Wastewater Management in Nassau and Suffolk Counties, New York

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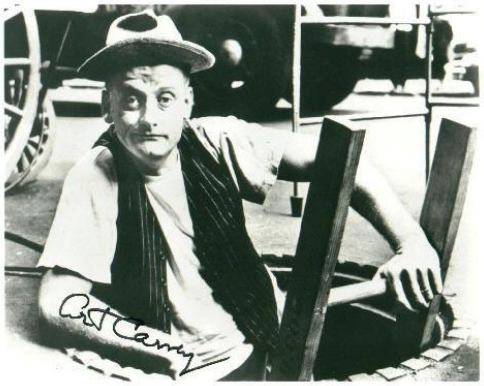
Abstract

Wastewater treatment on Long Island is essentially "A Tale of Two Counties". Nassau County is approximately 85% sewered (though large stretches of the north shore of Nassau County, approximately 50,000 houses, utilize cesspools or septic tanks), while only 26% of Suffolk County is connected to sewers. Nassau County's largest sewage treatment plant, in Bay Park, handling 40% of the County wastewater, has been discharging effluent that has only gone through secondary treatment prior to discharge into Nassau County's south shore embayment. About 74% of Suffolk County's wastewater is released essentially untreated and ultimately finds its way into ground and surface waters. About 360,000 houses in Suffolk County currently utilize non-performing cesspools or septic systems. As a result of these contrasting sewage treatment practices, each County has its own set of water quality and quantity issues.

Potential climate change effects are also a compounding consideration regarding sewage treatment practices in each county. While the Bay Park treatment plant was significantly damaged in Superstorm Sandy, Suffolk County's principle wastewater treatment plant at Bergen Point barely escaped unscathed. Options are being examined to pipe Bay Park's discharge out into the ocean while the portion of Bergen Point's ocean outflow pipe running through the Great South Bay is being replaced to avoid catastrophic failure. Diverting wastewater into the ocean rather than recharging to ground raises concerns about the water budget in Long Island's sole source aquifer and poses the tradeoff between water quality and water quantity. Other issues associated with ocean discharge include coping with future sea level rise and the resulting impacts on coastal infrastructure, declining groundwater levels, and the potential for salt water intrusion.

History



The Long Island Sanitary Commission (which included Robert Moses) was appointed by New York Governor Franklin D. Roosevelt on March 10, 1930 to "investigate the problem of developing a scientific administration and control over the disposal of sewage and garbage in Nassau and western Suffolk Counties…. The commission recommends that, pending the adoption of its plan by the county supervisors, no municipal sewage project shall proceed without approval… and that the commission provide and operate trunks or outlet sewers and sewage treatment plants wherever such facilities are required." The cost would be financed by county bonds to be paid by the county as a whole or paid by assessments on the benefitted properties. Reportedly, there were thirteen systems at this point, covering about 25% of the residents. Earlier in the century, the principle sewage treatment plants were opened in Garden City (1908), Hempstead (1911), Freeport (1920), Glen Cove (1920s), Mineola (1928), Rockville Centre (1928), and Mitchel Field (1920s). With a population of 300,000, Nassau County was the fastest growing county in the country. The first priority was "to maintain the purity of the water of the Long Island Sound, the Atlantic Ocean, and the numerous bays and inland streams….The greatest asset of Nassau County, and one of the greatest assets to the metropolitan community, is the shore front. Pollution of these waters is inevitable unless the problem of waste disposal is properly solved." (The New York Times, May 15, 1931, page 20).

By 1957, Nassau County's census population was 1,178,075. In reporting to the Commissioner of Public Works (May 1958) relative to trunk sewers and sewage treatment plants for proposed Sewage Disposal District (SDD) No. 3, the engineering firm of Lockwood, Kessler, & Bartlett (LKB) estimated the cost at $227,000,000. LKB recommended "complete biological treatment by the 'activated sludge' process, chlorination and disposal of clear, disinfected, inoffensive effluent into one of the major boat channels of the bay waters." Such treatment removes 90%-95% of biochemical oxygen demand and suspended solids, with the bacteria count kept below 50 coliforms per 100 cubic centimeter. There was no mention of nitrogen loading. The report further noted that, "Our hydrographic studies indicate that all the major boat channels provide sufficient dilution of waters and dispersion currents for disposal of the treated effluent." These conclusions were subject to completed improvements to Jones Inlet, Long Creek, and Fire Island Inlet.

The Bay Park Sewage Treatment Plant was placed into operation in 1950 with a design capacity of 27 million gallons per day (MGD) with only primary treatment. The plant expanded in the 1960s to 60 MGD with secondary treatment. A major upgrade in the 1980s brought capacity to 70 MGD, servicing an area of approximately 70 square miles (sq. mi.) with a population of 550,000. The Cedar Creek Water Pollution Control Plant was placed into operation in 1974 with a design capacity of 45 MGD. It was expanded in the 1980s to 72 MGD, servicing approximately 105 sq. mi. with a population of 600,000.

A 1972 report from the United States Environmental Protection Agency (USEPA) on the Environmental Impact Statement on Waste Water Facilities Construction Grants for Nassau and Suffolk Counties, New York offered a "general description of 'secondary' treatment plants….Nitrogen removal data is not given because the references cited did not give it. We know, however, that none of the processes described removes more than 30-50% of the effluent nitrogen (Eliasen and Tchobanoglous, 1969)….While the physical-chemical scheme described removes more phosphorous than conventional secondary treatment, it removes less nitrogen since biological growth which assimilates soluble is not promoted." As for recharging, "The Bay Park experiments so far have shown it is possible to recharge to the Magothy Aquifer with reclaimed sewage through the use of injection wells. However, the assessment of economic practicality must await better definition of (1) the rates and causes of injection-well clogging and (2) the geochemical stability and long-term character of the injected water."

Among other concerns raised by the 1972 EPA report were algal blooms which would create an anoxic environment detrimental to all oxygen dependent organisms. Loss of coastal wetland had adversely

impacted the biota and increased the impact of severe coastal storms. The concept of oceans as an infinite sink was rejected, since there had been no impact assessment of large inputs of trace materials in sewage effluent into coastal waters. Concern was expressed over the decline of groundwater levels resulting from discharge of treated sewage effluent into Long Island Sound and the Atlantic Ocean, especially regarding the "sacrificing" of water quantity to water quality. A cautionary note was sounded over the installation of community sewering capable of supporting higher density, the counter being control of zoning practices.

In 1961, a feasibility study was conducted to explore the construction of public sewers within Suffolk County. In 1965, Suffolk County established the County Sewer Agency, which was responsible for sewage collection, conveyance, treatment, and disposal. By 1970, the County acquired its first sewage treatment plant in the already constructed 1.5 MGD plant, located in Port Jefferson and known as Suffolk County Sewer District #1.

In an article entitled "U.S. Warns Suffolk It May Act on Sewers", Alan Eysen reported in Newsday on April 24, 1969: "Murray Stein, assistant commissioner for enforcement for the U.S. Water Pollution Control Administration, told a water pollution conference here that the federal government would join with the state in seeking development of a regional sewage collection and treatment system if the County of Suffolk fails to take action." More specifically, there was a call for duck farmers to install pollution treatment facilities.

In a Newsday article dated September 26, 1969, "Sewers Needed Now, Suffolk Warned," Earl Lane wrote, "Mention Long Island to some people in Bangalore, India, or Tashkent, USSR, and they might wrinkle their noses and ask, 'Isn't that where they have cesspools?' Recounting his travels through India, Russia, and other countries, Dwight Metzler, New York State's deputy health commissioner for environmental services, said, "Long Island is the outstanding example in the world where a major population discharges sewage in ground waters. Even people in underdeveloped countries tell me they can't understand it."

In 1969, according to "Utilities Inventory & Analysis" by the Nassau-Suffolk Regional Planning Board, "more than 50% of Nassau's homes and 98% of Suffolk's homes are still served by cesspools and septic tanks…. The critical need for sewage collection and treatment is a direct outgrowth of the inadequacies and failures of disposal by septic tanks and cesspools. In the past ten years these failures have become more obvious. Some of the resultant effects are as follows:

1. Pollution of the shallow fresh ground water supply.
2. The possibility of the rapid spread of intestinal disease caused by overflowing cesspools, has increased.
3. A slow but steady pollution of recreational waters has been produced."

The Report of the Suffolk County Sewer Agency to the Suffolk County Board of Supervisors (March 21, 1969) provided background on the Southwest Sewer District (SWSD) plans and cost estimates in preparation for the general election referendum authorizing the funding and construction of the SWSD on November 4, 1969. Total construction costs and interest over 40 years were projected at about $522 million. The project included the Bergen Point Sewage Treatment Plant (STP) (30.5 MGD capacity) with 71 miles of interceptor lines, 817 miles of lateral, main, and trunk lines, 14 pump stations, and a 4-mile ocean outfall. Construction was slated to occur in stages over 10 years. The Long Island Comprehensive Waste Treatment Management Plan (LICWTMP) prepared by the Board of Supervisors in 1978 indicated that, by 1976, 101 public and private sewage treatment plants were operating in Suffolk County with a total average discharge of 14.26 MGD.

In the late 1970s and 1980s, the SWSD, also known as Sewer District #3 (SD3), was created and the Bergen Point STP was built utilizing funding from the federal government and New York State. Bergen Point went online in October 1981. The SD3 is the largest sewer district in Suffolk County, consisting of an area of 57 sq. mi. with of 950 miles of sewer lines, 14 remote pumping stations, and serving an estimated population of 340,000. Evidence has shown that sewering can help reduce nitrogen loads to both ground and surface waters. For example, the average nitrogen level in the Carlls River in the 1970s was 3.2 milligrams per Liter (mg/L). By the 2000s, this level was reduced to 1.8 mg/L.

There is, however, there is a “flip side” to this scenario relating to stream flow and water quantity. Base flow in the Carlls River dropped from a 27.3 cubic feet per second (cfs) flow during predevelopment times, to 20.5 cfs during the 1968-1983 period. Furthermore, the United States Geological Survey (USGS) predicts that flow will decline to 11.9 cfs by 2020, a 50% loss of over 50% of its pre-development base flow. Similarly, East Meadow Brook in Nassau County is predicted to go to 0 cfs stream flow in 2020 (Buxton and Smolensky, 1999). Other surface water features in Nassau and western Suffolk Counties have seen similar declines in base flow accompanying an improvement in nitrate levels. A larger discussion of this topic is detailed in the 2016 State of the Aquifer Report (SOTA).

An outgrowth of the SD3 undertaking was the SWSD corruption case. It involved substantial delays and cost overruns. When started in 1969, the budget for construction was $315 million. By the time the first homes were hooked up in 1981, the cost of the project had ballooned to more than $900 million. Additionally, a project director and lawyers for the company that built the system had been convicted of conspiracy and racketeering. No public officials were convicted of criminal charges but several were assessed damages in civil suits filed by the County. As a result, no other major sewer projects were pursued in the ensuing forty years.

Wastewater Treatment in Nassau County

The Nassau County Department of Public Works is responsible for the operation and maintenance of the County’s three Sewage Facilities, which include the Bay Park Sewage Treatment Plant, the Cedar Creek Water Pollution Control Plant, and the Glen Cove Wastewater Treatment Plant). The Glen Cove plant has been recently upgraded to meet the requirements associated with protecting the Long Island Sound from hypoxia or low dissolved oxygen. This plant currently treats approximately 3 MGD, leaving a surplus capacity of over 2.5 MGD, which could be used to sewer some of the communities in the north shore that are currently served by cesspools. In addition to the sewage collection systems operated by the County, there are six (6) village-owned and operated collection systems in the County that discharge to the County’s sewage collection system. The villages are: Freeport, Garden City, Hempstead, Mineola, Rockville Centre, and Roslyn.

The County recently completed a joint project with the Villages of Cedarhurst and Lawrence to construct the infrastructure necessary to divert wastewater flows from the antiquated Village sewage treatment plants to the County’s Bay Park STP. The County assumed ownership of the Villages’ sanitary sewer collection systems and is currently undertaking the decommissioning and demolition of the former Villages’ sewage treatment plants. Excess treatment plant property will be returned to the Villages for their use.

Eight other independent treatment facilities operate within the County, including the City of Long Beach, Jones Beach, the Village of Great Neck, the Port Washington Water Pollution Control District, the Belgrave Water Pollution Control District, the Great Neck Water Pollution Control District, the Greater Atlantic Beach Water Reclamation District, and the Oyster Bay Sewer District. Together, these 10 facilities process 15% of the County’s effluent.

Nassau County also operates 57 sewage pump stations and approximately 3,000 miles of sewer main. The Bay Park STP collects wastewater from an area of approximately 70 sq. mi. in the western portion of Nassau County. It serves an estimated population of 524,000. The majority of the sanitary flow is from residential, with the remainder from commercial establishments. Only about 1.5% of the flow to Bay Park is from industrial facilities.

The Bay Park STP was originally constructed in the late 1940s and was placed into operation in 1950. It was initially permitted for the treatment of 27 MGD of municipal sanitary waste. The plant was first expanded in 1960 to provide secondary treatment and increase its capacity to 60 MGD. Beginning in the mid-1980s, the plant was expanded again to increase its capacity to achieve secondary treatment of an average daily flow of 70 MGD. The plant currently treats on average 50 MGD of wastewater. The plant discharges its treated effluent into Reynolds Channel through an 84-inch diameter outfall pipe, which is approximately 2.3 miles long.

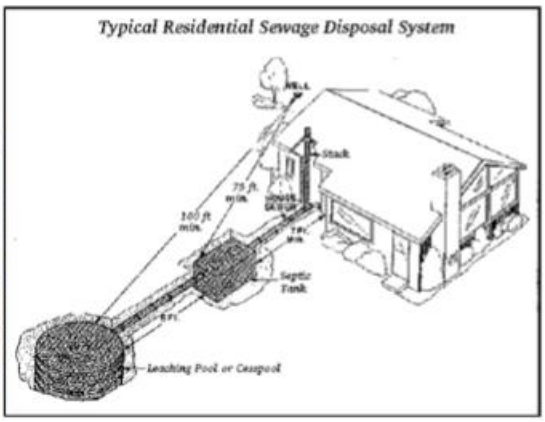
The Cedar Creek Water Pollution Control Plant (WPCP) collects wastewater from an area of approximately 105 square miles in the eastern portion of Nassau County and serves an estimated population of 600,000. Similar to Bay Park, the majority of the sanitary flow is from residential and commercial areas, with minimal industrial flows (1.5%). The Cedar Creek WPCP was originally constructed in the early 1970s and was placed into operation in 1974. It was initially permitted for the treatment of 45 MGD of municipal sanitary waste and complied with secondary treatment standards through the utilization of the activated sludge process. The plant was expanded as part of a capital improvements program in the mid-1980s through the early 1990s to achieve secondary treatment of an average daily flow of 72 MGD. The plant currently treats on average 55 MGD of wastewater. The plant discharges its treated effluent into the Atlantic Ocean through an 84-inch diameter outfall pipe approximately 2.5 miles off the shore of Jones Beach.

The Glen Cove Wastewater Treatment Plant (WWTP) serves an area of approximately 19 sq. mi. in the northern portion of the County with an estimated population of approximately 27,000. All of the sanitary flow is from residential and commercial areas. The Glen Cove WWTP was originally constructed in the 1920s with only primary treatment and chlorine disinfection. Beginning in 1950, the plant was upgraded to secondary treatment with the addition of trickling filters and secondary clarifiers. In 1980, a new plant was constructed that utilized the activated sludge process for secondary treatment. The old trickling filter plant was decommissioned and demolished. In 2002, the plant was upgraded to include processes for nitrogen removal from the wastewater. The plant is currently permitted for an average daily flow of 5.5 MGD. The plant actually treats approximately 3 MGD of wastewater. The plant discharges its treated effluent into Glen Cove Creek.

The County is responsible for the operation and maintenance of 57 sewage pump stations, which transport sanitary wastes where gravity is not a viable transport option. There are 25 pump stations that serve the collection system delivering sanitary wastes to the Bay Park STP, 15 pump stations that help deliver sanitary wastes to the Cedar Creek WPCP, and 17 pump stations that are tributary to the Glen Cove WWTP. The wastewater collection system operated by the County is comprised of approximately 3,000 miles of sanitary sewers (ranging in size from 8 to 108 inches in diameter), 64,000 manholes, and 300,000 individual service connections. The sewer maintenance program is designed to annually inspect and clean a portion of the sewers and manholes within the system. This program includes visual inspection, remote video inspection, power flushing, biological treatments (grease control), and herbicide treatments (root control).

The wastewater treatment plants' operations are regulated by the Clean Water Act under the direction of the United States Environmental Protection Agency (EPA). The EPA has delegated permitting authority to the New York State Department of Environmental Conservation (NYSDEC) which administers the State Pollution Discharge Elimination System (SPDES).

Wastewater Treatment in Suffolk County



In contrast to Nassau County, only 26 percent of Suffolk County is connected to a community sewage collection and treatment system capable of reducing nitrogen. The remaining 74 percent of the County utilizes on-site sewage disposal systems to meet their sewage disposal needs. These on-site sewage disposal systems are either systems consisting of cesspools (also known as leaching pools) or a combination of a septic tank and leaching pool (conventional on-site sewage disposal system). These systems typically have little nitrogen reduction capabilities. The wastewater effluent from these on-site sewage disposal systems discharges into the ground, eventually impacting ground and surface water resources. Suffolk County contains the highest density of on-site septic systems within the Tri-State area, with approximately 360,000 homes currently utilizing on-site sewage disposal systems. Of particular concern are the on-site septic systems located in the groundwater-contributing areas of potable supply wells and estuarine surface waters.

Suffolk County witnessed a population explosion between the 1950s and 1960s. According to United States Census data, the population of Suffolk County increased from approximately 276,000 in 1950 to over 1,127,000 by 1970, an increase of over 300 percent. Since that time, Suffolk County's population has grown at a much more modest pace (i.e., a population growth of 5.2 percent between 2000 and 2010). From 2010 through 2015, Suffolk County gained a mere 8,296 people bringing the total to 1,501,587. The population of Suffolk County is projected to grow modestly through 2035, ultimately reaching a population of approximately 1.77 million.

Fueled by national housing and transportation policies that favored suburban tract development, the landscape of the County began to be transformed as the population of Suffolk County increased. By 1970, the number of housing units within Suffolk County was just over 325,000. From 1970 to 2013, the number of housing units grew to over 568,000. Currently, approximately 360,000 housing units use on-site sewage disposal systems that have limited nitrogen-reducing capabilities. The remaining units are connected to a community wastewater treatment system.

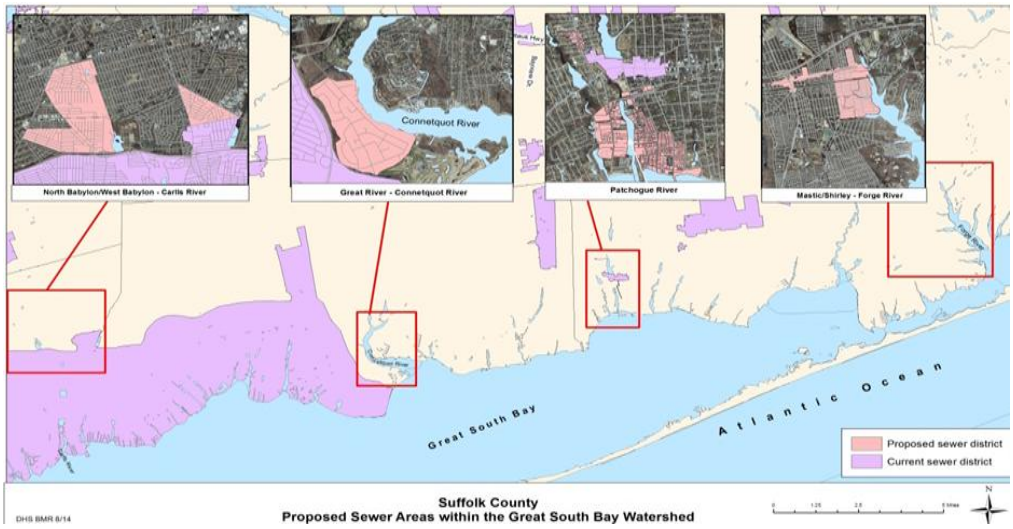
With population growth came an increased need for potable water and wastewater infrastructure to serve the needs of the people. A study was performed by the Suffolk County Department of Health Services (SCDHS) beginning in the early 1970s (known as the 208 Study) to determine the effects of building density on groundwater quality. The Long Island Comprehensive Waste Treatment Management Plan (LICWTMP) was based on the results of the 208 Study. Eight Groundwater Management Zones (GMZs), each with differing recharge characteristics, were identified. The 208 study showed that 1 acre zoning was needed to keep nitrate in groundwater impacts acceptable while allowing development utilizing on-site wastewater disposal systems to proceed. As a result, Article 6 was added to the Suffolk County Sanitary Code in 1981, which defined the means and methods for wastewater treatment in Suffolk County. Based on differences in regional hydrogeological and groundwater quality conditions, Article 6 delineated boundaries of the 8 GWMZs for protection of groundwater quality. The goal of creating the GWMZs was to limit groundwater nitrogen to 4 mg/L in GWMZs III, V, and VI and to 6 mg/L in the remaining zones.

In order to facilitate reaching these nitrogen goals, residential properties located within GWMZs III, V, and VI were required to have a minimum lot size of 40,000 square feet (sq. ft.) if using a conventional on-site sewage disposal system and either public water or private wells. Residential properties located in the remaining zones are required to have a minimum 20,000 sq. ft. of land when utilizing conventional on-site sewage disposal systems and public water or 40,000 sq. ft. with private wells. Commercial/industrial properties located in GWMZs III, V, and VI were limited to a total discharge of 300 gallons per day (GPD) per acre when using a conventional on-site sewage disposal system and a public water or private well. The remaining zones were allowed 600 per acre with public water or 300 GPD per acre with a private well. Exemptions from these guidelines were permitted for lots that existed prior to 1981, which allowed for higher densities in certain areas.

Projects that exceed the density requirements as stated 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. This is accomplished by connecting the site to an existing or proposed community sewage treatment plant. However, many areas of Suffolk County were built before the Article 6 density restrictions or prior to conventional treatment system requirements. The Suffolk County Department of Economic Development and Planning estimated that over 60 percent of the residential parcels in Suffolk County (more than 372,000) are less than or equal to one half acre. Of these, over 257,000 (52.9 percent) are not sewered. Additionally, there are over 214,000 residential parcels less than a quarter acre, of which 26.7 percent are not sewered. As of 2017, changes were being considered to Article 6 that would require innovative/advanced on-site wastewater treatment systems (I/A OWTS) for new construction, modification of 'grandfathering' provisions for commercial properties, and establish requirements for the replacement of conventional cesspools and septic systems.

Recent Developments

Suffolk County has recently started to evaluate the feasibility of sewering various areas throughout Suffolk County. In 2008, the Suffolk County Sewer District/Wastewater Treatment Task Force was established by the Suffolk County Legislature. The goals of the Task Force were, among others, to evaluate Suffolk County's existing wastewater treatment infrastructure and seek out public and private funding sources in order to expand its wastewater treatment facilities to additional areas within the County.



In 2014, Suffolk County was awarded $383 million of Superstorm Sandy Recovery funds from New York State to install sewers and connect approximately 10,000 properties to sewage collection and treatment systems. This will be the first major sewering based project within Suffolk County in more than 30 years. The goal of the project is to reduce nitrogen pollution to ground and surface waters and to improve coastal resiliency against future storm events. The areas to be sewered are listed below:

1. Mastic: Parcels in the Forge River area will be connected to a new wastewater treatment plant located near the Brookhaven Town Airport.
2. North Babylon, West Babylon, and Wyandanch: Parcels in the Carlls River area will be connected to the SWSD.
3. Great River: Parcels in the Connetquot River and Nicolls Bay area will be connected to the SWSD.
4. Patchogue: Parcels in the Patchogue River area will be connected to the Patchogue Sewer District.

Without extensive Federal support, sewering has become prohibitively expensive. As an example, the 465 sewer connections proposed for Great River (number 3 above), which would be financed with a low 2% interest loan from the Environmental Facilities Corporation and involves simply connecting to an existing Bergen Point STP interceptor beneath nearby Heckscher Parkway, would cost an estimated $3,000 per year per parcel. A recent estimate from D&B Engineering and Architects, P.C. for connecting 5,600 Nassau County north shore properties to sewers came in at $120,000 per parcel.

Annual Costs for Typical Property Owners (Sayville Sewer District Created)						
Property Type	"Typical" Assessed Value ($)	Annual Debt Service (Sewer Assessment)	Annual Electricity Cost & Service Contract	Annual O&M	Village of Patchogue Sewer User Fee	Total Annual Amount
Sayville Commercial Property	$45,000	$4,677	$1,850	$1,500	$8,270	$16,297
Sayville Residential Property	$45,000	$4,677	$375	$150	$745	$5,947

May 2014 Feasibility Study

Existing Sewage Treatment Plants and Sewering

As of 2013, Suffolk County has 197 operational STPs, 171 of which are designed to remove nitrogen from the wastewater with typical effluent total nitrogen of 10 mg/L or less. These types of plants are considered tertiary plants. The remaining 26 STPs are considered secondary plants, capable of reducing biochemical oxygen demand (BOD5) and suspended solids (SS). Of the 197 STPs, 15 discharge directly to surface waters. The 2013 average effluent total nitrogen for the tertiary plants in Suffolk County was 8.7 mg/L, which is less than the maximum allowed of 10 mg/L per SPDES permits.

The STPs in Suffolk County can be categorized as either centralized or decentralized. Centralized systems involve advanced processes that collect, convey, treat, and discharge large quantities of wastewater. Municipalities usually own the centralized STPs. There are approximately 23 centralized STPs located in Suffolk County. Some of the major centralized sewer districts in the County include Bergen Point (Sewer District #3) and Selden (Sewer District #11), owned and operated by Suffolk County and the Town of Riverhead and Village of Patchogue STPs, which are operated by those municipalities. Bergen Point STP is the largest treatment plant in Suffolk County with an operating capacity of 30 MGD and is currently under construction to expand the plant to 40 MGD. Bergen Point STP is a secondary plant that discharges treated effluent 2 miles offshore into the Atlantic Ocean.

Sewer collection systems in Suffolk County consist mainly of gravity sewer lines with remote pump stations. In certain cases, low pressure force mains have been utilized. The Village of Patchogue sewer district has been expanding in recent years through the use of low pressure force mains with pumping systems. The advantage of installing low pressure force mains is the cost. They reduce the number of remote pump stations required, reduce the need for costly deep excavations to install gravity sewers, and lower dewatering costs. Conversely, gravity sewers may be more expensive for developers or municipalities to install in certain cases but are less expensive for homeowners since the homeowner does not have to maintain and operate their own low pressure pump station located on their property.

Unsewered Areas in Suffolk County

Most of the STPs located within Suffolk County are considered decentralized. Decentralized STPs are designed to operate on a smaller scale than centralized STPs and do not require multiple remote pump stations to convey sewage to the plant. The historical use of decentralized STPs in the County has been to serve single lots containing condominium complexes, apartment complexes, hotels, or industrial or commercial buildings. The SCDHS has been actively requiring older plants that are under-performing and/or lack nitrogen removal capability to be renovated or replaced. During the past 15 years, 100 new STPs were constructed, 20 of which replaced existing facilities whose physical conditions and/or treatment capability had deteriorated. For example, the Kings Park STP, located on the grounds of the former Kings Park Psychiatric Center, was built in 1935, rehabilitated in 1960, and upgraded again in 2004.

Types of decentralized STPs in use throughout Suffolk County include rotating biological contactors (RBCs), sequence batch reactors (SBRs), extended aeration systems with a denitrification filter, membrane bioreactors (MBRs), and biologically engineered single sludge treatment (BESST) processes. All of these tertiary treatment plants are designed specifically to remove nitrogen. With the recent concerns regarding emerging contaminants (such as pharmaceuticals and personal care products [PPCPs]), some modifications may be required to some of the plants in order to remove these types of constituents in the future.

As stated previously, 74% of Suffolk County residences use on-site sewage disposal systems. The effluent from on-site sewage disposal systems is discharged into the ground. The sands, silts, gravels, and clays that make up the unsaturated zone and the aquifer function as a large sand filter and help to limit the impact of contaminants contained in effluents to groundwater as long as the density of development is not excessive.

Most commercial buildings within Suffolk County are also served by on-site sewage disposal systems. It has been estimated that there are over 39,000 active commercial properties within Suffolk County using on-site sewage disposal systems. Some of these sites have multiple on-site sewage disposal systems serving the building(s) located on the parcel. Similar to residential sewage disposal systems, commercial on-site sewage disposal systems that comply with current standards consist of a precast septic tank for primary treatment and precast leaching pool(s). In 1984, standards were developed to address both the construction of such systems as well as the allowable sanitary flow permitted to be discharged from a commercial/industrial parcel. 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.

Subsequent to a 2014 tour of the septic replacement programs in Maryland, New Jersey, Rhode Island, and Massachusetts, Suffolk County launched the first of two pilot programs to test innovative/alternative on-site wastewater treatment systems (I/A OWTS). Thirty-nine systems were donated by fourteen vendors and installed at homes around the County. As of early 2017, three of the systems have been provisionally approved by Suffolk County. These systems have reducing average nitrogen concentrations in the effluent from an average of 70 mg/L to less than 19 mg/L. An upcoming pilot will look to install several hundred systems in critical areas in close proximity to surface waters, as is done in the Maryland and Rhode Island programs. This preliminary success will prepare the County for the up to $22 million in water quality funding starting in 2018 for the five East End towns pursuant to the referendum that approved allocation of 20% of the Community Preservation Fund for that purpose.

Since the cost of sewering has become prohibitively expensive, it is expected that vast majority of the 360,000 residents and businesses using systems that do not reduce nitrogen or other contaminants will opt for the relatively reasonable cost of I/A OWTS. The typical price for such a system at a site with no complicating factors currently is $17,500. An amendment in 2016 of Article 19 of the Suffolk County Sanitary Code authorizes the SCDHS to act as ‘Responsible Management Entity’ in the evaluation, approval, registration and oversight of I/A OWTS installations. Given that the north shore of Nassau County has at least 50,000 homes on cesspool/septic systems and given the prohibitive expense of connecting to sewers, these developments address their circumstances.

Environmental Impacts Due To Wastewater Effluent

Nitrogen in various forms can present a public health hazard in drinking water and can impact surface waters. The SCDHS samples for total nitrogen in wastewater effluent. Tertiary wastewater treatment plants discharging into the ground in Suffolk County are required to have an effluent total nitrogen concentration of 10 mg/L or less. Total nitrogen consists of organic nitrogen, ammonia (NH4+), nitrate (NO3-), and nitrite (NO2-). It has been estimated that wastewater nitrogen contributes approximately 69 percent of the total nitrogen to ground and surface water resources. The main source of wastewater nitrogen in Suffolk County is from the approximately 360,000 on-site sewage disposal systems utilized by the residents of Suffolk County to meet their wastewater needs. Other sources of nitrogen to Suffolk County's water resources are storm water, fertilizers, and atmospheric deposition.

In 2014, the SCDHS prepared an evaluation report of nitrate trends in Suffolk County supply wells. This report was an expansion of work previously completed by Camp, Dresser, and McKee (CDM) in the Draft Comprehensive Water Resources Report which compared the 1987 and 2005 nitrate water quality data. The SCDHS expanded CDM's work by including 2013 nitrate data. Suffolk County has approximately 1,000 public water supply wells and an estimated 45,000 private wells. Several public water supply wells in Suffolk County are approaching or exceeding the nitrate drinking water standard and must blend or treat to reduce nitrate concentrations in drinking water delivered to the public. Public water suppliers on Long Island can spend an estimated $3.5 million in capital expenses for a nitrate removal system at a typical pump station and can spend an additional $125,000 per year in operating costs for electricity and disposal of waste products.

Nitrate data was compared at public supply wells screened in the Glacial and Magothy Aquifers. The Lloyd Aquifer was not evaluated since there are currently only a total of 5 public supply wells installed in the Lloyd Aquifer. The nitrate results for the Glacial Aquifer wells were based on samples collected from the same 173 wells sampled in 1987, 2005, and 2013. Nitrate concentrations in the Glacial Aquifer wells rose over 41 percent from an average concentration of 2.54 mg/L in 1987 to 3.58 mg/L in 2013. As with the Glacial Aquifer, the nitrate levels in the Magothy Aquifer were based on samples collected from the same 190 public supply wells sampled in 1987, 2005, and 2013. Nitrate concentrations in the Magothy Aquifer wells rose over 93.2 percent from an average concentration of 0.91 mg/L in 1987 to 1.76 mg/L in 2013. While these average concentrations are still below the drinking water standard of 10 mg/L, the increases are still a cause for major concern.

While nitrogen has historically been the most discussed and studied pollutant associated with wastewater management, it constitutes only one portion of our wastewater problem. Wastewater effluent contains other contaminants of concern such as pharmaceuticals, microfibers, 1,4-dioxane, volatile organic compounds, gasoline, herbicides, heavy metals, and pathogens. Some of these substances are legacy pollutants while others are newly emerging.

In addition to impacts on groundwater, wastewater effluent also impacts surface waters. Many of Suffolk County's 360,000 homes with cesspools and septic systems are situated in low-lying areas that have less than 10 feet separating their systems from the water table. When flooded or submerged in groundwater, septic systems do not function as designed and fail to adequately treat pathogens. In addition, the excess nutrient load from this wastewater is impacting coastal ecosystems through groundwater flow to our estuaries. Recent studies by researchers Kinney and Valiela demonstrate that 69 percent of the total nitrogen load for the Great South Bay is from septic systems and cesspools.

Impact of Wastewater Treatment on Water Balance

In the mid-1980s, the USGS did an extensive evaluation on the impact of sewering and reported that increasing eastward urbanization on Long Island during the past century has placed an increasing stress on the Island's ground-water resources. The introduction of sanitary sewers to reduce groundwater contamination from underground waste-disposal systems has deprived the groundwater reservoir of a large amount of water that would otherwise provide substantial recharge. This investigation was undertaken to predict the declines in groundwater levels and base flow that would result from an estimated loss of 140 cubic feet per second of recharge through the implementation of sewering in Nassau County SDD 2 and SDD 3 and, in Suffolk County, the SWSD. Results indicate that the stress will cause drawdowns as great as 8 feet along the Nassau-Suffolk County border, but the effects will decrease eastward across the subregional area. The predicted effect of sewering in southwest Suffolk

County is less severe than that in Nassau County (Reilly, T. E., and Buxton, H. T., 1985, "Effects of sanitary sewering on groundwater levels and streams, Long Island, New York. Part 3 Model development for southern Nassau County", U.S. Geological Survey Water-Resources Investigations 83-4210, p. 41).

Hydrologic conditions on Long Island since the 1950s have shown a direct response to increasing urbanization. Extensive impervious land-surfacing also contributed to a decrease in infiltration and resulted in further reduced recharge. From the late 1960s through the mid-1970s, the stress of lost recharge abated and the hydrologic system approached a temporary equilibrium condition. In addition, the steady increase in consumptive pumpage in neighboring Queens County had stopped. This had been a large stress with considerable effect on the area studied, but, during the 1970s, it remained relatively constant (Buxton and others, 1981).

By 1990, sanitary sewers in the Nassau County SDDs 2 and 3 and the Suffolk County SWSD were projected to divert to ocean outfall 140 cubic feet of water per second that would otherwise be returned to the groundwater system through septic tanks and similar waste disposal systems. Sanitary sewers have long been used in western Long Island to limit the amount of contamination entering the groundwater system through septic tanks and similar waste disposal systems. The disposal of the treated wastewater to the surrounding saltwater, however, instead of to the ground, removes a large volume of water that provided substantial recharge to the groundwater system. This reduction in recharge lowered the water table and potentiometric head throughout the groundwater system. The greatest water table decline (approximately 8 feet) occurs along the Nassau-Suffolk County border and decreases eastward. This is because most of the sewering stress is in Nassau County SDD 2 and 3.

The Comprehensive Water Resources Management Plan (the Comp Plan) concluded sanitary sewering systems that discharge to surface waters result in a net loss of groundwater from the aquifer system and a potential reduction in the local water table elevation. Because groundwater provides the baseflow for the County's fresh surface water features, sanitary sewering with surface water discharge can also result in a loss of stream baseflow. Consideration of these impacts requires site-specific evaluation. The impacts of sanitary sewering in Suffolk County's largest sewer district, Sewer District No. 3 (SWSD) on groundwater elevations and stream baseflow have been previously documented (CDM, 1995, 2002). Suffolk County considers the potential impacts of sanitary sewering on groundwater levels (an increase in the water table due to recharge of treated effluent or a decline in the water table due to discharge of treated effluent to a surface water body – as part of its evaluation of sewering feasibility (www.suffolkcountyny.gov/Departments/HealthServices/EnvironmentalQuality/WaterResources/ ComprehensiveWaterResourcesManagementPlan.aspx, pp. 3-102).

The present day water balance reflects the impacts of development, most notably groundwater withdrawals of 187 MGD, which account for 17 percent of total recharge. Although the installation of sanitary sewers in portions of the County has reduced the amount of water returned directly to the groundwater system, total recharge to the system (estimated to be 1,120 MGD) is calculated to be greater than total pre-development recharge. This is due to the construction of a network of storm sewers and recharge basins (Comp Plan, p. 3-107). Only minor differences in inflows and outflows exist in the pre-development and present day water balances. The construction of storm water recharge basins has resulted in an increase in total recharge from 1,203 MGD prior to development to a present day total of 1,367 MGD.

The water balances confirm earlier assessments that, on a county-wide basis, the aquifer system can sustain current and projected rates of water supply pumping. While development of a 'safe' or sustainable aquifer yield was not within the scope of this report, the water balances show that average water supply pumping is only approximately 15 percent of the average recharge rate. In fact, much of the water withdrawn in the County is returned to the aquifer system through on-site wastewater disposal systems. Consequently, throughout much of the County, significant declines of stream baseflow have not been observed (Comp Plan, p. 3-118).

Conclusion

One of Suffolk County's primary groundwater resource management goals is the reduction of nitrogen loading in order to protect current and future drinking water supplies and to restore/maintain ecological

functions of streams, lakes, estuaries, and marine waters. Also, the goal is to 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. Sanitary wastewater management is the most important factor affecting nitrate levels in groundwater throughout most of the County. Due to the significant contribution of groundwater baseflow to the County's surface waters, improved sanitary wastewater management practices can also affect nitrate levels in surface waters.

The impacts of rising sea level could be very significant in coastal areas and along the forks, with significant implications for water supply, storm water and sanitary waste management, as well as more widespread flooding. The impacts of sea level rise on the location of the saltwater interfaces must also be monitored and addressed from a water supply perspective. The impacts of both sea level rise and more frequent extreme precipitation events should also be monitored so that wastewater and storm water runoff management strategies can be developed and implemented.

Recommendations

Given the disparate construct of wastewater treatment between the Nassau and Suffolk Counties, the preponderance of recommendations must necessarily be tailored to their respective circumstances. There are, however, some shared principles. Their large-scale STPs are located in close proximity to the ocean and are thus subject to the vicissitudes of sea-level rise. It is one thing to draw notice to the jeopardy coastal infrastructure may face moving forward and another matter entirely to face as practical proposition, both in terms of logistics and costs. In the near term, the challenges faced by existing STPs will necessarily be addressed in place. It is essential to coordinate with federal, state, and local partners to continue to assess the vulnerabilities to sea level rise.

As harmful algal blooms are an island-wide issue, it is imperative to engage a coordinated strategy to reduce sources of nitrogen and other contaminants of concern and address wetland stewardship and shellfish restoration as well as continuing to support and fund the use, where appropriate, of marine plants and shellfish as biofiltration to reduce pollutants in surface waters.

Nassau County Priorities

Nassau County priorities include nitrogen reduction, storm hardening, and contaminants of emerging concern (CECs). Nitrogen reduction differs for Nassau County's north shore and south shore. The north shore must find cost effective means to improve residential on-site septic systems and to leverage the available wastewater treatment capacity of the Glen Cove WWTP. The south shore must remove the Bay Park STP effluent discharge from local waterway (Reynolds Channel/western bays) through either a new ocean outfall or diversion of treated effluent to the Cedar Creek WPCP to share existing ocean outfall. Funding for this project has not yet been identified. As learned from Superstorm Sandy, climate change is a concern as treatment facilities are located near shorelines for ease of discharge. Storm mitigation/hardening must be considered along with usual technical aspects of a project. Contaminants of emerging concern, including pharmaceuticals and personal care products, are increasingly being detected at low levels in surface water and there is concern that these compounds may have an impact on aquatic life. Given the vast number, types, and complexities of these contaminants, it is vital that federal and state agencies develop guidance information so that owners of wastewater treatment plants can include best practices in projects for mitigating impacts.

Suffolk County Objectives

STPs

- Siting of new or expanded STPs within the zero to twenty-five year contributing area to sensitive surface waters should be minimized to the extent feasible; if an STP is located within this zone, an advanced treatment process shall be provided (SCDHS, 2014).
- Widespread adaption of discharge regulation that utilize mass loading of nitrogen rather than effluent concentration (parts per million). Currently, STPs discharging to the Long Isalnd Sound have this type of restriction.
- Promotion of STP treatment technologies that addresses CECs.
- Accelerate wastewater reuse, mining for resources, energy production, and source separation as ways to better value wastewater.

- Identify and prioritize parcels and determine the sewage treatment plant capacity to permit the connection of identified parcels.
- Identify and implement treatment technologies to improve wastewater effluent quality to reduce impacts and for permitting water reuse akin to Riverhead STP's initiative to re-use wastewater effluent for golf course irrigation for consideration countywide.

I/A OWTS & Appendix A Systems

- Prioritize parcels in critical areas that shall be required to install nitrogen-reducing I/A OWTS
- Amend the Suffolk County Sanitary Code Article 6 to revise GWMZ 4 density requirements to conform to GWMZs 3, 5, and 6 to improve groundwater protection in the zone and improve surface water quality in the Peconic Estuary.
- Moving forward, separation distances between a water supply well and the leaching field of OWTS should be sufficient to ensure both pathogen removal and contaminants of emerging concern removal. Horizontal setback distances between OTWS and surface waters should be increased in order to increase treatment of CECs and PPCPs.
- Create a Wastewater Management District with a Responsible Management Entity (RME) to oversee the financing, operation, maintenance, and enforcement of I/A OWTS and cluster systems. Consider municipal partners to help advance installations.
- Create and/or identify funding sources and costs to meet on-site system objectives. Continue to advance a range and combination of onsite solutions that can treat to higher levels of treatment. Allow the vetting of systems to occur regionally to speed the acceptance of a larger range of options.
- Evaluate ways to reduce costs for the installation, oversight, and maintenance of on-site systems. (e.g., guaranteeing X number of sales to manufacturers, alternative reporting methods, reduced permit fees for I/A OWTS upgrades, etc.)
- Allow installations of nonproprietary, natural, and source separation systems.
- Modify the Sanitary Code to minimize the "grandfathering" of SPDES and/or SCDHS-permitted sanitary flows that exceed and predate Sanitary Code density requirements on other than single-family residential lots, without the installation of an I/A OWTS or connection to sewers; Review options to effect upgrades under the Environmental Conservation Law, New York State Codes, Rules, and Regulations, and SPDES. Assess feasibility of updating the Sanitary Code to prohibit the replacement of failed on-site wastewater technology (e.g., "replacement in-kind") without SCDHS approval.

Database

- Implement a comprehensive integrated data collection, analysis, and evaluation program to monitor groundwater, drinking water, and surface water, and guide informed protection and management strategies.
- Reinstate comprehensive groundwater and stream monitoring program and report annually.
- Implement and upgrade the Bureau of Public Health Protection and Division of Environmental Quality databases and enhance their capabilities to provide a comprehensive integrated geo-coded data management program for all regulated facilities, public, and non-residential private wells (location, pumpage, and quality), private well quality, groundwater and surface water quality data, saltwater intrusion monitoring data, facility data, inspection records, STP Discharge Monitoring Reports (DMRs) and monitoring data, and on-site wastewater management systems' installation, maintenance, inspection, and performance.
- Work closely with federal, state, and local partners to share readily accessible, actionable information, identify synergies, and share resources.
- Evaluate feasibility of inter-governmental water resource cradle-to-grave data management plan. (USEPA, USGS, NYSDEC, New York State Department of Health, SCDHS, Suffolk County water Authority, towns and villages, other suppliers, stakeholders, etc.).
- Continue to support and coordinate with the Peconic Estuary Program, the Long Island Sound Study, and the South Shore Estuary Reserve Program to implement projects.

References

The New York Times. May 15, 1931. “Sanitary Board Urged For Nassau.” Page 20.

Lockwood, Kessler, & Bartlett. May 1958. (Reporting to the Nassau County Commissioner of Public Works). A Report on Major Drainage Requirements of Eastern Nassau County, Part II, Sanitary Sewage.

Environmental Protection Agency. 1972. Environmental Impact Statement on Waste Water Facilities Construction Grants for Nassau and Suffolk Counties, New York.

Eliassen, R. and G. Tchobanoglous. Environmental Science & Technology, Volume 3, Number 6. 1969. Removal of Nitrogen and Phosphorous from Wastewater. Pp 536-541.

Eysen, E., Newsday. April 24, 1969. “U.S. Warns Suffolk It May Act on Sewers.”

Office of Suffolk County Executive, Suffolk County, New York. 1962. Report on Need and Feasibility for Public Sewerage Disposal Facilities in Western Suffolk.

Lane, E., Newsday. September 26, 1969. “Sewers Needed Now, Suffolk Warned.”

Nassau-Suffolk Regional Planning Board. March 21, 1969. Utilities Inventory & Analysis. Report of the Suffolk County Sewer Agency to the Suffolk County Board of Supervisors, New York.

Board of Supervisors. 1978. Long Island Comprehensive Waste Treatment Management Plan.

United States Census. QuickFacts, Suffolk County, New York. www.census.gov/quickfacts/table/PST045215/36103 http://censusviewer.com/county/NY/Suffolk.

Long Island Regional Planning Board. 1978. Long Island Comprehensive Waste Treatment Management Plan (Long Island 208 Study).

CDM Smith. May 2014. Suffolk County Sewer District Capacity Study (Sayville Study Area). www.suffolksewerstudy.cdmims.com/Libraries/documents/CP_8189_Sayville_Final.sflb.ashx.

Suffolk County Department of Health Services. 2014. Evaluation of Nitrates in Suffolk County, New York Public Water Supply Wells.

Jonathan Wanlass. Suffolk County Department of Health Services. 2010. Draft Comprehensive Nitrogen Impact Study on the South Shore of Suffolk County, New York.

Dvirka & Bartilucci Consulting Engineers for Suffolk County Department of Health Services. 1987. Suffolk County Comprehensive Water Resources Management Plan.

Kinney, E.L. and I. Valiela. Journal of Coastal Research 27. 2011. Nitrogen Loading to Great South Bay: Land Use, Sources, Retention, and Transport from Land to Bay. Pp. 672–686.

Reilly, T. E., and H.T. Buxton. United States Geological Survey. 1985, “Effects of Sanitary Sewering on Groundwater Levels and Streams, Long Island, New York. Part 3 Model Development for Southern Nassau County”. Water Resources Investigations 83-4210. P. 41.

Camp, Dresser, and McKee. 1995. Suffolk County Flow Augmentation Needs Study – Final 1995 Monitoring Report. Suffolk County Department of Public Works.

Camp, Dresser, and McKee. 2002. Suffolk County Flow Augmentation Needs Study - Final 2002 Monitoring Report. Suffolk County Department of Public Works.

www.suffolkcountyny.gov/Departments/HealthServices/EnvironmentalQuality/WaterResources/ComprehensiveWaterResourcesManagementPlan.aspx. Pp. 3-118.