Task 3A Report

Wastewater Management in Nassau and Suffolk Counties

This report expands upon existing reports in the Interim Long Island Commission on Aquifer Protection (LICAP) Groundwater Resource Management Plan (GRMP) related to wastewater management. Additionally, the costs of infrastructure relative to both Nassau and Suffolk Counties will be evaluated, where the latter has nearly 70% of the population unserved by community wastewater treatment (either public or private). Before delving into these specifics and for ease of reference, some history and statistics are presented. The sources of reference from Chapter 5 of the Interim GRMP and some of the references cited herein may differ nominally on exact figures and percentages, but all data is on the same order of magnitude and does not impact the purposes of this report relative to its analysis.

Long Island Wastewater Background

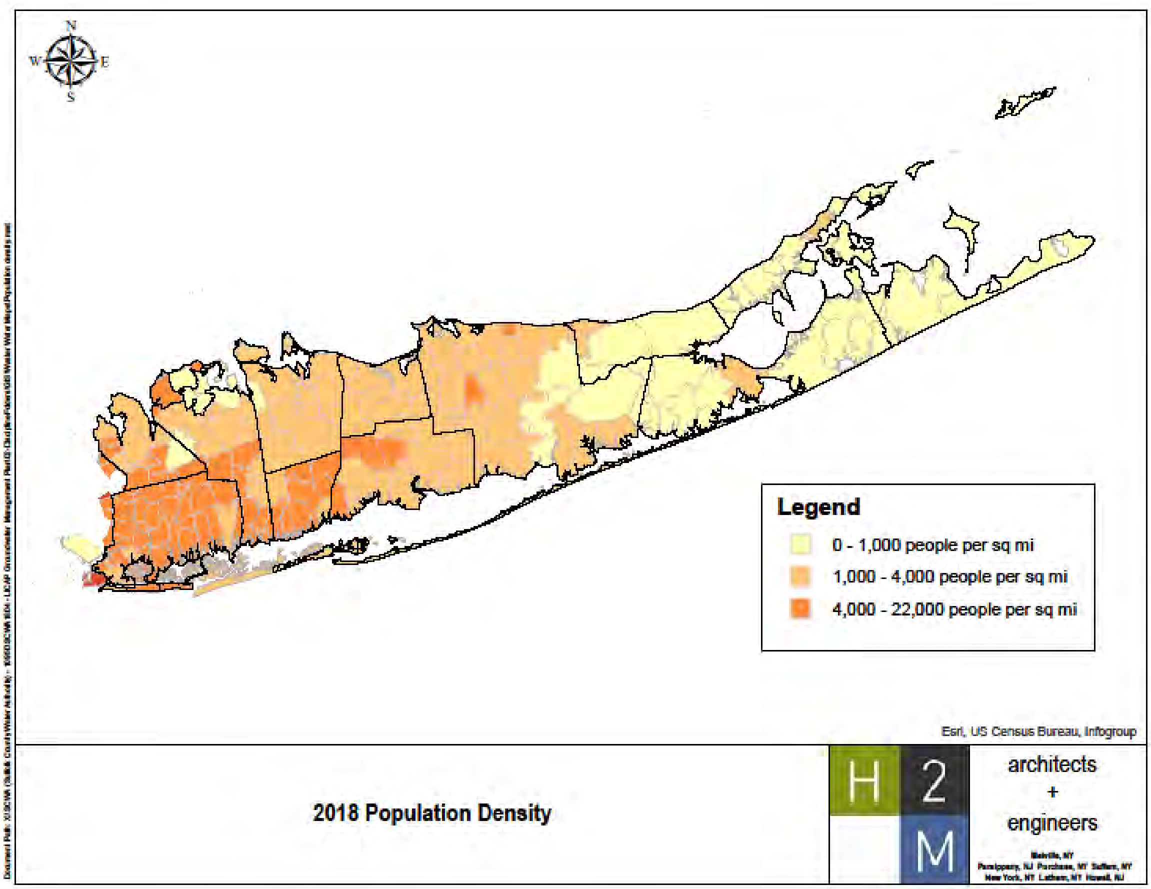
Modern wastewater collection, conveyance, and treatment infrastructure exists to varying extents throughout Nassau and Suffolk Counties. The oldest of this infrastructure dates to the early 1900s and was originally constructed to provide sanitation to many of the local downtown business corridors of Villages and Hamlets that did not otherwise have available space for the siting of individual on-site wastewater disposal systems. As development expanded outside of these local downtown business corridors, throughout Nassau and Suffolk Counties, environmental controls were put in place to regulate how wastewater was managed to protect the environment and human health. With advancements in technology, and our understanding of how new contaminants impact our local water resources (i.e. surface and ground waters), more rigorous regulations have evolved. These regulatory changes have done much to improve environmental impacts to streams, rivers, and oceans, along with their natural habitats; however, they are not identical to the regulatory requirements and concerns related directly to drinking water. Many of the new wastewater regulations have focused on reductions of nutrients, like nitrogen and phosphorus, in waterways, but do not consider the broader context and potential impacts of the various other constituents that are contained in municipal wastewater, such as pharmaceuticals and personal care products (PPCPs), heavy metals, and household solvents and cleaners. Scientific consensus on the criticality of PPCPs for example, does not yet appear to have been achieved.

Moreover, the efficacy of wastewater treatment processes for removal of these constituents, through practices currently routinely employed by conventional treatment facilities, is still under review. Research suggests that membrane reactor or activated sludge systems and aeration may be effective in managing endocrine disruptor chemicals (EDCs). Activated carbon has been demonstrated to be effective with pesticides and pharmaceuticals, but until wastewater regulations drive the implementation of these types of technologies, there will remain a gap between the two ends of the water cycle, wastewater, and drinking water.

Currently, Nassau County's wastewater infrastructure is primarily comprised of municipally owned and operated facilities that provide collection, conveyance, and treatment to approximately 90% of the wastewater generated. In contrast, Suffolk County's wastewater infrastructure is comprised of a mix of municipal, private, Federal and State agency owned and operated facilities, that combined, provide collection, conveyance, and treatment to approximately 30% of the wastewater generated.

For the purpose of performing a high-level assessment of the level of additional infrastructure build-out and costs, we will use population density and theoretical wastewater generation values to provide projections. Population data published by the United States Census Bureau, dated July 1, 2017[1], identify Nassau County to have an estimated population of approximately 1.37 million persons and Suffolk County as having an estimated population of approximately 1.50 million persons. The Census Bureau also defines the boundary of Nassau County to encompass a total area of 453 square miles, of which 285 square miles is comprised of land (i.e. 63%) and 168 square miles are comprised of water (i.e. 37%). The 285 square mile land area is further reduced by 25 square miles of parks and open space to arrive at approximately 260 square miles of developable land area. Dividing the population by this land area yields an average population density of approximately 5,270 persons per square mile. Similarly, the same data source defines the boundary of Suffolk County to encompass a total area of 2,373 square miles, of which 912 square miles are comprised of land (i.e. 38%) and 1,461 square miles are comprised of water (i.e. 62%). The Suffolk County land area is further reduced by 118 square miles, which includes parks, open space, and non-developable areas of the pine barrens, leaving approximately 794 square miles of developable space. This projects to a Suffolk County average population density of 1,890 persons per square mile. The population density in Nassau County is slightly less than three times greater than that of Suffolk County. Figure 1 shows this population density across Long Island.

Figure 1 Population Density on Long Island



[1] United States Census Bureau. Web. 3 April 2019. https://www.census.gov

To create theoretical per capita wastewater volumes, reference was made to the Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers (GLUMBR) Recommended Standards for Wastewater Facilities (commonly referred to as Ten States Standards), of 100 gallons per day per capita (gpdpc). This was applied to the estimated population for Nassau County and Suffolk County, to yield theoretical average daily wastewater generation rates of 137 million gallons per day (MGD) and 150 MGD, respectively.

Existing Nassau County Wastewater Treatment Status

The Bay Park Sewage Treatment Plant (STP) and Cedar Creek Water Pollution Control Plant (WPCP) provide treatment for approximately 88% of the 132 MGD of wastewater collected within Nassau County. The flow treated by these two facilities is collected within unincorporated areas of the county as well as the following municipal sewer districts: the Villages of Cedarhurst, Lawrence, Garden City, Freeport, Mineola, Hempstead, Roslyn, and Rockville Centre. The remaining 12% of the collected wastewater within Nassau County is treated at the following facilities: Glen Cove Water Pollution Control Plant, City of Long Beach Water Pollution Control Plant, Jones Beach State Park Sewage Treatment Plant, Port Washington Water Pollution Control District, Belgrave Water Pollution Control Plant, Great Neck Water Pollution Control District, Greater Atlantic Beach Water Reclamation District, and Oyster Bay Sewer District. See Table 1 below for permitted and actual flows, along with available capacities for each of the facilities currently in operation within Nassau County.

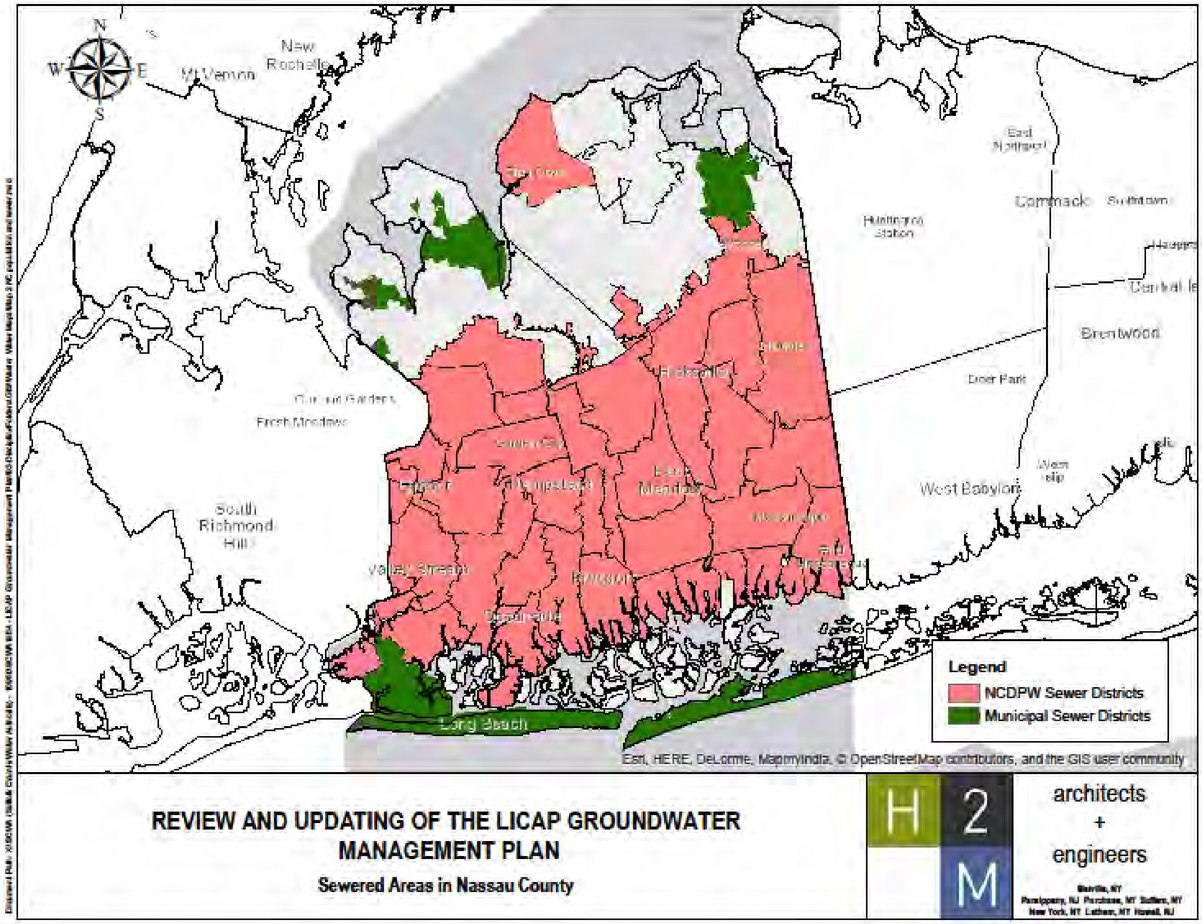
Table 1 Nassau County Treatment Facilities Flows[2]

Facility	Permitted Flow (MGD)	Actual Flow (MGD)	Available Capacity (MGD)
Bay Park	70.00	58.00	12.00
Cedar Creek	72.00	58.00	14.00
Glen Cove	5.50	2.70	2.80
Long Beach	7.50	4.60	2.90
Jones Beach	2.50	0.08	2.42
Port Washington	4.00	2.60	1.40
Belgrave	2.00	1.30	0.70
Great Neck	5.30	2.90	2.40
Atlantic Beach	1.50	0.80	0.70
Oyster Bay	1.80	1.10	0.70
Totals	172.10	132.08	40.02
		% Available Capacity	23%

Refer to Figure 2 for an overview map that illustrates the general location of the sewer coverage areas in Nassau County.

[2] Excess capacity as indicated may not necessarily be available for new development, as some or all of that excess capacity may already be associated with existing parcels.

Figure 2 Sewered Areas of Nassau County



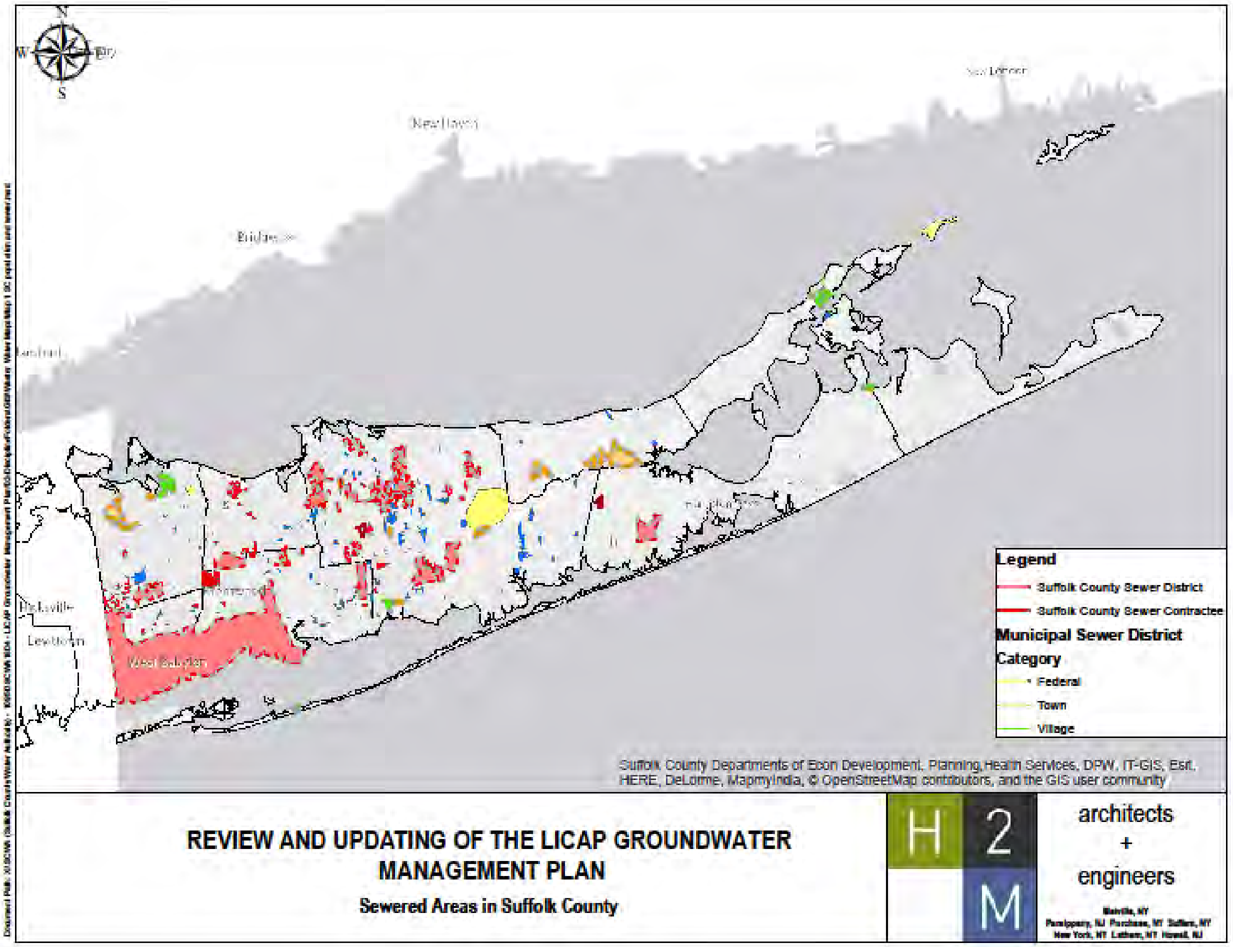
The wastewater treatment facilities summarized above discharge all treated effluent to surface waters surrounding Nassau County, totaling approximately 132 MGD of actual flow, with a permitted discharge equal to 172 MGD. This practice diverts this volume of potential recharge water from where it could help reduce water pumpage stress on the aquifer. The pumping stress is amplified during warm weather months when there is increased demand on the water supply wells, mainly due to residential/commercial irrigation and other non-potable uses (e.g. swimming pool make-up water, commercial HVAC cooling tower make-up water, etc.) that generally do not exert a demand on the water supply during cold weather months.

The remaining wastewater generated in Nassau County, approximately 5 MGD, is currently disposed via on-site wastewater disposal systems (consisting of septic tanks and/or cesspools), which provide no advanced levels of treatment and allow untreated wastewater to naturally attenuate through subsurface soils until it reaches the water table.

Existing Suffolk County Treatment Status

Suffolk County is essentially the inverse of Nassau County. Refer to Figure 3 for an overview map that illustrates the general location of the sewer coverage areas in Suffolk County.

Figure 3 Sewered Areas of Suffolk County



The existing wastewater infrastructure is comprised of facilities that are owned and operated by Federal, County, Town, Village, and private entities. Based on information obtained from Suffolk County Department of Public Works (SCDPW) last revised on September 24, 2012[3], there are four Federal facilities, 24 County districts, 9 Town districts, 5 Village systems and 153 private facilities. The total combined permit capacity for the Suffolk County wastewater facilities is approximately 58 MGD, with actual flows of approximately 47 MGD. Using the theoretical wastewater generated by Suffolk County at 150 MGD, this means that approximately 30% of Suffolk County is provided with wastewater collection, conveyance, and treatment infrastructure.[4] See Table 2 below for permitted flow, actual flow, and available capacities for each category of facilities currently in operation within Suffolk County.

[3] Suffolk County Department of Public Works. Web. 3 April 2019. https://www.suffolkcountyny.gov/Departments/Economic-Development-and-Planning/Planning-and-Environment/Cartography-and-GIS/Sewered-Areas-and-Sewage-Treatment-Plants-Maps

[4] Suffolk County estimates that in 2019 this number is closer to 26%.

Table 2 Suffolk County Treatment Facilities Flow[5]

Facility	Permitted Flow (MGD)	Actual Flow (MGD)*	Available Capacity (MGD)
29 County Districts	42.72	31.60	11.12
4 Federal Facilities	2.80	2.80	0.00
9 Town Districts	1.65	1.65	0.00
5 Village Systems	2.65	2.65	0.00
153 Private Facilities	8.20	8.20	0.00
Totals	58.02	46.90	11.12
		% Available Capacity	19%

* Actual flow values used for Federal, Town, Village, and Private facilities are equal to permitted flow using the assumption that there is no available capacity.

Based on the same data set, 32.8 MGD, or approximately 67% of actual flow, discharges treated effluent to surface water. The remaining treated wastewater in Suffolk County (14.1 MGD) is recharged into the ground.

Performance of Existing Sewage Treatment Plants in Suffolk County

As of 2017, Suffolk County has 200 operational centralized and decentralized STPs, the vast majority of which are designed to remove nitrogen from the wastewater with typical effluent total nitrogen of 10 milligrams per liter (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 2017 average effluent total nitrogen for the tertiary plants in Suffolk County was 6.3 mg/L, which is less than the maximum allowed of 10 mg/L per State Pollution Discharge Elimination System (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 24 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 has completed its expansion to 40 MGD with permit effective on July 22, 2019. Bergen Point STP is a secondary plant that discharges treated effluent two miles offshore into the Atlantic Ocean.

Recent Suffolk County Department of Health Services (SCDHS) actions facilitated STP upgrades and repairs, the reduction of nitrogen in STPs County-wide that has far surpassed regulatory requirements in many cases, and the overall compliance rate with New York State Department of Environmental Conservation (NYSDEC) effluent requirements is notable. Recent observations and trends included STP permit compliance improving significantly; overall tertiary STP compliance in 1990 was 35% and

[5] Excess capacity as indicated may not necessarily be available for new development, as some or all of that excess capacity may already be associated with existing parcels.

is now 93.7% (based on plants in steady state). This has translated into nitrogen reductions. Overall effluent Total Nitrogen (TN) for plants in steady state is down, from 9.9 mg/L in 2011 to 6.3 mg/L using data from all 175 tertiary plants in steady state in 2017 (6.6 mg/L if the seven non-steady State plants were included in the average). Nitrogen outputs from the 165 low risk tertiary plants now averages 5.5 mg/L.[6]

Recent Sewer System Expansion In Suffolk County

In 2014, Governor Andrew Cuomo announced that $383 million of funding would be made available to sewer communities along four river corridors, the Carlls River in Babylon; the Forge River in Mastic; the Patchogue River in Patchogue; and the Connetquot River in Great River, all of which are low-lying areas along Suffolk County's south shore that had been inundated by Superstorm Sandy. The leading goal of the project is to reduce nitrogen pollution to ground and surface waters to improve coastal resiliency against future storm events. These Suffolk County Coastal Resiliency Initiative (SCCRI) sewer extension projects are being funded through the Governor's Office of Storm Recovery's (GOSR) post-Sandy resiliency funding.

In January 2019, the Babylon, Mastic, and Great River projects went to ballot for public vote. As the Patchogue community was already served by a community sewer system, no vote was taken. The Babylon and Mastic projects were approved by 87% and 85%; while the Great River project, the smallest of the three, failed. Therefore, the two projects are being advanced as well as the Patchogue project. The funding earmarked for the Great River project was shifted to serve the Oakdale community, Great River's easterly neighbor. In addition, two other regional projects, the Ronkonkoma Hub extension and the Kings Park Business District, have received funding for design and/or construction.

The balance of the generated flow, approximately 103 MGD or 74% of estimated wastewater generated in Suffolk County, is handled via individual traditional on-site wastewater disposal systems that discharge wastewater directly back into the ground at each wastewater source location.

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) and serve most residential and commercial buildings within the County.

Suffolk County estimates indicate that there are approximately 19,000 active commercial properties within the 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 use cesspools as a means of sewage disposal.

Recent On-Site Treatment System Developments in Nassau and Suffolk Counties

[6] 2017 Suffolk County Sewerage Treatment Performance Report

To address the need for advanced treatment while recognizing the inherent expense associated with such treatment, the Suffolk County Comprehensive Water Resources Management Plan[7] established the first integrated framework to address the legacy problem from on-site wastewater disposal systems in an effective process 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 On-site Wastewater Treatment Systems (I/A OWTS) would be a critical component of any overall wastewater management strategy in Suffolk County.

To identify areas that might benefit most from I/A OWTS versus sewering and/or other mitigation measures, the Comp Water Plan recommended an integrated campaign to launch the use of I/A OWTS in Suffolk County. The integrated strategy began with two I/A OWTS demonstration programs to evaluate the performance of I/A OWTS in Suffolk County and to initiate creation and promotion of a local I/A OWTS market. Contemporaneously, the Suffolk County Legislature enacted Article 19 of the Suffolk County Sanitary Code in 2016, which permits the use of I/A OWTS in Suffolk County. In addition, it set forth the testing and approval requirements for new I/A OWTS; requirements for operation and maintenance (O&M) 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.

Since the cost of sewering has become prohibitively expensive in most applications, it is expected that a 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. As of September 2019, the typical cost for such a system at a site with no complicating factors is running at about $22,000-$25,000 with a pressurized shallow drainfield. An amendment in 2016 of Article 19 of the Suffolk County Sanitary Code authorizes the SCDHS to act as RME in the evaluation, approval, registration, and oversight of I/A OWTS installations.

In 2017, the Suffolk County Septic Improvement Program (SIP), was launched in New York State. The SIP promotes the use of I/A OWTS in Suffolk County and also acts as a pilot program for the eventual implementation of a larger county-wide 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 Pressurized Shallow Drainfields (PSDs) following their I/A OWTS (PSDs allow shallow dispersal of treated effluent to enhance treatment).

The State portion of the funds are 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

[7] https://www.suffolkcountyny.gov/Departments/Health-Services/Environmental-Quality/Water-Resources/Comprehensive-Water-Resources-Management-Plan

Suffolk County. The SSRP funds are available to residents in grants of up to $10,000 toward the purchase of an I/A OWTS.

Select individual Towns and Villages have also taken proactive measures to reduce nitrogen from (on-site disposal systems (OSDS) within their respective jurisdictions by setting forth local laws requiring the installation of I/A OWTS and/or by offering I/A OWTS rebate program using Community Preservation Funds (CPF). In 2018, the five East End towns, pursuant to a referendum, approved allocation of 20% of the CPF for rebate purposes.

Similarly, but on a much smaller scale, Nassau County was awarded $1 million from the State SSRP for the reimbursement of replacing property owners failing septic systems. The funds would be available for property owners in grants of up to $10,000 towards the installation of an I/A OWTS which reduces nitrogen concentrations in effluent by 30%. The program in Nassau County will be rolled out in 2020.

On-Site and Conventional Treatment Versus Water Quality Concerns

Existing on-site wastewater disposal systems are, at best, only partially treating wastewater and allow for nitrogen and other contaminants of concern to continue to impact surface and groundwater within both Counties. Suffolk County has commendably amended their Sanitary Code to allow for the installation of I/A OWTS to replace existing OSDS. The I/A OWTS is intended to reduce the nitrogen concentrations, compared to what would otherwise be discharged by a traditional on-site wastewater disposal system, into the ground. However, these systems do not address pharmaceuticals, personal care products, heavy metals, home cleaning agents, etc. While the I/A OWTS are not intended to allow for increased density, they are viewed as a cost-effective option when compared to providing advanced treatment to properties located in areas of the County where connection to central collection, conveyance and treatment infrastructure is not yet cost effective. The I/A OWTS program established by Suffolk County is a practice for Nassau County to consider in evaluating better on-site management of their water resources in the unsewered areas of the County. Importantly, traditional wastewater plants, with state-of-the-art technologies for advanced treatment do not currently focus on many of these contaminants either. Monitoring and evaluation of treatment impacts to water suppliers needs to be carefully assessed in concert with any decision to more expansively re-purpose the effluent from wastewater plants directly to the aquifer. Existing wastewater treatment facilities are not required, nor designed, to remove the same contaminants as drinking water treatment facilities. Therefore, discharge limits on wastewater facilities should be re-evaluated if groundwater recharge were to be implemented more broadly as a potential water resource recovery and reuse alternative, to promote improved quality of the local groundwater resources. In a very basic way, wastewater plants operating under current regulations would be discharging water with potential contaminants that receiving drinking water facilities would be required to treat (filter, air-strip, oxidize, etc.) for removal. It should also be noted that many of these contaminants are currently not directly regulated by the drinking water regulations. Requiring increased treatment of the wastewater facilities would essentially shift treatment costs for drinking water from the drinking water utility to the wastewater utility. Because, in the vast majority of cases on Long Island, there are different agencies or districts managing the two disparate enterprise goals, reconciliation of these costs would become an obvious issue needing resolution through appropriate policies. The New York State Department of Health (NYSDOH) and NYSDEC, while coordinated by the Governor's office on many planes, are somewhat autonomous of each other with regard to regulatory authority over the bifurcated responsibilities surrounding all aspects of water as a singular resource. The DOH is focused, as it relates to water, with drinking water and its impacts on public health. DEC is focused, as it relates to wastewater, on public health and water quality of the oceans, streams, estuaries, lakes, etc. Reconciling authority on issues related to all aspects of water, could perhaps pave the way for the resolution of the challenges related to different regulations created for different intents.

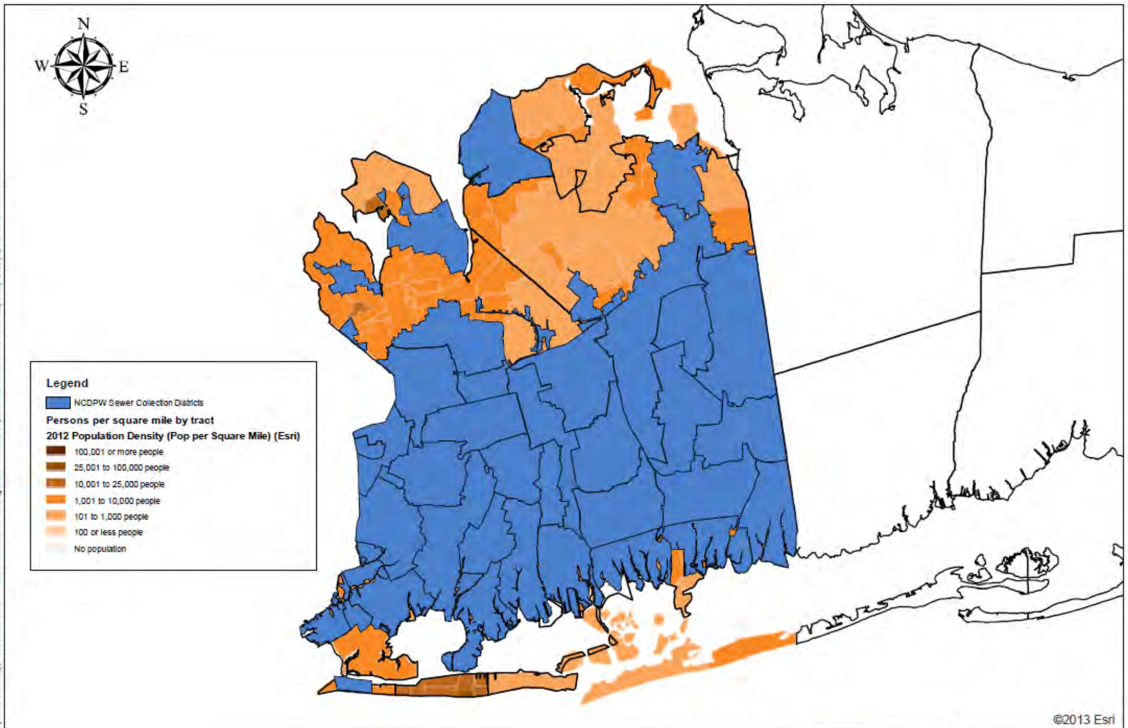
Concerns regarding sea level rise and associated increases in water table elevations, fall into two major categories. First, the likelihood of more frequent failures and second, the effects of untreated wastewater on the aquifer, as travel time between on-site disposal systems and the aquifer decrease.

Constrained manpower and financial resources required to keep pace with the large number of private facilities in Suffolk County has resulted in inconsistent effluent water quality oversight. Consolidation of facilities and/or districts in Suffolk County is one approach being considered to manage the effluent water quality. Reducing the number of facilities by converting existing treatment infrastructure into pump stations and interconnecting districts would reduce the total number of treatment facilities that need to be operated and maintained. However, initial capital improvement costs and limited land area for expansion are key factors that must be considered as part of the feasibility analysis that would be required as part of the planning process. In addition, the consolidation concept is viewed as a potential mechanism to reduce overall life cycle costs by providing larger scale treatment facilities, similar to what is in existence in Nassau County, that could be more effectively leveraged to support wastewater recovery, reuse, and potential recharge of treated wastewater back to the aquifer.

Potential for Additional Sewers on Long Island

Abandonment of existing on-site wastewater disposal systems and connection to collection, conveyance, and treatment infrastructure will remove direct point sources of nitrogen and other contaminants of concern from continuing to impact the water quality of the aquifer and related surface water bodies. By providing additional sewers and treatment facilities, the reduction of nitrogen and other contaminant discharges will allow for higher density districts and increase the potential for water reuse possibilities based on larger facilities with higher capacities and new designs which incorporate water resource recovery methods. In this section we discuss the approximate costs associated with providing additional collection, conveyance, and treatment to Nassau and Suffolk Counties.

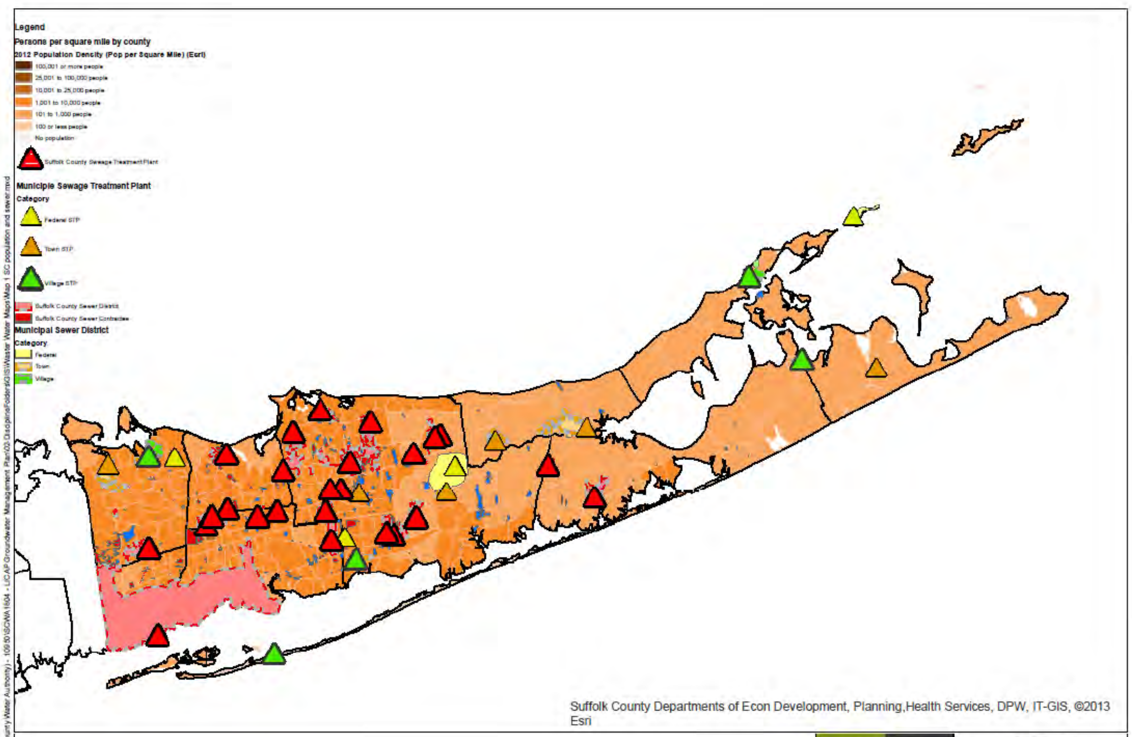
The figures below show the existing sewering and population densities of each of the respective counties:



REVIEW AND UPDATING OF THE LICAP GROUNDWATER MANAGEMENT PLAN

Sewered Areas and Population in Nassau County

H2M architects + engineers
Melville, NY
Parsippany, NJ Purchase, NY Suffern, NY
New York, NY Latham, NY Howell, NJ



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Costs:

Planning studies have been commissioned in both Nassau and Suffolk Counties to evaluate the feasibility of providing new sanitary infrastructure to parts of each County that are currently unsewered. These studies were spearheaded by each County's Department of Public Works (DPW). The analytical methods, including costs/benefits evaluation have been made available to varying levels of detail. For purposes of this report, the cost information identified in the Suffolk County DPW feasibility study to sewer portions of Mastic and Shirley has been used as the basis to distribute engineering design and construction costs consistently across the unsewered areas of both Counties. A $700 million project cost, which included engineering, soft and construction costs for collection, conveyance and treatment, was identified for approximately 9,900 properties across a seven square mile service area. The study further identified the breakdown in costs for conveyance to be 80% and treatment to be 20% of total costs. Extrapolating this data produces costs per parcel as shown in the table below:

Estimated Project Cost	Parcels Served	Cost/Parcel	Conveyance Component	Treatment Component
$700,000,000	9,900	$70,707	$56,566	$14,141

This cost breakdown is representative of the costs per parcel in the Mastic/Shirley area, which, for this discussion, is assumed to have a population density of 2800 capita per square mile. For analysis purposes a cost for overall treatment and conveyance of $71,000 and for conveyance only of $57,000 will be used, adjusted to the ratios of population densities in the distinct Counties. This approach presents a general macro level approach to identifying the order of magnitude of proposed costs. Utilizing this approach, rough estimates could be generated for more targeted areas dependent upon the specific population density of the focus area. So, for example, Nassau County's average population density is approximately 5,270 capita per square mile. Comparing the Nassau County unsewered areas to the Mastic/Shirley example would result in a factor of 2,800/5,270 or 0.531. Using this factor would suggest that the overall cost per parcel in an average unsewered area in Nassau County would be $37,630 per parcel ($71,000 x 0,531). Similarly, comparing against the average population density in Suffolk County of 1890 capita per square mile, you would arrive at a factor of 2,800/1,890 or 1.48. Extrapolating the Mastic/Shirley Cost to the Suffolk County average unsewered area yields a cost of $105,000 per parcel. ($71,000 x 1.48) The percentage allocation of 80/20 for conveyance and treatment would be viewed as remaining valid. These costs only do not account for the additional cost factors that would otherwise need to be considered for wastewater reuse. These additional costs are considered in greater detail below, but dependent upon location opportunity, they can range between 8-15% higher.

Nassau County recently conducted a sewer feasibility study within Hempstead Harbor communities such as Sea Cliff, Glenwood Landing, Glen Cove, Roslyn Harbor, Greenvale, Port Washington and Crescent Beach. Preliminary construction cost estimates were $670,000,000 to connect 5,606 properties which yields a cost of $120,000 per parcel. This estimate did not include soft costs such as legal, engineering, administrative, and financing.

It has been estimated, in a previous LICAP report,[8] that Nassau County has approximately 50,000 residential properties that currently discharge their wastewater to on-site wastewater disposal systems. Similarly, Suffolk County has approximately 360,000 residential properties discharging their wastewater to on-site wastewater disposal systems. For purposes of this report, it is assumed that each residential property discharging to an on-site wastewater disposal system is comprised of a single family residence and will generate approximately 300 gallons per day (gpd) of wastewater, based on the standard design criteria set forth by SCDHS and Nassau County Department of Public Works (NCDPW). Distributing this standard wastewater generation rate across the unsewered residential properties in Nassau and Suffolk County results in totals of 15 MGD and 108 MGD respectively. These wastewater generation rates and property counts will be used as the basis to estimate costs associated with collection, conveyance and treatment infrastructure as it pertains to the creation of new, consolidation of existing, and/or installation of I/A OWTS. These costs can serve as guides for assessment of necessary efforts to improve the water quality and quantity within Nassau and Suffolk Counties through better management practices focused on the recovery, reuse and potential recharge of wastewater. Note that these rates and volumes are theoretical values and while there is a minor differentiation between these values and actual recorded values at existing treatment facilities, they provide sufficient accuracy for the purpose of this analysis.

In Nassau County, there may be excess available capacity of approximately 38 MGD within the existing treatment facilities which in theory is enough to handle the expected 15 MGD from the 50,000 unsewered parcels. If we assume that collection and conveyance only is needed for the Nassau County unsewered areas for $$30,104 ($37,630 x 0.80) per parcel, this equates to a projected total for providing new sewers, as extensions of existing collection and conveyance systems, of $1.51 billion.

In Suffolk County there may be available capacity of approximately 11 MGD at the existing county facilities. Bergen Point in particular could offer perhaps the greatest opportunity for consolidation based strictly on available flow capacity of approximately 7 MGD. The larger single capacity would allow for the consolidation of a larger area to be served by this single facility. Assuming the entire existing available capacity were able to be utilized, approximately 37,000 parcels would be served at a cost of $84,000/parcel ($105,000 x 0.8), or $3.11 billion. The remaining 323,000 parcels, and 97 MGD, at approximately $105,000/parcel, would amount to an estimated $23.92 billion. In total this equates to an estimated $38.54.0 billion in total capital costs across both counties.

New I/A OWTS are now available to replace traditional on-site wastewater disposal systems for individual properties to provide nitrogen/nutrient removal prior to groundwater recharge. It has been estimated by the Suffolk County Department of Health Services Reclaim Our Water Septic Improvement Program[9] that the average cost for approved systems is approximately $19,200 per parcel which includes engineering and construction of a typical system where existing leaching structures are reused. Using this average cost per I/A OWTS on a typical property, this would result in approximately $960 million and $6.91 billion in today's dollars for Nassau and Suffolk Counties respectively, using the previous estimates of unsewered properties in each county. Use of I/A OWTS would improve nitrogen impacts from unsewered properties and require significantly less capital expenditure, but would not accomplish the higher level of treatment achieved even under current

[8] Dale, Dorian. *Wastewater Management in Nassau and Suffolk Counties*: Long Island Commission for Aquifer Protection, 2017. Web. 3 April 2019. http://liaquifercommission.com/images/Wastewater_Management_Report.pdf

[9] Suffolk County Department of Health Services Reclaim Our Water Septic Improvement Program. Web. 3 April 2019. https://reclaimourwater.info/SepticImprovementProgram.aspx

regulations, at conventional wastewater treatment plants. The difference in costs for the two approaches, total sewering versus exclusive use of IA/OWTS technology, would account for approximately $32 billion dollars. Consideration of how costs for additional treatment, at either a wastewater or drinking water facility, with regard to drinking water systems and the aquifer, which is the overall focus of the LICAP effort, should be analyzed in the context of overall cost benefit for the consumer/taxpayer.

Other Considerations:

The potential negative environmental impacts of sewering existing areas center on the elimination of decentralized groundwater recharge, especially in Suffolk County, where it is more prevalent. These discharges, from on-site wastewater disposal systems, have historically contributed to the overall recharge rate accounted for in the water budget. Concentrating the recharge at a centralized treatment site could affect the gradients in the shallow aquifer such that the rate and transport of existing contaminants of concern in the aquifer could shift and result in worse long-term impacts to supply wells. Conversely, diverting treated wastewater more directly into surface waters, rather than recharging into groundwater, has continued to raise concerns with the existing water budget by its potential reduction of groundwater elevation.

During the design of new sewers and treatment systems, these two methods of treated wastewater disposal must be considered as there will be a trade-off between the effects on water quantity and water quality. Today's wastewater treatment facilities are not currently designed to remove the emerging contaminants of concern, personal care products or pharmaceuticals. Until considerations are made to remove or handle these contaminants, discharge or recharge locations may continue to show elevated levels of these substances. In summary, the issues clearly suggest comprehensive modeling associated with any planned capital sewer collections and treatment initiatives.

Sewage treatment facilities also place a large demand on existing electrical infrastructure which may or may not be able to handle the new loads. Considerations in new designs should include the use of solar and/or wind power for electricity and for collecting biogas for use in supplementing heat generation equipment. Another challenge for sewage treatment is siting, which requires extensive environmental review and impact considerations, including required setbacks from inhabited areas. These challenges are not easily overcome especially in areas that are already developed based on plans that did not consider the siting of wastewater infrastructure, such as the case in already developed and unsewered areas of Nassau County and Suffolk County. Coupled with the aging existing infrastructure the overall cost to maintain the systems will increase the operations and maintenance expense budget. Suffolk County continues to assess and evaluate opportunities to create strategy, districting concepts, funding alternatives, and feasibility of the best-case alternative mix of localized public treatment and enhanced private on-site treatment.

Water Reuse Opportunities

Water reuse possibilities, from greywater to full potable re-use (direct or indirect), have been utilized throughout the country and has been proven to be an effective measures for conservation of water supplies. There are opportunities for recycling water all over Long Island. In the case of re-use systems, the challenges that arise come in many forms, including public perception and education regarding proper practices for handling reuse water and ensuring that there is no potential for unsafe/illegal cross connections. The inexpensive nature of drinking water was too often a deterrent to consideration of these approaches, but with the increased treatment and operations costs associated with emerging contaminant regulations, the economic cost benefit gaps are closing and require careful consideration in planning analyses. The Long Island Nitrogen Action Plan initiated a workgroup in 2017 looking into water reuse, with focus on its nitrogen reduction potential and other secondary benefits, currently establishing acceptable bacterial limits for wastewater reuse at golf courses.

Water Reuse Costs

Water recycling systems, similar to the wastewater treatment options previously discussed, can be restricted to individual on-site systems or be larger scale systems that serve multiple properties and/or regional area. An example of an individual on-site greywater recycling system would be secondary treatment including filtration and disinfection paired with collection piping and holding tank, pumping system and controls where distribution piping would be required to connect to the desired usage whether it is flushing water, cooling tower water or irrigation. A typical skid mounted system capable of up to 200 gpm could cost approximately $300,000 and would include the pumps, controls, UV disinfection and coarse/fine filters. This cost does not include the holding tank, collection piping or distribution piping. These additional costs would be defined based on the application and would be considerably less expensive on new construction as compared to outfitting an existing building which would require extensive demolition to retrofit the additional reuse plumbing appurtenances. Rain and stormwater can also be recycled using similar methods to greywater for similar applications. This is another alternative that can be considered when considering aquifer management to reduce demand exerted on the water supply by supplementing with other external sources. Large-scale/Regional reuse system costs must be considered in addition to the cost for wastewater treatment as current regulation stands. Enhanced levels of treatment, creation of supplemental reuse outfalls and distribution and conveyance systems for reuse water are all factors the need to be evaluated to determine economic impacts associated with any potential large-scale reuse opportunity. The 1.5 MGD Town of Riverhead Water Resource Recovery Facility (WRRF) is one example of a local reuse opportunity that has become a reality. The project was a retrofit of an existing 1.2 MGD Sequencing Batch Reactor including pre-treatment for the removal of inorganic material, an upgrade to the biological treatment process, a new effluent disinfection system and effluent reuse facility to meet the discharge permit, which had been modified to meet the total maximum daily load (TMDL) placed on the Peconic Estuary. The strict nitrogen discharge limit of this facility resulted in the necessity for effluent reuse. A secondary high strength ultraviolet disinfection vessel and two pumping systems were installed in a new effluent reuse facility building to transfer up to a total of 550,000 gallons per day of reuse water for make-up water at the WRRF (up to 100,000 gpd) and golf course irrigation (up to 450,000 gpd). The effluent reuse systems added approximately $2 million, resulting in a total construction cost of $23 million. The project saves up to 100 million gallons of aquifer withdrawals per year.

It should be mentioned that a unique factor of the Riverhead reuse project was that the golf course and the WRRF are direct neighbors sharing a fence between the two properties. A 1,200 linear foot (LF) horizontal directional drill was performed to install a new 10-inch diameter pipe to transfer the treated effluent to integrate with the existing irrigation supply piping. The proximity of both sites is noted as a major cost saving factor. Obviously, efforts to transport treated effluent water to facilities separated by greater distances will require both additional study and expense. To estimate the cost of distribution, a typical water main installation cost of $225 per foot can be used. This translates to approximately $1.2 million per mile, plus pumping and O/M costs, for a typical force main.

Photo 1 – Riverhead WRRF and Neighboring Indian Island Golf Course. The blue building in lower left contains reuse UV and pumping systems and the receiving building for golf course irrigation is located adjacent to the third fairway up from adjoining fence. Each building is approximately 1,200 LF from each other.

When reuse is desired, the economic benefits could be evaluated based on the costs of the reuse systems relative to the decrease in purchased potable/ground water. This would include capital costs for infrastructure and life cycle costs for the additional equipment operations (electricity) and maintenance (repairs and replacements) compared to the long-term water supply rates and projected usage.

Typical water costs on Long Island range from approximately $2/1,000 gallons in Suffolk County to upwards of $5/1,000 gallons in Nassau County. To use the Town of Riverhead example, their average water use for daily plant operations is approximately 100,000 gpd. At the current lower cost of water consumption, this is approximately $73,000/year. With the reuse system online, a 50 hp booster pump runs for 24 hours per day to maintain pressure within the on-site distribution piping. At an average of $0.17/kw-h, the cost to run the pump is approximately $55,000 for an annual savings of $18,000/year. This savings is coupled with up to 36.5 million gallons annually of groundwater that would not be removed from the aquifer to produce this demand by the Riverhead Water District. As water costs rise in Suffolk County, and with the higher costs already in Nassau County, this cost to benefit would likely increase and any payback period would decrease.

Potable Reuse – Indirect and Direct

Consideration of re-use systems involves establishing clear regulations for the use of treated wastewater, likely requiring improvements to current standards of treatment. Identifying wastewater treatment limits as it pertains to the emerging contaminants impacting the drinking water treatment industry, as well as re-imagining the water/wastewater treatment interrelation could optimize the volume of water drawn from the aquifer and create a cost effective, sustainable water resources management approach.

Currently, ground water recharge from treated wastewater is performed at or in proximity to the treatment facility. There are potential positive impacts of looking further into the concept of aquifer recharge by direct injection wells, considered indirect potable re-use. This is a method for providing strategic recharge in areas where quantity and/or quality of groundwater has been compromised. This practice requires extensive study of the hydrogeologic makeup of the receiving area. Injection wells must be carefully considered to minimize potential negative impacts based on over saturation, chemical/biological makeup of the injected vs. the receiving waters and the effect on the natural gradients of groundwater movement. This practice could be specifically directed at areas where emerging contaminants may be at elevated levels and it can be proven that treated wastewater does not contain such contaminants. All stakeholders, water suppliers, regulators and consumers would need to embrace this concept, practices used in places like Clearwater, Florida, and the State of Kansas. In the case of the latter, the Kansas Health Institute performed a 2017 health impact study to evaluate water reuse.

Direct Potable Reuse involves the treatment and distribution, as drinking water, of water without an environmental buffer. This is a concept that is being utilized in the more arid states and requires the wastewater treatment facilities to consider such a high level of treatment that the effluent can be piped directly to the drinking water facilities. On Long Island this alternative may seem impractical as it may make more sense to direct the cost of higher-level treatment capabilities to the drinking water facilities to manage the contaminants of the existing groundwater to meet the needs of the public supply.

Water recycling can be categorized by the different levels of treatment. At its simplest, water can be repurposed as greywater, when the water has been ‘gently’ used, such as the discharge from baths, sinks, washing machines or kitchen appliances. This water can potentially be reused for toilet flushing or other non-potable, non-contact usages. Underground drip irrigation systems in residential, industrial or commercial applications are feasible, but consideration must be given to contaminants such as phosphorus and 1,4 dioxane for example. Wastewater treatment facilities have historically reused the treated effluent for the purpose of supplementing the potable water supply for wash-water of various enclosed systems or makeup water for supplying chemicals into the wastewater treatment process. These practices are currently not mandatory and provide a potential legislative opportunity for increased conservation. For example, Riverhead Sewer District reuses 100,000 gallons of water per day for a 1 MGD treatment plant.

Nassau County constructed and unveiled a water re-use project at the Cedar Creek WPCP. In Wantagh in 2019. The project entails reusing screened effluent from the plant and provides additional treatment for solids removal and for high-level, multiple-barrier disinfection using chlorination and ultraviolet (UV) disinfection. The treated effluent replaces potable water which was used for processes, tank and equipment washing. This water re-use project will save 300 million gallons of potable water per year for an annual savings of $350,000 per year.

Photo 2 – Water re-use system and piping installed at the Cedar Creek Water Pollution Control Plant in Wantagh. The system saves 300 Million gallons of potable water per year for an annual savings of $350,000. The treated effluent is used at the plant for process, equipment and tank washing.

The concept of reusing wastewater effluent on Long Island, for applications with potential public contact was investigated by Nassau County in cooperation with the United States Geological Survey during the late 1960's through roughly 1984. Experiments with direct aquifer injection at the Bay Park STP were performed with mixed results while the East Meadow Brook Artificial Recharge Project returned over 840 million gallons of tertiary treated effluent in a 16 month period to the ground water reservoir through a series of recharge basins and injection wells. While demonstrating technical feasibility, the cost of tertiary treatment and operation of the facility were deemed prohibitive. Pilot studies performed by the Town of Riverhead/Riverhead Sewer District to take the treated water from their existing sequencing batch reactor (SBR) and providing additional treatment using membrane ultrafiltration and high strength ultraviolet disinfection, demonstrated that the health impacts of wastewater reuse for public irrigation, by way of sprinklers, can be considered negligible using currently available processes to provide the microbial and nutrient removals for public contact.

There are precedents and standards from across the country, such as California, Arizona, and Florida, that are in place to govern the level of treatment required for each avenue to ensure that safety is the number one goal in every application. In 1992, the United States Environmental Protection Agency developed a technical document entitled "Guidelines for Water Reuse" which was updated in 2004 and 2012. These standards and precedents can be utilized by regulators in New York State, as well as the local agencies on Long Island, to provide the roadmap for major water consumers to work towards further sustainability and aquifer management. For example, in the case of irrigation, standards for subsurface drip irrigation systems with greywater are very different from sprinkler applications, where highly treated tertiary effluent, to remove pathogens, is required due to the potential health impacts associated with human contact. There are currently no specific regulations for greywater systems in Nassau or Suffolk County. In order to create the standards for public irrigation, the Town of Riverhead had to demonstrate they met levels of treatment identified by the Suffolk County Department of Health Services and the New York State Department of Environmental Conservation, which were compiled based on the strictest standards from the states of Florida, California and Arizona as well as from the United States Environmental Protection Agency. A similar path can be followed for creating local regulations for all types of water reuse opportunities in both Nassau and Suffolk Counties as currently being developed by a workgroup created under the Long Island Nitrogen Action Plan.

Irrigation

Today's new treatment facilities operate within the limits of technology to produce high quality effluent water which is either discharged to surface waters or recharged into the ground after meeting strict permit limitations for nutrient reduction. With these advancements, the potential for recycling/reusing the treated water to decrease aquifer demands for applications such as irrigation for public use, including green space and golf courses, is increasing with every new project. Long Island is home to many recreational parks and athletic fields, crop farms, wineries and sod farms. There are other alternatives being considered or practiced in some arid areas of the country for reusing treated wastewater for irrigation purposes. These practices generally involve groundwater discharges and avoid direct leaf contact. Appropriate environmental and health studies by the regulatory oversight authorities on Long Island would be required to establish safe practices, etc. before implementation.

A typical 18-hole golf course may use up to 300,000 gallons per day to irrigate all the tees, fairways and greens[10]. This operation is typically started in the early spring months and is completed in the late fall months. If we assume a duration of May 1 – November 16 (200 days) and a daily consumption of 300,000 gallons per day, the average golf course could potentially use up to approximately 60,000,000 gallons per year of either potable or private well water. It is assumed that the majority of the irrigation water for golf courses is produced by private wells and that this reuse option will not have a great effect on the water production industry based on the water not being provided by potable water supplies, but will have a marked impact on aquifer water supply by reducing the amount of groundwater extracted by the private irrigation wells.

A listing of golf courses on Long Island from ***LongIslandGolfNews.com*** lists thirty-one (31) 9-hole golf courses and one hundred two (102) 18-hole golf courses. With an average of 300,000 gallons per day per 18-hole golf course, this equates to approximately 35 MGD of irrigation water on any given day. For purposes of converting this consumption to a number that is transferable to other types of sites, it is assumed that an average golf course is approximately 65 acres which leads to approximately 4,600 gallons/acre. Using the previous assumptions of 137 MGD and 150 MGD, 287 MGD total, of potential generated wastewater in Nassau and Suffolk Counties respectively, the golf course irrigation demand across Long Island could potentially reuse approximately 12% of the theoretical 287 MGD of effluent generated should it all be collected and treated or 20% of the 178 MGD currently being treated by existing facilities.

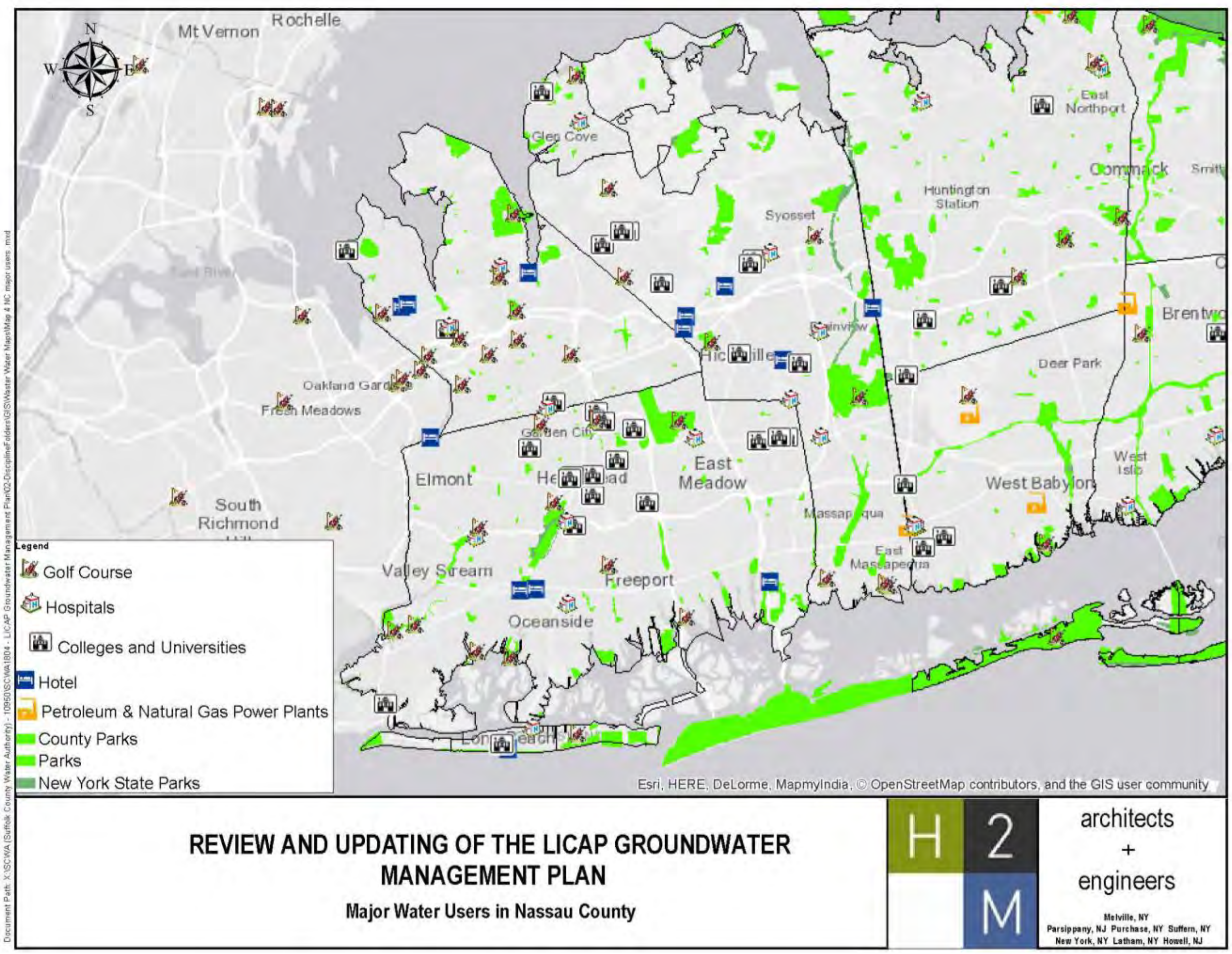
When referring to the Town of Riverhead project, irrigation has become a proven method for safe reuse of their treated wastewater. The main purpose of this project is the preservation of the Peconic Estuary as the diversion of treated effluent reduces the nitrogen mass loading during the warmer months when the receiving waters are being used for recreational purposes. The secondary benefit

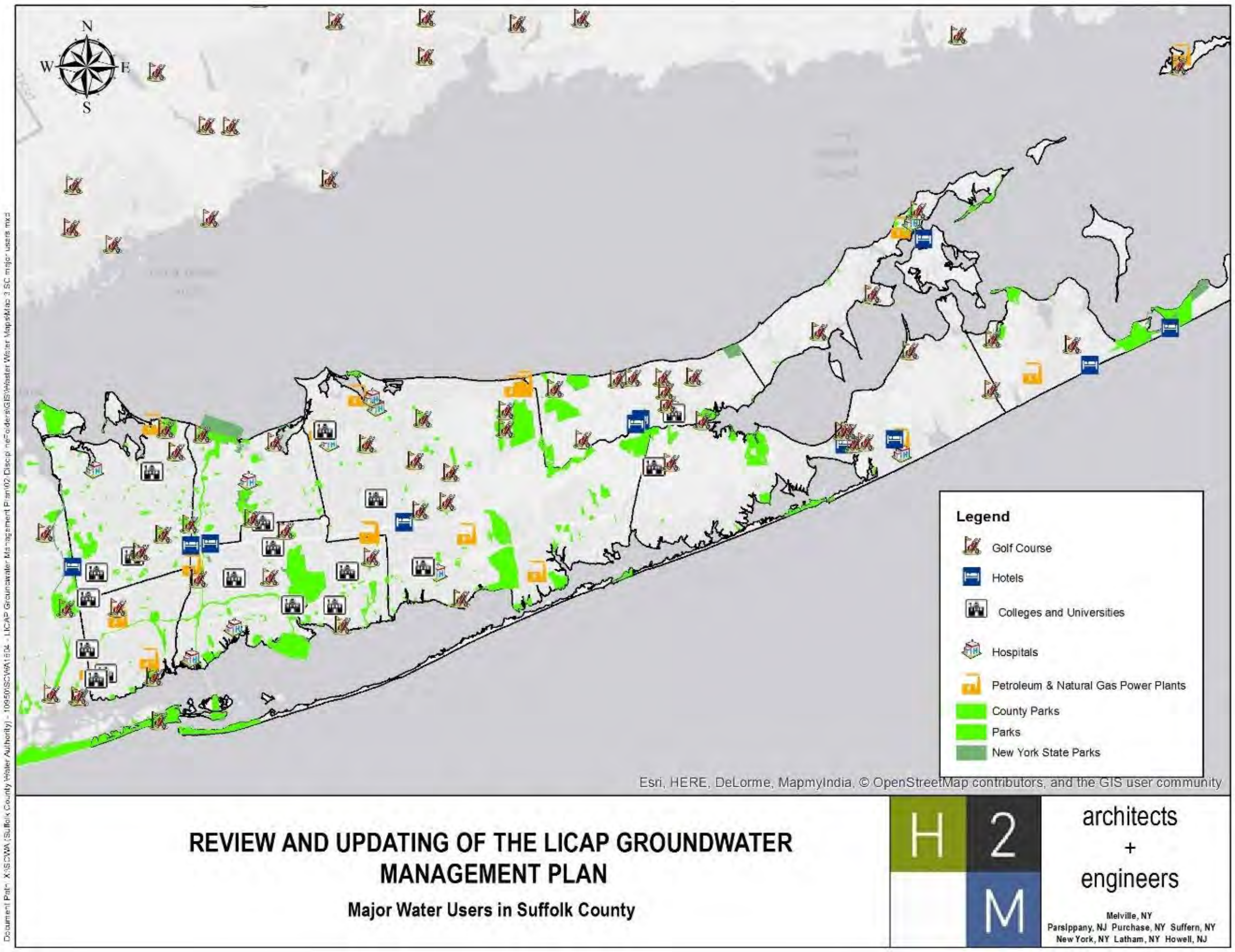
[10] Flow data based on Town of Riverhead records of reuse water supplied to the Indian Island Country Club 18-hole golf course.

is for reducing the demand on the groundwater supplies being utilized by the golf course by way of private wells. However, the seasonal shift to the colder months drives the wastewater plant to dispose of the effluent by way of their original outfall or to look for alternative reuse options.

Commercial/Industrial/Institutional Opportunities for Consideration

Other large water users such as colleges/universities, commercial lots, hospitals, senior care centers, nurseries, industrial facilities or power plants could also benefit from water reuse programs to reduce the demand of potable water supplies for various portions of their daily usage. These types of facilities make up a majority of the top water consumers across Long Island. From an aquifer management standpoint, it would be prudent to evaluate each consumer for whether the discharged wastewater ultimately is recharged to the ground or lost to surface water discharges.





Some examples of the major water users (and what district they are connected to) and their annual usage and average daily usage are:

- Power Utility (Suffolk County Water Authority) – 234 million gallons per year (641,000 gpd)
- Industrial User (South Huntington Water District) – 37 million gallons per year (101,000 gpd)
- Commercial User (Plainview Water District) – 36 million gallons per year (98,600 gpd)
- Commercial User – Irrigation only (Riverhead Water District) – 11.85 million gallons per year (32,500 gpd)
- Laundromat (West Hempstead Water District) – 10.34 million gallons per year (28,300 gpd)
- Hospital (Bethpage Water District) – 9.7 million gallons per year (26,500 gpd)
- Car Wash (West Hempstead Water District) – 7.2 million gallons per year (19,700 gpd)

New facilities can be designed with greywater distribution systems and/or stormwater management systems for use as flushing water or subsurface drip irrigation to offset the potable water use demand. Systems are available for new construction as well as for retrofit of existing buildings. Industrial water users could potentially reuse treated or recycled water for water cooled systems. Examples of this would be power generation facilities such as National Grid and PSEG LI. Additionally, commercial applications such as laundromats and car washes can utilize water recycling as a method of conservation. An example of a current regulation is the Amendment in July 2007 to the Code of the Town of Huntington, Chapter 164-14-F-4 which requires any new car wash or laundromat facility to utilize water recycling systems or equipment which will reduce the water usage by a minimum of 75%.

New or updated residential developments in locations adjacent to or near wastewater facilities could be constructed with potable and water reuse distribution utilities such that a new home could utilize reuse water for seasonal irrigation and flush water for toilets. An example of this possibility would be enhancing the Calverton Sewer District in the Town of Riverhead to incorporate disinfection, storage and secondary reuse outfall to the proposed upgrade which will utilize a membrane biological reactor (MBR) treatment system and groundwater recharge. Although the current facility is permitted for 100,000 gallons per day, projected expansion within the sewer district could be a candidate for a 'purple pipe' network where properties within the district could tap into the reuse water system to reduce their demand on the water supply.

The discussion above is focused primarily on the water volume/recapture potential that may be available in each of the opportunity areas. Planning studies, which would consider any of these options, would need to evaluate the suitability of the re-used water to the actual sector under consideration. For example, how would a laundromat utilize re-use water effectively?

Conclusion

The opportunities for water re-use on Long Island exist in significant numbers to have a meaningful impact on both the quality and quantity of groundwater drinking water supply. Increased treatment and operations costs associated with emerging contaminants, such as PFAS, PFOA and 1,4 dioxane, suggest that responsible water supply management would be required to consider re-use opportunities to the greatest extent possible. Regulations for re-use applications can leverage experiences from other states and municipalities but must be considered through the lens of what is appropriate for Long Island its sole source aquifer. They must also provide the greatest protection to public health. As more stringent drinking water regulations require more costly treatment alternatives, and as more stringent wastewater regulations create similar impacts and costs, the opportunity to envision a more holistic regulatory regime, one that more closely aligns the requirements of both sectors, becomes worthy of more serious considerations. Both the drinking and wastewater sectors should consider and evaluate the optimization of treatment requirements and consider the overall cost balance across both areas. Rate payers are responsible for both ends of the spectrum currently, so any efficiencies could realize overall rate relief for consumers.

Task 3B Report

Evaluation of the Utilization of New York City Department of Environmental Protection (NYCDEP) Reservoir Water Within Nassau County

Introduction

New York City delivers one billion gallons of potable water a day to nearly nine million residents of both New York City and upstate Counties from a reservoir system that routinely delivered two billion gallons of water per day a few decades ago. The Long Island Commission for Aquifer Protection (LICAP) conducted a precursory investigation of the potential for delivering water from the New York City system to Nassau County water suppliers. The following section identifies four opportunities that may merit further investigation.

This investigation does not imply that current solutions or needs exist. It simply delineates the engineering opportunities that are available on a "medium-range" forecast schedule, e.g. 10 to 20 years into the future. Beyond the technical issues addressed in this investigation, regulatory and public participation questions need to be addressed as well. The report highlights all three types of challenges, which include, among others:

- The locations and sizes of water mains required,
- Consideration of elevations and pressures
- Interconnection infrastructure,
- The impacts of introducing surface water into a groundwater water system,
- The delivery of fluoridated water to Nassau residents, who currently receive non-fluoridated water
- Corrosion control measures that would need to be implemented

Of equal importance to the above technical challenges is whether the citizens of Nassau County wish to receive some or all of their water from New York City's sources.

Consequently, additional detailed studies would need to be conducted to determine the feasibility of Nassau County water suppliers purchasing water from New York City. Of utmost importance would be guaranteeing that the Nassau supplies could rely and plan their operations to incorporate this infusion of water from the New York City system. Absent institutional measures and assurances, reliance on New York City would be difficult to justify, since the source could not be considered uninterruptible.

Background and Overview

Nassau County's western water suppliers bordering Queens County include New York American Water (Lynbrook District), The Water Authority of Western Nassau (WAWN), and the Manhasset/Lakeville Water District (MLWD). They are presented from south to north along the Queens County boundary of New York City. Each of the above systems have boundaries which either already have, or with proper study and infrastructure improvements could, provide interconnections with NYCDEP's water distribution system (predominantly surface water from their upstate supply system). The Water Authority of Great Neck North (WAGNN) presents opportunity as well, though water would have to move through the MLWD service area.

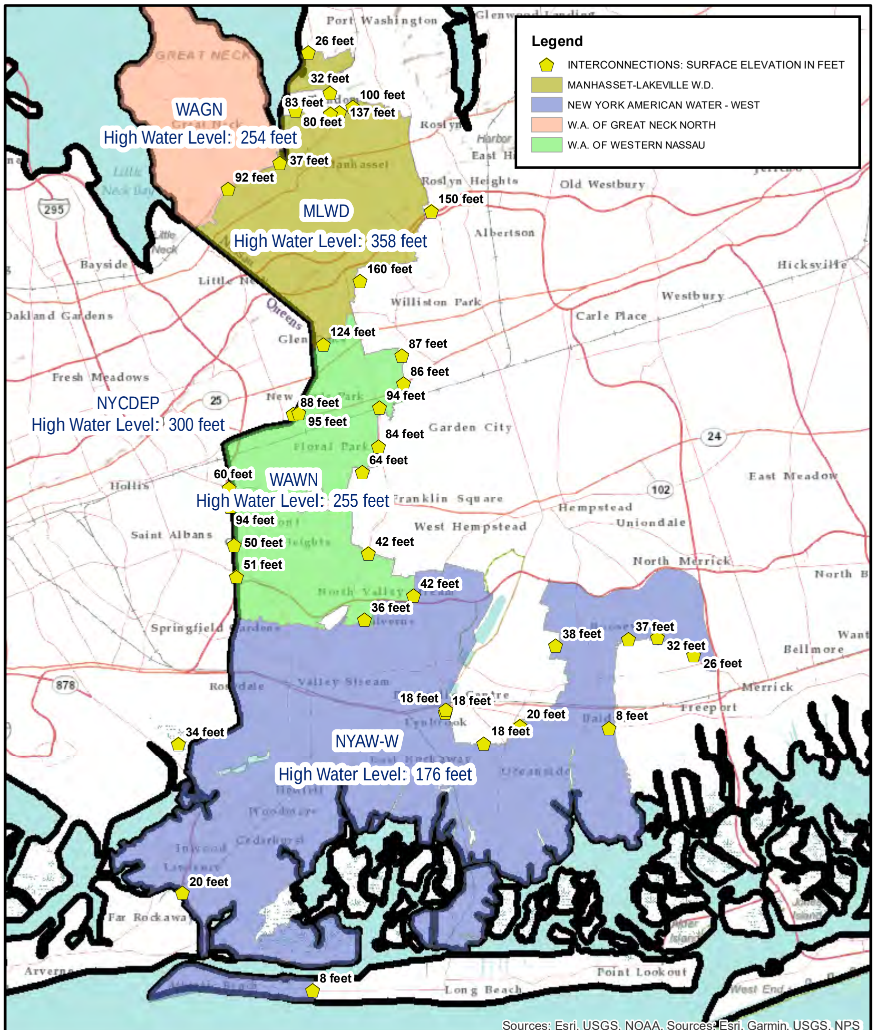


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Figure 1
Western Nassau County Water Supplier
Interconnection Locations

H2M architects + engineers

Table 1 Average Daily and Average Annual Demands of Select Nassau County Systems

Supplier	Population Served	Average Daily(MG)	Peak Day(MG)	Total Annual(BG)
NY American Water	220,000	28.8*	46.8*	9.83
WAWN	120,000	10.9	18.3	3.99
MLWD	45,000	6.2	12.1	2.27
WAGN	32,400	4.1	8.0	1.49
Total	417,400	50.0	85.2	17.58

*Estimated

The average daily demand of the four systems is approximately 50 million gallons per day (MGD) (see Table 1). By comparison, NYCDEP serves an average of 1.0 billion gallons per day (BGD) to nearly nine million residents of both New York City and upstate Counties. The scale of the DEP system is in stark contrast to the Nassau County providers and, contingent upon a number of both regulatory and political issues, could provide tremendous opportunity for inter-municipal water sharing agreements

Through significant focus on conservation and the implementation of universal metering, DEP has reduced the demands on its system, which is capable of delivering in excess of 2.0 BGD to the lowest average daily demands in decades. While assessment of overall transmission capability at potential connection points will require detailed assessment beyond the scope of this assignment, the general premise that flows up to the average daily demand of 50.0 MGD would likely not represent an overall challenge to the supply capabilities of the New York City system; and is reasonable, provided necessary infrastructure were put in place. It is presumed that adjustments to the DEP distribution system would be required at some level.

As improved groundwater modeling and testing provides greater insight into the potential challenges being faced by the Long Island providers, and particularly Nassau County, responsible planning would warrant careful consideration of all practical options, including interconnections with DEP. Importantly, given emerging, yet imminent increased regulatory requirements for Long Island suppliers and anticipated associated costs (capital and operational), the potential ability to partner with New York City on this issue is one that deserves a 360-degree comprehensive review, including prioritization of investments over time. However, it should also be understood that DEP would likely require inter-municipal partners to possess and maintain a separate supply to account for service in the event, either electively or on an emergency basis, DEP were forced to terminate service for any period of time. These are significant issues requiring planning discussions and clear expectations within any established agreement.

Any discussion about the potential to form an inter-municipal relationship with the New York City is best served by beginning with a basic history of the City system and its capabilities. In addition to New York City, DEP supplies water to more than 70 upstate communities and institutions in Ulster, Orange, Putnam, and Westchester counties that consume an average of 110 million total gallons of drinking water daily from New York City's water supply system.

"Water for the system is impounded in three upstate reservoir systems which include 19 reservoirs and three controlled lakes with a total storage capacity of approximately 580 billion gallons. The three water collection systems were designed and built with various interconnections to increase flexibility by permitting exchange of water from one to another. This feature mitigates localized droughts and takes advantage of excess water in any of the three watersheds. In comparison to other public water systems, the New York City system is both economical and flexible. Approximately 95% of the total water supply is delivered to the consumer by gravity. Only about 5% of the water is regularly pumped to maintain the desired pressure. As a result, operating costs are relatively insensitive to fluctuations in the cost of power. When drought conditions exist, additional pumping is required," (source: New York City Department of Environmental Protection).

The significant takeaway is that DEP harnesses a tremendous stored reserve which was designed and is capable of delivering in excess of 2.0 BGD. The total additional average daily demand of all four Nassau County suppliers is a small fraction of DEP's capacity to deliver water.

More of the history of the New York City system can be found in great part on their website:
https://www1.nyc.gov/html/dep/html/drinking_water/history.shtm

Figure 2

Over the years there have been many improvements, including the construction and commissioning of City Tunnel No. 3, which provides significant operational redundancy and security. It does not provide any additional supply. In 1996 New York City purchased the Queens Groundwater System (formerly Jamaica Water Supply; JWS), in South East Queens. In the years immediately following the takeover by the City, DEP committed tens of millions of dollars to improving distribution infrastructure, replacing and upsizing water mains, hydrants, valves, etc. From 1996 until 2000, the City operated the existing groundwater system at reduced levels, blended with the City's surface water supply to serve the constituents of South East Queens. In the walk up to unrealized calamities anticipated by the year 2000 computer clock concern, Y2K (a largely unrealized concern related to computer programming and date systems), New York City tested and implemented operations that provided 100% supply via the surface water system. In the ensuing years, due to water quality and economic considerations, utilization of the groundwater system was reduced further to the point of becoming a back-up supplemental supply. We understand that the Queens wells have not been utilized as a public supply source since approximately 2008.

New York City is currently in the process of resolving a serious defect to the Delaware Aqueduct, which is leaking up to 35 MGD, between Roundout Reservoir and West Branch Reservoir on the east side of the Hudson River. Recent presentations by senior DEP engineers project shutdowns of the Aqueduct for repair beginning in 2022 and being completed by 2023. Beyond that horizon, New York City's capacity to support Nassau County would appear of tremendous potential value in consideration of groundwater shortages, water quality, and other impacts such as saltwater intrusion.

Feasibility Considerations for Inter-Municipal Connections

As stated in the previous section, the potential availability of excess water from New York City presents a number of opportunities to provide interconnections to each of the water suppliers along its eastern Queens border. Each individual supplier will be considered below, but attention and consideration should also be given to opportunities to enhance intra-Nassau County interconnections between individual suppliers, allowing greater flexibility and potentially increasing the ability of DEP to supply more average daily supply. These intra-Nassau County interconnection considerations are not part of this report, but are noted here for future consideration. Existing interconnections opportunities are indicated on the map in Figure 1**.**

New York American Water (NYAW)

All of the DEP service area adjacent to NYAW operates at, or has the potential to operate at, a higher hydraulic gradient then the NYAW system. DEP trunk water mains in the area operate at unregulated pressure under the influence of the nominal 300 foot elevation of Hillview Reservoir at the Bronx/Yonkers border. This suggests that the necessity for additional pumping would be unlikely given appropriately sized transmission mains in the NYAW service area. Interconnection opportunities with NYAW already exist in a number of locations, including a significant (believed to be 20 inch diameter) connection near Central Avenue and Doughty Boulevard at the Queens-Lawrence border. Existing agreements between DEP and NYAW are outdated and consideration of relatively minor additional metering considerations, along with regulatory approvals, present the potential obstacles to water sharing at this location.

The Queens/Nassau boundary traverses a winding path as Rockaway Boulevard passes behind Kennedy Airport becoming Rockaway Turnpike and intersects with the Nassau Expressway as it moves towards Atlantic Beach. DEP operates a 48 inch diameter trunk main that follows along this general path, passing Meadowmere, crossing into Five Towns, through parts of Inwood, and terminating in Lawrence around Broadway and the Nassau County Expressway.

This main is believed to able to provide additional capacity of up to 10 MGD. This value would need to be validated by DEP during a planning or study phase of consideration. It currently terminates approximately 1.7 miles north of Park Street in Atlantic Beach. Contemplating potential supply to the City of Long Beach for example would entail extending a transmission main across Reynolds Channel to this point. It would then be 1.5 miles across Atlantic Beach to the border of The City of Long Beach, where concerns regarding future saltwater intrusion into its supply are noted. While more detailed analysis would be required to create an optimized design and cost, it is reasonable to consider that a connection from the DEP trunk main to a theoretical point on Park Street in Atlantic Beach with a 20 inch main, including the channel crossing, would entail a capital cost on the order of $3 million - $5 million. From that point, construction of a 16 inch main for the 1.5 mile distance through Atlantic Beach to the Long Beach boundary would potentially cost another $3 million - $4 million.

We understand that DEP continues the build out of its trunk water main system east along the Rockway Peninsula, with plans to complete a loop with its trunk water main system crossing under Jamaica Bay from Broad Channel's Cross Bay Boulevard. Upon completion of the construction of the final stages of the trunk water main loop, the DEP system in the area south of the Belt Parkway through Nassau County and into the eastern Rockaway Peninsula will be robust. Both existing and future possibilities along this corridor are significant potentials for additional interconnections.

Additional opportunity lay along Sunrise Highway at the borderline between Queens and Nassau in Valley Stream near the Green Acres Mall. DEP operates a 48 inch diameter trunk main that terminates at the Queens border and would provide an excellent opportunity for interconnection, which in this case would potentially prove mutually beneficial by improving water age for DEP. Estimated supply capability is approximately 5.0 MGD. From the NYAW perspective, the interconnection could provide valuable back-up or redundant supply, even potentially mitigate some planned capital treatment investments; while for DEP, creating demand at the end of this large main would potentially improve overall water quality in the New York City system in this area.

Finally, moving north along Hook Creek Boulevard, opportunity exists for interconnections between DEP, NYAW, and WAWN as all three providers exist in close proximity to each other near the intersection of 129th Avenue and Hook Creek Boulevard, Queens and Cumberland Place and Ocean Avenue, Nassau County. There are also opportunities for either Nassau County suppliers to enter discussions about the potential utilization of DEP well station 36 at this location, which is not currently being utilized by DEP for supply. There are a number of potential opportunities and agreement scenarios that exist here and could allow for the use of what is considered to be a good quality, serviceable well station. Assessment of this well station in the context of the emerging contaminants facing the Nassau County suppliers would have to, if not done so already, be performed, and the potential for any associated treatment investments weighed in conjunction with this assessment.

Potential Interconnection - Nassau Expressway, Lawrence

Potential Interconnection - Sunrise Highway at NYC/Nassau County Boundry

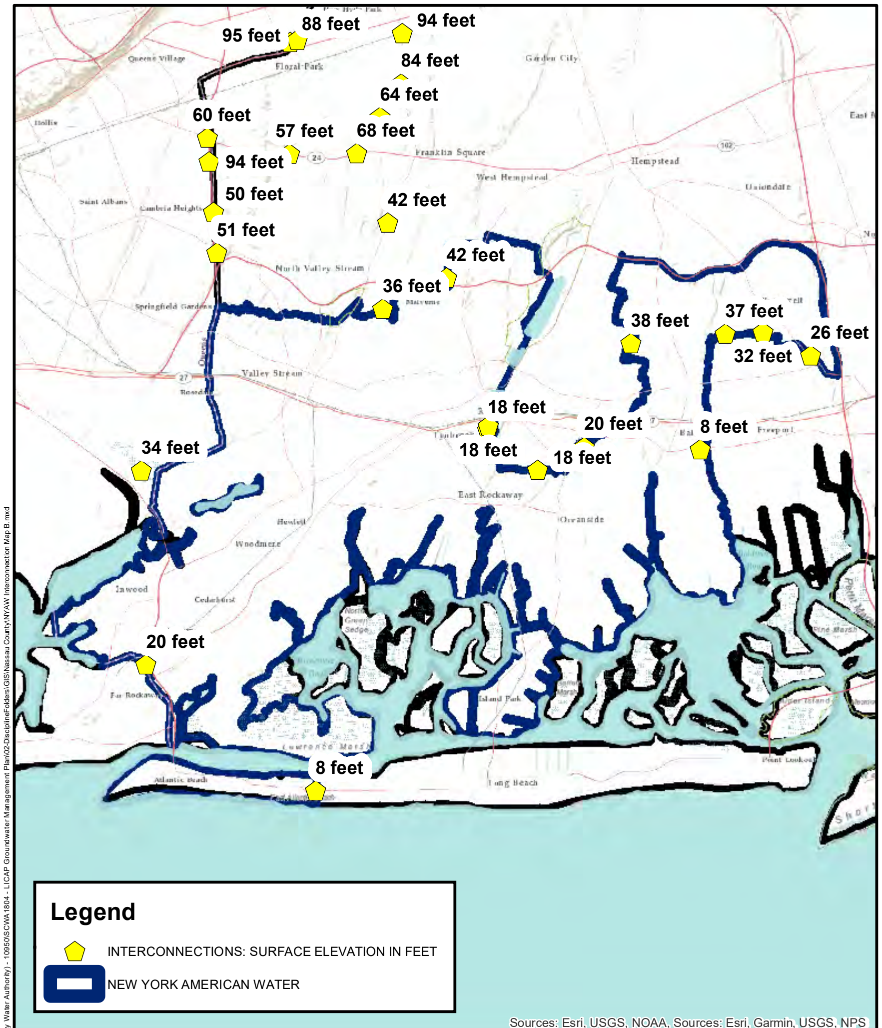

Figure 3
New York American Water
Interconnection Elevations
High Water Level: 176 feet

Water Authority of Western Nassau (WAWN)

There are a number of opportunities for interconnections in the vicinity of 129th Avenue and Hook Creek Boulevard, Queens and Cumberland Pl and Ocean Avenue, Nassau as described above. Additionally, there is opportunity for interconnections or inter-municipal water sharing associated with the existing DEP well station 36. Both DEP and WAWN maintain distribution piping in Hook Creek Boulevard/Ocean Avenue. From an infrastructure standpoint metering vaults and control valves would be required to establish an interconnect. While it would appear to be of significant potential in terms of infrastructure upgrades, the yield in terms of supply would likely be on the order of 3-4 MGD for an 8 inch interconnection with a modest pressure differential. While small for the DEP system, this amount of additional supply would be viewed as significant for any Nassau County supplier, approximating the equivalent of several supply wells. A proper assessment of the ability of the Nassau County suppliers to transport any additional supply throughout their service areas would necessarily have to be weighed to determine cost/benefit.

Similar interconnection opportunities exist along the Cross Island Parkway corridor borders between Cambria Heights/Queens Village and Elmont, Queens Village, and Floral Park, Nassau County and along Jamaica Avenue boundaries between Bellerose and Floral Park Queens and Floral Park, Nassau County (see Figure 4).

Additional opportunities, at larger scale exist along Hillside Avenue near the borders of Glen Oaks/Bellerose Manor and New Hyde Park, Nassau County. WAWN operates an elevated storage tank at an overflow elevation 255 feet above mean sea level (MSL), compared to New York City's Hillview Reservoir nominal operating elevation of 300 feet above MSL. This represents a 45 foot elevation difference between the WAWN tank and DEP's Hillview reservoir. A more rigorous hydraulic analysis, not considered as part of this task, would need to be considered to present a more thorough assessment of any potential need for booster pumping or pressure regulation of any degree. Aside from that potential, interconnection valving, metering pits, and telemetry equipment for both municipalities would be required to allow for water sharing.

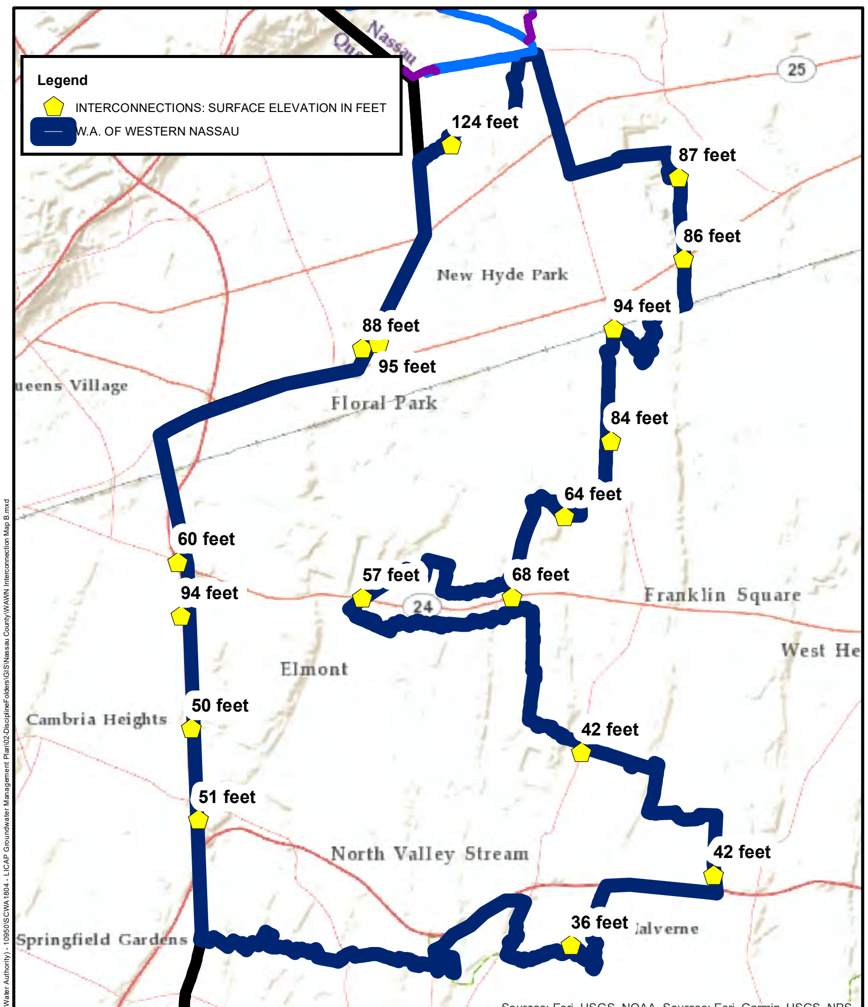

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Figure 4
Water Authority of Western Nassau
Interconnection Elevations
High Water Level: 255 feet

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Manhasset/Lakeville Water District (MLWD)

Similar to WAWN, there are some clear opportunities for direct connections to the DEP system, but as the topography changes and elevations rise in both Nassau and Queens, more hydraulic analysis is warranted. However, preliminary assessment of select locations suggest viable alternatives. It is believed that DEP operates a 20 inch diameter main along Northern Boulevard. Extending a 12 inch main, for example, from Glenwood Street at the Queens line to Merrivale Rd, in Great Neck, could manage up to 3.0 MGD of additional supply efficiently if available from DEP. Moreover, replacing the section from Greenwood Street to Lakeville Road with a 16 inch or larger main could present yet greater opportunity. It would provide a strong loop into the existing MLWD transmission mains already in Lakeville Road, but as importantly, with additional supply and stronger transmission capability MLWD would be better positioned to potentially share additional supply with WAGNN. These two scenarios would represent capital expenditures on the order of $2 million-$4 million plus engineering, planning, and permitting efforts.

Another connection point of consideration for MLWD is along Union Turnpike near the Queens/New Hyde Park border. DEP operates its distribution system, comprised of 12 inch and 20 inch mains in this area, at a gradient of approximately 210 feet. This would appear to present opportunity in much of the MLWD service areas except the highest elevations. The MLWD system has a transmission corridor along Lakeville Road, with mains of 16 inch, or in some cases larger diameter pipes. Hydraulic modeling could be performed to consider the value of a capital improvement to replace 10 inch diameter mains with 16 inch or larger diameter mains for approximately 3,000 feet from Union Turnpike to Marcus Avenue along Lakeville Road. At a budgetary estimate of $350/linear feet (LF), this would represent an investment of approximately $1 million, but would substantially increase the delivery capacity from a theoretical DEP connection at Union Turnpike. The additional demand on the DEP system would similarly warrant analysis to ensure that head losses remain acceptable with any projected flows. This could be independent or coupled with additional connections along Northern Boulevard. The cost benefit of this investment would be largely dependent upon the degree to which it might be utilized. Essentially, how much water would MLWD, or other Nassau County providers who could benefit, consider using, and how much would DEP reliably commit to supplying, understanding all the agreements, and other drivers. The value of such a redundancy or sharing agreement would appear greatly enhanced if the more southern supply wells became impacted by emerging contaminants or other problems.

The MLWD distribution system south of Union Turnpike, adjacent to the DEP system, contains distribution assets of 12 inch diameter or larger. This provides opportunity from a hydraulic perspective; however, more in-depth analysis of the demands here are needed, to assess the value of the connection. Initially this connection appears less significant for this area.

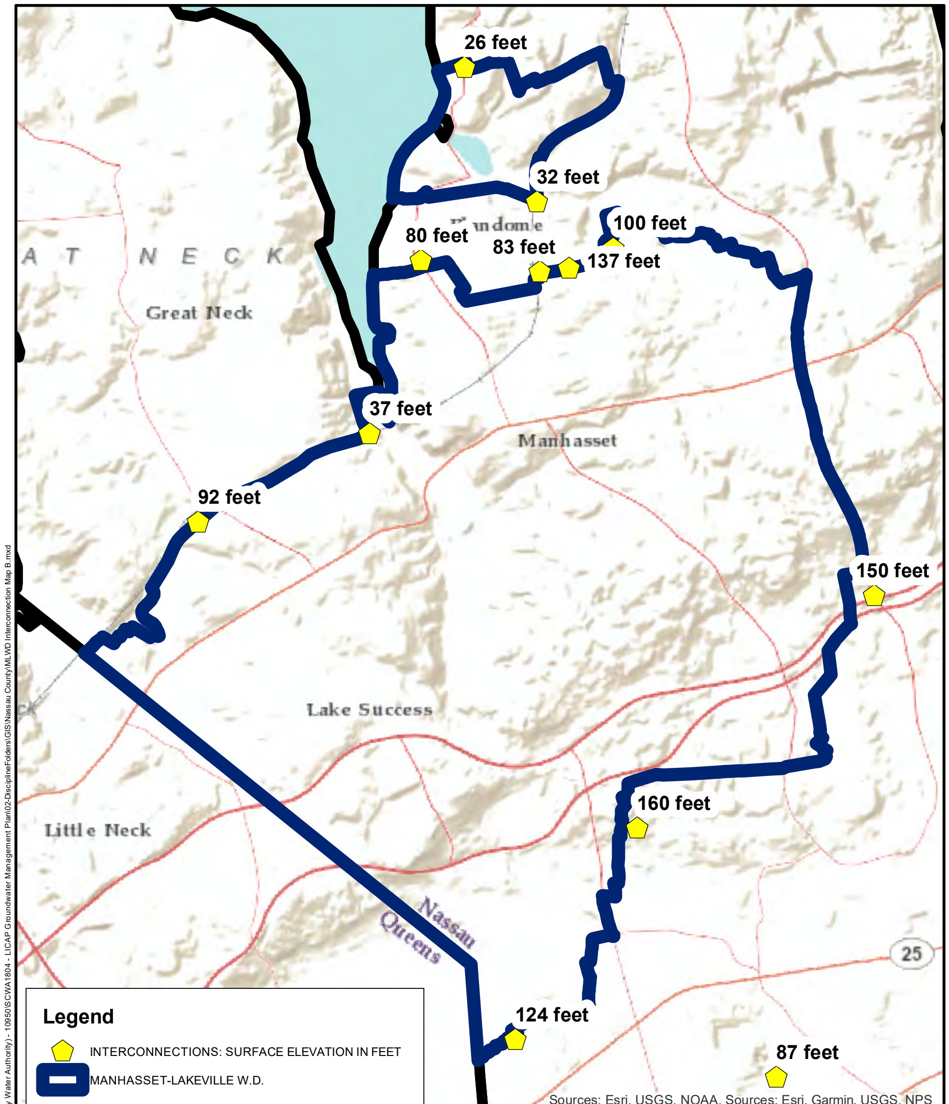


Figure 5
Manhasset Lakeville Water District
Interconnection Elevations
High Water Level: 358 feet

architects + engineers

Water Authority of Great Neck North (WAGNN)

While there are no direct interconnection locations between the DEP system and the WAGNN, it is feasible to envision a cooperative approach with the MLWD as described above, or an independent initiative that is structured similar to the approach laid out for MLWD along Northern Blvd. From a practical and economic standpoint, collaboration with the MLWD on an initiative would seem to provide the most overall value. There would be a need to assess metering arrangements between the two water suppliers, as there would obviously need to be done with NYCDEP, but these costs would be fractional incremental expenses from the more macro level consideration of the long-term value of potentially having access to an alternate supply.

Figure 6
Water Authority of Great Neck North
Interconnection Elevations
High Water Level: 254 feet

Consideration of Potential Costs

The discussion above presents an overall view of the feasibility of the potential for western Nassau County water suppliers to consider inter-municipal supply connections with the NYCDEP. The concept at some levels is basic, but in order to make judgments beyond the macro level planning viewpoint, far more detailed engineering and water quality analysis would need to be provided. Either a comprehensive hydraulic modeling effort for the several suppliers or a series of discrete sub-models for individual suppliers would provide great utility. Considering the overall opportunity, the argument for a comprehensive modeling effort would be compelling. Beyond the immediate direct interconnections, the prospects for neighboring suppliers, east of the four districts mentioned above, to share additional supply would appear to offer great opportunities. When further consideration is given to issues like the impact of emerging contaminants and over stressed demands on existing well supplies, regional water sharing conceptually suggests significant merit.

In several areas discussed above, budgetary values provide an order of magnitude cost for select conceptualized water main installations. Presented below is a planning level view of the potential supply capacities of theoretical connections based on size and pressure differentials. Further, we provide typical schematics and estimates for potential infrastructure improvements that would typically be required, such as bi-directional metering pits of various sizes, connection costs and a typical booster pump station should one be necessary. Coupled with specific water main installations or upgrades, a budgetary costing could be assembled for any or all connection opportunities (see Table 2). Planning and permitting costs would also need to be considered. In addition to capital improvement costs, operation and maintenance costs (O&M) and the cost of purchasing water from New York City would have be built into the cost benefit analysis. Assuming that the O&M costs are minor additions to existing Nassau County distribution O&M costs, the budgetary cost of water purchasing should be considered. New York City currently provides bulk water to upstate communities at a rate of $1.73 per 1,000 gallons, and provides in-city customers with water at a rate of $5.21 per 1,000 gallons. The in-city customers are receiving water that benefits from all the in-city treatment and capital investments. It is important to ensure any analysis in this areas considers "apples to apples" scenarios.

By contrast, western Nassau County suppliers have rates that range from $2.64 per 1,000 gallons to $6.47 for the same volume. A more in-depth cost evaluation than what is presented here should be performed to ensure that the assessments are comparable and inclusive of consistent variables effecting overall cost.

Table 2 Select Interconnection Capital Cost Estimates

Interconnection Type	Vault Size	Power Required	Construction Cost
2-Way	11' x 8'	no	$175,000
1-Way w/ Booster	11' x 8'	yes	$250,000
WM extension/LF	12"	No	$300.00
WM extension/LF	20"	No	$350.00

Interconnection Capacity

The potential capacities of individual interconnections can be estimated using a method developed by Hardman and Cheremisinoff [(1)], with modifications by H2M [(2)] (see Table 3). The equations used is:

$$\boldsymbol{Q = 0.0215\left[\frac{\Delta P\, D^{5.33}}{D^{1.33} + 0.285\, L}\right]^{0.5}}$$

Where

Q = flow through interconnection in cfs

ΔP = pressure differential across the interconnection in psi

D = inside pipe diameter in inches

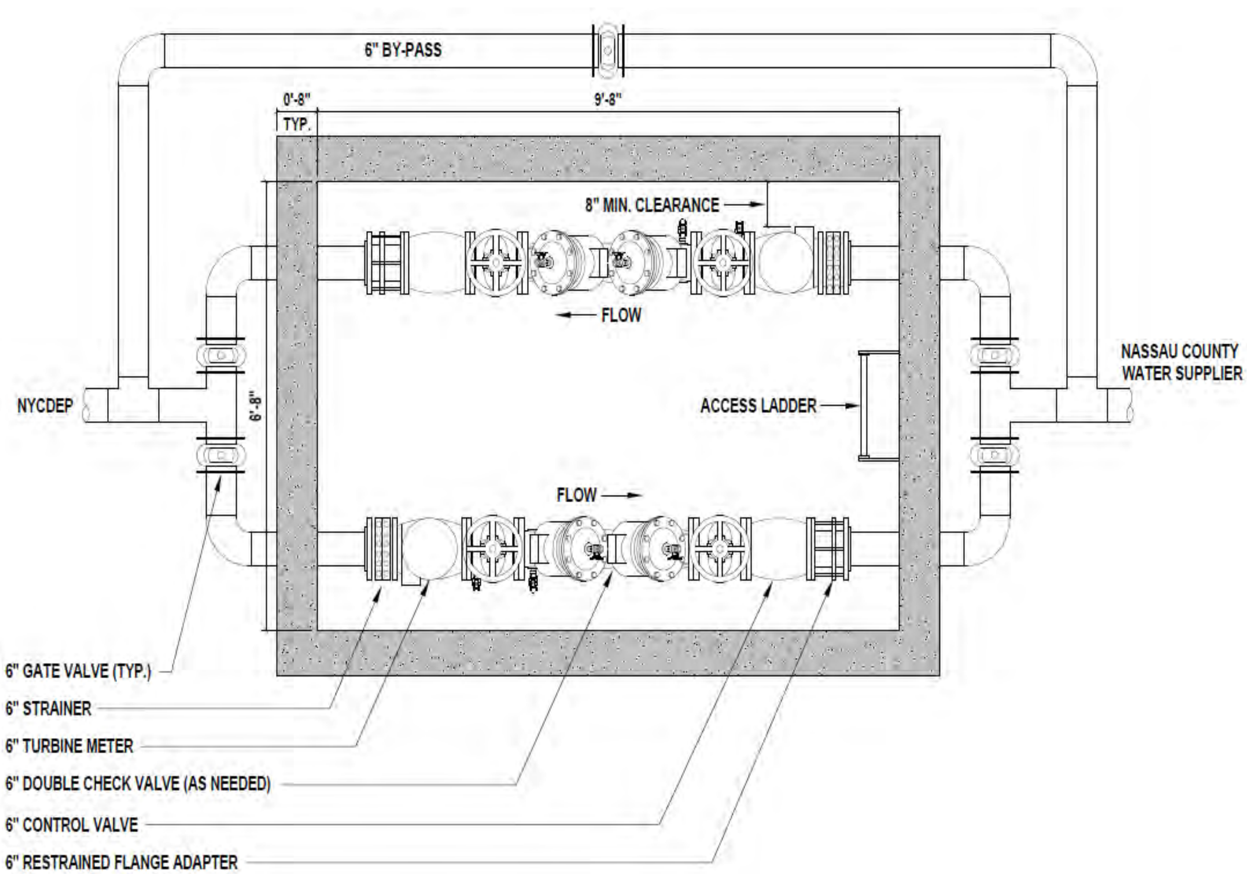
L = length of interconnection in feet, but not less than a minimum value of 100

(1) Hardman, J.L. and P.N. Cheremisinoff. "Determining the Utility Value of Water-Supply Interconnections, Part I, II and III." Water and Sewage Works, December 1978, January 1979 and February 1979.
(2) Holzmacher, McLendon and Murrell, P.C. "Master Water Plan - Nassau County, State of New York." September 1980.

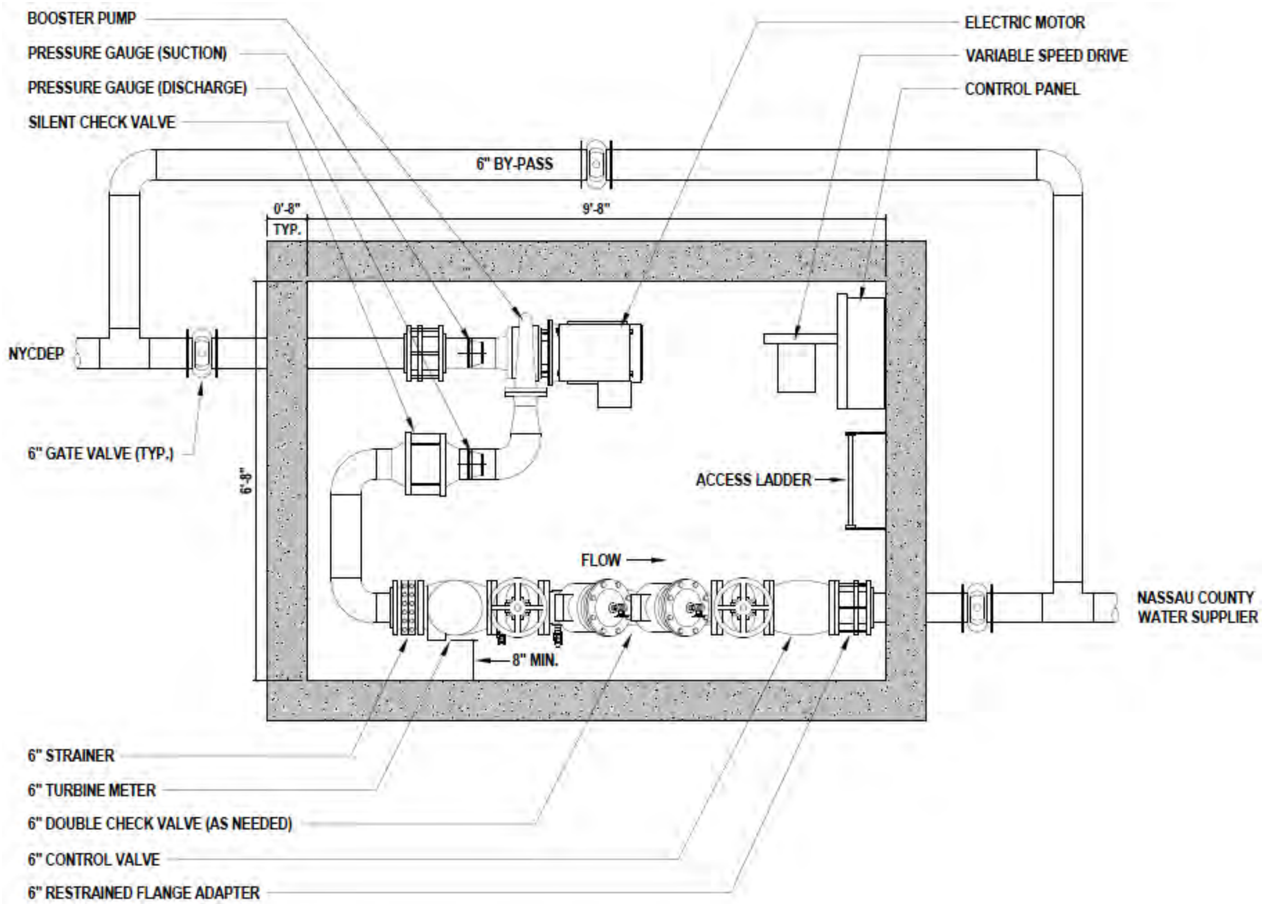
Table 3 Potential Capacity at an Interconnection with Respect to Main Size and Pressure Differential

Main Size [inches]	Pressure Differential [psi]	Flow [gpm]
6	5	40
6	10	577
8	5	826
8	10	1168
10	5	1413
10	10	1998
12	5	2172
12	10	3072

These values represent theoretical estimates. More refined analysis, with the input of NYCDEP's engineering staff, to determine feasibility and identify any flow limitations would be necessary as part of a deeper study.



Typical 2-Way Interconnection Vault Plan



Typical 1-Way Interconnection with Booster Vault Plan

Discussion of Potential Water Quality and Hydrological Impacts

The final area of high-level consideration for this assessment will touch on potential pros and cons of issues surrounding water quality and hydrology. Starting with the issue of water quality, overall compliance implications should be foremost in the evaluation. The experience of NYCDEP after the takeover of the former JWS provides valuable insight. Upon assuming responsibility for the JWS service area in 1996, NYCDEP increasingly provided blended water from its surface water system to the existing groundwater service area. Overall, compliance issues presented little concern. Adjustments to operations of the groundwater system were made, including the introduction of both fluoride and orthophosphate delivery systems to match the surface water chemical compositions. During the period of time from 1996 to 2000, when blended water was more prevalent, the challenges most frequently encountered were around aesthetic issues like color and iron. These issues were mostly associated with groundwater and the older tuberculated piping in the JWS distribution system. As water main replacement increased, the strength of the surface water transmission capabilities increased and the need for well supply decreased. There were also a number of wells that had become impacted by contaminants, mostly volatile organic compounds (VOC) like Tetrachloroethene (PERC) and Methyl Tertiary Butyl Ether (MTBE), that lead to decrease utilization of well supply. As noted above, during the walk up to the Y2K technology concerns, New York City tested and demonstrated its ability to provide surface water to the entire former JWS service areas. Thereafter less groundwater supply was delivered, to the point where it was essentially ceased entirely in the mid 2000's. As such, from the standpoint of concern about the blending interaction between the New York City surface water supply and groundwater supply, there is valuable history to draw from and overall regulatory compliance is not thought to be a concern. Proper due diligence would suggest however that proper testing be performed as part of any planning study.

Generally, New York City's surface water system does not face the same challenges as the Long Island suppliers with regard to volatile organics or issues like 1,4-Dioxane and perfluorinated compounds (PFAS). There are however a few other considerations, most notably the utilization of fluoride by New York City. First, it should be noted that New York City has a Legislative requirement to provide fluoride in its distribution system. That said, in May 2016, DEP lowered its fluoride application dosage to 0.7 milligrams per liter (mg/L) which is the recommended value by the U.S. Department of Health and Human Services. Nassau County suppliers do not apply fluoride, and this has been considered a major point of contention in consideration of inter-County water sharing. The merits and concerns of fluoride are a topic of study and debate far outside the scope of this report, but clearly an issue which would need to be resolved before further advancement of planning for inter-municipal water sharing. However, there are an estimated 350,000 Long Island non-resident commuters consuming New York City supply on a regular basis. The need for the various public health agencies to provide appropriate guidance will be critical to either the success or failure of any future initiatives in this area.

Fluoride can be removed from water through several processes. According to the United States Environmental Protection Act (USEPA), reverse osmosis and activated alumina are the best available technologies for the removal of fluoride from drinking water. Other treatment technologies include ion exchange, lime softening, electrodialysis, and adsorption with media, including activated carbon, bone chars, and clays. Adsorptive media is the most common method for fluoride removal. Efficiency is affected by initial concentration, water pH, contact time, and presence of competing ions. Removal is most efficient at a slightly acidic pH.

Another item of discussion is that New York City applies orthophosphate for corrosion control, while few Nassau County suppliers use it. NYAW is currently experimenting with its usage. While orthophosphate usage is not believed to be a large challenge to overcome, testing would be necessary to ensure that there are no adverse impacts, especially related to lead and copper compliance. If fluoride removal were considered, it could have implications on this process as well.

In light of the New York City system being surface water, a thorough understanding of the implications of disinfection by-products (THHM's and HAA's) should be realized. Water age and disinfection by-products (DBP) development are related and as the New York City water potentially travels further beyond its borders, careful analysis and testing of this and other water quality parameters is required.

Finally, there are potential pros and cons of reducing pumping requirements for the Nassau County suppliers. On the positive side, reduced pumping will allow for the groundwater levels to rebound and the aquifer to be subject to less stress. On the potential negative side, assessment of potential negative impacts of reduced pumping, including rising groundwater table, localized basement impacts, and plume migration should be assessed in the Southeastern Queens and Nassau County areas.

Task 3C Report

Regional Contamination Threats

The discussion of Regional Contamination Threats in the draft Groundwater Resources Management Plan (GRMP) focused almost exclusively on Nassau County. Suffolk County has experienced similar contamination from specific sites, along with Regional contamination from pesticides (such as aldicarb) and other widely used chemicals. A characterization of Regional contamination events is complex, as some threats may be localized, as in the case of hazardous waste sites, while other threats are multifocal and dispersed, as is often the case with the new emerging contaminants 1,4-Dioxane and per- and polyfluoroalkyl substances (PFAS).

More than 250 Inactive Hazardous Waste Sites have been identified on Long Island. The United States Environmental Protection Agency (USEPA) and the New York State Department of Environmental Conservation (NYSDEC) have identified approximately 145 inactive hazardous waste sites in Nassau County and 109 sites in Suffolk County. The following assessment expands upon the previous Long Island Commission for Aquifer Protection (LICAP) report by looking more closely at Regional contamination events in Suffolk County.

It is acknowledged, however, that except for PFAS-related sites, listing of major new superfund sites and spills have declined significantly over the past several years. At the same time, low-level volatile organic compound (VOC) contaminant occurrence has increased. In addition, pesticides and pharmaceuticals and personal care products (PPCPs) have become a growing concern. In 2015, Suffolk County completed a Comprehensive Water Resources Management Plan, which should be regarded as an incorporated reference. This management plan has been an invaluable tool to Suffolk County and may similarly serve as a basis for LICAP Plan recommendations.

Suffolk County

Of the NYSDEC listed sites[1] in Suffolk County shown in Table 1, 31 have been categorized as Class 2, defined as constituting a significant threat to the public health or environment. Four of these are among the 16 USEPA Superfund sites listed in Suffolk County. Among the largest sites are sites No. 3, 5, 17, and 32*, located in Upton, Port Jefferson Station, Riverhead, and East Setauket, respectively. Site No. 32* is not classed as a hazardous waste site by NYSDEC, but rather as a bulk storage site. In addition, two of these four sites, along with two others (No. 18 and 31) have been identified as sites where the emerging contaminants perfluorooctane sulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) were detected. PFOS and PFOA are currently known to be impacting groundwater. These six numbered sites are the "Featured Sites" shown on Figure 1 and are discussed in this task report.

All of these sites have posed a groundwater contamination threat in the past, and some of the sites continue to contaminate groundwater. Among the most prevalent contaminants are industrial solvents and fuels, such as perchloroethylene (tetrachloroethylene, PERC, or PCE) and its degradation products, as well as gasoline, diesel or jet fuel. Radioactive elements and heavy metals are also found at some of these sites. Perfluorinated compounds (PFOS, PFOA), are known to have extensively contaminated sites where they were utilized in the form of aqueous film forming foams (AFFF) to extinguish fires. The extent to which these may be found at any of the contaminated sites in Suffolk

[1] A "Registry of Inactive Hazardous Waste Disposal Sites" was created by the NY State Environmental Conservation Law Article 27. Sites listed in the Registry are commonly said to be sites in the "State Superfund Program." Sites are classified 1 through 5 based on its characteristics. Details of the Classification Codes may be found online at https://www.dec.ny.gov/chemical/8663.html

County remains under review and assessment. The New York State Department of Health (NYSDOH) is currently utilizing an EPA lifetime Health Advisory Level (HAL) in evaluating drinking water source contamination findings relating to PFOS and PFOA. In the July 24, 2019 New York State Register, NYSDOH published a proposed regulation which includes a 10 part per trillion (ppt) Maximum Contaminant Level (MCL) for each of these perfluorinated compounds. Pesticides also constitute a significant threat to groundwater quality and human health and are found most extensively near farms and greenhouses predominantly in eastern Suffolk County.

The most extensive impacts to groundwater in Suffolk County are from the oldest sites, many of which became active prior to World War II. These sites produced weaponry, aircraft, and other wartime products, and continued operations for many decades afterward. Disposal practices during that period often consisted of pits, trenches, drains, and similar structures, allowing these chemicals to infiltrate into the soil, eventually reaching and contaminating the groundwater. Some of the compounds sank deep into the aquifer system, while others floated on the water table. In both instances plumes of contaminants eventually migrated away from their disposal site, moving in the direction of groundwater flow.

Most of the contaminant plumes are situated within the Upper Glacial Aquifer, which is the shallowest aquifer in most of Suffolk County and the source for many residential wells. The underlying Magothy Aquifer is also contaminated by plumes, with some extending as deep as the Raritan Clay (approximately 900 feet below land surface, depending on location). These plumes change in extent, both vertically and horizontally, as they are influenced by factors such as chemical reactions in the subsurface, pumping of wells, and even tidal forces near the shoreline. Six large legacy sites in Suffolk County, which are undergoing continuing study and remediation, were chosen for discussion in this report. These six sites and the agencies providing oversight for their remediation are listed below:

- Brookhaven National Lab (NYSDEC and USEPA)
- Lawrence Aviation Industries (NYSDEC and USEPA)
- Calverton Naval Weapons Industrial Reserve (WIRP) Plant (NYSDEC)
- Gabreski Air National Guard Base (NYSDEC)
- Suffolk County Firematics (NYSDEC)
- Northville Industries (NYSDEC)

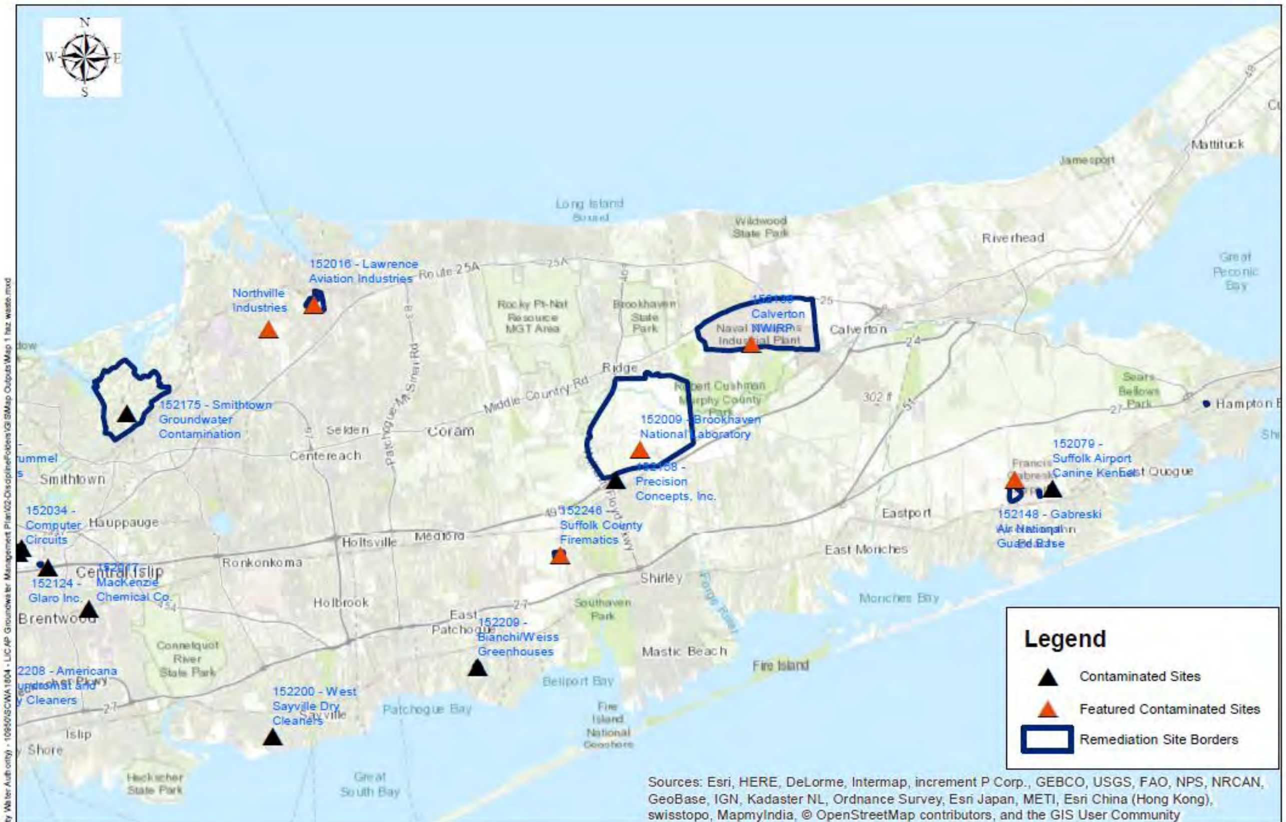


Figure 1
Suffolk County Active Hazardous Waste Sites

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Melville, NY
Parsippany, NJ Purchase, NY Suffern, NY
New York, NY Latham, NY Howell, NJ

In Figure 1 above and Figure 2 below, borders are shown for geographically larger sites.

Table 1 Suffolk County NYDEC Class 2 Hazardous Waste Sites

	Site Code	Site Name	City/Town	Address
1	152003	Deutsch Relays, Inc.	East Northport	65 Daly Road
2	152004	Fairchild Republic Aircraft; Old Sump	East Farmingdale	Route 110 (Broad Hollow Road)
3	152009	Brookhaven National Laboratory	Upton	William Floyd Parkway
4	152015	Chemical Pollution Control	Bay Shore	120 South 4th Street
5	152016	Lawrence Aviation Industries	Port Jefferson Station	Sheep Pasture Road
6	152017	MacKenzie Chemical Co.	Central Islip	One Cordello Avenue
7	152025	Pride Solvents and Chemical Co.	Babylon	78-88 Lamar Street
8	152033	Dzus Fastener Co., Inc.	West Islip	425 Union Boulevard
9	152034	Computer Circuits	Hauppauge	145 Marcus Boulevard
10	152036	Astro Electroplating, Inc.	East Farmingdale	170 Central Avenue
11	152039	Babylon Landfill	West Babylon	Gleam Street
12	152079	Suffolk Airport Canine Kennel	Westhampton Beach	Old Riverhead Road
13	152119	Target Rock Corp.	East Farmingdale	1966 East Broadhollow Road
14	152124	Glaro Inc.	Hauppauge	735 Old Willets Path
15	152125	Active Industrial Uniform	Lindenhurst	63 West Merrick Road
16	152130	Fairchild Republic Main Plant	East Farmingdale	1000 Conklin Street
17	152136	Calverton NWIRP	Riverhead	Swan Pond Road
18	152148	Gabreski Air National Guard Base	Westhampton Beach	Old River Head Road
19	152158	Precision Concepts, Inc.	Shirley	26 Natcon Drive
20	152162	100 Oser Avenue	Hauppauge	100 Oser Avenue
21	152175	Smithtown Groundwater Contamination	Smithtown	Moriches Road and Fifty Acre Road
22	152183	Brandt Airflex	East Farmingdale	937 & 965 Conklin Street
23	152187	Country Cleaners	Huntington	410 West Main Street
24	152188	Villa Cleaners	Deer Park	1887-1899 Deer Park Avenue
25	152200	West Sayville Dry Cleaners	West Sayville	61 West Main Street
26	152201	Levey Property	Copiague	1305 South Strong Avenue
27	152208	Americana Laundromat and Dry Cleaners	Bay Shore	1572 North 5th Avenue
28	152209	Bianchi/Weiss Greenhouses	East Patchogue	Orchard Road
29	152211	Beau Brummel Cleaners	Commack	2049 Jericho Turnpike
30	152239	Former Elka Chemical Company	Lindenhurst	340 West Hoffman Avenue
31	152246	Suffolk County Firematics	Yaphank	676 Maple Street
*32**	1-1720	Northville Industries	East Setauket	19 Belle Meade Road

Sites in the discussion to follow are shown in bold. * The Northville Industries Site is a Petroleum Bulk Storage Site and is addressed under the NYSDEC Spills Program, rather than the NY State Superfund Program. : Source- NYSDEC Environmental Site Remediation Database Search Website,: https://www.dec.ny.gov/cfmx/extapps/derexternal/index.cfm?pageid=3, accessed 2/28/19

Discussion and Status of Suffolk County Legacy Sites

Brookhaven National Lab (BNL) (EPA ID: NY7890008975)

This site covers approximately 5,265 acres in area and has 10 Operable Units[2] (OUs). Most of BNL's facilities are located near the center of the site, in an area covering about 1,700 acres (Figure 1). Remediation began at the site in 1992. The 10 OUs account for various types of contamination, any of which may have impacted the groundwater. These include radiological contamination, VOCs, semi-VOCs, metals, and ethylene dibromide (EDB). Many techniques have been utilized to contain or remediate groundwater contamination at BNL, including groundwater pump and treat systems, groundwater containment, leachate collection, subsurface barriers, and alternative water supplies.

The Upper Glacial and Magothy aquifers are most prone to contamination beneath BNL, since they are found at shallow depths below surface. The Lloyd aquifer is much deeper and surface contamination may take decades or longer to reach it. One unique aspect of BNL's location is that it is situated within the headwaters of the Peconic River. Therefore, contaminants emanating from BNL have the potential to contaminate surface water as well as groundwater.

BNL has constructed numerous disposal areas, including tanks, cesspools, pits, and landfills; most of which either have been or currently are in remediation. Groundwater has been contaminated with VOCs, radionuclides, and pesticides, both on and off the BNL property. There has been ongoing monitoring of both groundwater plumes and the Peconic River. The site is served by BNL's own public drinking water supply.

Among the contaminants of concern at BNL is tritium. Since 1997, on-site management of the tritium plume has been achieved through hydraulic containment. Approximately 335 million gallons have been processed. Another 650,000 gallons were directly removed from the reactor source. Tritium undergoes radioactive decay with a half-life of 12.3 years. It is estimated that of the tritium mass that was present in the groundwater plume in 1997, approximately 29% remains in the groundwater at BNL as of 2019.

VOC and strontium have also contaminated groundwater extensively at BNL. Remediation of these contaminants is ongoing using 11 pump-and-treat systems. These systems have extracted approximately 23 billion gallons of groundwater contaminated by VOCs (approximately 7,300 pounds) and approximately 143 million gallons of groundwater contaminated by strontium (30 millicuries).

Some source areas, such as the interim landfill, chemical/animal pits and glass holes, and the carbon tetrachloride tank have each been addressed successfully and are no longer considered to be threats to groundwater. This was achieved by the late 1990s mostly via soil removal and disposal (for the chemical/animal pits and glass holes), and via a pump-and-treat system for the carbon tetrachloride tank plume. Once cleanup goals were met, the remediation equipment was dismantled.

In the headwaters of the Peconic River, mercury-contaminated sediment, along with other metals, has been an ongoing issue. Through 2015, approximately 21,000 cubic yards of contaminated sediment

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[2] An administrative term used to identify a portion of a site that can be addressed by a distinct investigation and/or cleanup approach. For example, groundwater contamination at a site may be considered as one operable unit, and soil contamination at the same site may be dealt with as a second operable unit. An operable unit can receive specific investigation, and a particular remedy may be proposed. A Record of Decision is prepared for each operable unit.

were removed from both on-site and off-site areas along the Peconic River. Additional sediment removal was planned for 2016.

Additional groundwater testing performed by BNL has indicated the presence of PFAS compounds and 1,4-Dioxane in groundwater monitoring wells and in the effluent of remedial treatment systems both on and off-site. A concentration of 18 parts per billion (ppb) of 1,4-Dioxane was reported by BNL in an off-site monitoring well in 2017. PFOS and PFOA have been detected in on-site groundwater monitoring wells in concentrations more than 75 times the USEPA's HAL of 70 ppt. As reported in the BNL 2018 Annual Water Quality Report, results from BNL's own compliance sampling of their on-site public water system wells confirmed results of samples collected by SCDHS indicating the presence of six specific perfluorinated compounds (PFOS, PFOA, PFBS, PFHpA, PFHxS, and PFNA). The concentrations did not exceed EPA's 70 ppt HAL for PFOS and/or PFOA for drinking water or the NYSDOH regulatory MCLs of 50 ppb (for the balance of these PFAS, recognized as Unspecified Organic Compounds under Section 5-1-1 (ce) of the NY State Sanitary Code), All of the detected compounds but one are related to the use of firefighting foam. The sixth detected compound, PFBS, is classified as a surfactant used in plastic production.

Table 2 BNL: SCWA Well Fields Downgradient

SITE NAME	ADDRESS	COMMUNITY
Sally Lane Future Well Field & Pump Station	Sally Lane	Ridge
William Floyd Parkway Well Field & Pump Station	William Floyd Parkway	Yaphank
Country Club Drive (Pine Hills) Well Field & Pump Station	Country Club Drive (Private Community)	Manorville
River Road Future Well Field & Pump Station, E/S of River Road	River Road	Shirley
Lambert Avenue Well Field & Pump Station	Miramar Street	Mastic
Main Street Well Field & Pump Station	Main Street	Mastic
Margin Drive East Well Field & Pump Station	Margin Drive East	Shirley
Old Neck Road Well Field & Pump Station	Old Neck Road	Center Moriches
Middle Country Road	Middle Country Rd.	Ridge

For most of the SCWA well fields listed in Table 2, their groundwater contributing areas identified in the 2003 Source Water Assessment Program (SWAP) indicate no likely impact from BNL contamination within the 100 year time of travel contributing area. The Lambert Avenue well field is the one exception. Its SWAP analysis shows groundwater being drawn in from within BNL's property in the range of 50-100 years. As of December 2018, BNL's community advisory council had urged BNL to test off-site residential wells for perfluorinated compounds, specifically PFOS and PFAS. SCDHS has identified approximately 90 properties potentially served by 92 private/ on-site wells downgradient of the BNL site, based upon a hydrogeological evaluation that considered a groundwater flow travel time of approximately 50 years from the site boundary. Other private wells are significantly further away. Private well sampling by Suffolk County Department of Health Services (SCDHS) was initiated in 2019 with notices offering free testing. This effort is ongoing.

Following the completion of a Remedial Investigation/ Feasibility Study[3] (RI/FS), a Record of Decision[4] (ROD) was issued. It is on file with the EPA and can be found at: https://www.bnl.gov/gpg/files/B96/B96_Final_ESD_07-16-09.pdf

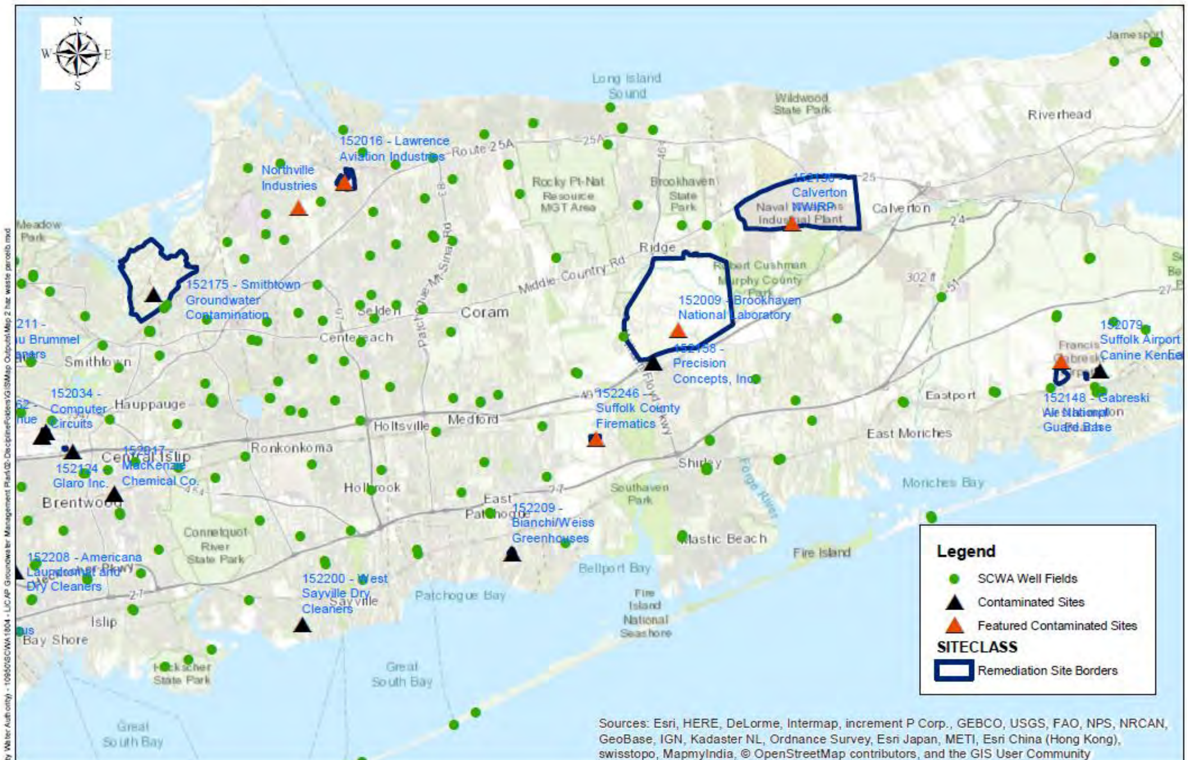

Figure 2
SCWA Well Field Sites

H2M architects + engineers

[3] Studies designed to gather the data necessary to determine the type (nature) and extent (location) of contamination at a hazardous waste site. The RI is usually performed at the same time as a Feasibility Study in a process known as the "RI/FS."
[4] A document which provides the definitive record of the cleanup alternative that will be used to remediate a hazardous waste site. The ROD is based on the Remedial Investigation / Feasibility Study and public comment.

Lawrence Aviation Industries (LAI) (EPA ID: NYD002041531)

LAI (Figure 1) is located on approximately 125 acres in the unincorporated Hamlet of Port Jefferson Station in the Town of Brookhaven. From 1959-1991 this facility produced titanium sheet metal for use in the aviation industry. Its waste stream included fluorides, sludges, caustic acids, and halogenated solvents. Wastes were disposed of in on-site lagoons and cesspools, eventually leading to significant groundwater contamination.

In 1991, SCDHS installed and sampled 12 profile wells downgradient of the subject site. Trichloroethene (TCE) was detected in 5 of these wells, with concentrations ranging up to 2,600 ppb. TCE was also identified by SCDHS in stream samples that were collected in Port Jefferson Creek in concentrations exceeding 500 ppb.

The site was initially placed on the National Priorities List (NPL) in 2000 under USEPA. A 2001 preliminary remedial investigation/feasibility study (RI/FS) through the New York State Superfund identified several contaminated and potentially contaminated private wells. Additionally, a pond and a creek located downgradient from the site have been contaminated from groundwater emanating from Lawrence Aviation. A record of decision (ROD) was issued in 2006. This ROD:

- Required groundwater extraction and treatment through pump and treat and chemical oxidation
- Directed further identification of private wells impacted by site related contamination and their connection to public water
- Required installation and operation of an off-site groundwater extraction and treatment system located at the downgradient edge of the VOC plume

TCE and PCE were detected at multiple depths in groundwater at concentrations exceeding the clean-up criteria. The ROD groundwater remedy called for the plume and source containment and treatment of contaminated groundwater, which included, in part:

- Construction of two groundwater extraction and treatment systems
- Long-term groundwater and surface water sampling to monitor changes in contaminant concentrations and distribution over time
- Investigation of vapor intrusion into structures within the plume area and implementation of an appropriate remedy (such as sub-slab ventilation systems) based upon the investigation results

On-site and off-site pump and treat has been operational since the end of 2011. Removing all oils in the on-site building press pit sumps and additional actions were ongoing as of 2014. EPA's consultant now submits a monthly operation, maintenance, and monitoring report on the pump and treat systems and a five year review report was completed by EPA in July of 2015.

In order to minimize risk to human health, the site is fenced and posted with signage informing people that nearby surface waters (Old Mill Creek Pond) are contaminated and not safe to drink. Public water serves the area, private well surveys have been conducted on multiple occasions, and no nearby private wells are believed to be utilized. As indicated in the Task 2 Private Well evaluation, data suggests approximately 21 private wells are in the general groundwater flow direction, further offsite.

The ROD for this site can be found at: https://semspub.epa.gov/work/02/108509.pdf

Northville Industry Corporation: East Setauket Terminal Gasoline Leak

Approximately 1.2 million gallons of gasoline leaked into the ground and groundwater beneath the Northville Industry Corporation's East Setauket Terminal (Figure 1). This was originally discovered in 1987. The source was underground piping within the terminal. It is unknown when the leaking began but it is believed to have possibly occurred over several decades. After repairs to the leaking pipe and further inspection of the fuel storage tanks and other pipes, Northville Industries took steps to quantify the extent of contamination and to recover gasoline from the groundwater and prevent further spread of the contamination. On October 13, 1994, Northville Industries entered a Consent Order with New York State. The Consent Order defined actions necessary for the completion of site remediation and closure.

There is one Suffolk County Water Authority Well Field (Figure 2) and approximately 11 private wells downgradient of the East Setauket Terminal.

Table 3 Northville Industries I-1720: SCWA Wellfields Downgradient

SITE NAME	ADDRESS	COMMUNITY
Sherry Drive Well Field & Pump Station	Sherry Drive	Setauket

Groundwater beneath the Northville site flows toward the north. Given groundwater flow conditions, the geologic complexity beneath the site, and the long period over which the release may have occurred and the nature of the contaminant (floats on water and chemically degrades over time), it can be stated that a release of this size may have posed some level of concern at a prior point in time. Based on action taken, there appears to be no evidence that groundwater contamination still exists at this site.

Calverton Naval Weapons Industrial Reserve Plant (NWIRP) (NYSDEC Site Code:152136), (EPA ID: NYD003995198)

The Calverton NWIRP site, located near Riverhead is shown in Figure 1. A portion of the site was used as an aircraft parts and sub-assembly plant by Northrop Grumman Corporation through 1996. Active hazardous waste disposal took place during the period of 1952-1984. Operations originally occupied more than 3,000 acres in size; the current site today is smaller, consisting of 209 acres across three disconnected parcels where environmental investigation and remedial activities currently are taking place. The Calverton site is situated on a groundwater divide, and so groundwater flow is highly variable. Groundwater beneath the site can move either to the north and south away from the divide, as well as to the east, toward the Peconic River. For this reason, the fate and transport of contaminants beneath the Calverton facility is highly dependent on the source location. There are private wells downgradient of the site.

Contamination from the site is found primarily in the Upper Glacial aquifer. Groundwater beneath the northern half of the facility flows to the northeast, while groundwater beneath the southern half of the facility flows southeastward toward the Peconic River.

The contaminants of concern (COCs) at the site include toluene, 1,1,1-trichloroethane and methyl ethyl ketone. Many different operable units have been established in order to address groundwater contamination. Within OU2 designed Site 7, a former fuel depot, a full-scale air sparging/soil vapor extraction system was approved and implemented in 2006. Site 10A was a jet fuel systems laboratory. Contamination at this site includes VOCs and petroleum products. A skimmer system to recover free product fuel from the water table operated at this location until 1996. OU3 was used for testing of aircraft engine and fuel systems. Groundwater contaminants found included free product fuel. Groundwater contamination consisting of chlorinated fuel components and VOCs are considered to relate to spills of chemicals used to clean the aircraft engines and fuel systems. Ongoing groundwater contamination migrating from the OU3 source area has been documented.

An on-site public supply well (Riverhead Water District well 12-1, emergency use only) became contaminated with chlorinated solvents above drinking water standards was formerly treated and is currently not in service. No other public water supplies are known to be impacted by the site, although no information could be found regarding the extent of emerging contaminant impacts.

The 11 acre OU4 Site 2 area was a fire training area used to simulate plane crashes. For 30 years through the mid-eighties, 450 gallons of waste solvents per year were used in the training exercises. Free product was removed from wells. Although not addressed in the earlier investigations, the Department of Defense is currently investigating its current and former facilities including Calverton relative to possible PFAS, PFOS, and PFOA from aqueous firefighting foams associated with firefighting and fire training activities at its locations.

The ROD for this site can be found at: https://www.navfac.navy.mil/products_and_services/ev.html

Suffolk County Firematics, (NYSDEC Site Code: 152246)

Located on approximately 28 acres in Yaphank, New York, Suffolk County Firematics (Figure 1) is owned by Suffolk County. It has been used as a firefighting training facility since 1959. Groundwater in the upper Glacial aquifer flows toward the southeast and is contaminated with PFOS and PFOAs. While there is currently no specific enforceable Drinking Water Standard for these two chemicals, EPA has issued a lifetime Health Advisory Level (HAL) of 70 ppt, either alone or in combination. New York State standards are under development.

There is one SCWA wellfield (Figure 2) in the vicinity of the Firematics site. The 25- and 50-year contributing areas for these public supply wells do not intersect the Firematics facility, and so there are not believed to be any anticipated groundwater impacts to these public supply wells. There are private wells generally located downgradient, some of which are in proximity of the site. Most of these wells are screened in the Upper Glacial Aquifer and are relatively shallow.

Table 4 Suffolk Firematics (NYSDEC Site Code: 152246): SCWA Wellfield Located Downgradient

SITE NAME	ADDRESS	COMMUNITY
Margin Drive East Well Field & Pump Station	Margin Drive East	Shirley

The SCDHS Office of Water Resources initiated a groundwater investigation in July 2016 to evaluate the potential for PFOS/PFOA groundwater contamination. Groundwater profile samples from 12 temporary wells on-site and immediately downgradient (between the site and the private wells) were collected. PFOS/PFOA detections were reported in all 12 profile wells:

- Sixteen well water samples in seven different wells exceeded the USEPA Health Advisory Limit (70 ppt, PFOS + PFOA or individually).

- Five wells had PFOS/PFOA detections below the HAL.
- On-site detections exceeding the HAL were as high as 418 ppt of PFOS/PFOA combined.
- Off-site detections exceeding the HAL ranged up to 986 ppt of PFOS/PFOA combined.

Significant investigation is continuing. A full remedial investigation is being conducted on and around the site in order to determine the extent and magnitude of the PFOS/PFOA contamination in the groundwater. Forty-one downgradient private wells have indicated PFOS and/or PFOA detections, with 18 of those wells exceeding the HAL. As a result of these findings, 45 homes were connected to public water and three point of entry treatment systems were installed by the county at properties that had been served by private wells. Lastly, aquatic biota studies are underway to evaluate the potential PFOA/PFOS impacts to the coastal environment.

Gabreski Air National Guard Base (NYSDEC Site Code 152148)

This site is an Air National Guard (ANG) base located at the Gabreski Airport in Westhampton (Figure 1). The ANG leases 88.5 acres of runways, aviation facilities, a former fire training area, and an additional 0.5-acre Airport Fire Training Area has also been used. Operations at the base include aircraft and ground vehicle maintenance, which historically involved the disposal of many hazardous materials used in routine` activities. Additionally, the firefighting agents used at crash sites and fire training areas contained both PFOA and PFOS. Operable units were established at the site to address the former septic systems, perfluorinated compounds and other hazardous compounds separately.

The direction of groundwater flow beneath the airport is generally toward the south-southeast. There are two SCWA well fields (Figure 2) located downgradient of the site (located as close as one mile southeast). Private wells are in some downgradient proximity to the airport as a whole. A 1994 site investigation was conducted to determine if the contaminants detected in the septic systems had migrated to soil and/or groundwater, but did not address PFOA and PFAS, since at that time these compounds were not considered to be threats to groundwater and human health. The SCDHS has conducted private well sample collection downgradient of the ANG base. Approximately 75 properties were identified as being served with a private well. About 60 were sampled and eleven indicated PFOS and/or PFOA concentrations exceeding the USEPA health advisory level. Public water was extended to 65 properties.

SCWA has sampled its public supply wells and has provided analytical assistance for private well samples collected by SCDHS in 2016 near the site and downgradient of contaminated areas. The sampling showed groundwater impacts by PFOS and PFOA downgradient of the base. Granular activated carbon (GAC) treatment was installed for some of the contaminated wells as recently as 2016. In 2018, significant groundwater (and soil) contamination were found at the Fire Training Area. The results of the sampling effort show that both Fire Training Areas appear to be contributing significantly to a PFOS and PFOA plume.

Table 5 Gabreski Air National Guard Base (NYSDEC Site Code 152148) SCWA Wellfields Downgradient

SITE NAME	ADDRESS	COMMUNITY
Meeting House Road Well Field, Pump Station & Elevated Tank	South Country Road	Quogue
Gus Guerrera (C.R. 31 South) Well Field & Pump Station	Permanent Easement	Village of Westhampton Beach

Emerging Contaminants 1,4-Dioxane and PFAS

In addition to the NYSDEC Class 2 and EPA Superfund Sites discussed above, the emerging contaminants 1,4-Dioxane, PFOS and PFOA have some likelihood to be found at any of the listed sites, given their extensive use by industry over the last century. This is likely to be the case for some Brownfields and other NYSDEC legacy sites as well (see Tables 6 and 7).

1,4-Dioxane is a chemical that was used to stabilize chlorinated solvents including 1,1,1-trichloroethane (TCA), which is among the most widely used of all solvents. Because of this, 1,4-Dioxane is often found at many of the most contaminated sites across the United States.

PFAS have been manufactured and used in a variety of industries since the 1940s. PFOA and PFOS have been the most extensively produced and studied of these chemicals. PFOS (also known as perfluorooctane sulfonic acid) was the key ingredient in Scotchgard, a fabric protector made by 3M, and numerous stain repellents. Their association with certain aqueous firefighting foams (AFFS) is well documented. “Per”- and polyfluoroalkyl substances (PFAS) are a group of man-made chemicals that includes PFOA, PFOS, GenX and many other chemicals.

Both chemicals are very persistent in both the environment and in the human body, since they don’t easily degrade, and they bio-accumulate (in proteins) over time. All the active hazardous waste sites in Suffolk County as well as most of the legacy sites will likely require groundwater testing for these compounds.

Table 6 Suffolk County Brownfields Sites

CLEANUP NAME	LOCATION ADDRESS	CITY NAME
5 North 15th Street	5 North 15th Street	Wheatley Heights
Hubbard Power & Light Inc. Property	1600 Fifth Avenue	Bay Shore
8 Andrews Avenue	8 Andrews Avenue	Wyandanch
Former Bellport Gas Station	1401 Montauk Highway	East Patchogue
William Kubach	70 Moffitt Boulevard	Bay Shore
Municipal Parking Lot	Railroad Street And New York Avenue	Huntington
37 Commonwealth Drive	37 Commonwealth Drive	Wyandanch
Rotundo	1345 New York Avenue	Huntington Station
In and Out Food Mart	1491 & 1499 Straight Path	Wyandanch
Blue Point Laundry	1 Park Street	Blue Point

CLEANUP NAME	LOCATION ADDRESS	CITY NAME
1617 Straight Path	1617 Straight Path	Wyandanch
SCSD Gabreski Airport STP	County Road 31	West Hampton Beach
7 North 15th Street	7 North 15th Street	Wheatley Heights
Lawrence Junkyard	156 Grant Avenue	Islip
Medigen Of New York	95 Eads Street	West Babylon
Former Central Islip Psychiatric Center	Carleton Avenue	Islip

NYSDEC is currently contacting site owners to schedule sampling for these chemicals in groundwater. Samples will be analyzed for a NYSDEC selected PFAS target analyte list to understand the nature of contamination. It also may be necessary to discriminate between various PFAS compounds based on association because of the variety of PFAS uses in consumer products.

A 2017 amendment to the NY State Public Health Law created a 12-member Drinking Water Council as a science based advisory board. The Law charged the Council with providing NYSDOH with guidance as the selection of unregulated contaminants for monitoring, notification levels for unregulated contaminant public reporting, and the establishment of MCLs as appropriate. The amendment directed the Council to initially focus on 1,4-Dioxane, PFOS and PFOA. The Council met five times in 2017-18 and recommended the establishment of a 1 ppb MCL for 1,4-Dioxane, and a 10 ppt MCL for PFOS and for PFOA. The State Commissioner of Health accepted these recommendations. On July 24, 2019, NYSDOH proposed amendments to Part 5 NY State Sanitary Code incorporating these MCLs and monitoring requirements for public water suppliers. Final Code adoption may be completed late in 2019 or early 2020.

Table 7 NYSDEC Class 4 Sites in Suffolk County

SITE CODE	SITE NAME	CITY/TOWN	ADDRESS
152002	Blydenburgh Landfill, Town of Islip	Hauppauge	600 Blydenburgh Road
152006	Jameco Industries, Inc.	Wyandanch	248 Wyandanch Avenue
152011	RCA Rocky Point	Rocky Point	Rocky Point-Middle Island Road
152013	Sonia Road Landfill	West Brentwood	Sonia Road
152021	Cantor Brothers, Inc.	East Farmingdale	50 Engineers Lane
152022	Goldisc Recording	Holbrook	Broadway Avenue
152029	Spectrum Finishing Corp.	West Babylon	50 Dale Street
152030	Preferred Plating	East Farmingdale	32 Allen Boulevard
152031	Peerless Photo Products	Shoreham	4 Randall Road
152035	Cardwell Condenser Corporation	Lindenhurst (V)	80 East Montauk Highway
152040	Huntington Landfill	Huntington	Town Line Road
152052	North Sea Landfill	Southampton	Majors Path
152077	ServAll Laundry	Bay Shore	8 Drayton Avenue
152082	Circuitron Corp.	East Farmingdale	82 Milbar Boulevard
152102	I.W. Industries, Inc.	Melville	35 Melville Park Road
152103	Commercial Envelope Mfg. Co., Inc.	Deer Park	900 Grand Boulevard

SITE CODE	SITE NAME	CITY/TOWN	ADDRESS
152106	Rowe Industries, Inc.	Sag Harbor	Bridgehampton Turnpike
152108	Liberty Industrial Finishing Products	Brentwood	500 Suffolk Avenue
152123	B.B. & S. Treated Lumber Corporation	Speonk	1348 Speonk-Riverhead Road
152139	Bulova Watch Factory	Sag Harbor	15 Church Street
152140	National Heatset Printing Co.	East Farmingdale	1 Adams Boulevard
152147	Minmilt Realty (Hygrade Metal Moulding)	East Farmingdale	540 Smith Street
152157	Eugene's Dry Cleaners	Babylon	54 East Main Street
152159	K - Sag Harbor MGP	Sag Harbor	Bridge Street
152169	New York Twist Drill (Loading Dock Area)	Melville	25 Melville Park Road
152184	Mom's Cleaners	West Islip	556 Union Boulevard

Pesticide Monitoring

NYSDEC implements a groundwater monitoring program to determine if the use of pesticides impairs groundwater quality beneath Long Island. Results from this program provides information for NYSDEC decisions on pesticide approval and use regulation. Since 1997, under contract to NYSDEC, SCDHS has collected and analyzed samples from groundwater monitoring wells, private water supply wells, and both community and non-community public supply wells located in both Nassau and Suffolk Counties. Samples are submitted to the Suffolk County Public Environmental Health Laboratory (PEHL) for pesticide analysis. Approximately 1,200 groundwater samples have been collected per year. Each year new pesticide products are brought to market, and this points out the need for continued improvement to available analytical capabilities.

NYSDEC maintains a webpage that documents its ongoing efforts implementing the Long Island Pesticide Pollution Management Strategy (https://www.dec.ny.gov/chemical/87125.html). NYSDEC reports that the SCDHS cooperative program consists of more than 24,000 samples, which includes analytical results for as many as 300 parameters, including 150 pesticides, pesticide metabolites, and other agricultural chemicals. Sampling locations have included as many as 200 monitoring wells. The most recent public summary of water quality monitoring analytical data was assembled by NYSDEC in 2014. Annual work plans for this monitoring program were not available for release/review, to ensure the privacy of cooperating private parties. Table 8 summarizes the core elements of the SCDHS workplan monitoring well commitment for 2019-2020.

Table 8 SCDHS Pesticide Workplan Monitoring Well Program Summary

2019-2020 Pesticide Work Plan Summary		
Project	# of Sites	# of Wells
Vineyard Monitoring	8	23
Golf Course Monitoring	12	15
Row/ Field Crop Monitoring	6	19
Greenhouse Monitoring	8	23
Sod Farm Monitoring	2	6
Residential Turf Monitoring	3	7
Nursery Monitoring	4	11
Public Utilities Right of Ways	3	9
Mixed Use/Transitional Use Monitoring	7	8
Trend Analysis	5	24
Total	58	145

This monitoring program and a further discussion of findings also is discussed in Chapters 3 and 4 of the LICAP Groundwater Resources Management Plan.