed to write and implement 90 Integrated Pest Management Plans over the next ten years. When appropriate, funding sources should prioritize parcels impacting the Long Island Sound and Peconic Estuary;
- Provide technical support staff, educational and cost-sharing opportunities to improve agricultural stewardship specifically oriented to Suffolk County's agricultural and environmental concerns;
- Fund research to develop best management practices that reduce nitrogen and pesticide impacts on the environment;
- Provide educational programs that encourage the adoption of best management practices that prevent or reduce non-point or point contamination from agricultural inputs;
- Provide long-term sufficient funding to continually improve best management practices to prevent or reduce non-point and point contamination from agricultural inputs;

- Provide technical support, educational and cost-sharing opportunities to more effectively utilize groundwater for irrigation and to integrate water withdrawal information into an overall resource management strategy;

- Establish an active Agricultural Stewardship Advisory Council that will guide stewardship efforts and assist in consumer outreach, marketing, obtaining funding, and evaluation of the program; and,

- Provide an on-going evaluation of the stewardship program, which will target pesticide and nitrogen use and the development and adoption of best management practices. Produce an annual report which shall summarize on-going stewardship efforts and evaluate programmatic effectiveness. Evaluation of this program will require long-term, targeted groundwater monitoring.

Cornell Cooperative Extension of Suffolk County - In 2004, funding was made available through Suffolk County's Water Quality Protection and Restoration Program to finance an Agricultural Stewardship Program through Cornell Cooperative Extension (CCE) of Suffolk County. In subsequent years, funding has been awarded annually allowing for the expansion and continuation of research and education programs. Since 2004, the Agricultural Stewardship Program has worked in conjunction with Cornell University faculty and staff, CCE's agricultural specialists, and numerous agricultural and environmental partner organizations to provide the commercial horticultural and agricultural industries a comprehensive program of research, education, and on-farm demonstration projects. Local research has resulted in the development of improved technologies and increased adoption of best management practices by farmers including the use of controlled/slow release nitrogen fertilizer (CRNF), cover crops, and reduced tillage. Field days, workshops, and conferences provide farmers with educational opportunities. By conducting on-farm demonstration projects the Program demonstrates the costs and benefits of adopting new technology and best management strategies that will protect the environment while maintaining the agricultural industry's economic viability for generations to come.

Nitrogen Management and Implementation Project - Funding awarded through the Environmental Protection Fund has provided critical funding to further the research and education goals of the Suffolk County Agricultural Stewardship Plan. This project has the following research and education objectives:

- Evaluation and development of BMPs for CRNFs in vegetable crops;

- Development of strategies to reduce fertilizer leaching from containerized plants in greenhouses and nurseries;

- Best Management Practices in conjunction with groundwater monitoring;

- Improving nitrogen Best Management Practices and grower adoption of nitrogen use efficiency and CRNF; and

- Minimizing nitrogen use in vegetable and potato production through variety trial evaluations.

This funding is also supporting staff and staff training for the Suffolk County Soil and Water Conservation District, in order to increase capabilities to draft Nutrient Management Plans, as well as cost share funding to support the implementation of the management plans and BMPs.

Suffolk County Soil & Water Conservation District (SCSWCD) and Natural Resources Conservation Service (NRCS) - The SCSWCD and the NRCS have a well-established and effective partnership in which they advance on-farm conservation planning and practice design and implementation for the protection and enhancement of soil, water, air, plant and animal resources. NRCS and SWCD assist growers with on-farm conservation planning including nutrient management plans, and assist growers in moving forward with the implementation of best management practices through technical guidance and cost-share funding opportunities. Both agencies also participate in education and outreach programming to further engage and educate the County's growers on the conservation planning practices

Regional Conservation Partnership Program (RCPP) - Subsequent to plan development, the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) awarded Suffolk County $1.2 million between the years 2017 and 2021 for farmers to implement best management practices on their farmland. This award is administered by the Regional Conservation Partnership Program (RCPP) and falls within Suffolk County's broader "Reclaim Our Water" initiatives. This grant will help the County implement recommendations made in the unanimously approved "2016 Agricultural Stewardship Plan". This RCPP funding provided by the NRCS has enabled Suffolk County to hire an agronomist in the Suffolk County Soil and Water Conservation District to write nutrient and pest management plans for local farmers that are tailored to Suffolk County's unique agricultural commodities and resource concerns. On-farm certified nutrient management and integrated pest planning will then unlock additional federal cost-share funding for Suffolk County farmers in the Peconic Estuary Watershed to accelerate their adoption of best management practices (including cover cropping, irrigation water management, and controlled release fertilizers,) to protect Suffolk County surface and groundwaters.

The goal of the RCPP funding is to help farmers protect surface and ground waters and protect and improve soil health within the Peconic Estuary Watershed. The funding will facilitate the development of 51 nutrient and integrated pest management plans to encourage adoption of NRCS-approved best management practices on Suffolk County farms to help farmers implement 3200 acres* of conservation practices aimed at addressing water quality, soil quality and fish and wildlife habitat through NRCS-EQIP cost-share funding.

8.4.12.1.2 Long Island Nitrogen Action Plan Fertilizer Workgroup

The Long Island Nitrogen Action Plan (LINAP) Fertilizer Management Workgroup was established to provide input and support in the development and implementation of the LINAP. The workgroup incorporates members from the landscape industry, fertilizer manufacturers, golf courses, environmental groups, and state and county government.

*Acreage can be counted multiple times on a single farm – for example, if the same farm did 60 acres of cover cropping and 60 acres of irrigation water management on the same 60 acres, that counts as 120 acres.

The workgroup's purpose includes:

1. Acting as a forum to understand and make people aware of actions taken to date by the various industries to reduce fertilizer pollution; and
2. Identifying actions that can be taken looking forward to further reduce nitrogen pollution from fertilizer use.

Beginning in 2018, the LINAP has convened several workgroup meetings to share perspectives and examine measures to improve management and reduce the use of fertilizer in agriculture, golf courses, the landscape industry, and by homeowners.

In 2019, the Fertilizer Workgroup created recommendations for residential and golf course fertilizer application. The Fertilizer Workgroup created recommendations, posted on their website (https://www.dec.ny.gov/lands/108654.html#Fertilizer)along with recommendations on best management practices to minimize the amount of fertilizer that leaches to groundwater. It should be noted that the recommendations provided above do not include agricultural turf (e.g., sod farms/sod production) which are exempt from the recommendations below.

Recommendations for residential fertilizer applications and fertilizer packaging include:

- A 40 percent reduction in the annual and single event fertilizer application rates (Annual = 1.8 lbs N/1,000 sq ft and Single = 0.6 lbs N/1,000 sq ft);
- Fertilizer application date restrictions (no application between November 1st - March 31st);
- Fertilizer retail sale date restrictions (no sale between November 1st - March 15th);
- Fertilizer products should be removed from display on the sales floor between November 8th and March 15th;
- The default (or standard) directions for equipment settings on product packaging should be the single application rate of 0.6 pounds of total nitrogen per 1,000 square feet;
- Directions should be provided in both English and Spanish;
- The recommended single and annual application rates should be clearly and prominently stated on the packaging;
- The product packaging should state the total square footage of lawn that the package will cover when applied at the single application rate;
- The slowly available nitrogen content as a percent of the total nitrogen contained in the product should be clearly stated on the product packaging;
- At least 50 percent of the nitrogen in any turfgrass fertilizer product should be “slowly available nitrogen;”

- A statement such as "Apply this product as directed on the label. Do not overapply product. Overapplication can lead to poor water quality" should be included on the product packaging;
- Fertilizer products should not be applied on any impervious surface including parking lots, roadways, storm drains, frozen ground, and sidewalks, or where there is standing water on turf. If such application occurs, the fertilizer should be immediately contained and either applied to lawn or non-agricultural turf or placed in an appropriate container, and
- Fertilizer products should not be applied to any lawn or non-agricultural turf on any real property within twenty feet of any surface water, except that this restriction should not apply where a continuous natural vegetative buffer, at least ten feet wide, separates an area of lawn or non-agricultural turf and surface water, and except that, where a spreader guard, deflector shield or drop spreader is used to apply fertilizer, such application should not occur within three feet of any surface water. This should not apply to an application of fertilizer for newly established lawn or non-agricultural turf during the first growing season.

Recommendations for golf course fertilization include:

- Fertilizer should only be applied between April 2nd and October 31st;
- Application must still comply with the requirements listed in the "Application Restrictions" section. This is in adherence with the Nutrient Runoff Law (Title 21 of Article 17 of Environmental Conservation Law);
- A seasonal limit should be implemented on the amount of nitrogen applied per calendar year not to exceed 2.7 pounds of total nitrogen per 1,000 square feet;
- Applicants should only apply fertilizer that has at least forty percent slowly available nitrogen, according to the following guidelines: a single granular fertilizer application rate of no more than 0.7 pounds per thousand square feet of total nitrogen, and no more than 0.5 pounds per thousand square feet per application of one hundred percent liquid, water soluble fertilizer;
- Golf courses may exceed the application rate of fertilizer when the turf grass has suffered a loss of greater than 10 percent turf loss per thousand square feet, and
- Owners of golf courses should maintain records of application dates and rates.

Please see https://www.dec.ny.gov/docs/water_pdf/linapfertilizer.pdf for the full list of recommendations including recommendations to golf course application and recommended BMPs. The LINAP will continue to evaluate the effectiveness of existing strategies to minimize the impact of nitrogen from fertilizers on Long Island's water bodies and will evaluate if additional fertilizer management strategies might be valuable in some or all SWP subwatersheds to achieve nitrogen load reductions.

Other Efforts Related to Turf BMPs - A comprehensive Best Management Practices for New York State Golf Courses has been developed (http://nysgolfbmp.cals.cornell.edu/), detailing recommendations for best management practices for cultural practices, irrigation, nutrient management and more. The research-based, voluntary guidelines are designed to protect and preserve our water resources and enhance open space using current advances in golf turf management.

Numerous resources and outreach materials have been developed to increase awareness of and implementation of best management practices in home landscapes. Many are included in this effort and associations and agencies such as Suffolk County, Cornell Cooperative Extension of Suffolk County, Nassau Suffolk Landscape Grounds Association, Long Island Nursery and Landscape Association, Peconic Estuary Program. These efforts should continue to be advanced to promote and facilitate the implementation of BMPs for turf.

8.4.12.1.3 Initial Recommendations for Fertilizer

Based on the findings of the SWP and progress of the Suffolk County Agricultural Stewardship Plan and the LINAP, the following initial recommendations are provided for fertilizer management in Suffolk County:

1. Continue to work closely with the LINAP to advance recommendations that reduce fertilizer from residential land use. Consider subwatershed-specific fertilizer recommendations in subwatersheds with high population density coupled with poor flushing (e.g., Great South Bay, SSER coastal ponds, etc.);

2. Continue implementing the recommendations set forth in the 2016 Suffolk County Agricultural Stewardship Plan. Work with agricultural partners to continue researching new technologies that farmers can implement;

3. Continue to hold quarterly RCPP meetings and work closely industry professionals to advance the recommendations in the Suffolk County Agricultural Stewardship plan;

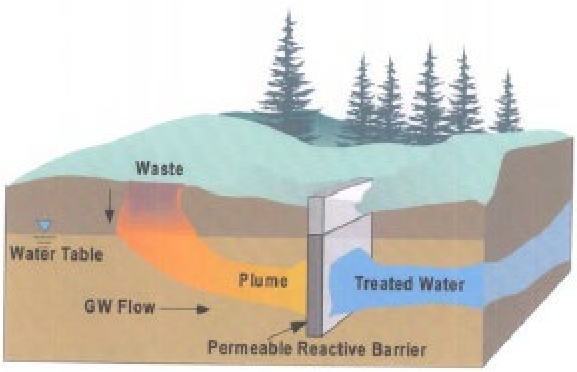
4. Continue to pursue funding opportunities to offset the cost for implementation of BMPs and/or local research to identify Suffolk County specific nitrogen formulations that produce equivalent crop quality while reducing the amount of nitrogen that leaches to groundwater;

5. Advocate for legislation that will encourage additional forms of nitrogen removal from our waterways including the approval of sugar kelp production as a bio-harvesting strategy in Suffolk County; and,

6. Locate additional funding sources to help research and implement nitrogen reduction efforts and best management practices.

8.4.12.2 Permeable Reactive Barriers

Permeable Reactive Barriers (PRBs) consist of a reactive barrier installed perpendicular to the flow of groundwater for the in-situ removal of nitrate in groundwater. The barrier provides a source of



labile organic carbon which provides a food source for nitrate-reducing bacteria. PRBs are typically constructed using three methods:

- Trench and backfill with traditional backhoe (Maximum installation depth ~20 feet below land surface);
- Trench and backfill using deep trenchers (Maximum installation depth ~40 feet below land surface).
- Installation of injection wells and periodic injection of a soluble/semi-soluble carbon source (molasses, corn syrup, emulsified vegetable oil).

When properly designed and in the proper setting, PRBs can removal nitrogen to non-detect levels in groundwater and can be a cost-effective solution to removing legacy nitrogen from groundwater, particularly where there are concentrated nitrogen plumes (e.g., >10 mg/L). As discussed in Section 2.2.1, PRBs have a broad, but cost-competitive unit cost per pound of nitrogen removed

when compared to other nitrogen mitigation measures. Despite their benefits, the installation of PRBs can have unanticipated negative financial, environmental, and health consequences if they are incorrectly designed and/or installed in locations that are not suitable for installation of a PRB. For example, PRBs may generate unwanted "secondary" water quality effects including the release of heavy metals and iron from the environment at concentrations exceeding MCLs. Long Island's aquifer is known to be iron-rich and iron concentrations of >1,000 mg/L have been documented downgradient of PRBs. PRBs may also generate methane and sulfide that can be dangerous to human health if it accumulates beneath or within public gathering areas. In addition, PRBs essentially remove all dissolved oxygen from groundwater that passes through them. If they are installed too close to a surface water body with existing dissolved oxygen impairments, it is possible that the PRB could exacerbate the issue, particularly in water bodies with a significant groundwater baseflow contribution relative to tidal flushing/mixing. Finally, unlike above grade treatment equipment that can be modified or adjusted to increase performance, there generally are no corrective measures that can be implemented to improve performance of a non-functioning PRB which can result in total financial loss of a non-functioning newly installed system.

There currently is no known regulatory framework to oversee the design, installation, and maintenance of voluntary PRBs in Suffolk County. Historically, PRBs have been used under Federal or State Superfund or similar groundwater regulatory programs which inherently provide a regulatory oversight mechanism to mitigate improper design and installation.

8.4.12.2.1 Initial Recommendations for PRBs

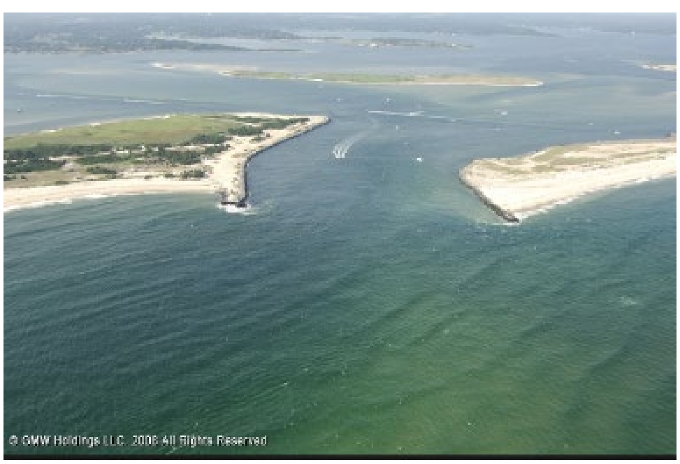
PRBs represent a viable nitrogen mitigation tool for legacy nitrogen or to address nitrogen plumes from current land use where no other cost effective or practical solutions exist to control the source. However, voluntary installations are currently unregulated in Suffolk County and incorrectly designed PRBs can have adverse impacts on the environment and potentially human health. The following initial recommendations are made for PRBs in Suffolk County:

- Establishment of a regulatory oversight and permitting mechanism to ensure all PRBs are properly designed and monitored;
- Preparation of a PRB Feasibility Study or Guidance Document through LINAP or other initiative that:
  - Evaluates PRB installation methods in Suffolk County and relative cost-benefit; and
  - Builds upon the findings of the LINAP SWP and/or other studies such as the Peconic Estuary Solute Transport Model currently under development to identify locations that might benefit from PRBs in Suffolk County and establishes a priority ranking framework for further evaluation.

During the interim, individual PRB projects could potentially leverage SEQRA requirements as a means to mitigate any potential negative consequences to the environment.

8.4.12.3 Hydromodifications

Hydromodifications involve channel modification, dams, and stream modifications to facilitate a wide variety of needs including, but not limited to, temporary construction diversions, energy production, and environmental restoration. In Suffolk County, hydromodifications could be used as a means for mitigating the effects of nitrogen enrichment by enhancing the flushing of tidal water bodies or coastal ponds. Based upon a preliminary assessment of select water bodies within the SWP, hydromodifications could be a cost-competitive means to improve water quality in water bodies where wastewater management and/or other mitigation measures are insufficient to achieve load reduction goals. It should be emphasized that the evaluation and design of hydromodifications would require careful execution as their installation could result in negative consequences to local ecosystems and coastal resiliency.



Based on the initial findings in the SWP, hydromodifications appear to have the greatest benefits in the smaller coastal ponds that have high load reduction goals. For example, it is forecast that a properly maintained hydromodification could significantly reduce the nitrogen loads toward load reduction goals in Mecox Bay, Georgica Pond, Sagaponack Pond, and Goldsmith Inlet (average 58 percent load reduction through hydromodification alone). However, the load reduction to Great South Bay, East was only 5 percent when evaluating the overall benefit of the natural breach in eastern Great South Bay. Similarly, the average estimated cost per pound of nitrogen removed was significantly lower in the coastal ponds when compared to Eastern Great South Bay. It should be noted that these estimates were preliminary, planning level estimates only.

Waterbody Evaluated	Estimated Equivalent Nitrogen Load Reduction Obtained through Hydromodification
Georgica Pond	94%
Mecox Bay	39%
Sagaponack Pond	59%
Goldsmith Inlet	78%
Great South Bay, East	5%

8.4.12.3.1 Initial Recommendations for Hydromodifications

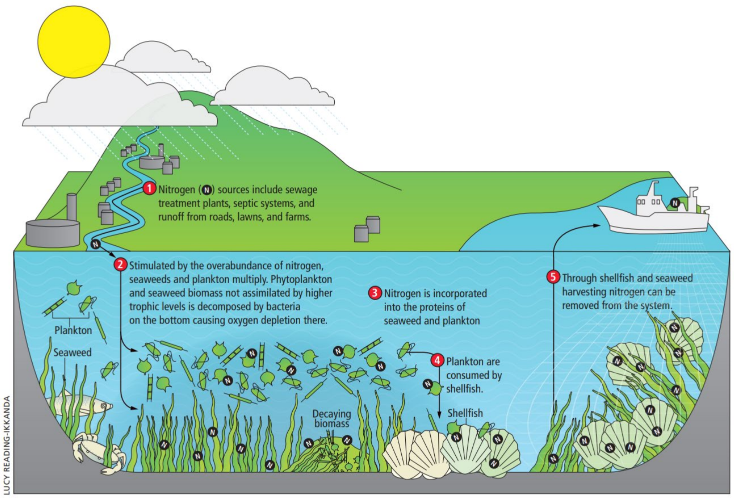
Similar to PRBs, hydromodifications represent a viable nitrogen mitigation tool for legacy nitrogen or to supplement nitrogen reductions when source management alone is insufficient to achieve load reduction goals. However, the installation of hydromodifications could have negative consequences to the ecosystem and coastal resiliency. The following initial recommendations are made for hydromodifications in Suffolk County:

- Preparation of a Hydromodification Feasibility Study through LINAP or other initiative that:
- Assesses the impact to residence time through hydromodification at several locations using existing SWP hydrodynamic models;
- Evaluates initial capital and O&M costs for hydromodifications (and comparison to nitrogen load reduction cost-benefit through wastewater management or other means where existing information exists from the SWPs);
- Assesses potential for increase in surface water elevations and related impacts; and
- Initial assessment of potential ecological impacts based upon estimated changes to salinity, nutrients, and temperature.

While an integrated water quality model would provide refinement of the potential ecological impacts associated with hydromodifications, it is recommended that the first step build on the use of existing tools that have been generated through the SWPs and/or other readily available models. Detailed assessment of potential impacts can be assessed on a project-specific basis through project-specific FS and/or satisfaction of NYS SEQRA requirements.

8.4.12.4 Nutrient Bioextraction

Nutrient bioextraction employs the use of shellfish and seaweed cultivation for nutrient remediation. Nutrient bioextraction can be an effective alternative management tool when used as an additional management tool and not as a replacement for existing nitrogen source-control efforts.



Nutrient bioextraction has been proposed as an environmental management strategy to mitigate the effects of eutrophication by removing particulate nitrogen, contained in plankton and organic detritus, directly from the water through their filter feeding activities. Potential nitrogen removal mechanisms include the incorporation of nitrogen into animal tissue and shell growth, enhancement of denitrification activities under shellfish reefs or aquaculture gear, the burial of shell as reefs grow, and in the case of aquaculture operations, through the harvest of cultivated shellfish and seaweed.

Shellfish and seaweed also provide other ecosystem services such as habitat for microbenthic species and improved water clarity for submerged aquatic vegetation (SAV), that makes nutrient bioextraction a valuable strategy in a comprehensive nutrient management program.

As discussed in Section 2.2.2, when cost and efficiency (i.e., nitrogen removal per unit area) are considered, it is clear that nutrient bioextraction using shellfish aquaculture compares favorably with the other nitrogen mitigation measures.

8.4.12.4.1 Initial Recommendations for Nutrient Bioextraction

Nutrient bioextraction represents a viable nitrogen mitigation tool to supplement existing nitrogen source-control management when land-based management efforts alone are insufficient to achieve load reduction goals. However, access to underwater lands for the cultivation of commercial seaweed is currently limited, with Suffolk County's Aquaculture Lease Program limiting access to shellfish aquaculture only. Additionally, there currently is no regulatory mechanism to permit commercial seaweed aquaculture in New York. The following initial recommendations are made for nutrient bioextraction in Suffolk County:

- Development of a nutrient bioextraction feasibility study through LINAP that:
    - Contributes to existing data available for nutrient bioextraction studies conducted in NY Bight; and,
    - Evaluates efficacy of nutrient bioextraction using shellfish and seaweed aquaculture;
- Development a GIS-based nutrient bioextraction siting tool that employs suitability analysis to identify appropriate locations for shellfish and seaweed aquaculture that will have the greatest potential effect on nitrogen reduction based on relevant data including biophysical conditions and potential use conflict; and,

- Establishment of a regulatory oversight and permitting mechanism for commercial seaweed aquaculture.

8.4.12.5 Stormwater

Stormwater runoff is generated from precipitation that does not infiltrate into the ground, but that runs off impervious surfaces such as roads, driveways and roofs and is captured by storm sewers that discharge to surface waters from stormwater outfalls or to recharge basins or leaching structures that recharge the groundwater. Stormwater can contain nitrogen pollution from three primary sources including:

- Wet and dry atmospheric deposition (nitrogen contained within the precipitation itself);
- Pet and animal waste; and,
- Fertilizer.

In addition to the above, there may be small contributions of nitrogen from natural organic material that is captured by the stormwater.

The volume of stormwater runoff created is directly related to the type of surface cover and slope of the land. Impervious surfaces such as roads or roofs generate significantly more stormwater runoff then pervious surfaces such as natural vegetation, lawns, and landscaping beds. Likewise, surface topography that is relatively flat will generate less stormwater than topography with large slopes. While conditions vary across the county, Suffolk County, generally is characterized with relatively low slopes and pervious land uses and soils that are not conducive for the generation of significant stormwater volumes. It is noted however that exceptions exist for the north shore of Suffolk County which does exhibit significant variation in surface topography

When compared to adjacent counties such as Nassau County and the five boroughs, Suffolk County has significantly less impervious surface resulting in relatively low stormwater runoff volumes regionally. Stormwater that is generated in Suffolk County is often collected and locally recharged to groundwater through recharge basins or stormwater (leaching) pools. Stormwater that is collected along the immediate coastline of surface waters is typically diverted directly to the adjacent surface water body through a stormwater outfall.

Based upon a preliminary evaluation of stormwater nitrogen loads, it is believed that for most water bodies in Suffolk County, the overall nitrogen load from storm water is a very small percentage of the nitrogen loads received annually from other sources. As one conservative example, a nitrogen stormwater loading calculation was completed for Hart's Cove in Suffolk County and compared to the total nitrogen load calculations from the SWP. For this evaluation, a nitrogen loading coefficient of 0.23 lbs per acre-foot for medium density residential land use (e.g., lbs of nitrogen per acre of runoff area per foot of rainfall) was used as documented in the Suffolk County 208 Study (Suffolk County, 1978). This loading coefficient was the highest documented loading coefficient for nitrogen in the study and includes nitrogen loading from atmospheric deposition, fertilizer runoff and pet waste. If one conservatively assumes a coastal drainage area of 1,000 feet from the shoreline, the regional stormwater shed area is approximately 330 acres resulting in a nitrogen stormwater pollutant loading rate of 76 pounds per foot of rainfall. If an average annual precipitation rate of 46.49 inches per year (https://www.usclimatedata.com/climate/islip/new-york/united-states/usny0715) is used, than the total annual nitrogen load from stormwater to Hart's Cove would be 294 pounds per year. For comparison, the calculated annual nitrogen load from groundwater is (e.g., 25-year contributing area calculated in this SWP) is 33,507 pounds per year making nitrogen loading from stormwater less than one percent of the total load discharging via groundwater. A study by the USGS (Groundwater Recharge Rates in Nassau and Suffolk Counties, New York, David Peterson, U.S. Geological Survey Water-Resources Investigations Report 86-4181, 1987) found that only 0.7 percent of precipitation in Suffolk County became stormwater runoff, although Countywide, that value may have increased to approach 2 percent due to the additional impervious areas associated with increased development since that time.

While stormwater runoff is not a major contributor of nitrogen to surface waters on a countywide basis, individual subwatersheds with significant impervious surface or and/or significant slope may warrant local evaluation and mitigation of nitrogen loads from stormwater. In addition, stormwater represents the single greatest source of pathogen pollution discharging to our surface water bodies (Suffolk County, 1978; NURP, 1987). New York State, Suffolk County, and local municipalities have all acknowledged the needs for local stormwater mitigation through multiple initiatives and strategies, including, but not limited to:

- As described above, both New York State's Nutrient Runoff Law and Suffolk County's Local Law 41-2007 are already in place to address stormwater runoff from fertilizer. Further information can be found in Section 3.3.3.2 of the 2015 Suffolk County Comprehensive Water Resources Management Plan, at https://healthylawns.suffolkcountyny.gov and https://www.dec.ny.gov/chemical/67239.html#requirements; and,

- All municipal separate storm sewer systems (MS4s) that are located in urban areas (as determined by the Census Bureau) must comply with the USEPA's Phase II Stormwater Regulations, including preparation of a stormwater management plan and implementation of programs to reduce the discharge of pollutants and protect water quality. Suffolk County, along with many Towns and Villages must comply with the Phase II Regulations. Suffolk County funds Cornell Cooperative Extension of Suffolk County to fulfill the County's MS4 requirements. In addition, all constructions sites in New York State that disturb greater than or equal to one acre of land are regulated under the small construction activity portion of Phase II.

Additional information regarding Suffolk County's existing management program to address potential pollution from stormwater runoff from County roads and facilities can be found at https://appt.suffolkcountyny.gov/stormwater/Home.aspx.

In summary, nitrogen pollution from stormwater is estimated to be a very small fraction of the nitrogen reaching our surface waters in the County. However, the contribution of nitrogen from stormwater may be more significant for water bodies that:

- Have relatively small contributions of groundwater baseflow when compared to stormwater volumes; and,

- Have relatively small surface water volumes with high residence times such as coastal and freshwater ponds.

In addition, stormwater represents the most significant source of pathogen pollution to our surface waters.

Based on the above it is recommended that stormwater be managed locally through existing programs as follows:

- Municipalities managing individual stormwater outfalls should take advantage of existing grant programs that are available to upgrade stormwater infrastructure and mitigation measures such as:
  - Suffolk County's Drinking Water Protection Program for Environmental Protection;
  - NYSDEC's Water Quality Improvement Program; and,
  - Town Community Preservation Funds (East End Towns only).
- New York State (https://www.dec.ny.gov/chemical/8468.html) provides a variety of resources including:
  - A calendar of stormwater management training events, including continuing education classes and information on regional and statewide conferences;
  - Construction Stormwater Toolbox – identifies tools and sources of information regarding the General Permit for construction activities as well as design, and the
  - MS4 Toolbox, which includes videos, design tools, guidance documents and manuals, decision trees and timelines to help implement stormwater permitting and management.

Finally, municipalities should take advantage of the data and findings presented within this SWP to support prioritization of water bodies for evaluation of stormwater pollutant loads and mitigation measures. Likewise, municipalities are encouraged to share new data that documents nitrogen loading from stormwater (generated through local studies) with Suffolk County so that the data can be considered as part of the long-term adaptive process discussed within Section 8.4.11.

8.5 Summary of Program Recommendations

For ease of use, SWP recommendations, including activity lead agency, collaborators, priority, implementation timing and funding status are summarized on **Table 8-25** at the end of this section. As discussed within this SWP, the recommendations provided in the SWP will not be advanced unless a stable, recurring revenue source is established that makes the cost of wastewater upgrades affordable to the residents of Suffolk County. Ultimately, the recommendations in this study provide one possible timeline based upon a presumed revenue range. Additional evaluation of how, when, and where to expend the financial resources (including funding for upgrades using individual I/A OWTS, clustering, sewering, etc.), as well as the overall timing of the recommended upgrades, will be considered as part of the Adaptive Management Plan, (see Section 8.4.11) after the nature and value of the recurring funding source are clarified.

8.6 Stakeholder Engagement Plan

Ongoing stakeholder and public education and engagement is paramount to ensure the long-term success of the recommendations provided in the SWP. Stakeholder engagement will generally be incorporated and documented into the adaptive management plan and annual review process. Stakeholder and public engagement will include, but not be limited to:

- Provide public outreach and education through presentations at all available opportunities such as civic meetings, individual estuary program meetings, local Town/Village forums, and other open public meetings.
- Work closely with the Article 6 Workgroup, which consists of representatives from Town/Village planning officials, legislators, the regulatory community, estuary programs, building trades, environmental groups, and other interested organizations. The Article 6 Workgroup will continue to provide feedback on draft or proposed sanitary code and construction standard revisions and other applicable program recommendations. In addition, the Article 6 Workgroup will have an opportunity to review and comment on annual SWP reviews and reports.
- Provide updates to the Suffolk County Legislature and Suffolk County Council on Environmental Quality, as appropriate; and,
- Continue to work closely with the LINAP, NYSDEC, and LIRPC to collaborate and optimize program efficiency in the context of other local and state, and island-wide initiatives.

Additional documentation of the stakeholder engagement plan will be included in the Adaptive Management and Long-Term Monitoring Plan.

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Section 8 Tables

Table 8-25 Subwatershed Wastewater Plan Recommendations

Area	Recommendation	Priority	Owners	Collaborators	Key Milestones and Actions	Schedule	Funding Status
1.0 Recommended Countywide Wastewater Upgrade Program Phase I - Program Ramp-up	1.1 Establish County Wastewater Management District (CWMD)	1	Suffolk County Executive's Office, SCDEDP and SCDPW	SCDHS, LIRPC, LINAP	a. Issue RFP	Complete	Funding from LIRPC
					b. Select consultant and execute contract.	Underway	Funding from LIRPC
					c. Select most appropriate CWMD implementation approach.	Short-term	Funding from LIRPC
					d. Conduct outreach and education.	Short-term	SCUPE and TBD
					e. Enabling legislation as necessary.	Short-term	N/A
					e. Hold referendum as necessary.	Short-term	N/A
					f. Establish administrative framework and staffing to collect and manage funds.	Short-term	TBD
	1.2 Establish Stable and Recurring Revenue Source	1	Suffolk County Executive's Office and SCDEDP	SCDHS, SCDPW, LIRPC, LINAP	Based on recommendations from the CWMD study, assess all potential funding mechanisms, including financing mechanism for long term loans for homeowners, grant opportunities, aquifer protection fee, tax credits, insurance rate adjustments, public private partnerships, benefit assessments, user fees, tax credits, etc. and implement recommended funding approach(es).	Short-term	TBD
	1.3 Continue I/A OWTS Demonstrations, Voluntary Incentive Programs, and Program Ramp Up	1	SCDHS, Suffolk County Executive's Office, SCDEDP, NYSDEC, Towns w/CPF Programs	SCDPW, Article 6 Workgroup	a. Continue to work with manufacturers to evaluate technology effectiveness.	Continuous	SCUPE
					b. Continue to work with installers to maintain and install I/A OWTS	Continuous	SCUPE
					c. Continue to work with designers (e.g., engineers, architects, surveyors or installers depending on selected alternative) to increase design capacity.	Short-term	SCUPE
					d. Continue to staff RME.	Short-term	SCUPE
					e. Develop approach to streamline I/A OWTS approvals.	Underway	In-place
					f. Construct Responsible Management Entity User Portal and Database (EHIMS)	Underway	SCUPE, Suffolk County Capital Budget
					g. Continue promoting use and monitoring performance of alternate leaching technologies on nitrogen removal, phosphorus removal, pathogen removal, and CEC removal.	Short-term	SCUPE, Suffolk County 1/4% Drinking Water Protection Program
					h. Consider revisions to the Suffolk County Sanitary Code and/or the Construction Standards for Approval of Plans and Sewage Disposal Systems to require the use of alternate leaching technologies in select site settings based upon performance monitoring data (e.g., freshwater/coastal ponds, pathogen prone areas, sea level prone areas, areas with high nitrogen load reduction goals, etc.).	Short-term	SCUPE, Suffolk County 1/4% Drinking Water Protection Program
					i. Continue County Septic Improvement Program	Short-term	SCUPE, Suffolk County 1/4% Drinking Water Protection Program
					j. Continue NYS Septic Improvement Program	Short-term	NYS Governor's Budget
					k. Continue Town CPF I/A OWTS Incentive Programs	Short-term	Town CPF
	1.4 Revisions to Appendix A of the Construction Standards for Other than Single Family Residential	1	SCDPW, SCDHS	Suffolk County Executive's Office, SCDEDP, Article 6 Workgroup, NYSDEC	Modify Appendix A of the Standards for Approval of Plans and Construction for Other than Single Family Residences to increase the allow design flow to <30,000 gpd and reduce setbacks based upon land use type.	Short-term	Existing County Resources, SCUPE

Table 8-25 Subwatershed Wastewater Plan Recommendations

Area	Recommendation	Priority	Owners	Collaborators	Key Milestones and Actions	Schedule	Funding Status
1.0 Recommended Countywide Wastewater Upgrade Program Phase I - Program Ramp-up	1.5 Reevaluate Recommendations and Resolve Datagaps for Sewer Expansion and/or Cluster Systems	2	Suffolk County Executive's Office, SCDPW, SCDHS	SCDEDP, Towns, Villages	a. After establishment of a source of revenue, reevaluate the sewering alternative identified in the SWP to assess the impact of funding availability	Short-term	Existing County Resources, SCUPE
		2	Suffolk County Executive's Office, SCDPW, SCDHS	SCDEDP, Towns, Villages	b. Based on the updated sewer evaluation, identify locations where sewering is a preferred option and consider identifying these parcels as I/A OWTS exempt areas	Short-term	Existing County Resources, SCUPE
		2	Suffolk County Executive's Office, SCDPW, SCDHS	SCDEDP, Towns, Villages	c. Consider to re-evaulate the potential for centralized sewering and implementation of cluster systems as part of the SWP Adaptive Management Plan	Long-term	Existing County Resources, SCUPE
		2	Suffolk County Executive's Office, SCDPW, SCDHS	SCDEDP, Towns, Villages, Article 6 Workgroup	d. Develop recommendations for streamlined approvals to facilitate the use of clustered systems in Suffolk County.	Long-term	Existing County Resources, SCUPE
	1.6 Subwatersheds Wastewater Plan Addendum for Commercial Parcels with Design Flows Greater than 1,000 gpd and Other New Data Sources	2	SCDPW, SCDHS	Suffolk County Executive's Office, SCDEDP, LINAP, NYSDEC	- Complete scanning and indexing of Office of Wastewater Management files to identify location of priority commercial parcels. - Identify priority areas and recommendations for wastewater upgrades to existing commercial projects with design flows of greater than 1,000 gpd; - Identify priority areas and recommendations for public schools; - Incorporate, to the extent practical depending on information availability, updated recommendations for subwatersheds identified as requiring additional study; - Incorporate recommendations for additional onsite treatment alternatives including experimental systems, I/A OWTS polishing units, and alternate leaching technologies; - Refined recommendations for expanded sewering areas and/or clustered systems based upon anticipated revenue streams and other new data sources; - Identify existing commercial parcels or areas that potentially have US EPA designated Large Capacity Cesspools; and, - Refine the initial recommendations provided within this SWP for sea level rise by providing a detailed recommended framework for wastewater upgrades within sea level rise protection areas.	Short-term	SCUPE
	1.7 Development of Adaptive Management and Monitoring Plan	1	SCDHS	SCDPW, SCDEDP, LINAP, NYSDEC	a. Define Program review intervals	Short-term	Existing County Resources, SCUPE
		1	SCDHS	USEPA, NYSDEC, Suffolk County, Estuary Programs, LINAP	b. Establish monitoring plan to track Program progress	Short-term	Existing County Resources, SCUPE
		1	SCDHS	USEPA, NYSDEC, Suffolk County, Estuary Programs, LINAP	c. Prioritize data collection needs to address data gaps identified in the SWP.monitoring and data evaluation programs to prioritize,	Short-term	Existing County Resources, SCUPE
		1	SCDHS	USEPA, NYSDEC, Suffolk County, Estuary Programs, LINAP	d. Develop and implement monitoring and data evaluation programs to address data gaps.	Short-term	Existing County Resources, SCUPE
		1	SCDHS	USEPA, NYSDEC, Suffolk County, Estuary Programs, LINAP	e. Establish reporting requirements and procedures	Short-term	Existing County Resources, SCUPE
		1	SCDHS	USEPA, NYSDEC, Suffolk County, Estuary Programs, LINAP	f. Modify SWP as indicated by new information and progress.	Long-term	Existing County Resources, SCUPE

Table 8-25 Subwatershed Wastewater Plan Recommendations

Area	Recommendation	Priority	Owners	Collaborators	Key Milestones and Actions	Schedule	Funding Status
1.0 Recommended Countywide Wastewater Upgrade Program Phase I - Program Ramp-up	1.8 Develop Recommended Plan for Areas of Special Consideration	2	SCDHS	SCDEDP, SCDPW, NYSDEC,	a. Evaluate and address Other than Single Family Parcels including grandfathered commercial parcels with flows that exceed 1,000 gpd, schools, and parcels using failed sulfur/limestone denite systems installed between 1985 and 1994, sites with high groundwater and/or small lot sizes.	Short-term	Use existing resources and continue to seek supplemental funding sources
		1	SCDHS	SCDEDP, ACOE, FIMI	b. Coordinate with ACOE to implement I/A OWTS while implementing FIMI to elevate coastal homes.	Short-term	Use existing resources and continue to seek supplemental funding sources
	1.9 Prepare Constrained Site Feasibility Studies	1	Towns/Villages	SCDHS, SCDEDP, SCDPW, County Executive's Office	Develop feasibility studies for constrained sites.	Short-term	Use existing resources and continue to seek supplemental funding sources
	1.10 Modify Suffolk County Sanitary Code Article 6	1	SCDHS	Suffolk County Executive's Office, SCDEDP, Article 6 Workgroup	Modify Article 6 to require I/A OWTS for new construction.	2020-2024	Existing County Resources, SCUPE

Table 8-25 Subwatershed Wastewater Plan Recommendations

Area	Recommendation	Priority	Owners	Collaborators	Key Milestones and Actions	Schedule	Funding Status
2.0 Recommended Countywide Wastewater Upgrade Program, Phases II, III and IV	2.1 Continue Voluntary, Town and Village I/A OWTS installations	1	SCDHS, Towns, Villages	Suffolk County Executive's Office, SCDEDP, Article 6 Workgroup	Continue County Septic Improvement Program, NYS Septic Improvement Program and Town CPF I/A OWTS Incentive Programs	Short-term	SCUPE, Suffolk County 1/4% Drinking Water Protection Program, Town CPFs, NYS Governor's Budget
	2.2 Phase IIA - Implement Wastewater Upgrades	1	SCDHS	Suffolk County Executive's Office, SCDEDP, Article 6 Workgroup Towns, Villages, NYSDEC, LINAP	Continue I/A OWTS installations for new contruction and new additions	2024-2054	TBD - possible options include new stable and recurring revenue source, existing Town CPF programs, Suffolk County 1/4% Drinking Water Protection Program including existing County SIP program, NYS septic replacement runds, NYS WQID Program, estuary program grants
		1	SCDHS	Suffolk County Executive's Office, SCDEDP, Article 6 Workgroup Towns, Villages, NYSDEC, LINAP	Modify Article 6 to target I/A OWTS installations for new construction and additions and at failure in 0 to 2 year contributing area and Groundwater Priority Rank 1 areas	2024-2054	TBD - possible options include new stable and recurring revenue source, existing Town CPF programs, Suffolk County 1/4% Drinking Water Protection Program including existing County SIP program, NYS septic replacement runds, NYS WQID Program, estuary program grants
	2.3 Phase IIB - Implement Wastewater Upgrades	1	SCDHS	Suffolk County Executive's Office, SCDEDP, Article 6 Workgroup Towns, Villages, NYSDEC, LINAP	Modify Article 6 to target I/A OWTS installations for new construction and additions and at failure and property transfers in 0 to 2 year contributing area and Groundwater Priority Rank 1 areas	2026 - 2054	TBD - possible options include new stable and recurring revenue source, existing Town CPF programs, Suffolk County 1/4% Drinking Water Protection Program including existing County SIP program, NYS septic replacement runds, NYS WQID Program, estuary program grants
	2.4 Phase IIC - Implement Wastewater Upgrades	1	SCDHS	Suffolk County Executive's Office, SCDEDP, Article 6 Workgroup Towns, Villages, NYSDEC, LINAP	Modify Article 6 to target I/A OWTS installations for new construction and additions and at failure and property transfers in 0 to 2 year contributing area and Groundwater Priority Rank 1 areas and failure in Surface Water Priority Rank 1 areas	2037 - 2054	TBD - possible options include new stable and recurring revenue source, existing Town CPF programs, Suffolk County 1/4% Drinking Water Protection Program including existing County SIP program, NYS septic replacement runds, NYS WQID Program, estuary program grants
	2.5 Phase IID - Implement Wastewater Upgrades	1	SCDHS	Suffolk County Executive's Office, SCDEDP, Article 6 Workgroup Towns, Villages, NYSDEC, LINAP	Modify Article 6 to target I/A OWTS installations for new construction and additions and at failure and property transfers in 0 to 2 year contributing area, Groundwater Priority Rank 1 areas and Surface Water Priority Rank 1 areas	2039 - 2054	TBD - possible options include new stable and recurring revenue source, existing Town CPF programs, Suffolk County 1/4% Drinking Water Protection Program including existing County SIP program, NYS septic replacement runds, NYS WQID Program, estuary program grants
	2.6 Phase III - Implement Wastewater Upgrades	1	SCDHS	Suffolk County Executive's Office, SCDEDP, Article 6 Workgroup Towns, Villages, NYSDEC, LINAP	Modify Article 6 to target I/A OWTS installations for new construction and additions and at failure and property transfers in Groundwater Priority Rank 2 and Surface Water Priority Ranks 2-4 areas	2054 - 2069	TBD - possible options include new stable and recurring revenue source, existing Town CPF programs, Suffolk County 1/4% Drinking Water Protection Program including existing County SIP program, NYS septic replacement runds, NYS WQID Program, estuary program grants
	2.7 Phase IV - Implement Wastewater Upgrades	1	SCDHS	Suffolk County Executive's Office, SCDEDP, Article 6 Workgroup Towns, Villages, NYSDEC, LINAP	Modify Article 6 to target I/A OWTS installations for new construction and additions and at failure and property transfers at all remaining parcels Countywide	2069 - TBD	TBD - possible options include new stable and recurring revenue source, existing Town CPF programs, Suffolk County 1/4% Drinking Water Protection Program including existing County SIP program, NYS septic replacement runds, NYS WQID Program, estuary program grants

Table 8-25 Subwatershed Wastewater Plan Recommendations							
Area	**Recommendation**	**Priority**	**Owners**	**Collaborators**	**Key Milestones and Actions**	**Schedule**	**Funding Status**
3.0 Land Use Management Options for Wastewater Nitrogen Mitigation	3.1 Increase Minimum Parcel Size	2	SCDHS	Suffolk County Executive's Office, SCDEDP, Article 6 Workgroup	a. Consider revision of Article 6 of the Sanitary Code to require a minimum lot size of 40,000 square feet in GMZ IV.	Medium-term	Existing County Resources, SCUPE
		2	SCDHS	Suffolk County Executive's Office, SCDEDP, Article 6 Workgroup	b. Consider revision of Article 6 of the Sanitary Code to require a minimum lot size of 40,000 square feet in select subwatesrheds.	Medium-term	Existing County Resources, SCUPE
		2	Towns/Villages	SCDHS	c. Consider zoning revisions to identify minimum 40,000 square feet parcel size in select subwatersheds.	Medium-term	N/A
	3.2 Land Preservation	1	SCDEDP	SCDHS, Towns, Villages	Purchase parcels in priority areas	Short-term	TBD - possible options include Town CPF and Suffolk County Open Space
	3.3 Transfer of Development Rights (1)	2	SCDHS	Suffolk County Executive's Office, SCDEDP, Article 6 Workgroup, Towns, Villages	Consider limiting Density Transfer into "sensitive zones", including restriction of transfers into Surface Water Priority Area Ranks 1 and 2 water bodies, and limitation of transfers from surface water and groundwater areas of lower priority rank to higher priority rank	Medium-term	Existing County Resources, SCUPE
		2	SCDHS	Suffolk County Executive's Office, SCDEDP, Article 6 Workgroup, Towns, Villages	Consider limiting receiving parcels to water bodies with current nitrogen load capacity or cap the maximum nitrogen load increase resulting from TDRs to water bodies with no nitrogen load capacity, including projected build-out nitrogen loads	Medium-term	Existing County Resources, SCUPE
		1	SCDHS	Suffolk County Executive's Office, SCDEDP, Article 6 Workgroup	Based upon SWP Addendum findings, Identify locations of high priority commercial parcels and consider revision to Article 6 TDR requirements.	Medium-term	Existing County Resources, SCUPE
		2	SCDHS	Suffolk County Executive's Office, SCDEDP, Article 6 Workgroup	Consider incentives for transfer of development rights out of high priority areas and/or areas with high nitrogen load reduction goals.	Medium-term	TBD - possible options include ???
		2	SCDHS	Suffolk County Executive's Office, SCDEDP, Article 6 Workgroup	Establish Countywide TDR tracking database and periodically review sending and receiving parcels	Medium-term	TBD - possible options include SCUPE plus???

(1) A SEQR evaluation will be required for any new policy affecting Transfer of Development Rights

Table 8-25 Subwatershed Wastewater Plan Recommendations

Area	Recommendation	Priority	Owners	Collaborators	Key Milestones and Actions	Schedule	Funding Status
4.0 Initial Recommendations for Other Nitrogen Sources including Legacy Nitrogen in Groundwater	4.1 Continue to reduce nitrogen load from homeowner fertilizer application.	2	SCDEDP	SCDHS, PEP, NYSDEC, CCE, Towns and Villages, LINAP	Continue to work closely with the LINAP to advance regulations that reduce fertilizer from residential land use. Consider subwatershed-specific fertilizer regulations in subwatersheds with high population density coupled with poor flushing (e.g., Great South Bay, SSER coastal ponds, etc.);	Short Term	Use existing resources and continue to seek supplemental funding sources
	4.2 Continue to work with agricultural community to implement BMPs which reduce fertiilzer loading to groundwater	2	SCDEDP	SCDHS, CCE, LINAP	a. Continue to hold quarterly RCPP meetings and work closely industry professionals to advance the recommendations in the Suffolk County Agricultural Stewardship plan;	Short Term	Use existing resources and continue to seek supplemental funding sources
		2	SCDEDP	SCDHS, NYSDEC, CCE, LINAP	b. Continue to pursue funding opportunities to offset the cost for implementation of BMPs and/or local research to identify Suffolk County specific nitrogen formulations that produce equivalent crop quality while reducing the amount of nitrogen that leaches to groundwater; and,	Short Term	N/A
		3	SCDHS	CCE, SCDEDP, NYSDEC	c. Evaluate Suffolk County specific leaching rates for various fertilizer applications through a comprehensive groundwater monitoring program.	Short Term	Use existing resources and continue to seek supplemental funding sources
	4.3 Evaluate and implement Permeable Reactive Barriers (PRBs) into the Program at appropriate locations to mitigate legacy nitrogen and provide rapid water quality benefits	2	LINAP	NYSDEC, SCDHS, SCDPW Towns, Villages	Establish regulatory oversight and permitting mechanism to assure proper design, construction and monitoring	Medium-term	TBD - possible options include LINAP, SCUPE, Town CPF, Suffolk County 1/4% Drinking Water Protection Program, NYS WQID Program, estuary program grants
		1	LINAP	NYSDEC, CCE, SCDPW, USEPA, CCWT, SCDHS	Prepare a PRB Guidance Document to identify suitable locations, design parameters and monitoring requriements	Medium-term	TBD - possible options include LINAP, SCUPE, Town CPF, Suffolk County 1/4% Drinking Water Protection Program, NYS WQID Program, estuary program grants
	4.4 Evaluate the potential to incorporate hydromodification into the Program at appropriate locations to reduce hydraulic residence time and provide water quality benefits	2	LINAP	NYSDEC, SCDHS, USGS, SCDPW, Estuary Programs, Towns, Villages	Prepare a Hydromodification Feasilbity Study to use existing hydrodynamic models to evaluate the impact of hydromodification on residence times and unit nitrogen loading, evaluates capital and maintenance costs and benefits, and evaluates potential impacts including the potential for flooding and scouring, and modification to salinity, temperature and local ecosystems	Medium-term	TBD - possible options include LINAP, SCUPE, Town CPF, Suffolk County 1/4% Drinking Water Protection Program, NYS WQID Program, estuary program grants
	4.5 Evalute the potential to incorporate Bioextraction into the Program at appropriate locations to reduce the impacts of nitrogen loading and provide rapid water quality benefits	1	LINAP	NYSDEC, CCE, SCDHS, SoMAS, SCDPW, Estuary Programs, Towns, Villages	a. Develop a bioextraction Feasibility Study to assess the potential for shellfish and seaweed culture to remove nutrients from surface waters	Short-term	TBD - possible options include LINAP, SCUPE, Town CPF, Suffolk County 1/4% Drinking Water Protection Program, NYS WQID Program, estuary program grants
		2	LINAP	NYSDEC, CCE, SCDHS, Estuary Programs, Towns, Villages	b. Develop a GIS-based nutrient bioextraction siting tool that employs suitability analysis to identify appropriate locations for shellfish and seaweed aquaculture	Medium-term	TBD - possible options include LINAP, SCUPE, Town CPF, Suffolk County 1/4% Drinking Water Protection Program, NYS WQID Program, estuary program grants
		2	LINAP	NYSDEC, SCDHS, SCDPW, Estuary Programs, Towns, Villages	c. Establish a regulatory oversight and permitting mechanism for commercial seaweed aquaculture.	Medium-term	TBD - possible options include LINAP, SCUPE, Town CPF, Suffolk County 1/4% Drinking Water Protection Program, NYS WQID Program, estuary program grants

Table 8-25 Subwatershed Wastewater Plan Recommendations

Area	Recommendation	Priority	Owners	Collaborators	Key Milestones and Actions	Schedule	Funding Status
5.0 Recommendations for Contaminants of Emerging Concern	5.1 Develop and implement CEC monitoring plan to assess CEC removal capabilities of alternative technologies	1	SCDHS	NYSDEC,LICAP, CCWT, SCWA, USGS	a. Develop and implement CEC monitoring plan to assess CEC removal capabilities STPs and alternative onsite technologies including I/A OWTS and drainfields.	Short-term	Use existing resources and continue to seek supplemental funding sources
		1	SCDHS	NYSDEC,LICAP, CCWT, SCWA, USGS	b. Develop recommendations for technology selection and design recommendations for CEC removal and identify recalcitrant CECs.	Short-term	Use existing resources and continue to seek supplemental funding sources
	5.2 Identify, develop and test new technologies for CEC removal.	1	CCWT	SCDHS, SCWA	a. Develop new technologies as necessary to remove CECs.	Medium-term	CCWT NYSDOH Drinking Water Grant and continue to seek supplemental funding sources
		3	SCDHS	LINAP, LICAP, CCWT, SCWA	b. Prepare cost/benefit evaluation of alternative treatment technologies, including wastewater treatement and potable supply treatment alternatives.	Short-term	Use existing resources and continue to seek supplemental funding sources
6.0 Recommendations for Sea Level Rise	6.1 Monitor and consider updated sea level rise projections and response plans	1	SCDHS and SCDEDP	Suffolk County Executive's Office, SCDPW, NYSDEC, Towns, Villages, USACOE, Article 6 Workgroup	a. Monitor updated sea level rise projections as they are developed.	Long-term	Use existing resources and continue to seek supplemental funding sources
		1	SCDHS and SCDEDP	Suffolk County Executive's Office, SCDPW, NYSDEC, Towns, Villages, USACOE, Article 6 Workgroup	b. Work collaboratively in the development of new local or regional sea level rise management plans and regulations and evaluate the impacts of new applicable management plans and regulations developed by others on wastewater management in Suffolk County as part of the Adaptive Management Plan	Long-term	Use existing resources and continue to seek supplemental funding sources
	6.2 Evaluate and implement alternative responses as part of SWP Addenda and the Adaptive Management Plan	1	SCDHS and SCDEDP	Suffolk County Executive's Office, SCDPW, NYSDEC, Towns, Villages, USACOE, Article 6 Workgroup	a. Evaluate potential wastewater management policies in areas projected to be impacted by sea level rise, including: consideration of increasing the minimum separation distance to groundwater based on long-term objective of maintaining minimum 3-foot separation in 2100, implement a cluster sewer system(s) and locate recharge outside of sea level rise area, purchase of parcels in the sea level rise protection area for open space preservation, provide incentives to property owners for making parcels in the area TDR sending parcels	Long-term	Use existing resources and continue to seek supplemental funding sources
		1	SCDHS and SCDEDP	Suffolk County Executive's Office, SCDPW, NYSDEC, Towns, Villages, USACOE, Article 6 Workgroup	b. Implement selected wastewater management policies in areas projected to be impacted by sea level rise	Long-term	Use existing resources and continue to seek supplemental funding sources

Table 8-25 Subwatershed Wastewater Plan Recommendations

Area	Recommendation	Priority	Owners	Collaborators	Key Milestones and Actions	Schedule	Funding Status
7.0 Recommendations for Phosphorus from Wastewater	7.1 Develop and implement phosphorus monitoring plan to assess phosphorus removal capabilities of alternative technologies	2	SCDHS, CCWT	NYSDEC	Collect influent and effluent phosphorus data at I/A OWTS and recharge facilities (e.g., drainfields) to identify treatment and/or recharge technologies capable of reducing effluent phosphorus.	Short-term	Use existing resources and continue to seek supplemental funding sources
	7.2 Assess phosphorus reduction requirements to protect fresh water bodies	2	SCDHS, SoMAS	NYSDEC	Evaluate phosphorus loads and develop phosphorus balances to freshwater and coastal ponds with known water quality degradation. Identify required phosphorus load reductions to protect surface waters	Short-term	Use existing resources and continue to seek supplemental funding sources
	7.3 Identify, develop and test technologies for phosphorus removal	2	SCDHS, CCWT	NYSDEC	Develop and/or complete demonstration testing of new wastewater technologies as necessary to remove phosphorus	Short-term	Use existing resources and continue to seek supplemental funding sources
8.0 Recommendations for Pathogens from Wastewater Sources	8.1 Develop and implement pathogen monitoring plan to assess sources of observed pathogen indicators	1	SCDHS, NYSDEC, CCE, USGS	Towns, Villages	a. Map storm sewer discharges with respect to the surface water sampling locations to identify whether or not discharge of stormwater is the source of the pathogen impairment.	Short-term	Use existing resources, SCUPE, and continue to seek supplemental funding sources
		1	SCDHS, NYSDEC, CCE, USGS	Towns, Villages	b. Conduct bacterial source tracking evaluations to identify waterbodies with sanitary derived pathogen sources	Short -term	Use existing resources, SCUPE, and continue to seek supplemental funding sources
	8.2 Support development and implementation of pathogen TMDL	1	NYSDEC	SCDHS, SCDPW, Towns, Villages	The NYSDEC is currently completing source tracking, modeling, and development of a pathogen TMDL for Suffolk County surfac waters. Continue to collaborate with the NYSDEC on the development of the TMDL and related monitoring and modeling efforts to ensure alignment with County program(s)	Short-term	N/A
	8.3 Develop and implement pathogen removal requirements from wastewater sources	2	NYSDEC, SCDHS	Towns, Villages	Identify impacted water bodies with pathogen loading and pathogen load reduction requirements from wastewater sources	Short-term	Use existing resources, SCUPE, and continue to seek supplemental funding sources
		2	NYSDEC, SCDHS, SCDPW, CCWT	Towns, Villages	Identify pathogen removal technologies compatible with I/A OWTS and evaluate	Medium-term	Use existing resources, SCUPE, and continue to seek supplemental funding sources
		2	SCDHS	NYSDEC, Suffolk County Executive's Office, SCDEDP, Article 6 Workgroup	Incorporate results into SWP Amendment and provide recommended Sanitary Code and/or Construction Standard revisions	Long-term	Use existing resources, SCUPE, and continue to seek supplemental funding sources

Table 8-25 Subwatershed Wastewater Plan Recommendations

Area	Recommendation	Priority	Owners	Collaborators	Key Milestones and Actions	Schedule	Funding Status
9.0 Implementation of Adaptive Management and Data Collection to Address Data Gaps	9.1 Implement Adaptive Management and Monitoring Plan	1	SCDHS	SCDPW, SCDEDP, Suffolk County Executive' Office	a. Establish Program Lead	Short-term	Use existing resources and continue to seek supplemental funding sources
		1	SCDHS	SCDPW, SCDEDP, Sufolk County Executive's Office	b. Define Program goals and objectives	Short-term	Use existing resources and continue to seek supplemental funding sources
		1	SCDHS	SCDPW, SCDEDP	c. Define Program review intervals	Short-term	Use existing resources and continue to seek supplemental funding sources
		1	SCDHS	USEPA, NYSDEC, Suffolk County, Estuary Programs	d. Establish monitoring plan to track Program progress	Short-term	Use existing resources and continue to seek supplemental funding sources
		1	SCDHS	USEPA, NYSDEC, Suffolk County, Estuary Programs	e. Prioritize data collection needs to address data gaps identified in the SWP.monitoring and data evaluation programs to prioritize,	Short-term	Use existing resources and continue to seek supplemental funding sources
		1	SCDHS	USEPA, NYSDEC, Suffolk County, Estuary Programs	f. Develop and implement monitoring and data evaluation programs to address data gaps.	Short-term	Use existing resources and continue to seek supplemental funding sources
		1	SCDHS	USEPA, NYSDEC, Suffolk County, Estuary Programs	g. Establish reporting requirements and procedures	Short-term	Use existing resources and continue to seek supplemental funding sources
		1	SCDHS	USEPA, NYSDEC, Suffolk County, Estuary Programs, Suffolk County Executive's Office	h. Modify SWP as indicated by new information and progress.	Medium-term	Use existing resources and continue to seek supplemental funding sources
	9.2 Collect Additional Data to Fill Identified Datagaps	1	SCDHS	SCDPW, SCDEDP, LINAP	a. Identify specific nitrogen loading rates for commercial, industrial, and institutional parcels (including high flow and grandfathered parcels)	Short-term	SCUPE
		1	SCDHS	SCDPW, SCDEDP, LINAP	b. Establish countywide GIS-based database of crop types with mechanism to provide annual updates	Short-term	TBD - possible options include LINAP, SCUPE, Town CPF, Suffolk County 1/4% Drinking Water Protection Program, NYS WQID Program, estuary program grants
		1	SCDHS	SCDPW, SCDEDP, LINAP	c. Obtain subwatershed specific estimates of domesticated animals and wildlife populations (e.g,. waterfowl) that could contribute to nitrogen loading	Short-term	TBD - possible options include LINAP, SCUPE, Town CPF, Suffolk County 1/4% Drinking Water Protection Program, NYS WQID Program, estuary program grants
		1	SCDHS	USEPA, NYSDEC, Suffolk County, Estuary Programs, LINAP, SBU SoMAS	d. Collect benthic flux data from high priority/high load reduction goal subwatersheds	Short-term	TBD - possible options include LINAP, SCUPE, Town CPF, Suffolk County 1/4% Drinking Water Protection Program, NYS WQID Program, estuary program grants
		1	SCDHS	USEPA, NYSDEC, Suffolk County, Estuary Programs, LINAP, SBU SoMAS	e. Complete hyporheic zone attenuation studies for high priority/high load reduction goal subwatersheds	Short-term	TBD - possible options include LINAP, SCUPE, Town CPF, Suffolk County 1/4% Drinking Water Protection Program, NYS WQID Program, estuary program grants
		1	SCDHS	USEPA, NYSDEC, Suffolk County, Estuary Programs, LINAP, SBU SoMAS	f. Collect additional bathymetric data from waterbodies with limited existing data (e.g., small estuaries).	Short-term	SCUPE, existing SCDHS Marine Bureau monitoring
		1	SCDHS	USEPA, NYSDEC, Suffolk County, Estuary Programs, LINAP, SBU SoMAS	g. Collect additional water quality data from waterbodies with insufficient data to properly characterize existing water quality (e.g., all freshwater lakes and coastal ponds, small estuaries, etc.)	Short-term	TBD - possible options include LINAP, SCUPE, Town CPF, Suffolk County 1/4% Drinking Water Protection Program, NYS WQID Program, estuary program grants
		1	SCDHS	USEPA, NYSDEC, Suffolk County, Estuary Programs, LINAP, SBU SoMAS, USGS	h. Deploy continuous monitoring sensors to evaluate total nitrogen concentrations and dissolved oxygen in poorly characterized waterbodies and/or in well characterized waterbodies with high priority rank and load reduction goals.	Medium-term	TBD - possible options include LINAP, SCUPE, Town CPF, Suffolk County 1/4% Drinking Water Protection Program, NYS WQID Program, estuary program grants

Table 8-25 Subwatershed Wastewater Plan Recommendations

Area	Recommendation	Priority	Owners	Collaborators	Key Milestones and Actions	Schedule	Funding Status
9.0 Implementation of Adaptive Management and Management and Data Collection to Address Data Gaps		1	SCDHS	USEPA, NYSDEC, Suffolk County, Estuary Programs, LINAP, USGS, CCE	i. Complete pathogen source tracking studies for waterbodies at high risk for pathogens from wastewater sources	Short-term	TBD - possible options include LINAP, SCUPE, Town CPF, Suffolk County 1/4% Drinking Water Protection Program, NYS WQID Program, estuary program grants
		1	SCDHS	USEPA, NYSDEC, Suffolk County, Estuary Programs, SBU SoMAS	j. Continue monitoring of HABs and coordinate with the Harmful Algal Bloom Action Plan advisory group to refine approaches for HAB-related load reduction goals	Short-term	TBD - possible options include LINAP, SCUPE, Town CPF, Suffolk County 1/4% Drinking Water Protection Program, NYS WQID Program, estuary program grants
		1	SCDHS	USEPA, NYSDEC, Suffolk County, Estuary Programs	k. Collect OSDS failure data through the SHIP portal to refine the estimate of system failure rate	Short-term	SCUPE
		1	SCDHS	USEPA, NYSDEC, Suffolk County, Estuary Programs, LINAP, CCWT	l. Collect I/A OWTS and alternate leaching performance data for phosphorus, pathogens, and CECs (CECs should also be monitored at STPs)	Medium-term	TBD - possible options include LINAP, SCUPE, Town CPF, Suffolk County 1/4% Drinking Water Protection Program, NYS WQID Program, estuary program grants

Key:

Priority - 1 highest to 3 lowest

Schedule - short term - < 5 years
5 years < medium > 10 years
Long term > 10 years

LIST OF ACRONYMS

CCE	Cornell Cooperative Extension	NYSDOS	New York State Department of State
CCWT	Center for Clean Water Technology	NYSEFC	New York State Environmental Facilities Corporation
CP	Capital Program	PEP	Peconic Estuary Program
CPF	Community Preservation Fund	RME	Responsible Management Entity
CWMD	Countywide Wastewater Management District	SCDEDP	Suffolk County Department of Economic Development
FEMA	Federal Emergency Management Agency	SCDHS	Suffolk County Department of Health Services
GMZ	Groundwater Management Zone	SCDPW	Suffolk County Department of Public Works
I/A OWTS	Innovative Alternative Onsite Wastewater Treatment System	SCUPE	
LINAP	Long Island Nitrogen Action Plan	SCWA	Suffolk County Water Authority
		SoMAS	Stony Brook School of Marine & Atmospheric Sciences
LIRPC	Long Island Regional Planning Council	SSER	South Shore Estuary Reserve
LISS	Long Island Sound Study	STP	Sewage Treatment Plant
NFWF	National Fish and Wildlife Federation	TNC	The Nature Conservancy
NOAA	National Oceanic and Atmospheric Administration	USACOE	United States Army Corps of Engineers
NRCS	National Resources Conservation Service	USEPA	United States Environmental Protection Agency
NYSDEC	New York State Department of Environmental Conservation	USGS	United States Geological Survey

Section 9

Long Term Monitoring and Recommendations for Further Evaluations

This Subwatersheds Wastewater Plan (SWP), while comprehensive, is the first step of a long-term Countywide wastewater upgrade program. The focus of the SWP was to use readily available existing data and information to:

- Provide a range of recommended wastewater management policy options to policymakers that considered the established priority areas, load reduction goals, code and standard changes, and potential funding needs to facilitate implementation of an integrated Countywide strategy; and,

- Identify data gaps where additional information was needed before policy recommendations could be set forth and to provide a recommended road map of to close each of the identified data gaps.

The SWP is one aspect of a Countywide program to reduce the total nitrogen mass load to groundwater and surface water within the County. Suffolk County remains dedicated to tracking the implementation of the program and to working with local jurisdictions and continuing coordination with related programs (e.g., estuary programs, LINAP, LICAP, Towns/Village) to ensure the Countywide implementation strategy addressing nitrogen sources is advanced. The following section summarizes the identified data gaps, uncertainties, and opportunities to refine the results of the SWP.

9.1 Nitrogen Load Estimates

First-order nitrogen loads were developed based upon available information to characterize the nitrogen loading from sanitary wastewater, fertilizer, pets and atmospheric deposition to each subwatershed. As the nitrogen loads components were developed, several areas were identified where additional information or evaluations could further refine or add confidence to the nitrogen load estimates.

9.1.1 Nitrogen Loading Rates

- Parcel-specific nitrogen loads from sanitary wastewater for commercial and industrial parcels was based upon typical flow rates and a single effluent nitrogen concentration. As discussed in Section 2.1.5, nitrogen loads from commercial and industrial uses are highly variable. As this first-order evaluation was based on County land use datasets that do not specify the type of commercial usage for each parcel, additional refinement of commercial loads may be beneficial for individual subwatersheds where commercial land use comprises a significant percentage of the contributing area.

- Nitrogen loading rates from fertilizer can vary significantly across agricultural areas based upon crop type, and crop type in a particular field can also vary over time. While every attempt was made to use the best available data, there is still uncertainty regarding crop type on agricultural parcels. It is assumed that the Peconic Estuary Program database for crop type is the best available data set, followed by the USDA CropScape coverage. Nitrogen loading from fertilizer can also vary based on type of fertilizer and fertilization practice. Implementation of best management practices such as use of controlled release fertilizer as appropriate, split applications, appropriate rates, application and timing can all reduce nitrogen loads. Comparison of simulated community supply well nitrogen concentrations to actual measured concentrations showed that the simulated concentrations were lower than observed in some areas where agricultural land comprised the majority of the contributing area, suggesting that the regional rates were not representative of historical or actual fertilization rates. While the regional databases were sufficient for the Countywide first-order evaluation, further refinement of crop types and fertilization rates would be required to develop more detailed subwatershed evaluations in East End agricultural areas.

- Nitrogen loading from pet waste was included based on limited available data characterizing the pet population and nitrogen load per animal in the County. Although overall, pet waste comprised a very small percentage of the total nitrogen load, additional refinement to the pet population and nitrogen load associated with canine and feline populations could improve the estimates.
- While literature suggests that wildlife, such as geese, deer, etc., essentially recycle nitrogen within a particular watershed, data confirming this assumption for Suffolk County was not available. Further study would be warranted to confirm this assumption, and census counts of wildlife and the avian population would be necessary to quantify nitrogen loading from birds and wildlife.

9.1.2 Other Sources of Nitrogen

Two additional sources of nitrogen that were not included in this evaluation and that may provide significant nitrogen contributions to some subwatersheds were identified:

- Nitrogen from the ocean boundary, and
- Nitrogen from benthic demand.

Consideration of nitrogen from the ocean boundary would need to be incorporated into any linked hydrodynamic-water quality models that may be implemented on a water body-specific basis. Evaluation of the potential for nitrogen loads from benthic demands to impact nitrogen loads would be warranted for poorly-flushed water bodies, especially those where calculated nitrogen loads are low and not consistent with observed water quality.

9.1.3 Nitrogen Attenuation

Estimates of nitrogen attenuation rates are a significant component of the subwatershed-specific nitrogen load development. Based on comparison of model-simulated nitrogen concentrations in the shallow upper glacial and measured concentrations in the shallow upper glacial community supply wells, the assigned nitrogen attenuation rates are representative of Countywide conditions.

However, on a local basis, additional characterization may result in improved loading estimates as identified below:

- Based on literature values and Focus Area Work Group guidance, the nitrogen load calculations from septic systems incorporated a six percent loss of nitrogen within the septic tank. This Countywide evaluation also treated the on-site wastewater systems on all parcels identically; there is no distinction between older cesspools and more modern septic systems. Cesspools would presumably provide less attenuation than a septic tank/effluent field. Further consideration of nitrogen losses in septic tanks/cesspools, and differentiation of septic systems/cesspools could support a more refined analysis.

- Parcel-specific fertilizer leaching rates likely vary significantly based upon crop type, irrigation practices, actual application rates, and other parcel specific factors and should be evaluated further.

- There is considerable uncertainty regarding denitrification through the hyporheic zone as the denitrification rate is spatially variable, even within the same water body. Denitrification through the hyporheic zone was included in the subwatershed-specific nitrogen load development with an estimated attenuation rate through wetlands, in acknowledgement of its potential importance on a site-specific basis. If the impact of the hyporheic zone is to be further considered, discrete subwatershed-specific sampling would be required to provide site-specific attenuation rates. This may be warranted for subwatersheds with high nitrogen load reduction goals, to further refine the load reduction targets.

- Although nitrogen loading from pet waste was a small fraction of subwatershed-specific nitrogen loads, the values could be refined based on further study of pet waste volatilization rates.

9.2 Ecological Endpoints

Through the years, Suffolk County has collected an extensive database of information to characterize their water resources; this database has been invaluable in characterizing subwatershed water quality and identifying the need for nitrogen load reductions.

Nevertheless, the evaluation of target load reductions identified additional data that would help to:

- Better understand the relationships between nitrogen loads and receiving water quality, and

- Refine the nitrogen load reductions required to restore/protect surface water quality.

Areas where additional data collection would be useful are briefly identified below.

Water Depths – Water depths for many of the surface water bodies are well documented, particularly for surface waters that are navigable. Water depths were not readily available to characterize some of the smaller water bodies, particularly the ponds. Unit nitrogen loads and residence times are dependent on surface water volume. While surface areas of each water body can be readily obtained from sources such as Google maps, estimates of water body depths were developed for some of the smaller surface water bodies based on best available data. Unit nitrogen loads and residence times of the smaller shallow ponds could be significantly impacted if the assumed depths are either too high or too low. This would result in ponds being assigned to a nitrogen load group that is either too low or too high, and required nitrogen load reductions that are either higher or lower respectively, than the actual nitrogen load reductions required.

Hyporheic Zones – Hyporheic zones can significantly reduce the nitrogen load from groundwater that is delivered to a surface water body. While conservative hyporheic zone nitrogen load reductions were incorporated into the Task 4 nitrogen loading estimates for targeted areas within the subwatersheds; the reduced nitrogen loads were not included in the travel-time specific nitrogen loads from groundwater that were used to derive the nitrogen load reduction targets. It is hypothesized that nitrogen reduction through the hyporheic zone could be responsible for some of the apparent discrepancies between the calculated nitrogen load groups and observed water quality, where the observed water quality did not show the degraded water quality conditions observed in other surface waters with similar unit nitrogen loads and residence times. Nitrogen removal within the hyporheic zone could significantly reduce the nitrogen load from groundwater that is actually delivered to a surface water body. Characterization of the areas where the hyporheic zones successfully reduced the nitrogen loads and quantification of the nitrogen removal would help to improve the understanding of the impacts of nitrogen loads on water quality and help to refine the nitrogen load reduction requirements.

Benthic Flux - The release of nitrogen from subsurface sediment to the overlying water column may be a significant source of nitrogen to some water bodies. Organic matter and decaying phytoplankton that settle to the bottom of quiescent water bodies can provide a source of nutrients to the overlying water column that can be significant nitrogen sources in some cases. These benthic fluxes of nitrogen from sediments are water body-specific, depending on a variety of factors, including the gradient between nitrogen concentration in the sediment pore water and the nitrogen concentration in the overlying water column, water body currents and pore water diffusion rates, sediment grain size (e.g., gravel, sand, silt, clay), etc. Further subwatershed-specific characterization of benthic fluxes, particularly in water bodies with long residence times would be useful in developing more comprehensive understanding of nitrogen sources and in development of a nitrogen balance. Characterization of benthic fluxes would also be useful to support future surface water quality modeling evaluations.

9.3 Wastewater Treatment and Nitrogen Reduction

As part of the Adaptive Management Plan described in Section 8.4.11, the County will continue to update the SWP approach as existing wastewater technologies removing nitrogen are advanced, and new technologies are developed. In addition, as described in Section 8.4.11, the suite of wastewater parameters addressed by I/A OWTS may be modified to incorporate CECs, and phosphorus and pathogens, as appropriate.

Finally, alternative approaches to reduce or remove nitrogen from groundwater (e.g., permeable reactive barriers) or surface water (e.g., bioextraction) and to reduce the impacts of nitrogen on surface waters (e.g., hydromodification) can also be evaluated for incorporation into overall nitrogen management planning.

9.3.1 Wastewater Treatment Technologies

Wastewater treatment technologies that are being evaluated, tested or developed have been discussed in Sections 2 and 8 of the SWP as listed below:

- Continued improvement of nitrogen removal technologies to provide increased nitrogen removal (e.g., see Section 2.2.1.3);
- Alternative Leaching Technologies (see Section 2.2.1.4);
- Removal of Contaminants of Emerging Concern (see Section 8.4.4);
- Phosphorus Removal (See Section 8.4.6) and
- Pathogen Inactivation (See Section 8.4.8).

As areas that would benefit from additional nitrogen removal are identified, and more effective – or cost-effective I/A OWTS technologies become available, they can be incorporated into the SWP framework. Similarly, areas contributing to fresh waters that may benefit from phosphorus removal can incorporate treatment systems removing phosphorus after identification and successful demonstration and the SWP can be modified to address areas requiring pathogen removal, particularly areas with high groundwater tables or projected to be affected by sea level rise. Advances in CEC identification, identification of impacts and treatment options are reported nearly daily; these can be incorporated into the SWP addenda as appropriate.

9.3.2 Alternative Nitrogen Reduction Technologies

Alternative nitrogen reduction technologies have been discussed in Sections 2 and 8 of the SWP as follows:

- Permeable reactive barriers (See Sections 2.2.2.2 and 8.4.12.2);
- Bioextraction (See Section 8.4.12.4) and
- Hydromodification (See Section 8.4.12.3).

Areas that would benefit from removal of legacy nitrogen or nitrogen from non-wastewater sources, or areas where a rapid reduction in nitrogen load is desired can be identified and after further evaluation, the alternative nitrogen reduction technologies can be incorporated into an SWP Addenda.

9.4 Recommendations for Areas that Cannot Be Addressed with Wastewater Management Alone

9.4.1 Subwatersheds that Cannot Be Addressed with Wastewater Management Alone

Subwatersheds with nitrogen load reductions that cannot be completely achieved by implementation of I/A OWTS are listed on **Table 9-1** (please see tables at the end of this section). More detailed evaluation, including additional water quality monitoring of those subwatersheds that are not well characterized could first be conducted to verify the recommended nitrogen load reduction. For well-characterized subwatersheds where information is available, the potential impacts of historical land use should be explored to assess whether legacy nitrogen contributed from previous land uses is the cause of observed water quality impairments. The potential for hyporheic zone attenuation of the nitrogen load from groundwater should be considered.

After it is confirmed that the nitrogen load reductions cannot be achieved by implementation of I/A OWTS alone, the following approaches can be considered, as was described in Section 8:

- Implementation of polishing units or pressurized shallow drainfield can be considered to reduce nitrogen loads from sanitary wastewater in subwatersheds comprised primarily of developed areas;
- Fertilizer management should be explored, if the subwatershed contributing area includes significant agricultural areas or golf courses and fertilizer is estimated to be a large percentage of the nitrogen load.
- Permeable Reactive Barriers can be explored for subwatersheds with shallow flow fields and anticipated legacy nitrogen contributions.

9.4.2 Community Supply Wells that Cannot Be Addressed with Wastewater Management Alone

There are only two wellfields where implementation of I/A OWTS throughout the contributing area is not anticipated to achieve 4 mg/L nitrogen in untreated water withdrawn from the wellfield; SCWA's Race Avenue and Browns Hills Road wellfields. For Race Avenue, I/A OWTS implementation is projected to significantly reduce nitrogen levels in the supply well such that the 10 mg/L MCL is achieved. Nitrogen concentrations in the Browns Hills Road wellfield have long been elevated above 10 mg/L due to the surrounding agricultural area. Implementation of I/A OWTs throughout the wellfield contributing area (e.g. Priority Rank 1 for groundwater) is projected to reduce nitrogen levels to significantly less than the 10 mg/L MCL.

9.5 Data Collection and Monitoring

SCDHS maintains a robust surface water monitoring program. Nevertheless, data gaps were identified when developing the subwatershed-specific characterizations. Additional data collection would help to improve confidence in subwatershed-specific nitrogen load reduction targets for the poorly-characterized subwatersheds identified in **Table 9-2** (please see tables at the end of this section). To the extent that resources permit, addition of these subwatersheds to monthly sampling events would provide additional confidence in the SWP projections.

In addition:

- The existing detection limit for phosphorus (PO_4) reported by SCDHS's Public and Environmental Health Laboratory is 0.005 mg/L. It would be beneficial to reduce the detection limit to 0.001 mg/L, the half-saturation constant for algal growth, to enable evaluation of phosphorus limitations and algal growth and productivity. Implementation of a reduced detection limit for samples collected from fresh or mixed water bodies would be most useful.

- Deployment of sensors measuring dissolved oxygen continuously would provide better characterization of diurnal variations and identification of low oxygen conditions that occur during the evening hours as a result of algal respiration.
- Macroalgae overgrowth is generally not well characterized or documented in Suffolk County, particularly in its marine waters.

9.5.1 Water Body Specific Evaluations

Data was not available to completely characterize some of the water bodies included in this SWP; this includes most of the fresh and coastal ponds. Recommendations for further evaluation of specific water bodies are summarized in **Table 9-3**.

Table 9-3 Water Bodies Requiring Further Evaluation

Water Body ID or Location	Concern and Rationale
Cold Spring Harbor	Water body is poorly characterized. In addition, southern Cold Spring Harbor is hydrodynamically isolated from the rest of the harbor. Further disaggregation and study of the southern portion is warranted and should be reanalyzed as a separate study area during a future SWP Addendum.
Mecox Bay	Insufficient water quality data to properly characterize water body. Recommend collecting additional data and reevaluate as part of a future SWP Addendum.
Three Mile Harbor	Data collected by SCDHS as part of the Peconic Estuary Program indicate good water quality in the main body of the harbor. However, recent data collected by Stony Brook University School of Marine and Atmospheric Science indicate poor water quality, including the presence of HABs and hypoxia in a hydrodynamically isolated section at the head of the harbor. The head of the harbor should be reanalyzed as a separate study area during a future SWP Addendum.
Freshwater Lakes and Streams, including Coastal Ponds	Generally all have insufficient water quality data to properly characterize the water bodies resulting in the inability to use the reference water body method for establishing load reduction goals in the SWP. Recommend routine monitoring of all water bodies (including water bodies with anticipated good water quality) so that refinement of load reduction goals can be complete in a future SWP Addendum.
Countywide Shallow Estuaries/Embayments	The bathymetry of shallow estuaries and embayments was generally poorly characterized. Recommend collecting additional bathymetry data from all tidal estuaries and reevaluating load reduction goals in a future SWP Addendum.

Water Body ID or Location	Concern and Rationale
Fisher's Island	Water quality for all water bodies on Fisher's Island are poorly characterized. In addition, there is no groundwater model or hydrodynamic model available to evaluate relative priority rank and load reduction goals. Recommend collecting routine water quality data and consider the development of a local groundwater model and hydrodynamic model. Evaluate Fisher Island water bodies as part of a future SWP Addendum.

9.5.2 Fishers Island

Fishers Island is an island in the Town of Southold located approximately 11 miles off of the eastern end of Long Island. The island is about nine miles long and one mile wide and is accessible from New London, CT by plane and regular ferry service. As of the 2010 census, there were 236 people living year-round on 4.1 square miles of land; however, the population rises to about 2,000 during peak summer weekends. The water quality of surface water bodies on Fishers Island is generally acceptable for recreational use, with the exception of occasional shellfish closures due to pathogens. The principal concern regarding wastewater management on the island is for the protection of its public drinking water supply. Drinking water is provided through two upper glacial public supply wells as well three freshwater lakes during periods of dry weather. In addition, Beach/Island Ponds warrant evaluation as these water bodies are used as an Oyster Hatchery and Farm.

Insufficient water quality and other data exists for a full evaluation of Fishers Islands water resources using the methodologies described in this SWP. Specifically, additional information and data would be required to develop an island-wide groundwater model that would be capable of delineating individual subwatersheds and establishing predicted nitrogen loads and concentrations. In addition, there is insufficient surface water quality data to make statistically significant conclusions regarding existing water quality, particularly with respect to nitrogen and excessive nutrient related impacts. Nonetheless, the following subsections present a summary of readily available existing water quality data, provide an overview of the existing wastewater and public water supply framework on the island, and provide initial recommendations for further study which could be completed as part of a SWP addendum, full term LINAP element, or other locally driven plan.

9.5.2.1 Existing Water Quality

Surface water samples were collected by SCDHS staff on 4/17/17 from the water bodies listed in **Table 9-4**. Parameters analyzed included total and fecal coliform bacteria, ammonia, nitrate+nitrite, total and dissolved nitrogen, total and dissolved phosphorous, ortho-phosphate, and chlorophyll-a. Physical measurements were also taken and included temperature, dissolved oxygen, salinity/conductivity, and pH. All samples were collected from the shoreline, at knee depth, in accordance with the requirements set forth in the SCDHS Water Quality Monitoring Standard Operating Procedures (SOP) and the Peconic Estuary Program Surface Water Quality Monitoring Quality Assurance Project Plan (QAPP). All samples were analyzed by the SCDHS Public & Environmental Health Laboratory (PEHL) which maintains certification from the NYS Environmental Laboratory Approval Program (ELAP).

Table 9-4 Summary of Water Quality Data for Surface Water Samples on Fishers Island

Bay Station	Sampling Dat	Time	Temeratu	Dissolvec Oxygen	Salinity	Conductivi	pH	Total Colifo	Fecal Colifo	Ammoni	Nitrate + Nitrite	Total Nitrog	Dissolvec Nitrogen	Total Phosphoro	Dissolvec Phosphoro	Ortho-Phosphat	Chlorophyll Total
			©	(mg/L)	PSU	(uS/cm)		(MPN/100 ml)		(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	ug/L
Barlow Pond	4/17/2017	10:06	16.7	10.4	0.04	80	8.5	< 20	< 20	< 0.02	0.0373	0.41	0.394	< 0.05	< 0.05	< 0.01	2.71
Beach Island Farm	4/17/2017	10:28	17.5	7.8	21.5		7.5	< 20	< 20	0.044	< 0.005	0.654	0.573	< 0.05	< 0.05	< 0.01	2.74
Middle Farm Pond	4/17/2017	10:17	15.2	10.7	0.04	62	8.2	20	< 20	< 0.02	0.127	0.572	0.509	< 0.05	< 0.05	< 0.01	6.52
Treasure Pond	4/17/2017	10:49	17.1	9.6	0.05	92	8.2	130	< 20	< 0.02	0.0066	0.639	0.455	< 0.05	< 0.05	< 0.01	1.56

As shown in **Table 9-4**, existing water quality data for the sole marine water body, Beach Island Farm, shows acceptable levels of dissolved oxygen above NYSDEC criteria and chlorophyll-*a* below the target threshold of 5.5 μg/L for the protection of eelgrass. The total nitrogen concentration of 0.654 mg/L is elevated above the regional background concentration of ~0.21 mg/L for the open waters surrounding Suffolk County. As discussed throughout the SWP, the impact of nitrogen on marine ecology has significant dependence on the overall residence time or flushing time of the water body. Unfortunately, without an estimate of the surface water residence time (flushing time) for Beach Island Farm, it is difficult to assess whether the concentration of 0.654 mg/L is cause for concern. However, based upon what appears to be a relatively poor hydraulic connection between Beach Island Farm and Block Island Sound, it is possible that this water body is sensitive to excess nutrients. Therefore, it is recommended that additional monitoring be completed to capture the seasonal variation of all water quality parameters. In addition, it is recommended that the residence time and predicted nitrogen loads be estimated so that a full assessment of the water body can be completed in accordance with the methodologies provided in this SWP.

Although the dataset does not represent a full suite of traditional public water supply analytes, water quality from the three secondary public water supply ponds (Barlow, Middle Farm, and Treasure) indicate acceptable water quality for the use as a public supply water. The data is consistent with historical data in the Suffolk County Office of Water Resources public supply database and indicate low levels of nutrients and salinity and compliance with pathogen indicator criteria.

9.5.2.2 Existing Public Water Supply

Public water is provided to the island by the Fishers Island Water Works Corporation. The source of water for Fishers Island is groundwater pumped from two wells located in the Middle Farms area that are drilled into the Upper Glacial aquifer. A backup water supply to the wells is surface water from Barlow Pond and Middle Farms and Treasure Ponds utilized during dry weather periods.

The Fishers Island Water Works Corporation provides treatment at all wells to improve the quality of the water pumped prior to distribution to residents. The pH of the pumped water is adjusted upward by the addition of soda ash to reduce corrosive action between the water and water mains and in-house plumbing. The water is also chlorinated with sodium hypochlorite to protect against the growth of bacteria in the distribution system. A polyphosphate AquaMag is added to the water for iron sequestering. Water supplied with surface water from Barlow, Middle Farms and Treasure Ponds receives additional treatment that includes chemical addition of aluminum sulfate for coagulation, sedimentation and sand filtering for the removal of solids.

9.5.2.3 Wastewater Management

Wastewater is managed on the island through two community collection and disposal systems and through several individual OSDS (for parcels that are not connected to a community systems). The primary community system consists of a collection system, pump station, septic tank(s) for primary treatment, and leaching galleys for grey water disposal. The primary system serves approximately 66 individual tax lots of mixed use with single family residential representing the majority of wastewater collected by the community system.

Figure 9-1 Fishers Island Wastewater System

The cinema on Whistler Avenue is served by its own sewage disposal system located adjacent to the building. This system consists of a 1,500-gallon septic tank and two galley trenches. There are three cottages on Reservoir Road that are served by a separate community sewage disposal system consisting of a 2,000-gallon septic tank and four leaching pools. The remaining parcels on the island include single family residential parcels and golf courses which are all served by individual OSDS.

Fishers Island represents a unique opportunity for wastewater management because of the existing common collection system that collects wastewater from areas with the most intense land use. In many sewering projects, the cost for installation of the collection system represents the most significant cost of the project.

9.5.2.4 Preliminary Recommendations

Preliminary recommendations for Fishers Island include:

- Installation of monitoring wells for the collection of water level and water quality data.
- Development of a groundwater model to delineate the groundwater contributing area to all surface water bodies and public supply wells, including individual subwatershed delineations for:
    - West Harbor;
    - Hay Harbor;
    - Barlow Pond;
    - Beach and Island Pond;
    - Middle Farms Pond; and,
    - Treasure Pond.
- Development of a groundwater solute transport model to predict nitrogen concentrations within the Upper Glacial Aquifer and public supply wells.
- Use of the model to predict nitrogen loads to each of the water bodies referenced in recommendation two above.
- Collection of quarterly routine surface water quality monitoring data from all subwatersheds referenced in recommendation two above.
- Preparation of a SWP addendum or similar document to prioritize and rank the surface water subwatersheds and public water supply wells of Fishers Island.
- Building upon information from the SWP addendum or similar document, preparation of a wastewater feasibility study that evaluates various wastewater management options for the island, including, but not limited to:
    - Upgrade of all community wastewater systems with either I/A OWTS, an Appendix A or Appendix B sewage treatment plant, or alternate treatment system such as constructed wetlands or vegetated recirculating gravel filters.
    - Upgrade of all individual onsite disposal systems with I/A OWTS.
    - Identification of additional areas that might benefit from the use of common collection and clustered treatment using I/A OWTS or other treatment technology.

9.5.3 Other Assessments

The groundwater flow fields used to delineate the subwatersheds incorporated annual average community supply pumping rates based on reported pumping rates supplied by community suppliers. However, irrigation pumpage for golf courses and agricultural areas were largely assumed, based on irrigation requirements found in the literature. Refinement of irrigation pumping data would be beneficial for understanding the hydraulic influence of irrigation wells on adjacent watersheds, particularly in eastern Suffolk County.

9.5.4 Integrated Long-Term Monitoring Plan

A long-term monitoring plan will be developed as part of the Adaptive Management and Long-Term Monitoring Plan. The long-term monitoring plan will incorporate recommendations for additional data collection, as described in Section 9, plus the core elements of existing monitoring programs already established. Existing monitoring programs will include, but not be limited to:

- Routine marine surface water quality monitoring data to track water quality during implementation of the Program. Typical monitoring parameters will include total nitrogen, total phosphorus, chl-a, secchi depth, salinity, and dissolved oxygen. Data may be collected under multiple programs including:
  - Surface water quality data collected as part of the Suffolk County Marine Water Quality Monitoring Program, including data collected from each of the three major estuaries;
  - Surface water quality data, with an approved QAPP, collected from other local initiatives including the PEP, SSER, and LISS;
  - Harmful algal bloom data collected by the NYSDEC (or its consultant) or the Suffolk County Bureau of Marine Resources;
  - Pathogen data collected from the Suffolk County Bathing Beach Program;
- Routine groundwater and fresh surface water quality data collected by the Suffolk County Division of Environmental Quality and/or the USGS. Monitoring parameters will include total nitrogen and water level measurements, but may also include chl-*a*, secchi depth, and dissolved oxygen;
- Public supply well data provided to the Suffolk County Office of Water Resources;
- Private supply well data collected as part of the Suffolk County voluntary private supply well sampling program; and,
- Special projects completed by Suffolk County or other local initiative that may be beneficial to evaluation of the plans objectives (e.g., eelgrass bed surveys, benthic flux studies, etc.).

Additional details regarding the long-term monitoring plan will be included in the Adaptive Management and Long-Term Monitoring Plan.

Section 9 Tables

Table 9-1 Subwatersheds Where I/A OWTS Implementation Does Not Completely Achieve Nitrogen Load Reduction Targets

Subwatershed	Reference Water Body Overall Water Quality Improvement Goal	Reference Water Body HAB/DO Improvement Goal	Probability-based Chl-*a* Goal (based on high unit N load and 80% Percentile)	Nitrogen Reduction Goal for Protection of Downgradient Water Bodies	Achievable Reduction through On-Site Wastewater Management
Abets Creek	91%	83%	90%	95%	48%
Acabonack Harbor	**70%**	**41%**	**0%**	**0%**	**39%**
Agawam Lake	72%	N/A	86%	N/A	56%
Aspatuck Creek and River	80%	61%	76%	93%	47%
Brightwaters Canal, Nosreka, Mirror, and Cascade Lakes	59%	18%	74%	53%	15%
Brushes Creek	90%	81%	88%	73%	13%
Cold Spring Pond and Tribs	**50%**	**0%**	**0%**	**73%**	**38%**
Connetquot River, Lower, and Tribs	**92%**	**84%**	**91%**	**95%**	**42%**
Connetquot River, Upper, and Tribs	78%	N/A	N/A	95%	49%
Conscience Bay and Tidal Tribs	58%	16%	49%	0%	42%
Corey Creek and Tidal Tribs	64%	28%	56%	0%	42%
Corey Lake and Creek, and Tribs	92%	84%	90%	95%	48%
Crab Meadow Creek	60%	19%	51%	0%	46%
Cutchogue Harbor - East Creek	**62%**	**24%**	**54%**	**0%**	**38%**
Cutchogue Harbor - Mud Creek	69%	38%	63%	0%	37%
Cutchogue Harbor - Wickham Creek	74%	49%	69%	0%	26%
Deep Hole Creek	**90%**	**79%**	**88%**	**73%**	**32%**
Dunton Lake, Upper, and Tribs and Hedges Creek	94%	88%	98%	95%	52%
Flanders Bay, East/Center, and Tribs (North)	**71%**	**43%**	**62%**	**73%**	**17%**
Flanders Bay, East/Center, and Tribs (South)	**71%**	**43%**	**62%**	**73%**	**17%**

Table 9-1 Subwatersheds Where I/A OWTS Implementation Does Not Completely Achieve Nitrogen Load Reduction Targets

Subwatershed	Reference Water Body Overall Water Quality Improvement Goal	Reference Water Body HAB/DO Improvement Goal	Probability-based Chl-*a* Goal (based on high unit N load and 80% Percentile)	Nitrogen Reduction Goal for Protection of Downgradient Water Bodies	Achievable Reduction through On-Site Wastewater Management
Flanders Bay, West/Lower Sawmill Creek	**56%**	**11%**	**46%**	**73%**	**14%**
Forge River and Tidal Tribs	**93%**	**86%**		**69%**	**49%**
Fresh Pond	30%	0%	16%	0%	27%
Georgica Pond	58%	N/A	93%	N/A	34%
Goldsmith Inlet	**79%**	**58%**	**75%**	**0%**	**35%**
Goose Creek	59%	18%	0%	0%	41%
Goose Neck Creek	76%	51%	71%	73%	37%
Grand Canal	86%	71%	83%	95%	50%
Great Cove	**42%**	**0%**	**30%**	**53%**	**7%**
Great Peconic Bay and minor coves	**73%**	**47%**	**66%**	**N/A**	**16%**
Great South Bay, East	**95%**	**91%**	**94%**	**N/A**	**28%**
Great South Bay, Middle	**53%**	**6%**	**66%**	**N/A**	**6%**
Great South Bay, West	**39%**	**0%**	**27%**	**N/A**	**5%**
Green Creek, Upper, and Tribs	94%	88%	93%	95%	52%
Gull Pond	40%	0%	27%	0%	31%
Hallock/Long Beach Bay and Tidal Tribs	**67%**	**34%**	**61%**	**0%**	**6%**
Heady and Taylor Creeks	87%	74%	84%	0%	41%
Hog Creek and Tidal Tribs	78%	56%	74%	0%	45%
Howell's Creek	87%	74%	85%	95%	48%
Huntington Harbor	**72%**	**44%**	**66%**	**0%**	**41%**
James Creek	90%	80%	88%	73%	48%
Lake Ronkonkoma	**52%**	**N/A**	**N/A**	**N/A**	**44%**
Lawrence Creek, O-co-nee and Lawrence Lakes	51%	3%	65%	53%	14%
Ligonee Brook and Tribs	31%	N/A	N/A	81%	28%
Mattituck Inlet/Creek	**66%**	**32%**	**59%**	**0%**	**34%**

Table 9-1 Subwatersheds Where I/A OWTS Implementation Does Not Completely Achieve Nitrogen Load Reduction Targets

Subwatershed	Reference Water Body Overall Water Quality Improvement Goal	Reference Water Body HAB/DO Improvement Goal	Probability-based Chl-*a* Goal (based on high unit N load and 80% Percentile)	Nitrogen Reduction Goal for Protection of Downgradient Water Bodies	Achievable Reduction through On-Site Wastewater Management
Meetinghouse Creek and Tribs	**57%**	**14%**	**48%**	**73%**	**32%**
Menantic Creek	72%	45%	67%	0%	42%
Middle Pond	52%	3%	42%	0%	48%
Mill Creek and Tidal Tribs	**52%**	**4%**	**0%**	**0%**	**42%**
Mill Pond	90%	80%	88%	0%	51%
Moriches Bay East	**79%**	**57%**	**74%**	**N/A**	**39%**
Moriches Bay West	**37%**	**0%**	**24%**	**N/A**	**8%**
Mud and Senix Creeks	89%	79%	87%	69%	50%
Mud Creek, Robinson Pond, and Tidal Tribs	87%	75%	88%	95%	44%
Narrow Bay	**69%**	**38%**	**63%**	**37%**	**45%**
Neguntatogue Creek	19%	0%	2%	39%	10%
Nicoll Bay	**92%**	**83%**	**90%**	**95%**	**45%**
Nissequogue River Lower/Sunken Meadow Creek	**78%**	**57%**	**74%**	**0%**	**44%**
Nissequogue River Upper, and Tribs	67%	N/A	N/A	78%	44%
Northwest Creek and Tidal Tribs	**45%**	**0%**	**0%**	**0%**	**25%**
Noyack Creek and Tidal Tribs	**73%**	**45%**	**0%**	**0%**	**28%**
Old Fort Pond	56%	12%	47%	0%	47%

Table 9-1 Subwatersheds Where I/A OWTS Implementation Does Not Completely Achieve Nitrogen Load Reduction Targets

Subwatershed	Reference Water Body Overall Water Quality Improvement Goal	Reference Water Body HAB/DO Improvement Goal	Probability-based Chl-*a* Goal (based on high unit N load and 80% Percentile)	Nitrogen Reduction Goal for Protection of Downgradient Water Bodies	Achievable Reduction through On-Site Wastewater Management
Orchard Neck Creek	92%	83%	90%	69%	49%
Pardees, Orowoc Lakes, Creek, and Tidal Tribs	83%	67%	85%	53%	39%
Patchogue Bay	**91%**	**81%**	**89%**	**95%**	**39%**
Patchogue River	93%	86%	98%	95%	49%
Pattersquash Creek	82%	65%	79%	69%	54%
Peconic River, Lower, and Tidal Tribs	**86%**	**71%**	**83%**	**86%**	**32%**
Penataquit Creek	83%	67%	80%	53%	33%
Phillips Creek, Lower, and Tidal Tribs	80%	60%	76%	71%	42%
Quantuck Bay	**93%**	**85%**	**91%**	**93%**	**39%**
Quantuck Canal/Moneybogue Bay	**91%**	**82%**	**89%**	**93%**	**47%**
Quantuck Creek and Old Ice Pond	80%	61%	76%	93%	37%
Quogue Canal	93%	86%	91%	37%	40%
Reeves Bay and Tidal Tribs	**67%**	**35%**	**61%**	**73%**	**45%**
Richmond Creek and Tidal Tribs	66%	31%	59%	0%	19%
Sag Harbor Cove and Tribs	**81%**	**62%**	**0%**	**0%**	**44%**
Sampawams Creek	80%	59%	84%	39%	40%
Scallop Pond	11%	0%	0%	73%	10%

CDM Smith

Table 9-1 Subwatersheds Where I/A OWTS Implementation Does Not Completely Achieve Nitrogen Load Reduction Targets

Subwatershed	Reference Water Body Overall Water Quality Improvement Goal	Reference Water Body HAB/DO Improvement Goal	Probability-based Chl-*a* Goal (based on high unit N load and 80% Percentile)	Nitrogen Reduction Goal for Protection of Downgradient Water Bodies	Achievable Reduction through On-Site Wastewater Management
Seatuck Cove and Tidal Tribs	**86%**	**71%**	**83%**	**37%**	**36%**
Setauket Harbor	**61%**	**22%**	**53%**	**0%**	**46%**
Sheepen Creek	54%	7%	44%	69%	54%
Shinnecock Bay - Bennet Cove (Cormorant Cove)	**50%**	**0%**	**0%**	**0%**	**47%**
Shinnecock Bay West	**71%**	**42%**	**65%**	**3%**	**38%**
SI Sound Trib/Moores Drain, Lower, Tribs	63%	26%	87%	0%	16%
Speonk River	88%	76%	85%	79%	44%
Stillman Creek	97%	94%	96%	95%	51%
Stirling Creek and Basin	43%	0%	0%	0%	40%
Stony Brook Harbor and West Meadow Creek	**60%**	**19%**	**52%**	**0%**	**43%**
Swan River, Swan Lake, and Tidal Tribs	96%	92%	96%	73%	50%
Terrell River	72%	44%	83%	37%	37%
Terry's Creek and Tribs	**91%**	**82%**	**89%**	**73%**	**27%**
Tiana Bay and Tidal Tribs	68%	36%	62%	3%	46%
Town/Jockey Creek	**63%**	**26%**	**55%**	**0%**	**49%**
Tuthills Creek	94%	88%	96%	95%	48%
Wading River	88%	76%	86%	0%	38%

Table 9-1 Subwatersheds Where I/A OWTS Implementation Does Not Completely Achieve Nitrogen Load Reduction Targets

Subwatershed	Reference Water Body Overall Water Quality Improvement Goal	Reference Water Body HAB/DO Improvement Goal	Probability-based Chl-*a* Goal (based on high unit N load and 80% Percentile)	Nitrogen Reduction Goal for Protection of Downgradient Water Bodies	Achievable Reduction through On-Site Wastewater Management
Weesuck Creek and Tidal tribs	72%	44%	66%	71%	36%
West Creek and Tidal Tribs	46%	0%	35%	73%	27%
West Neck Bay and Creek	**68%**	**37%**	**62%**	**0%**	**35%**
Wooley Pond	**42%**	**0%**	**0%**	**0%**	**40%**

Table 9-2 Poorly Characterized Water Bodies

Subwatershed	SWP PWL Number	Final Rank
Abets Creek	1701-0327-AC	1
Agawam Lake	1701-0117	1
Amityville Creek	1701-0087+0372	1
Aspatuck Creek and River	1701-0303-AC	1
Awixa Creek	1701-0093+0338	1
Beaverdam Creek	1701-0324+0104	1
Beaverdam Pond	1701-0307+0306	1
Belmont Lake	1701-0021+0089	1
Big Reed Pond	1701-0281	2
Big/Little Fresh Ponds	1701-0125	3
Brightwaters Canal	1701-0338-BC+0342	1
Brown Creek	1701-0097+0333	1
Brushes Creek	1701-0247-BC+0249	1
Carmans River Upper, and Tribs	1701-0102-rev+0322+0323	1
Cedar Beach Creek and Tidal Tribs	1701-0243	3
Champlin Creek	1701-0019+0338+0340	1
Cold Spring Harbor, and Tidal Tribs	1702-0018+0156	3
Connetquot River, Upper, and Tribs	1701-0095+0339	1
Conscience Bay and Tidal Tribs	1702-0091	3
Corey Creek and Tidal Tribs	1701-0244	3
Corey Lake and Creek, and Tribs	1701-0329+0327-CL	1
Crab Meadow Creek	1702-0232-CMC+0234	2
Cutchogue Harbor - Mud Creek	1701-0045-MC	3
Cutchogue Harbor - Wickham Creek	1701-0045-WC	3
Dam Pond	1701-0228	3
Deep Pond	1701-0270	4
Dering Harbor	1701-0050+	4
Dickerson Creek	1701-0242-DC	4
Dunton Lake, Upper, and Tribs	1701-0330-HC+0327	1
Far Pond	1701-0295-FP	4
Fish Cove	1701-0037-FC	4
Flax Pond	1702-0240	3
Fort Pond	1701-0122	2
Fort Pond Bay	1701-0370	4
Fresh Pond	1701-0279	4
Fresh Pond Creek and Tribs	1702-0244	3
Georgica Pond	1701-0145	1
Goose Creek	1701-0236	3

Table 9-2 Poorly Characterized Water Bodies

Subwatershed	SWP PWL Number	Final Rank
Goose Neck Creek	1701-0272-GNC	2
Grand Canal	1701-0337-GC	1
Green Creek, Upper, and Tribs	1701-0096+0333	3
Gull Pond	1701-0231	3
Halsey Neck Pond	1701-0355	1
Heady and Taylor Creeks and Tribs	1701-0294	1
Hog Creek and Tidal Tribs	1701-0277	3
Hook Pond	1701-0131	2
Howell's Creek	1701-0327-HC	1
James Creek	1701-0247-JC+0249	1
Kellis Pond	1701-0290	1
Lake Panamoka (Long Pond)	1701-0134	4
Laurel Pond	1701-0128	2
Lawrence Creek/Lakes, O-co-nee	1701-0338-LC	1
Ligonee Brook and Tribs	1701-0352+0353	2
Little Long, and Shorts Pond	1701-0291	3
Marion Lake	1701-0229	3
Mattituck (Marratooka) Pond	1701-0129	1
Mecox Bay and Tribs	1701-0034+0289+0292	1
Menantic Creek	1701-0242-MC	2
Middle Pond	1701-0295-MP	3
Mill Pond	1702-0261	1
Mill Pond and Sevens Ponds	1701-0113+0289	1
Mud and Senix Creeks	1701-0312-MSC	2
Mud Creek, Robinson Pond, and Tribs	1701-0101+0331+0327	1
Napeague Bay	1701-0369	4
Neguntatogue Creek	1701-0088+0372	1
Nissequogue River Upper	1702- 0235+0013+0238+0237+0236	1
Ogden Pond	1701-0302	1
Old Fort Pond	1701-0295-OFP	3
Old Town Pond	1701-0118	1
Orchard Neck Creek	1701-0312-ONC	2
Oyster Pond/Lake Munchogue	1701-0169	4
Pardees, Orowoc Lakes, Creek, & Tribs	1701-0094+0341+0338	1
Patchogue River	1701-0099+0018+0055+0327	1
Pattersquash Creek	1701-0319-PC	2
Peconic River Middle, and Tribs	1701-0261+0262+0269	1
Peconic River Upper, and Tribs	1701-0108+0265+0266+0269	1
Penataquit Creek	1701-0092+0338	1
Penny Pond and Creeks	1701-0298-rev+0033	2

Table 9-2 Poorly Characterized Water Bodies

Subwatershed	SWP PWL Number	Final Rank
Phillips Creek, Lower, and Tidal Tribs	1701-0299	1
Pipes Cove	1701-0366	3
Quantuck Creek and Old Ice Pond	1701-0303-QC+0304	1
Quogue Canal	1701-0301	1
1 Creek Pond and Tidal Tribs	1701-0250	1
Richmond Creek and Tidal Tribs	1701-0245	2
Sagaponack Pond	1701-0146+0286	1
Sampawams Creek	1701-0090+0372+0343	1
Sans Souci Lakes	1701-0336+0335	1
Santapogue Creek	1701-0016+0372	1
Scallop Pond	1701-0354	1
Sheepen Creek	1701-0319-SC	2
SI Sound Trib/Moores Drain, Lower, Tribs	1701-0232+0233	3
Speonk River	1701-0306-SR	1
Spring Pond	1701-0230	3
Stillman Creek	1701-0329-SC	1
Stirling Creek and Basin	1701-0049	2
Swan River, Swan Lake, and Tidal Tribs	1701-0100+0332+0329+0327	1
Terrell River	1701-0103+0313+0314	2
Tiana Bay and Tidal Tribs	1701-0112	2
Town/Jockey Creek and Tidal Tribs	1701-0235	3
Tuthill Cove	1701-0309-TC	2
Tuthills Creek	1701-0098+0327+0329+0334	1
Unchachogue/Johns Neck Creeks	1701-0319-UC	2
Wading River	1702-0099+0243	1
Wainscott Pond/Fairfield Pond	1701-0144	1
Weesuck Creek and Tidal Tribs	1701-0111-rev	1
West Creek and Tidal Tribs	1701-0246	1
Wickapogue Pond	1701-0119	1
Wildwood Lake (Great Pond)	1701-0264	4
Willets Creek	1701-0091+0175+0372	1

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Section 11

List of Acronyms

3VS	Triple Value Simulation
ACOE	[United States] Army Corps of Engineers
AEM	Agricultural Environmental Management
AOPs	Advanced Oxidation Processes
ASRF	Assessment Stabilization Reserve Fund
AWWA	American Water Works Association
AX	AdvanTex
BAT	Best Available Technology
BEACH	Beaches Environmental Assessment and Coastal Health [Act]
BESST	Biologically Engineered Single-Sludge Treatment
BMPs	Best Management Practices
BNL	Brookhaven National Laboratory
BOD_5	Biological Oxygen Demand
BPA	Bisphenol A
BRF	Bay Restoration Fund
BST	Bacterial Source Tracking
CASTNET	[USEPA] Clean Air Status and Trends Network
CCE	Cornell Cooperative Extension
CCMP	Comprehensive Conservation and Management Plan
CCWT	[Stony Brook University] Center for Clean Water Technology
CECs	Contaminants of Emerging Concern
CFD	Cumulative Frequency Distributions
CFU [/100ml]	Colony Forming Units

COD	Chemical Oxygen Demand
CPF	Community Preservation Funds
CRAs	Critical Resource Areas
CRNF	Controlled/Slow Release Nitrogen Fertilizer
CT DEP	Connecticut Department of Environmental Protection
DEET	Carbaryl, N,N-Diethyl-meta-toluamide
DEP	Department of Environmental Protection
DEQ	[SCDHS] Department of Environmental Quality
DMR	Discharge Monitoring Report
DNA	Deoxyribonucleic Acid
DO	Dissolved Oxygen
DSP	Diarrhetic Shellfish Poisoning
DTGW	Depth to Groundwater
ECOM	Estuarine, Coastal and Ocean Model
EFC	Environmental Facilities Corporation
EFDC	Environmental Fluid Dynamics Code
EHIMS	Environmental Health Information Management System
EIS	Environmental Impact Statement
ELAP	Environmental Laboratory Approval Program
EPA	Environmental Protection Agency
EPCAL	Enterprise Park at Calverton
EPG	Electronic Program Guide
EQIP	Environmental Quality Incentives Program
ESDC	Empire State Development Corporation
FEMA	Federal Emergency Management Agency
FIMI	Fire Island to Moriches Inlet
FIMP	Fire Island Inlet to Montauk Point

FINS	Fire Island National Seashore
FOG	Fats, Oils, and Grease
FS	Feasibility Study
FVCOM	Finite Volume Community Ocean Model
FY	Fiscal Year
GAC	Granular Activated Carbon
GOSR	Governor's Office of Storm Recovery
GPD	Gallons Per Day
GSB	Great South Bay
GW	Groundwater
GWMZ/GMZ	Groundwater Management Zones
HAAs	Haloacetic acids
HAB	Harmful Algal Bloom
HBCD	Hexabromocyclododecane
I/A OWTS	Innovative and Alternative On-site Wastewater Treatment Systems
IDA	Industrial Development Agency
IT	Information Technology
LICAP	Long Island Commission on Aquifer Protection
LiDAR	Light Detection and Ranging
LIFB	Long Island Farm Bureau
LINAP	Long Island Nitrogen Action Plan
LIRPC	Long Island Regional Planning Council
LIS	Long Island Sound
LISS	Long Island Sound Study
MASSTC	Massachusetts Alternative Septic System Test Center
MBR	Membrane Bioreactor
MCL	Maximum Contaminant Level

MDL	Method Detection Limit
MGD	Million Gallon Per Day
MLSLI	Multiple Listing Service of Long Island
MPN [/100ml]	Most Probable Number
MS	Microsoft
MS4	Municipal Separate Storm Sewer System
MTBE	Methyl tert-butyl ether
N	Nitrogen
NADP	National Atmospheric Deposition Program
NCDC	[NOAA] National Climatic Data Center
NCDPW	Nassau County Department of Public Works
NDMA	n-Nitrosodimethylamine
NLM	Nitrogen Load Model
NOAA	National Oceanic and Atmospheric Administration
NOVs	Notice of Violation
NRBs	Nitrogen Reducing Biofilters
NRCS	Natural Resources Conservation Service
NTN	[NADP] National Trends Network
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSDOS	New York State Department of State
O&M	Operation and Maintenance
OE	[SCDHS] Office of Ecology
OWM	[SCDHS] Office of Wastewater Management
OWR	[SCDHS] Office of Water Resources
OSDS	On-Site Disposal Systems
PAC	Powdered Activated Carbon

PCP	Pentachlorophenol
PDR	Purchase of Development Rights
PE	Peconic Estuary
PEP	Peconic Estuary Program
PEHL	Public and Environmental Health Laboratory
PFAS	Per- and Polyfluoroalkyl Substances
PFBS	Perfluorobutanesulfonic acid
PFCs	Perfluorinated Compounds
PFHpA	Perfluoroheptanoic acid
PFHxS	Perfluorohexanesulfonic acid
PFNA	Perfluorononanoic acid
PFOA	Perfluorooctanoic Acid
PFOS	Perfluoro Octane Sulfonate
POE	Point of Entry
POU	Point of Use
PPCPs	Pharmaceuticals and Personal Care Products
PRB	Permeable Reactive Barrier
PSD	Pressurized Shallow Drainfield
PSP	Paralytic Shellfish Poisoning
PSU	Practical Salinity Unit
PWL	Priority Water body List
QAPP	Quality Assurance Project Plan
RCPP	Regional Conservation Partnership Program
RFP	Request For Proposal
RFEI	Request for Expression of Interest
RLR	Revised Local Reference
RME	Responsible Management Entity

RO Reverse Osmosis

RWQC [USEPA] Recreational Water Quality Criteria

SAB Scientific Advisory Board

SAV Submerged Aquatic Vegetation

SBR Sequence Batch Reactor

SBU CCWT Stony Brook University Center for Clean Water Technology

SBU/SUNY SoMAS / SoMAS Stony Brook University School of Atmospheric and Marine Sciences

SC Suffolk County

SCCRI Suffolk County Coastal Resiliency Initiative

SCDEDP Suffolk County Department of Economic Development and Planning

SCDHS Suffolk County Department of Health Services

SCDPW Suffolk County Department of Public Works

SCSWCD Suffolk County Soil & Water Conservation District

SC SWP / SWP Suffolk County Subwatersheds Wastewater Plan

SCSD Suffolk County Sewer District

SCUPE Suffolk County Septic/Cesspool Upgrade Program Enterprise

SCWA Suffolk County Water Authority

SD Sewer District

SEQRA State Environmental Quality Review Act

SES Socio-Ecological Systems

SGPA Special Groundwater Protection Areas

SHIP Septic Haulers Information Portal

SI Shelter Island

SIP Septic Improvement Program

SLOSH Sea, Lake and Overland Storm Surges from Hurricanes

SOP Standard Operating Procedures

SPDES	State Pollutant Discharge Elimination System
SSER	South Shore Estuary Reserve
SSRP	[State] Septic System Replacement Program
STP	Sewage Treatment Plant
STV	Statistical Threshold Value
SW	Surface Water
SWAP	Source Water Assessment Program
SWSD	Southwest Sewer District
TCEP	Tris[2-chloroethyl]phosphate
TCPP	tris (1-chloro-2-propyl) phosphate
TDCPP	Chlorinated Tris
TDR	Transfer of Development Rights
THMs	Trihalomethanes
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TNC	The Nature Conservancy
TOC	Total Organic Carbon
TOD	Transit Oriented Development
TP	Total Phosphorus
TSS	Total Suspended Solids
UCONN	University of Connecticut
UMASS	University of Massachusetts
USDA	United States Department of Agriculture
US EPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	US Geological Survey
UV	Ultraviolet

VOCs	Volatile Organic Compounds
WPAC	Wastewater Plan Advisory Committee
WQIP	Water Quality Improvement Project
WQMD	Water Quality Management District
WQPRP	Water Quality Protection and Restoration Program
WRRF	Water Resource Recovery Facility
WW	Wastewater
WWTP	Wastewater Treatment Plant

Suffolk County

Department of Health Services

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