EXHIBIT 12

PART 1 OF 2

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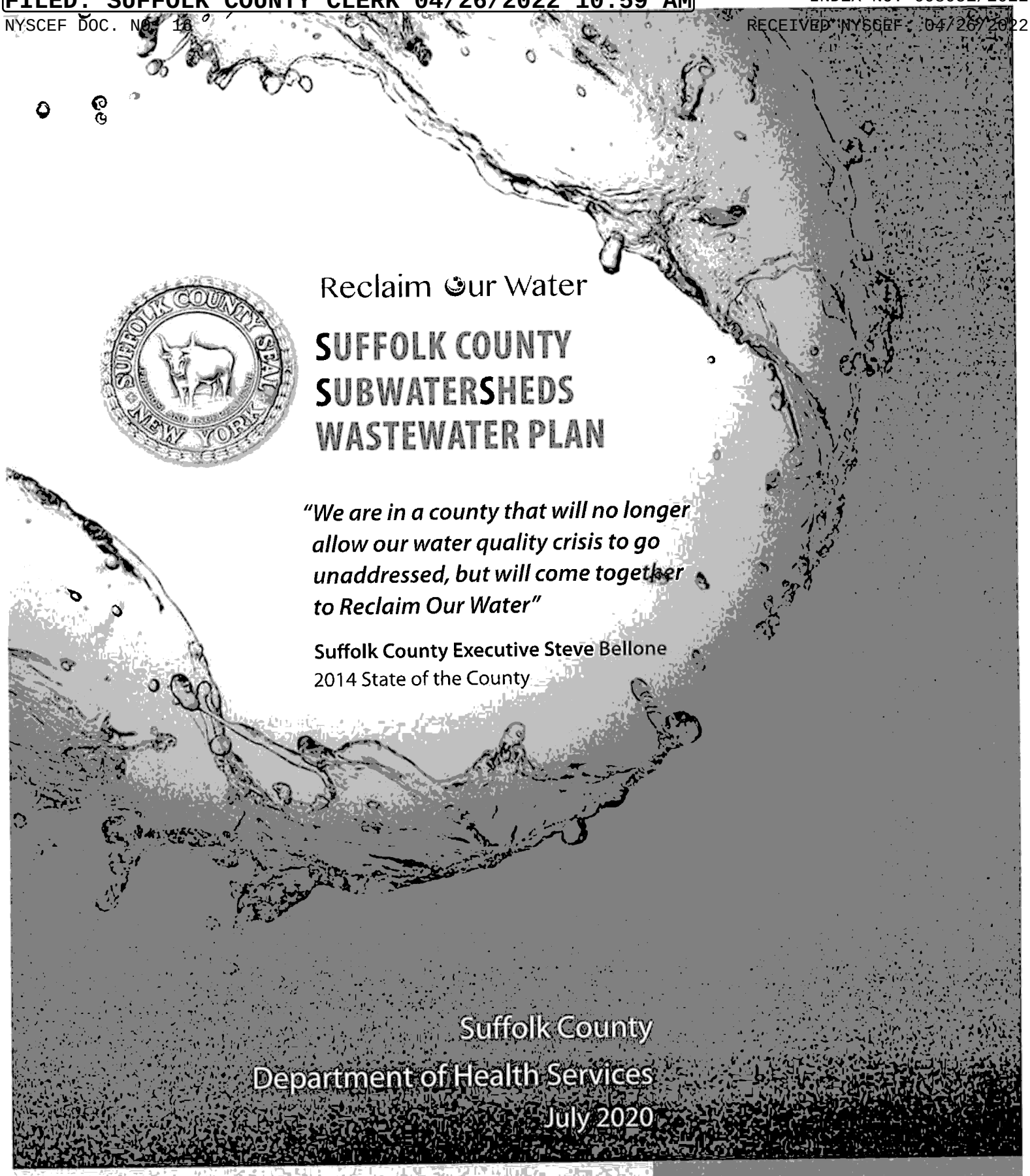

Reclaim Our Water

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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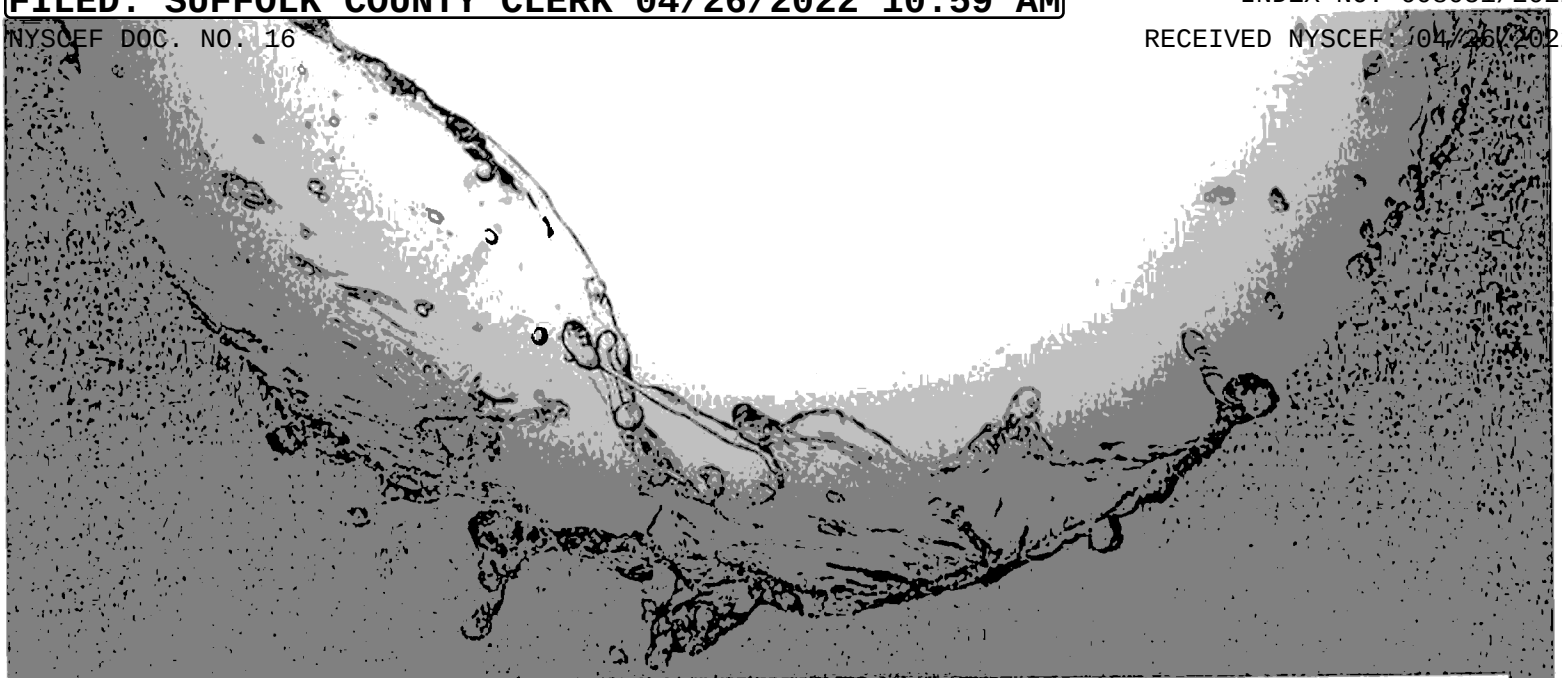

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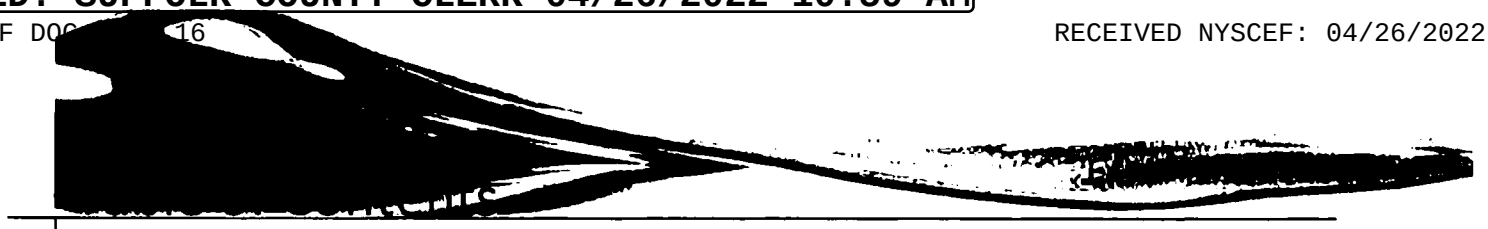

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Introduction

"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.

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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

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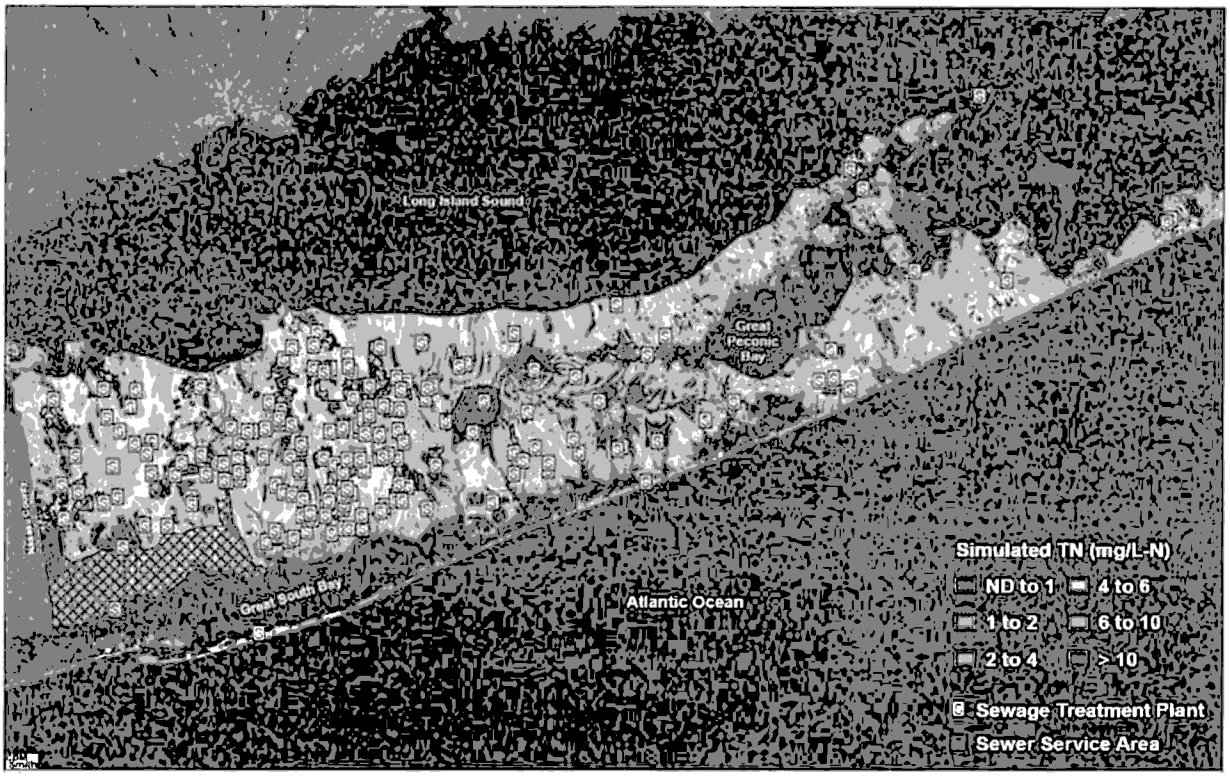

Figure 1-1 Model-Simulated Nitrogen Concentration in the Shallow Upper Glacial Aquifer after 50 Years of Existing Land Use and Wastewater Management

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

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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**).

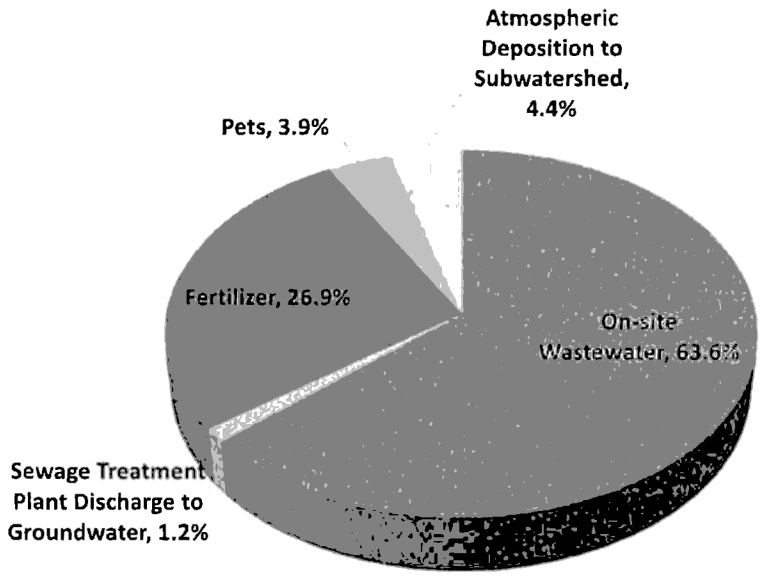

Figure 1-3 Nitrogen Load Components from Groundwater to Suffolk County Subwatersheds

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.

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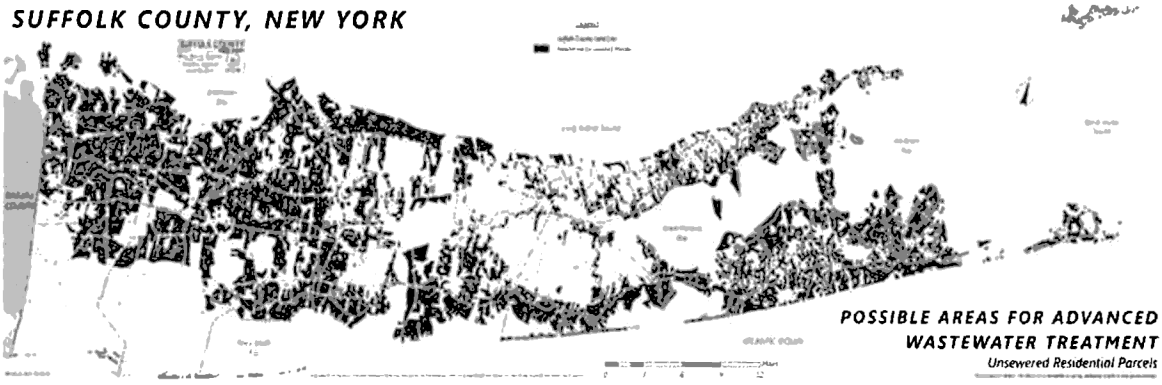


A fundamental basis of all wastewater management recommendations set forth in the Comp Water Plan was the recommendation for development and implementation of a Countywide wastewater management plan to limit the impacts of nitrogen from wastewater and other emerging wastewater constituents (personal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

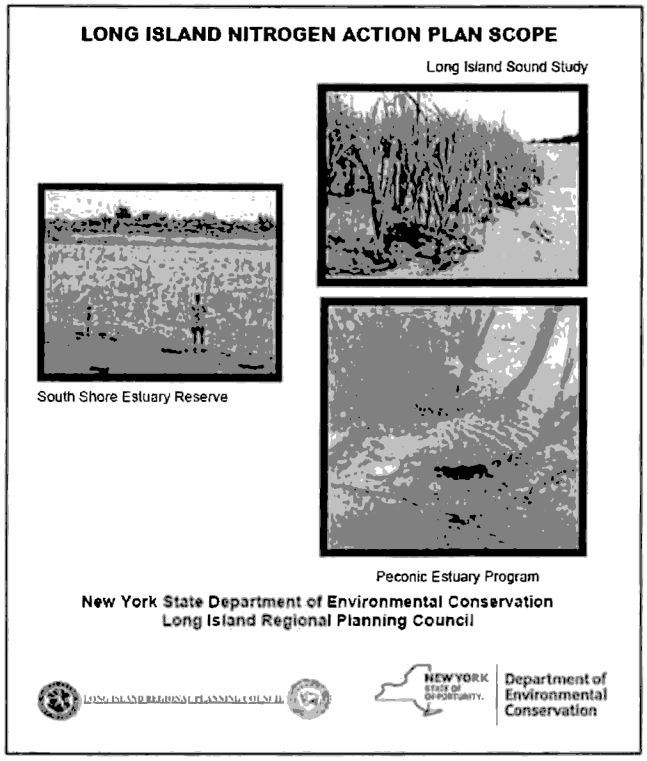
> "Nitrogen loading should be reduced for the protection of current and future drinking water supplies and to restore/maintain ecological functions in streams, lakes, estuaries and marine waters. Arrest and reverse the trend of increasing nitrogen concentrations in ground and surface waters to the greatest 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:

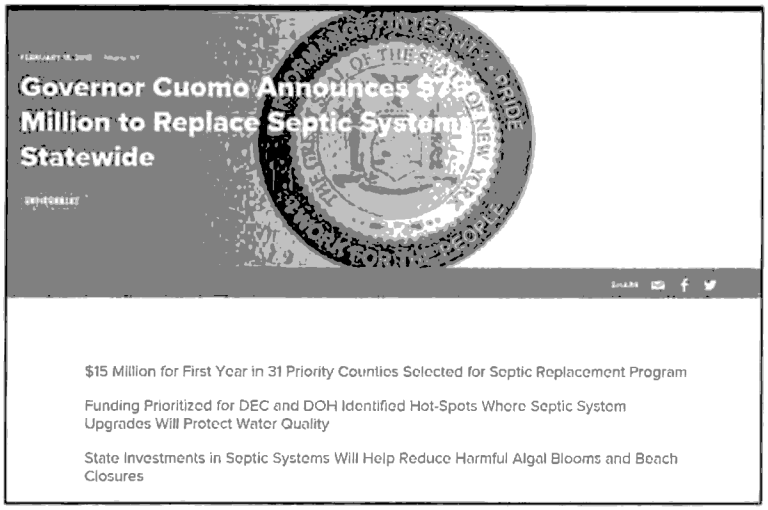


- Identify sources of nitrogen to surface waters and groundwater,
- Establish nitrogen reduction endpoints, and
- Develop an implementation plan to achieve reductions.

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.

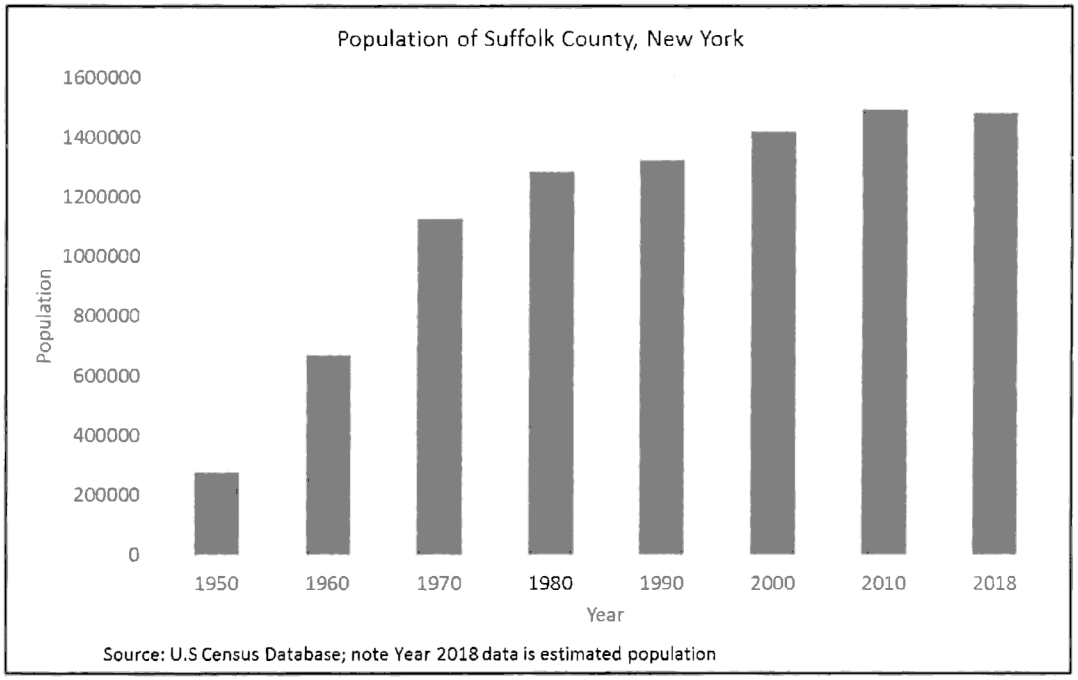


Figure 1-4 Population Growth in Suffolk County

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.

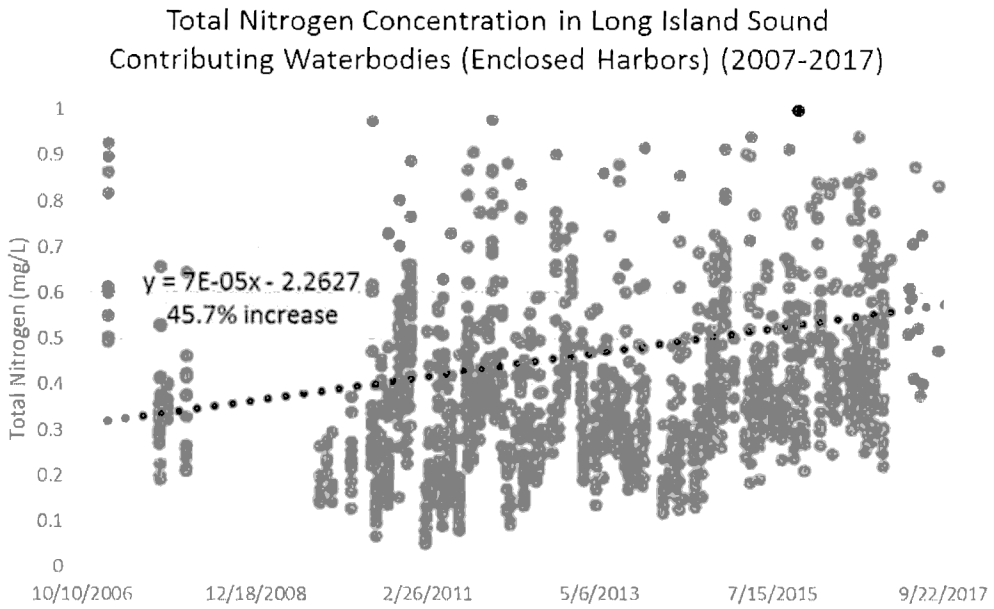
- Great South Bay Middle (Great Cove area, representing partially sewered area) have increased 26.7 percent over the past 10 years.
- Great South Bay West (open water samples representing sewered area) have increased 23.7 percent over the past 10 years.

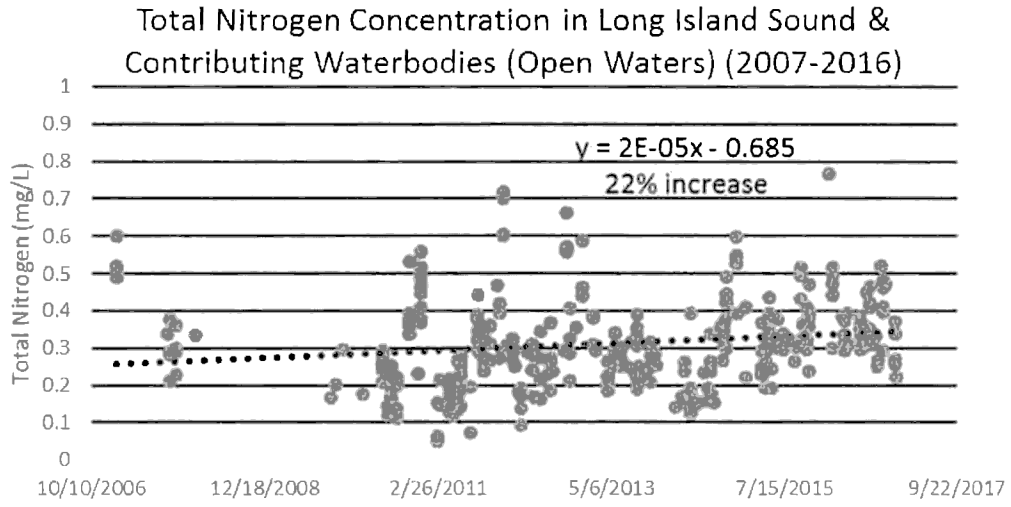
Concentration trend plots for each of the observations described above are provided in **Figures 1-5a** through **1-5h** respectively.

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.

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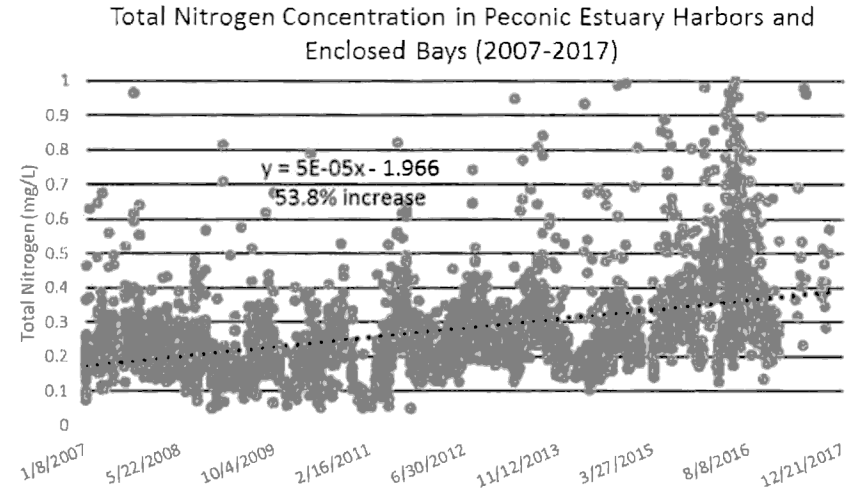
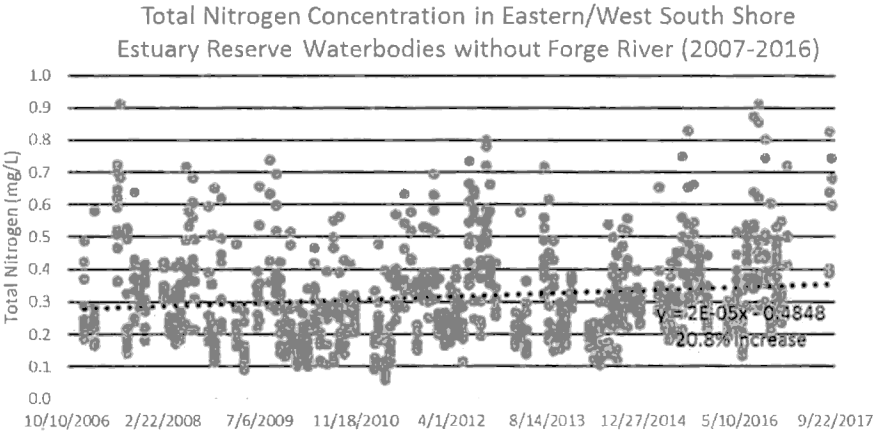
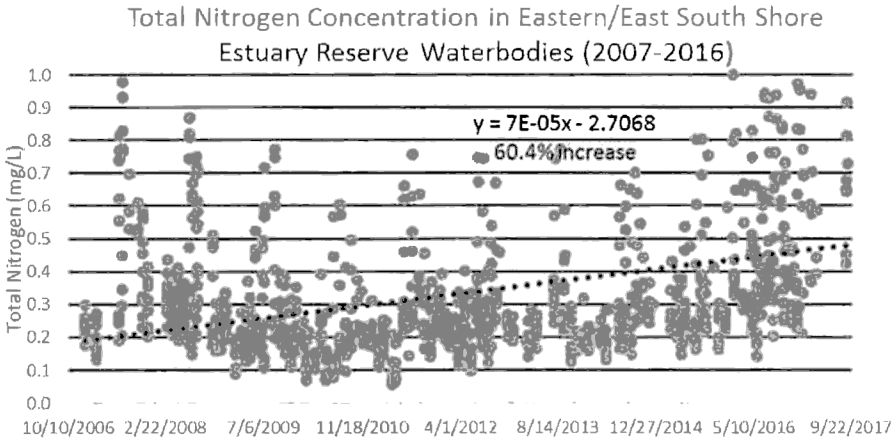
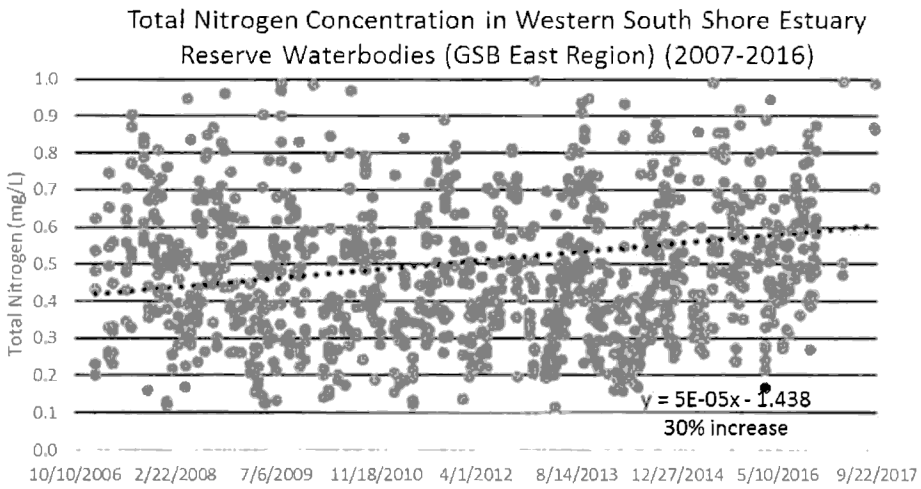


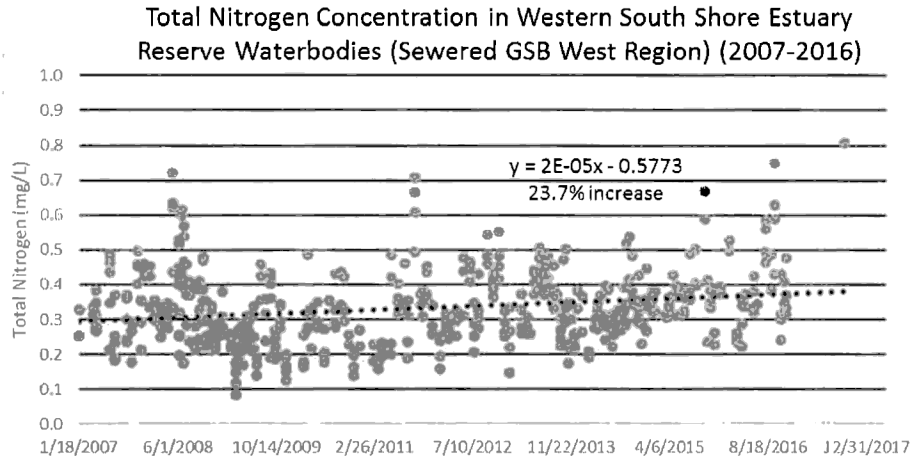


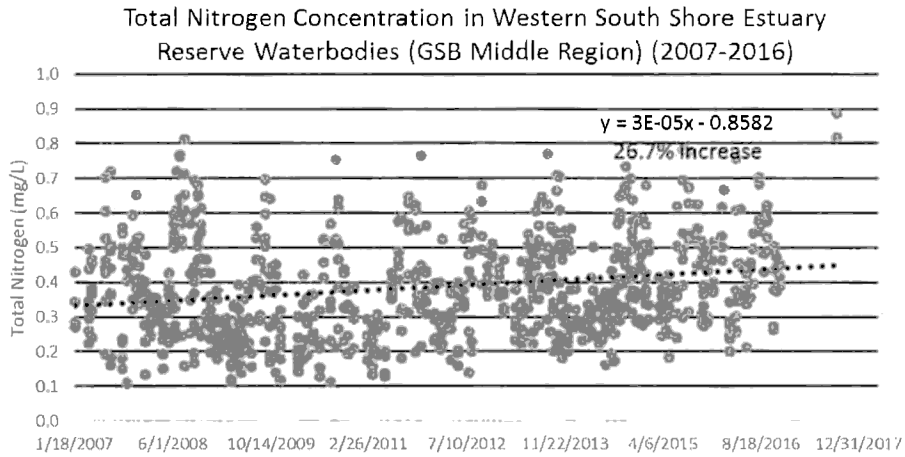


Figures 1-5c, 1-5d and 1-5e Nitrogen Trends in the Peconic Estuary, Eastern South Shore Estuary Reserve and Eastern/West South Shore Estuary Reserve Water Bodies from 2007 through 2016

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.

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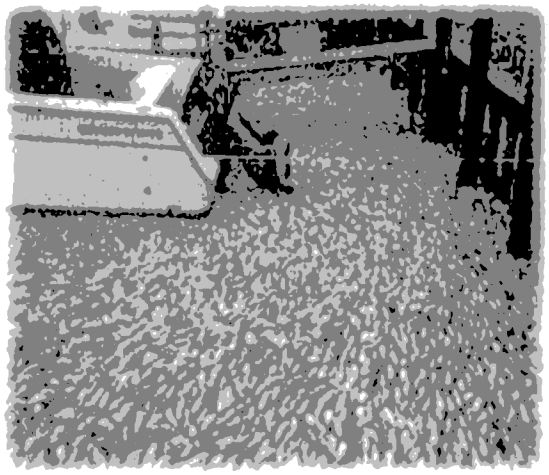
Locally, all three major estuary programs in Suffolk County identify addressing nutrient enrichment related eutrophication of its coastal waters as a top priority and identify nitrogen from wastewater sources as a primary cause of nutrient enrichment. Finally, as discussed within this SWP, local Towns 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.

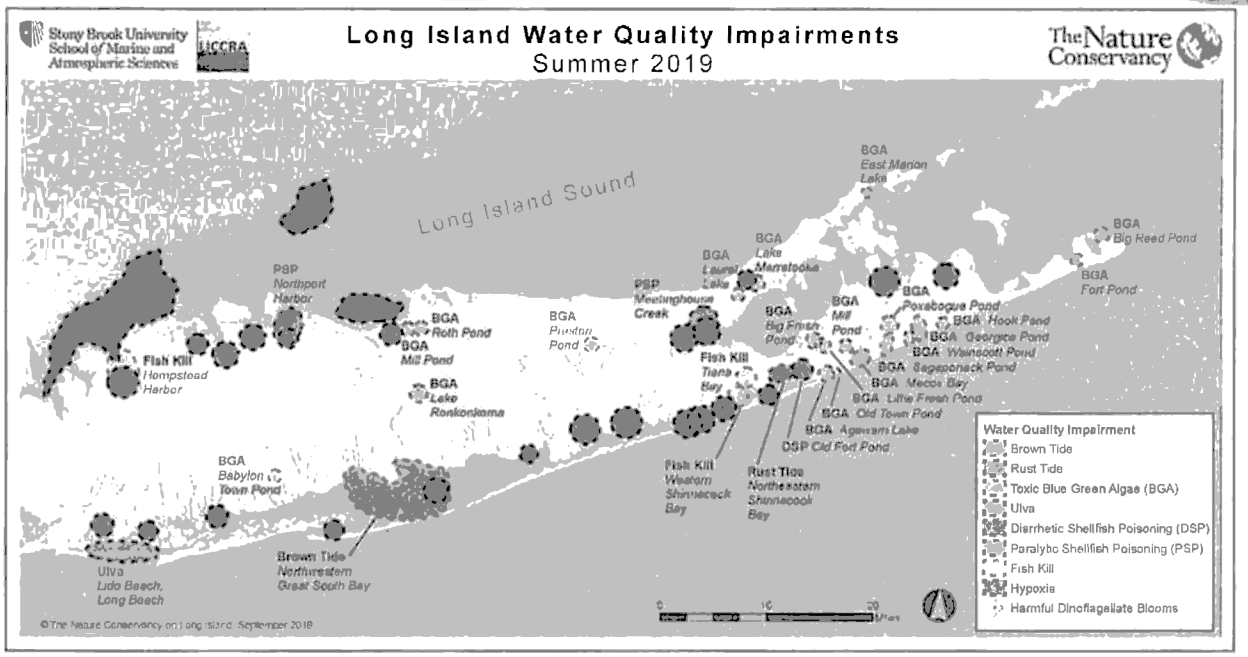


Figure 1-6 Summary of Documented Water Quality Impairments in 2019 Source: SUNY Stony Brook SoMAS

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**)].

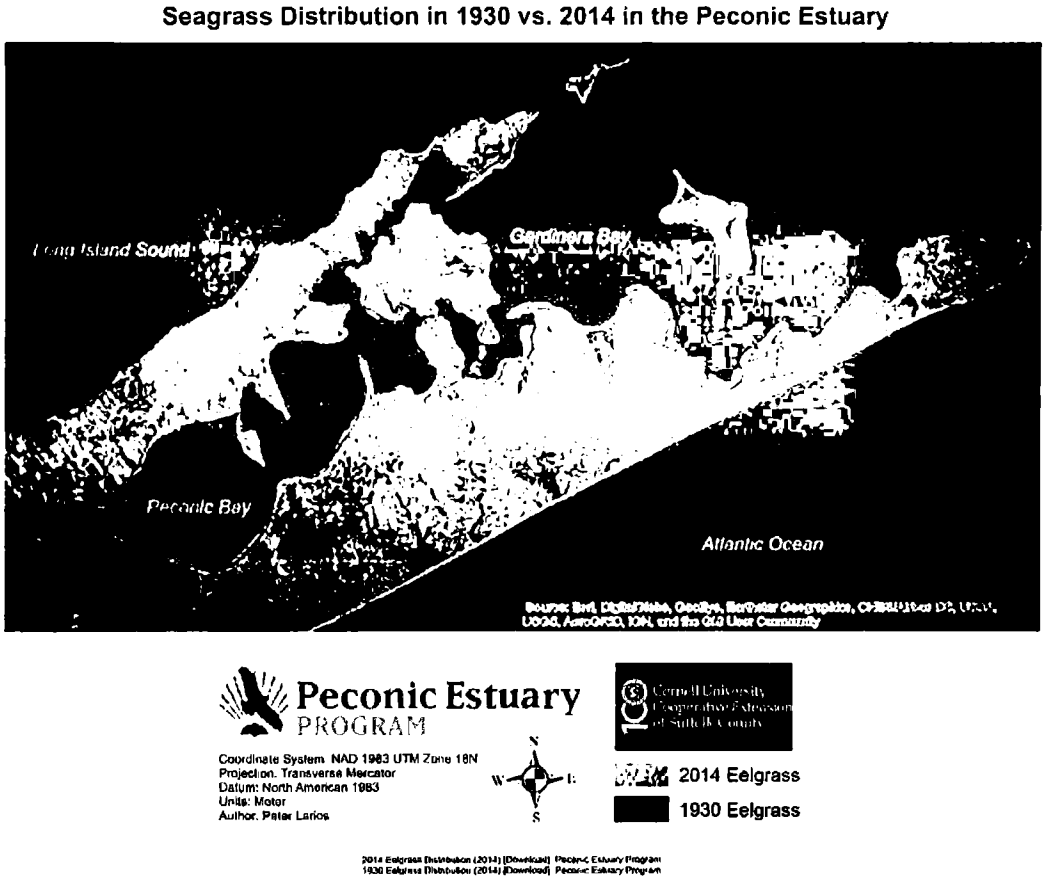


Figure 1-7 Seagrass Distribution in 1930 vs. 2014 in the Peconic Estuary Courtesy of Peter Larios, Peconic Estuary Program and Cornell Cooperative Extension of Suffolk County

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);

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- 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**.

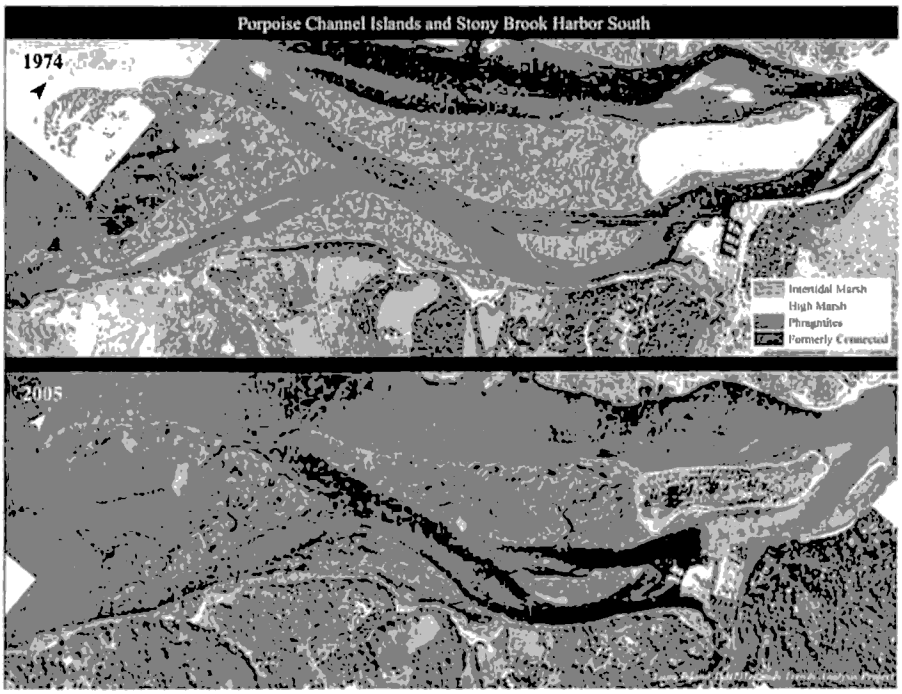

Figure 1-8 Comparison of Wetlands Extent in 1974 and 2005
Source NEIWPCC, 2015

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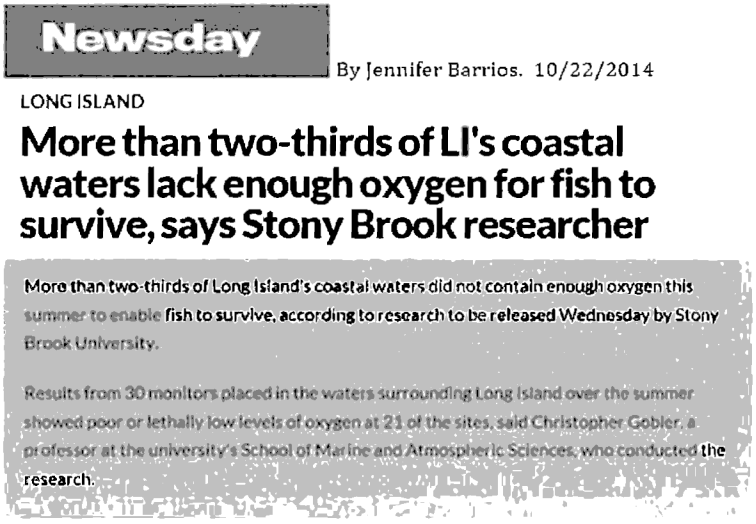
1.1.3.3.2 Dissolved Oxygen

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.

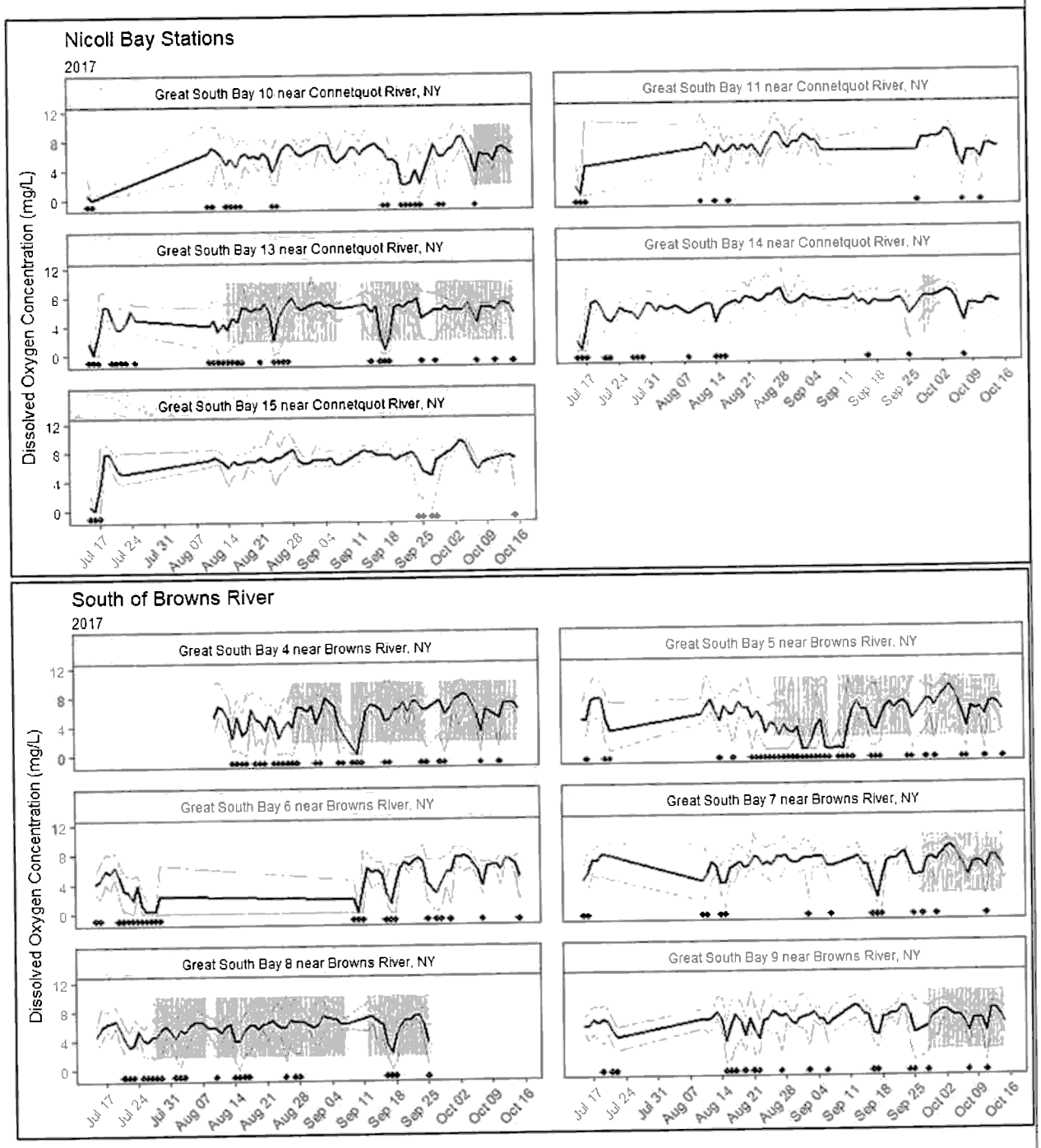
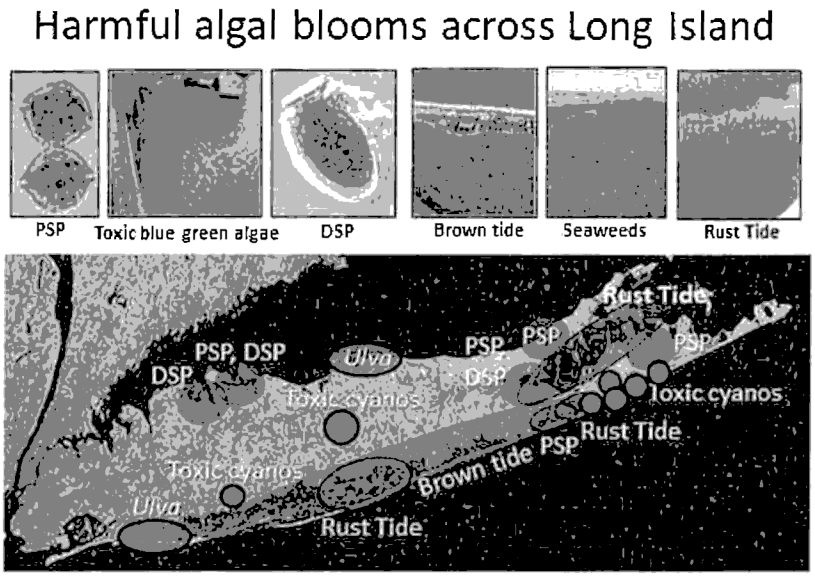


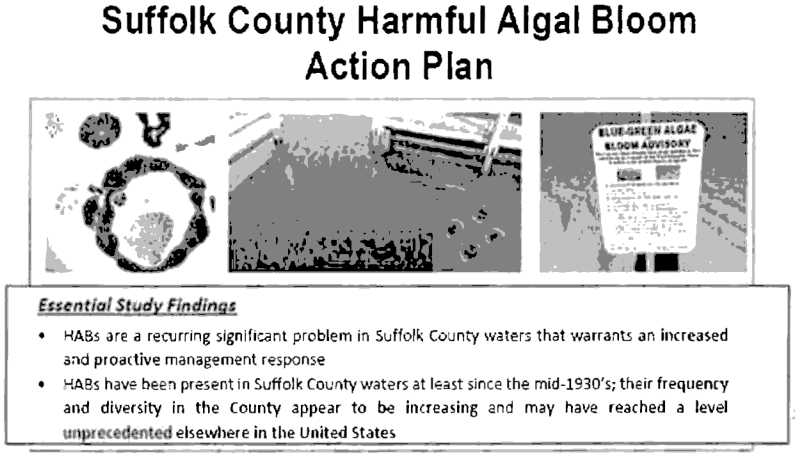
Figure 1-9 Violations of Chronic and Acute Dissolved Oxygen Water Quality Criteria

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**"].

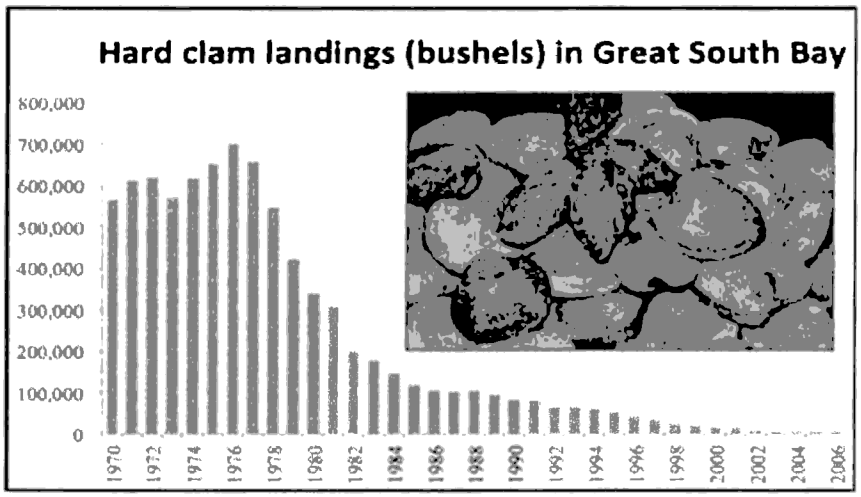
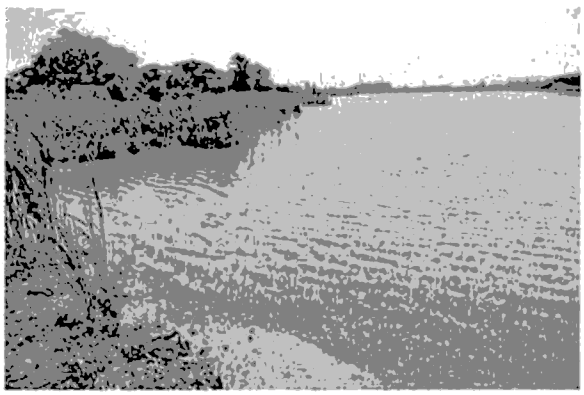


Figure 1-10 Reduction in Hard Clam Landings in Great South Bay

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

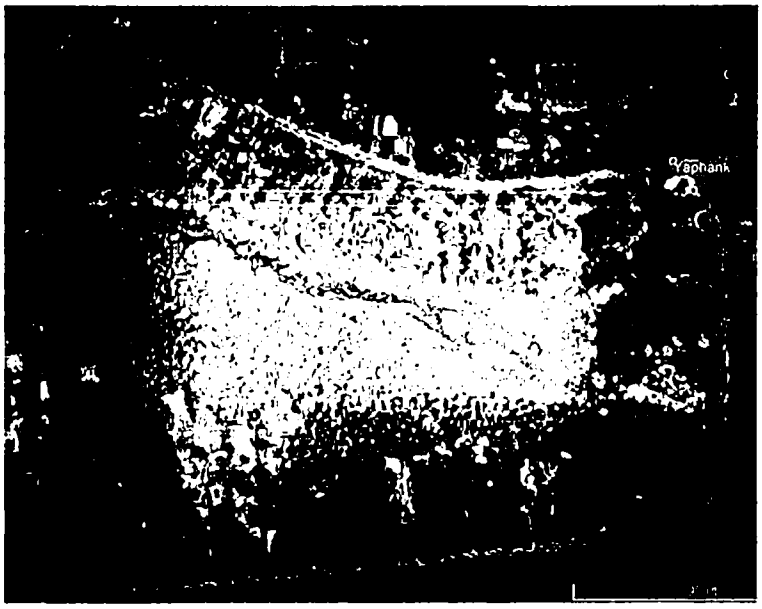
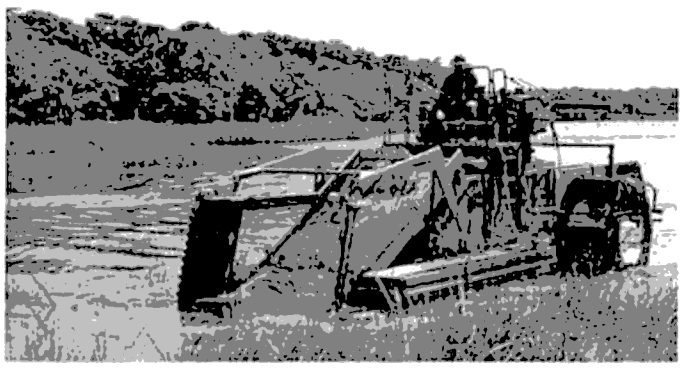


Figure 1-11 Macroalgae Bloom in Lily Lake

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**.

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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.

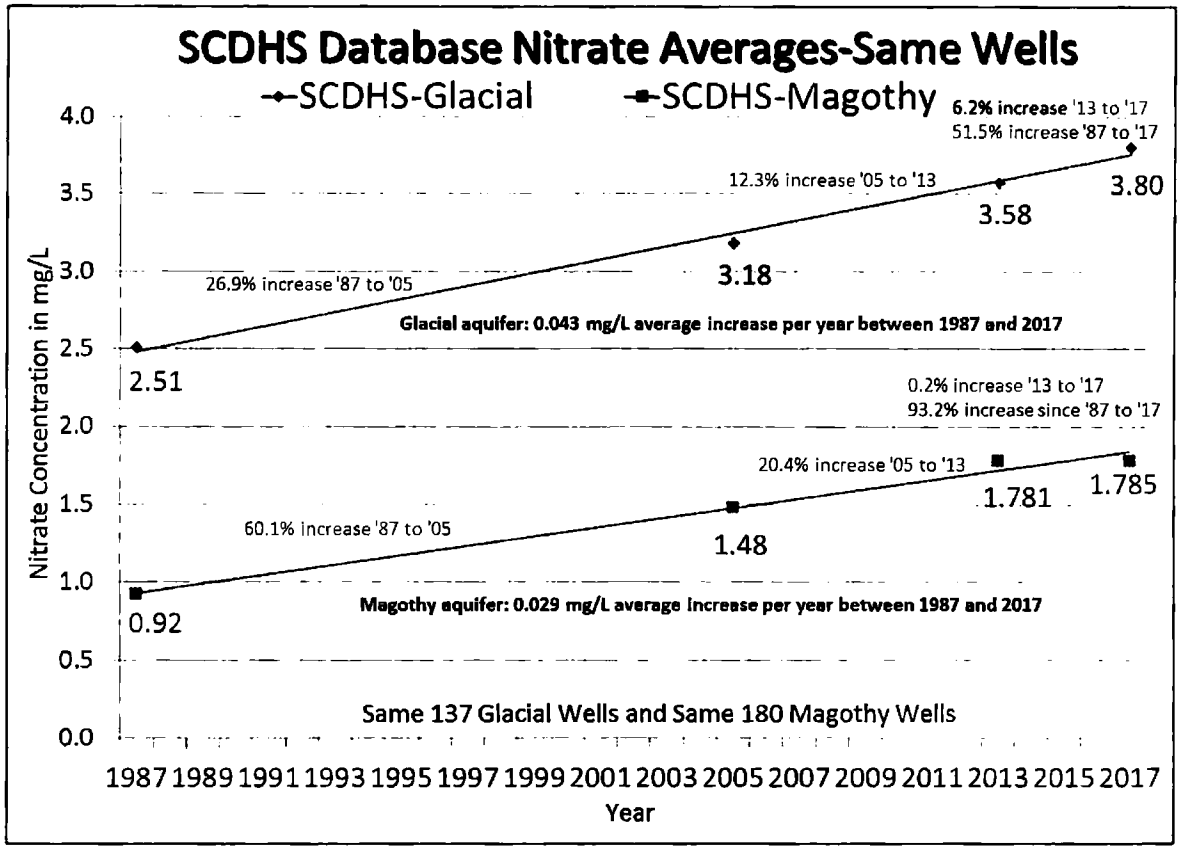

Figure 1-13 Nitrate Concentrations from Community and Non-Community Supply Wells in the Upper Glacial and Magothy Aquifers from 1987 to 2013

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.

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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.**

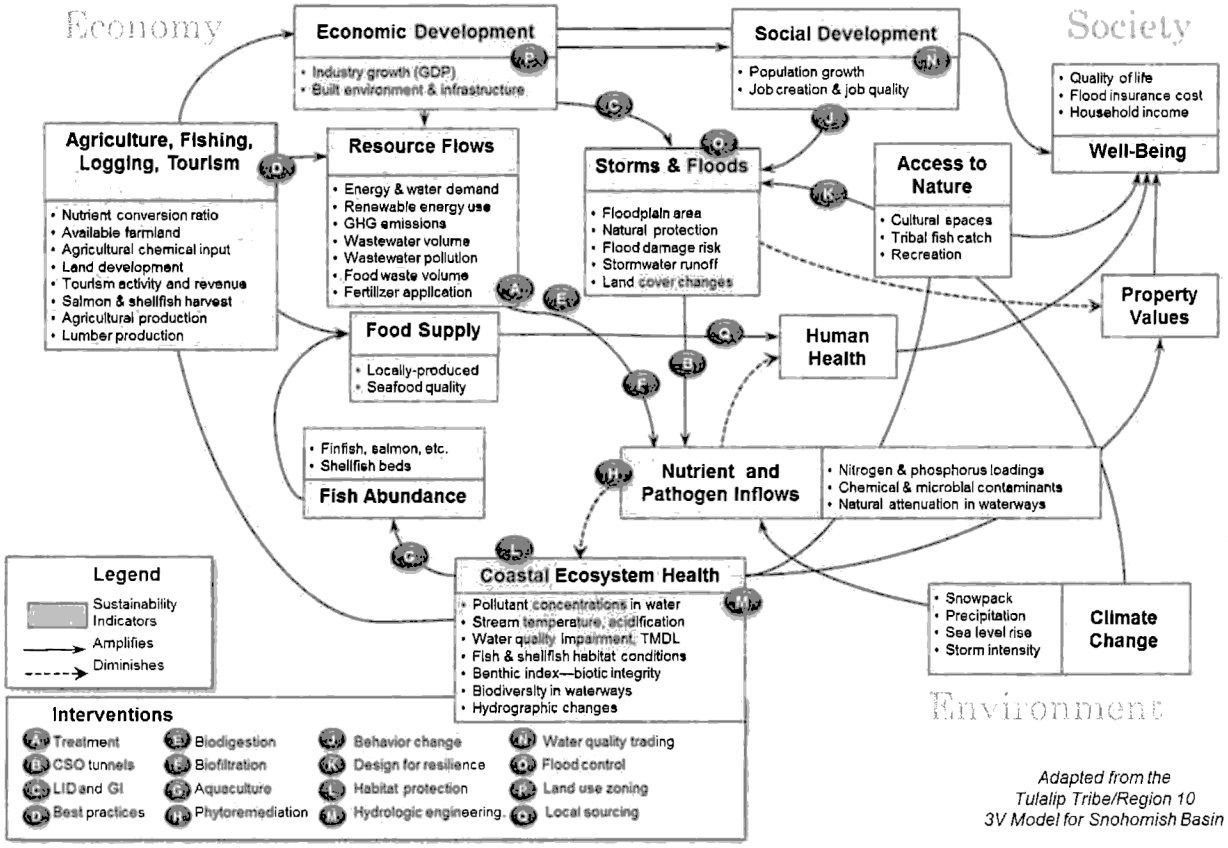

Figure 1-14 Participatory Systems Modeling to Explore Sustainable Solutions: Triple-Value Simulation Modeling Cases Tackle Nutrient and Watershed Management from a Socio-Ecological Systems (SES) Perspective (Poster by US EPA, Buchholtz ten Brink, et. al.)

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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.

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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.

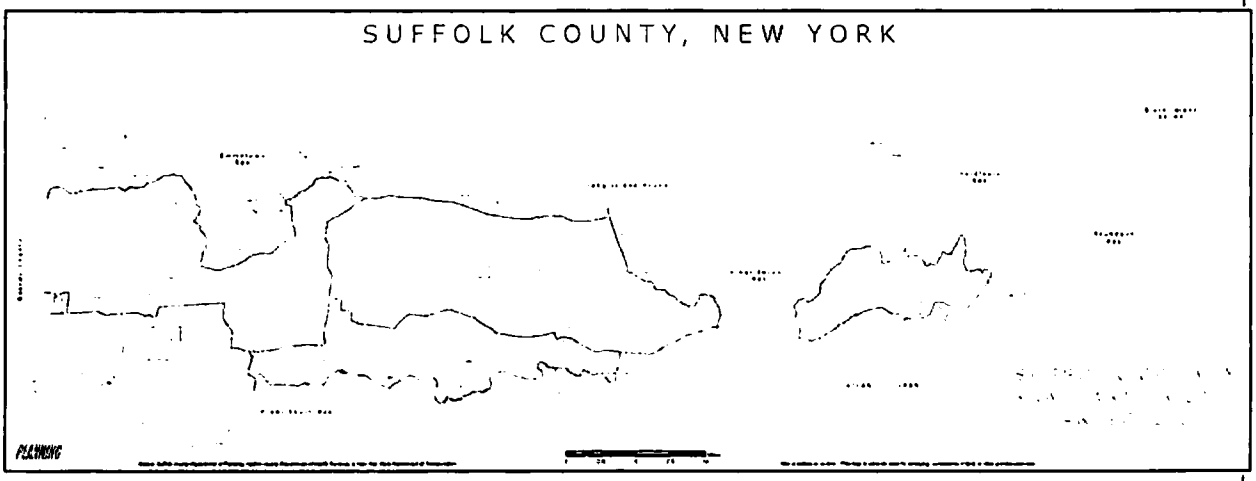

Figure 1-15 Suffolk County Sanitary Code Article 6 Groundwater Management Zone Map

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 Unsewered 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

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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.

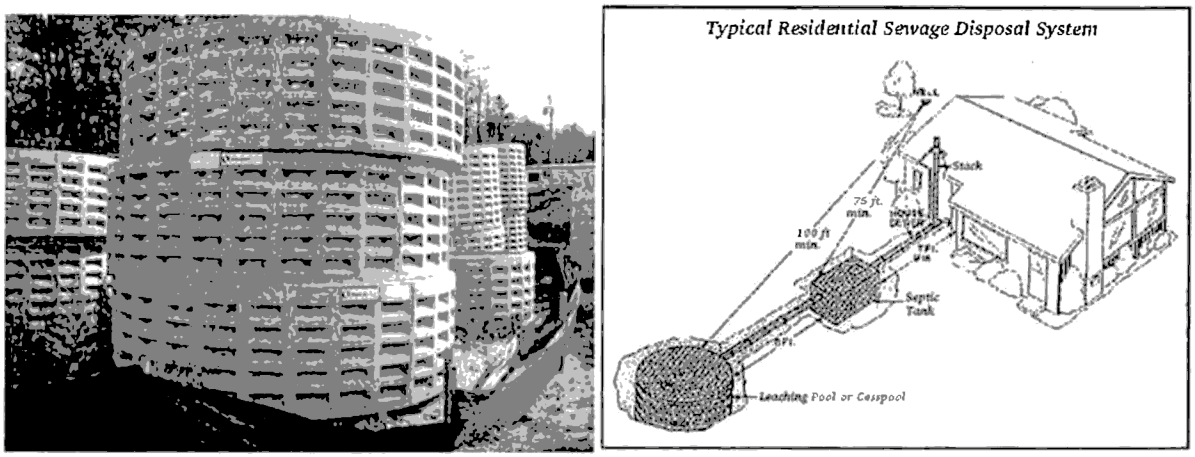

Figure 1-16 Precast Leaching Rings (Left) & Typical System layout (Right)

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.

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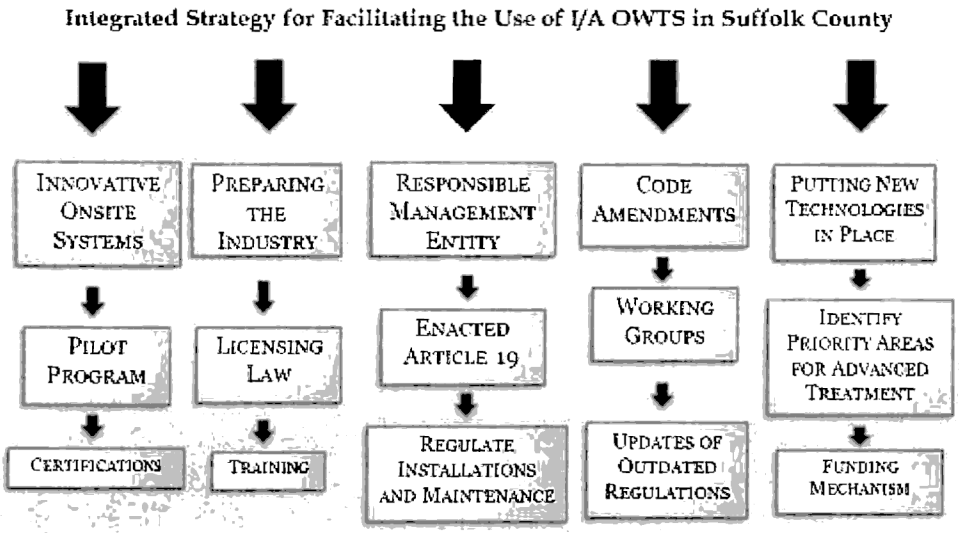
To identify areas that might benefit most from I/A OWTS versus sewering and/or other mitigation measures, the Comp Water Plan recommended the development and implementation of a Countywide wastewater management plan. The recommendations in the Comp Water Plan resulted in the inception of an aggressive 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**.



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.

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

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, recommended 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.

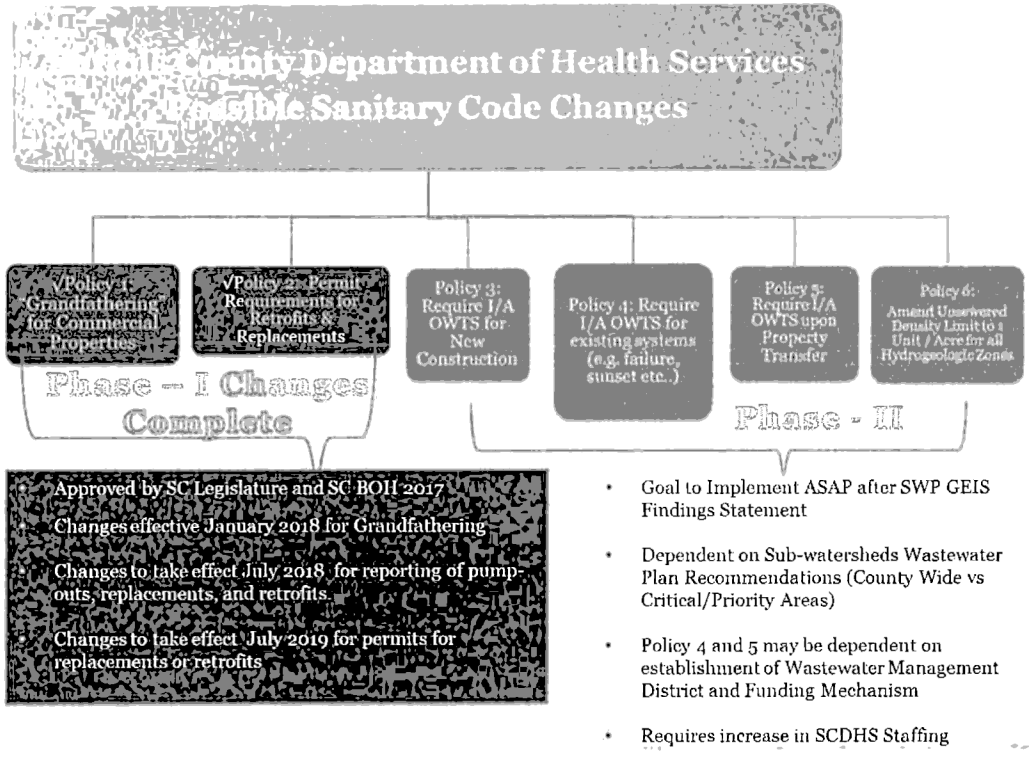


Figure 1-18 Potential Suffolk County Sanitary Code Changes

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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.

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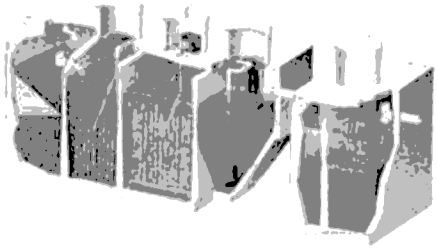
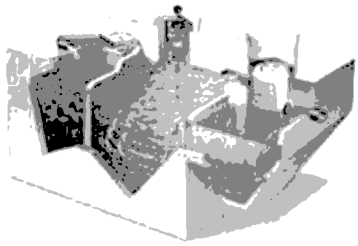
I/A Septic Demonstration Pilot
Phase-I



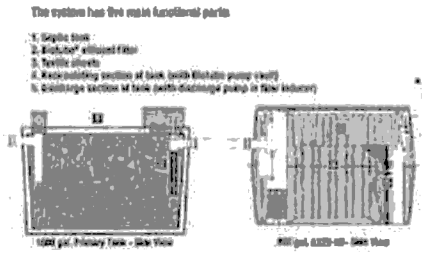
Norweco Hydro-Kinetic



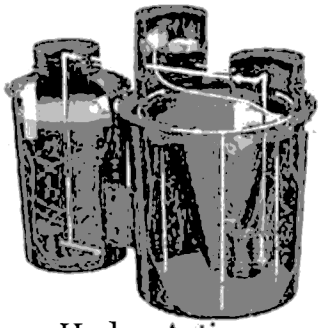
Norweco Singulair TNT

Busse MBR

Orenco AdvanTex AX20



Orenco AdvanTex AX-RT



Hydro-Action
AN Series

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

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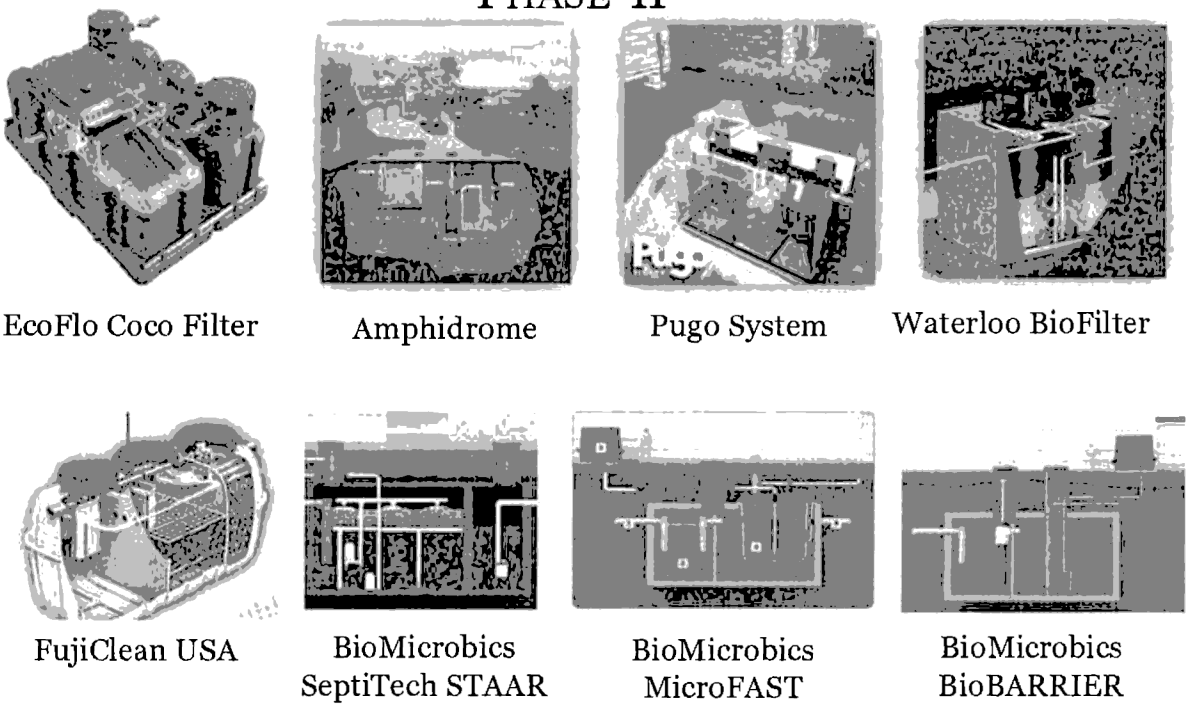

Figure 1-20 Technologies Piloted in Phase 2 of the Suffolk County I/A Septic System Demonstration Program

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.

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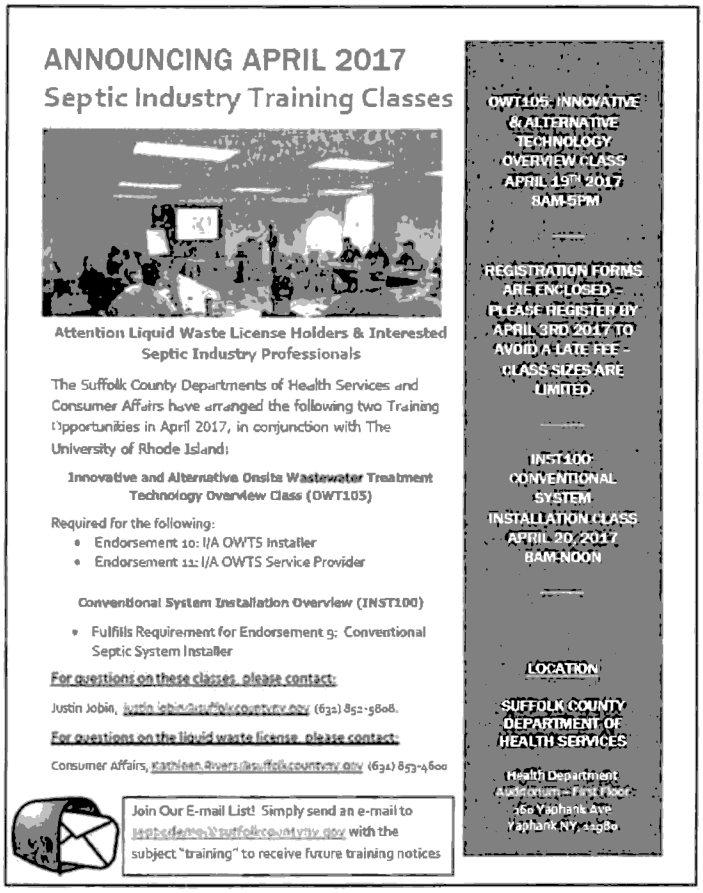
1.1.6.4.2 Suffolk County I/A OWTS Industry Training

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:



ANNOUNCING APRIL 2017
Septic Industry Training Classes

Attention Liquid Waste License Holders & Interested Septic Industry Professionals

The Suffolk County Departments of Health Services and Consumer Affairs have arranged the following two Training Opportunities in April 2017, in conjunction with The University of Rhode Island:

Innovative and Alternative Onsite Wastewater Treatment Technology Overview Class (OWT105)

Required for the following:
- Endorsement 10: I/A OWTS Installer
- Endorsement 11: I/A OWTS Service Provider

Conventional System Installation Overview (INST100)
- Fulfills Requirement for Endorsement 9: Conventional Septic System Installer

For questions on these classes, please contact:
Justin Jobin, justin.jobin@suffolkcountyny.gov (631) 852-5808.

For questions on the liquid waste license, please contact:
Consumer Affairs, kathleen.rivers@suffolkcountyny.gov (631) 853-4600

Join Our E-mail List! Simply send an e-mail to septicdemo@suffolkcountyny.gov with the subject "training" to receive future training notices

OWT105: INNOVATIVE & ALTERNATIVE TECHNOLOGY OVERVIEW CLASS APRIL 19TH 2017 8AM-5PM

REGISTRATION FORMS ARE ENCLOSED – PLEASE REGISTER BY APRIL 3RD 2017 TO AVOID A LATE FEE – CLASS SIZES ARE LIMITED

INST100: CONVENTIONAL SYSTEM INSTALLATION CLASS APRIL 20, 2017 8AM-NOON

LOCATION
SUFFOLK COUNTY DEPARTMENT OF HEALTH SERVICES
Health Department Auditorium – First Floor
360 Yaphank Ave
Yaphank NY 11980

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
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
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.

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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);

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- 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.

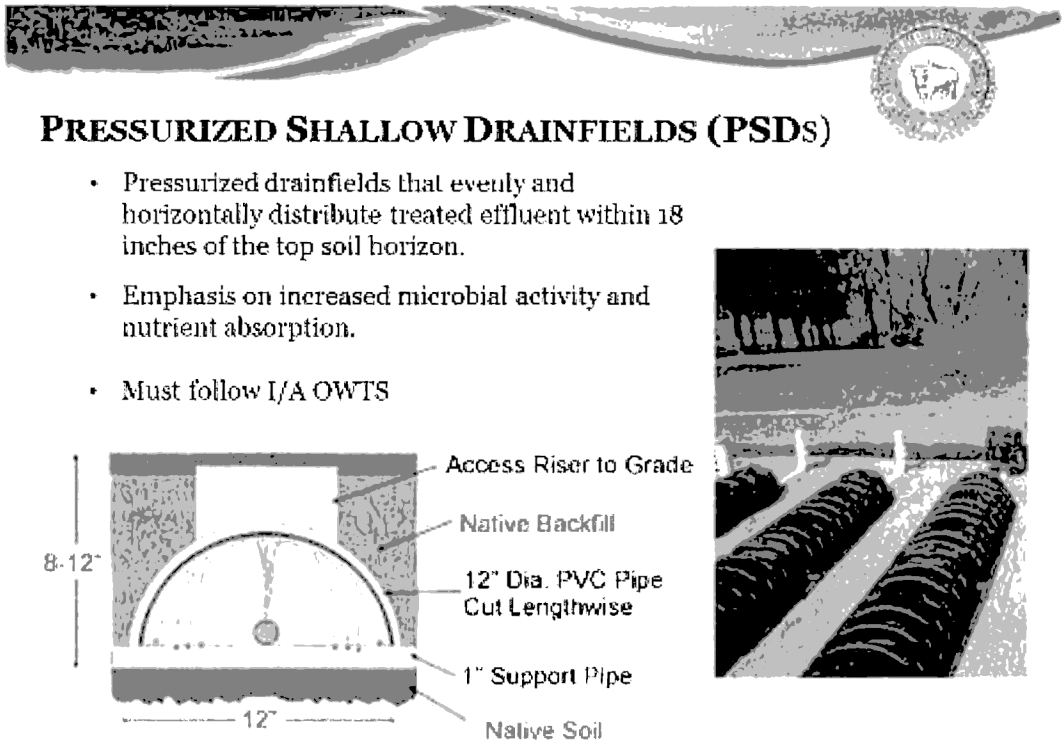

Figure 1-21 Pressurized Shallow Drainfields

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.

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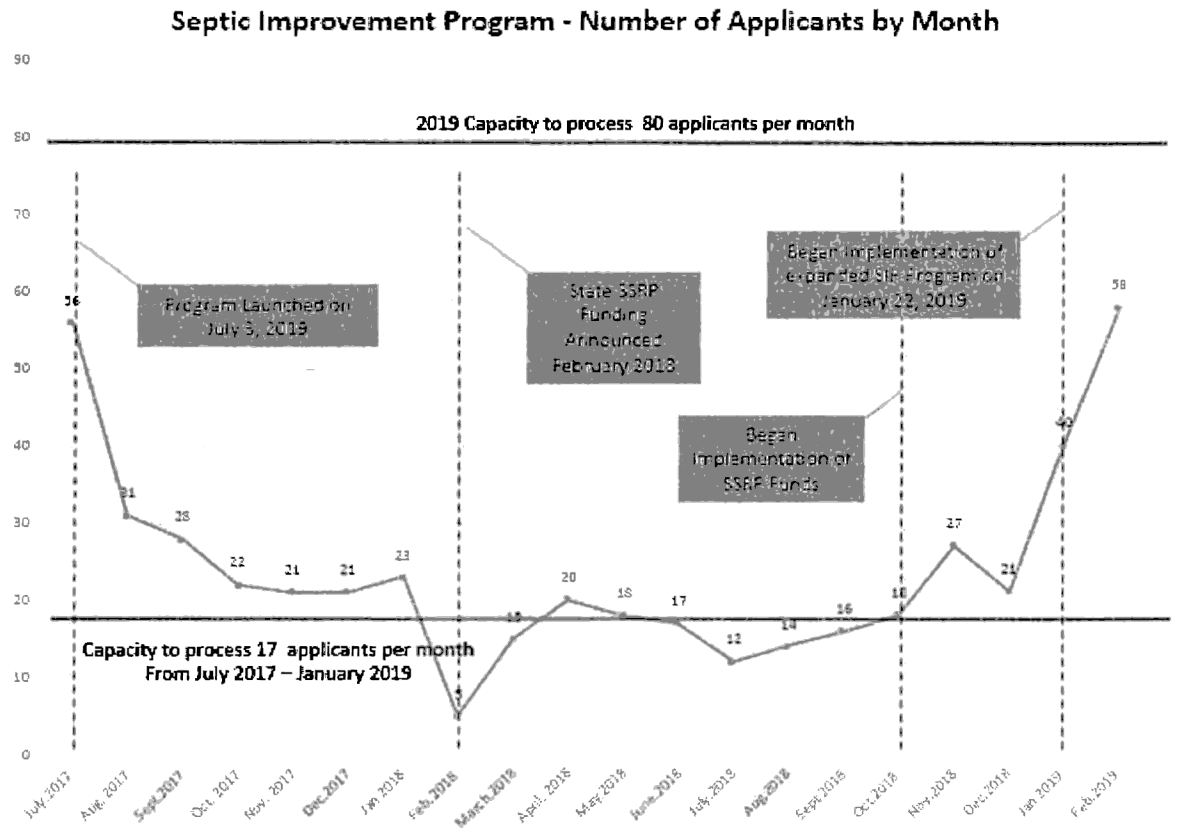

Figure 1-22 Septic Improvement Program Applicants

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.

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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