Water Conservation and Efficiency Report

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Abstract

On Long Island, the only prime source of water supply is the vast groundwater system made up of a series of tiered aquifers below the surface. More than 1,000 wells serve the area's numerous community water supply systems, tapping one of the nation's most critical and prolific sole source aquifers. Further, freshwater draining the aquifer through stream and subsurface flow helps to maintain water quality and quantity of water discharging to the Island's coastal embayments. Therefore, proper proactive management of our water resource is vital to both the quality and quantity of Long island's groundwater and coastal water systems. This section will review and recommend water efficiency strategies and the overall benefits from an overall environmental and economic perspective to ensure there will be a viable water supply for future generations.

Introduction

All residents of Nassau and Suffolk Counties (over 3 million people) obtain potable water from a federally-designated Sole Source Aquifer (SSA). This determination made by the United States Environmental Protection Agency (USEPA) in 1978, pursuant to the Safe Drinking Water Act, (42 U.S.C. Part 300), established that the aquifer is “the principal source of drinking water” for Nassau and Suffolk Counties and that “if the aquifer system were contaminated, it would create a significant hazard to public health” (Federal Register Notice, June 21, 1978). Furthermore, the designation underscores the wise and efficient use of Long Island’s drinking water resources.

Long Island’s SSA system consists of three major aquifers -- the Upper Glacial, the Magothy, and the Lloyd. The Upper Glacial and Magothy Aquifers are the significant water supply sources for most of the region, while the Lloyd Aquifer has been reserved primarily for coastal communities in Nassau County. Together, the three primary aquifers store over 60 trillion gallons of water and provide on average 375 million gallons of water per day to Nassau and Suffolk County residents.

At present, there is no shortage of drinking water on Long Island. However, due to the combination of groundwater pumpage from the aquifers and ocean discharge of treated sanitary waste, the overall volume of water in the aquifers has decreased over the past several decades, causing water table elevations to drop and the saltwater interface to move landward. This has resulted in a loss or reduction of surface water wetlands such as streams, ponds, and lakes. This loss of wetlands has required the implementation of expensive habitat and flow restoration programs in some areas, such as Massapequa Creek. Because of changing climate conditions, proactive planning and implementation of efficiency measures to reduce water use will be vital to ensure that future Long Islanders will have both a safe and adequate supply of drinking water and healthy and abundant surface waters.

Proactive water efficiency measures have far reaching financial, emergency preparedness, and operational benefits for water suppliers and the communities they serve. These water efficiency measures also can provide significant environmental benefits that result from reduced pumping rates. These benefits include maintenance of surface water features by minimizing the lowering of the water table, minimizing saltwater intrusion incidents, and slowing the potential downward movement of contaminants entrained in the groundwater.

Efficient and sustainable use of potable water also will reduce energy demand, since pumping water from wells requires electric power. High-capacity electric pump motors, ranging in capacity from 60 to 200 horsepower, provide the primary power required to draw water from the aquifer and ultimately deliver it to homes. More efficient use of water will reduce electric demand on the water supplier and ultimately on the entire power system maintained by the electrical utility. In addition, less pumpage, particularly under peak conditions, allows water suppliers to reduce local stresses on the aquifer. This also ensures that an ample supply of water will be available during an emergency (such as a fire).

Water Demand and Usage

Water demand within both counties has been increasing in recent years due to increased usage, primarily from lawn irrigation, as depicted in Figures 1 and 2 below. This trend is even more significant in Suffolk County (Figure 2).

Figure 1 – Water Use in Nassau County from 2000 through 2014

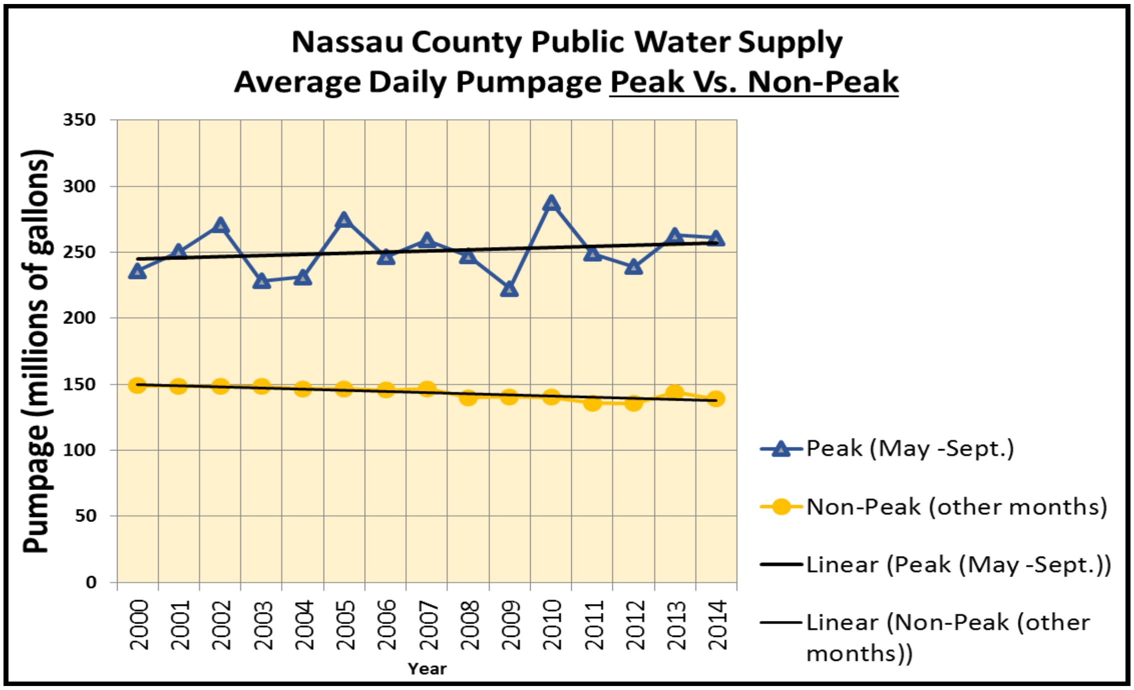
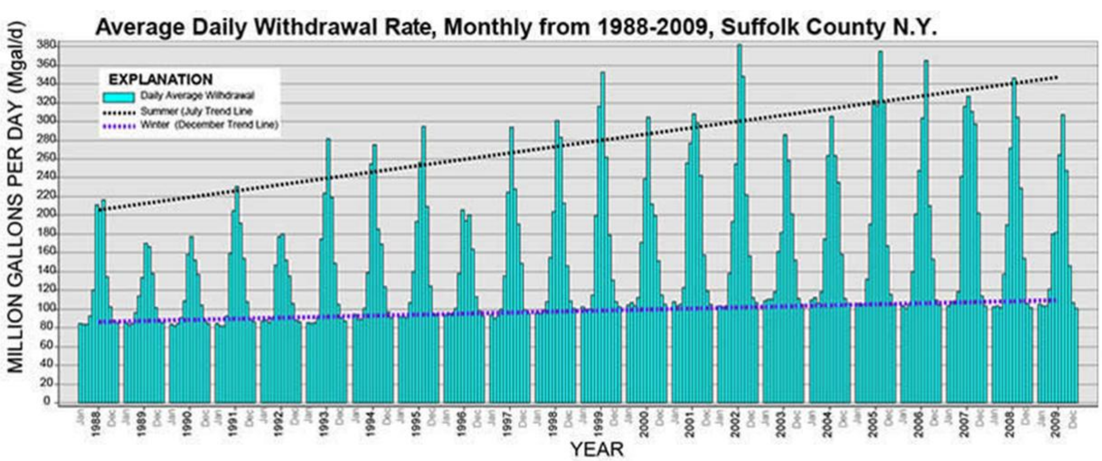
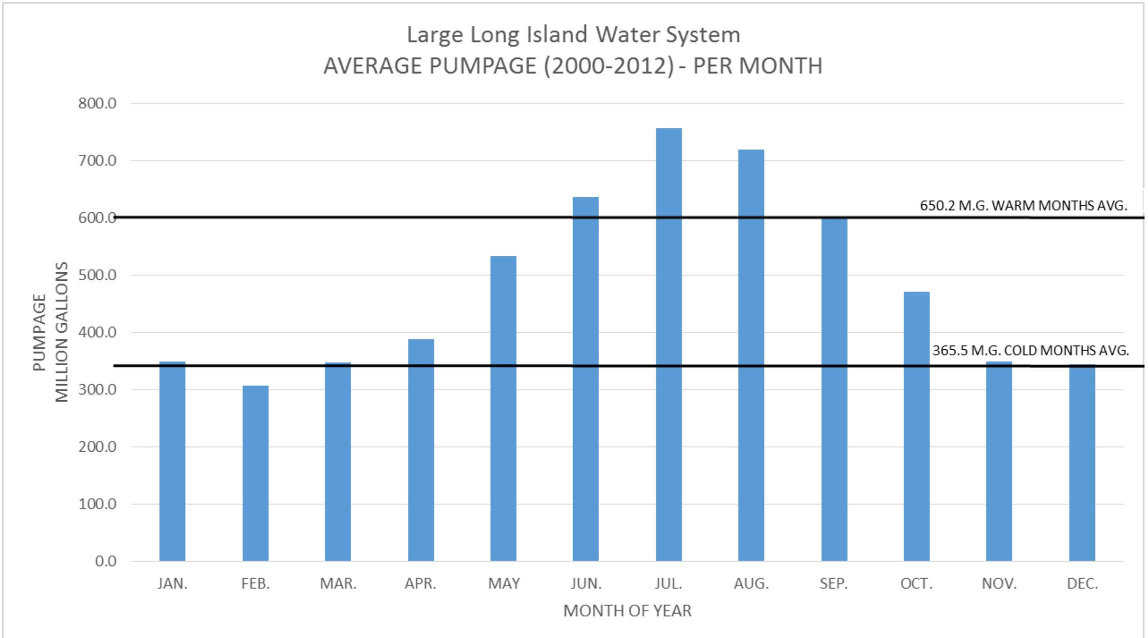


Figure 2 – Water Use in Suffolk County from 1988 through 2009



Non-peak or cold weather water demand has been in slight decline in Nassau County and relatively flat in Suffolk County. This can be attributed to specifications in the state plumbing code requiring the use of water-conserving plumbing fixtures in both new construction and building retrofits. Figure 3 illustrates the clear difference between warm (May through September) and cold (October through April) weather pumpage. Peak summer pumpage is more than triple the average winter usage for a typical Long Island water system. Therefore, lawn irrigation is a practice that should be targeted in an attempt to prevent annual water demand from continuing to increase in the future.

Figure 3 – Average Pumpage per Month for a Typical Large Water System



This increased warm weather water demand is largely due to automatic underground lawn irrigation systems. Such systems are more prevalent as real estate values increase and residents and business owners place a higher emphasis on property beautification through landscaping.

In order to meet this increased demand, water purveyors need to accelerate their efforts at public education and conservation enforcement.

Pumpage and Safe Yield

Safe yield is defined as the maximum quantity of water which can be extracted from an underground reservoir, yet still maintain the supply unimpaired (Todd, 1959). Pumping in excess of safe yield leads to overdraft, which is a serious problem in certain groundwater basins in the United States and elsewhere. Until overdrafts are reduced to safe yields, permanent damage or depletion of the ground water supplies can be expected.

Alley et al. (1999) and Maimone (2004) have described the case of Nassau County, New York, as a tradeoff between groundwater quality and surface-water quantity. In the 1970s and 1980s, with nitrate concentrations in ground water increasing due to on-lot septic systems, a decision was made to install sewer lines and treatment facilities in approximately 85% of the Nassau County land area. The treated effluent then was discharged through ocean outfalls. In the ensuing years, groundwater levels dropped by as much as 14 feet in some parts of Nassau County. Thus, a decision had been made to allow for significant surface water and groundwater quantity impacts in exchange for improved groundwater quality.

In contrast to Nassau County, approximately 70% of Suffolk County is unsewered. As a result, most streams in Suffolk County still have relatively undiminished base flow. Suffolk County officials chose to maintain groundwater and surface water quantity through the widespread use of on-site sewage disposal systems. This decision resulted in some degree of water quality impairment as a result of the use of such sewage disposal systems. Although Suffolk County has not adopted a formal definition of sustainable yield, the acceptable impact to streams has been defined. Permissible sustainable yields have been tentatively defined in water budget areas as percentages of the average recharge rates in order to control salt water intrusion (Maimone, 2004).

The 1986 Long Island Groundwater Management Plan estimated the safe yield for Nassau County to be 180 million gallons per day (MGD). The plan also provided an estimate for Suffolk County of 466 MGD. It should be noted that those were just initial estimates. In addition, different approaches were used to formulate the initial estimates. Detailed scientific study and review is needed to determine actual safe yield. Such a detailed study is underway and is part of the $6 million Long Island Groundwater Sustainability Project that United States Geological Survey (USGS) is performing for the New York State Department of Environmental Conservation (NYSDEC).

It is estimated that Nassau and Suffolk counties together have approximately 60 trillion gallons of groundwater stored within its aquifer system. Additionally, precipitation adds approximately 438 billion gallons of recharge to the aquifers annually (Masterson, 2016). According to the NYSDEC public water supply well pumpage data from 2000 through 2013, total annual pumpage from the aquifer system beneath Nassau and Suffolk Counties is approximately 137 billion gallons (this estimate is for public water supply only). Therefore, total pumping throughout Long Island is less than recharge by precipitation, and only a fraction of the overall volume of water already stored in the aquifer system. However, only about 5% to 10%, or 3 to 6 trillion gallons, is "drainable" from the aquifers. So, while there is an abundance of groundwater beneath Long Island, judicious and efficient use of it is key to its sustainability. It should also be noted that there are natural discharges or outflows from the aquifer system that need to be maintained with the "excess" water in storage. This includes discharge to streams, and flow to deeper aquifers. Therefore, safe pumpage must be maintained at quantities far below recharge, in order to preserve these outflows and keep the entire hydrogeologic system intact.

The 15-year daily pumpage average in Nassau County (from 2000 through 2014) has been 189 MGD, which is in excess of the initial estimated sustained yield of 180 MGD. Average daily water withdrawal in Suffolk County over the same period has been documented to be 187 MGD which is less than the estimated safe yield of 466 MGD. The following summarizes recharge, withdrawal, and underflow to surface water bodies for each county:

<u>Nassau County</u>

- On average, 330 MGD of recharge enters the groundwater system.
- Withdrawal, on average, is 189 MGD from the system.
- Therefore, we have 152 MGD of underflow to subsurface sediments and surface water bodies.
- Saltwater intrusion is a concern in Great Neck, Port Washington, Glen Cove, Locust Valley, Bayville, and the southwestern section of the county.

<u>Suffolk County</u>

- On average, 1,120 MGD of recharge enters the groundwater system.
- Withdrawal, on average, 213 MGD from the system.
- 933 MGD as underflow to subsurface sediments and surface water bodies.
- Saltwater upconing concerns on North and South Forks.

Since the 1950s, consolidation of water supply systems in Nassau County has been discussed. Comprehensive studies in 1971 and 1980 formulated recommendations for various degrees of consolidation to address forecasted water supply deficits during the 1990s. Both studies projected that countywide pumpage would exceed permissible sustained yield during the respective planning periods. All water suppliers undertook responsible action during the mid to late 1980s to address potential water deficit concerns by embracing the Nassau County Water Conservation Ordinance (see Section 6.2). The ordinance was promulgated in 1986. Water utilities used this Ordinance to promote customer awareness and educate the public on conserving water.

This data clearly shows that a uniform (applied in a consistent manner to both counties) and more refined method for calculating safe yield must be developed. The current data shows that Nassau County needs to evaluate water use and implement progressive water efficiency measures based on current pumpage patterns and preliminary safe yield estimates. Although Suffolk County pumpage is below the estimated safe yield, water efficiency strategies and measures should also be implemented to address regional saltwater intrusion concerns, reduce the likelihood of wetland loss, and reduce the rate at which contamination moves downward into the groundwater system.

Climate Conditions

During the past century, the rate of global mean sea level rise was about 0.7 inches per decade and observations indicate that the rate of global sea level rise is accelerating. Therefore, sea level rise will increase the potential for saltwater intrusion on Long Island. In a report issued in early 2011, the New York State Sea Level Rise Task Force assessed sea-level rise impacts and identified the greatest threats to coastal communities and natural resources that included saltwater infiltration of surface waters and aquifers.

Should climate change predictions hold true, Long Island will have shorter, wetter winters and oppressively hot summers, with rising seas and stronger storm surges (New York State Energy Research and Development Authority, NYSERDA, 2014). Hotter summers probably will translate into an increase in warm weather water demand and potential decline in water levels. The role of water use efficiency and conservation in response to these changes is obvious.

Current Water Conservation and Efficiency Initiatives

NYSDEC Pumpage Caps

During 1987, the New York State Department of Environmental Conservation (NYSDEC) imposed pumpage constrains, or “caps” on all Nassau County public water suppliers. The long-term preservation of Long Island’s underground water supply by maintaining existing water levels was the basis for these caps. The caps were predicated on a then-current 5 year running average and a maximum volume in any one year, while still maintaining the 5 year average when developed in 1987. According to the NYSDEC, the caps have been maintained at their 1987 levels.

During the late 1980s, several water suppliers challenged the pumpage caps due to perceived inadequacies with the methodology utilized by the NYSDEC in developing the caps. These perceived shortcomings included: no allowance for water conservation programs that may have been implemented before the caps and no consideration of safe permissible yield and mathematical deficiency in the NYSDEC rules for calculating the current 5 year cap that produces a “roller coaster” effect. Despite these perceived shortcomings, the regulatory initiative had one of its intended effects, namely of promoting water conservation awareness and the virtues of reducing water waste.

Based on prior legal challenges and the aforementioned inadequacies, the NYSDEC has authority to take enforcement action on the caps with the exception of the Village of Bayville. The agency recognizes the inadequacy of current practice and cap calculation and will looking in the future to formulate the caps in a way that can balance sustainable yield with the needs of the individual water suppliers. The NYSDEC plans to have a conservation plan template completed during 2016. Discussions will ensue with each water supplier regarding overall conservation in general and its pumpage cap specifically.

Nassau County Water Conservation Ordinance (Ordinance 248-A-1987)

In 1987, a progressive water conservation ordinance was adopted by Nassau County (Ordinance 248-A-1987). The centerpiece of the ordinance involved strategies to reduce outdoor water use. In particular, lawn sprinkling is prohibited from the hours of 10:00 a.m. to 4:00 p.m. and is limited during other hours to odd and even days, corresponding to a resident’s street address number. In addition, the ordinance also regulated outdoor water hose usage by requiring the use of a hand operated automatic-off nozzle valve. Furthermore, the hosing of driveways, sidewalks and streets is prohibited. Habitual violators of the county ordinance can be subject to a $50 fine from the local police department. Since the promulgation and enforcement of the lawn sprinkling regulation over 27 years ago, many Nassau water purveyors have found the ordinance to be a valuable water resource management tool. It has been determined that outdoor water use is more uniformly distributed with the odd / even irrigation ordinance. This subsequently reduces peak water demand significantly which results in far reaching environmental, financial and operational benefits for water suppliers and the community.

Presently Suffolk County has not adopted such an ordinance. In October of 2015, the Town of Brookhaven adopted an ordinance requiring new in-ground irrigation systems be equipped with a rain sensor. Rain sensors prevent an irrigation system from activating while it is raining or the lawn is still moist and watering is not needed.

NYSDEC Water Conservation Plans

In July 1988, the Governor of New York State signed legislation requiring a water conservation program as a condition of a water supply permit. To assist local governments in complying with this new requirement, the law directed the NYSDEC to develop a model water conservation plan which includes beneficial short- and long-range water conservation procedures reflecting local water resource needs and conditions. This manual serves as a model to help advise local officials regarding water conservation techniques which individual suppliers may use to conserve water.

Current plans (submitted with Water Withdrawal Permit Applications) include an evaluation of existing information consisting of source water inventory; water usage; metering and rate structure; water supply auditing; leak detection and repair; and the review of current water conservation initiatives. Recommended water conservations polices evaluated reducing distribution system losses; leak detection; water efficient landscaping; water audits; and public awareness.

Recently, the NYSDEC has stressed that all water conservation plans must have measurable short-term objectives that will require an annual update. This includes a commitment to finance water conservation measures. The plan must provide time frames/schedules; discuss funding allocated or to be allocated for implementing water conservation measures; and state a commitment to implement measurable objectives. Applicants must use the term “will implement” rather than “should implement”.

A conservation plan must cover the following elements:

- Water rate structure – how often reviewed.
- Water meters – number of replaced, tested, calibrated, and/or repaired per year.
- Top ten water users – have provisions to provide audits.
- Leak detection – miles of main surveyed.
- Water main replacement – 100-year replacement schedule.
- Measures to reduce unaccounted-for water. (i.e., leak detection, main replacement, and/or water meter replacement/calibration).
- Public outreach efforts – bill stuffers, newsletters, social media, news releases, etc. Must go beyond ADWQR.
- Flagging of high bills/potential leaks
- Automatic irrigation – customer education and outreach.
- Reduce summer peaks associated with irrigation demand.
- Leak repairs – number of leaks, time to repair.

Most water suppliers have many of the above elements implemented, so the requested changes should not have a significant impact. The NYSDEC will be preparing a template in the near future.

Benefits and Best Efficiency Practices

Since best practices take time and planning to effectively implement, water efficiency measures must be proactively implemented prior to the onset of drought and emergency conditions. Effective water efficiency measures will provide numerous environmental, infrastructure, and economic benefits while helping to ensure that a high quality supply of drinking water will be available to future generations.

Environmental and infrastructure benefits include protection of wetlands, prevention of saltwater intrusion, better water quality, less energy use, reduced strain on the electric grid, and improved drought and emergency response/preparedness. The following details the benefits:

Water Quality:

- Efficient pumpage management assists with addressing water quality concerns.
- The less stress that is placed on the local aquifer segment reduces the potential for drawing contaminants deeper into the groundwater system. This leads to better management of contamination plumes.

Environmental

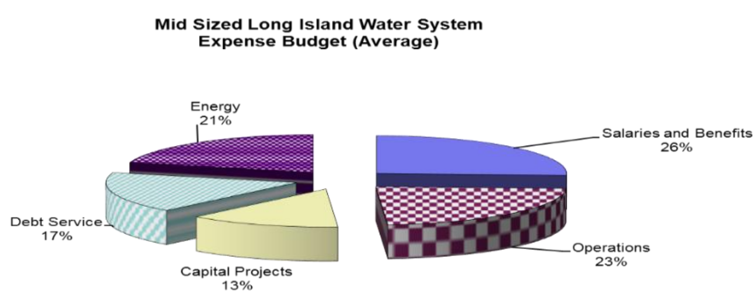
- Protection of wetlands.
- Prevention of saltwater intrusion.

Energy Use:

- Water transmission and distribution requires a significant amount of electric power
- High capacity electric pump motors, ranging in capacity from 60 to 200 horsepower, provide the primary power required to draw water from the aquifer and ultimately to the home.
- Lower water demand results in lower energy use. Reduces potential for local brownouts and blackouts.
- Less energy that is used the less fossil fuel is used resulting in reduction of greenhouse gas emissions.

Economic Benefits:

- Since water systems are designed to meet peak day and hour demand, less water demand results in less water supply infrastructure required in order to meet peak demand.
- Less use of treatment chemicals, since less overall water is pumped.
- Lower energy costs. As shown below energy costs can range from 20 to 30% of the budget of a mid-sized Long Island water supplier
- For consumers, lower water and energy use could lead to lower monthly bills.
- Effective sustainable practices will decrease energy, chemical, maintenance, and capital costs.



Challenges to the successful implementation of sustainable practices include lack of public engagement, the proliferation and widespread improper use of automatic irrigation systems, aging infrastructure, the low cost of water (under valuation), and loss of revenue through metered water sales. To engage the public in order to change water use habits requires proactive public outreach. In order to be effective, outreach and education initiatives must be implemented through various platforms such as schools (engage the younger population to develop good water use habits), civic associations, newsletters, press releases, and social media.

Changing habits through public engagement is an obvious and important element for promoting sustainable water efficiency. However, an evaluation and implementation of programs and measures that will achieve large-scale water savings must be undertaken. Such programs should focus on outdoor water use, water rate structure, aging, and homeowner leak repair.

Studies disseminated by Cornel Cooperative Extension of Nassau County have concluded that lawns on Long Island tend to be over-irrigated. Irrigation of lawns every other day at a rate of 1 inch per week is sufficient for most areas of Long Island. Because of this overwatering by automated irrigation systems, focusing efficiency efforts in this area yields the greatest potential results.

The proper design and operation of automatic irrigation systems are vital to efficient use of the resource. Understanding and properly using various water applications, such as spray versus drip irrigation, can have a profound impact on water use. For example, the type of spray head and pattern are critical for optimizing water use. The strategic and proper use of weather sensors (such as solar radiation, temperature, rain, and/or freeze sensors), soil moisture sensors, and flow control devices can also achieve water savings. Use of smart controllers and weather sensors on lawn irrigation systems will automatically adjust water usage based on weather and soil moisture conditions. Finally, having a good understanding of the watering needs for particular landscape is essential to system design. Proper training and knowledge in the area of outdoor irrigation is necessary to achieve sustainable watering goals.

Irrigation industry professionals can be an invaluable asset in helping use water more efficiently. The Irrigation Association of New York (IANY), established in 1985, is a professional organization of contractors representing all specialties and disciplines of New York State's irrigation industry. It aims to foster development and economic advancement for its members and to promote water conservation through efficient irrigation practices and products. One of the organization's objectives is to support legislation to require irrigation contractors be certified and adhere to "Best Management Practices". The association has introduced the "Landscape Irrigation Contractor Certification Act" in the New York state legislature as a consumer-protection measure that will foster adherence to the highest professional standards by irrigation contractors. Certifying irrigation professionals promotes the protection of public health and safety, supports the environmental, economic and social benefits of cultivated landscapes, and helps to ensure the efficient use of water resources.

Louisiana, New Jersey, North Carolina, and Texas are the only states that require irrigation contractors to obtain a license in order to practice landscape irrigation. The following states have provisions as an irrigation sub-category under plumbing or landscape contracting: California, Connecticut, Oregon, Illinois and Rhode Island. Florida offers a voluntary license that exempts the licensed individual from local irrigation contracting licenses.

In summary, outdoor water efficiency can be optimized through restrictions, efficient landscape design, properly scheduled irrigation (reducing peak demand impacts to water systems), efficiently designed and constructed irrigation systems, and the use of technology (rain sensors, tensiometers, etc.). In addition, certification of irrigation contractors can provide Long Island water supply systems with a central database of contractors. This database could prove valuable to water suppliers who can use it to contact irrigation installers for assistance in cases where irrigation systems need to be adjusted or use of them needs to be controlled or restricted.

Xeriscaping is a systematic method of promoting water conservation in landscaped areas. Although xeriscaping is mostly used in arid regions, its principles can be used in any region to help conserve water. Basic xeriscaping principles consist of the following:

- Planning and design. Provides direction and guidance, mapping water and energy conservation strategies, both of which will be dependent upon regional climate and microclimate.
- Selecting and zoning plants appropriately. Selecting and locating plants that will thrive in the regional climate and microclimate; grouping plants with similar water needs together.
- Limiting turf areas. Reducing the use of bluegrass turf, which usually requires a lot of supplemental watering, and substituting with a turf grass that uses less water.
- Improving the soil. Enabling the soil to better absorb water and to encourage deeper roots.

- Irrigating efficiently. Using the irrigation method that waters plants in each area most efficiently.
- Use of mulches. This keeps plant roots cool, minimizes evaporation, prevents soil from crusting, and reduces weed growth.
- Maintaining the landscape. Keeps plants healthy through weeding, pruning, fertilizing, and controlling pests.

Water suppliers should work with local planning boards to promote water-friendly landscaping and efficient irrigation system design.

"Unaccounted-for water" is water that is pumped by suppliers, but is not consumed by their customers. It is calculated by subtracting the water that is billed from the total water pumped. Unaccounted-for water consists of water used for flushing of water mains, water lost to leaks, main breaks and fire fighting, and numerous other purposes. This water is important to track and understand. As water main infrastructure ages, the potential for water leaks increases. This is critical to determine the effectiveness of conveying water to the consumer with minimal losses in the transmission and distribution system.

In 1996, the American Water Works Association (AWWA) Leak Detection and Accountability Committee recommended 10 percent as a benchmark for "unaccounted -for" water. Water systems that are approaching the 10 percent threshold, or have exceeded it, should strongly consider the implementation of a proactive leak detection program. At a general cost of $120 per mile of water main surveyed, the payback can be considerable when leaks that have not surfaced are detected and repaired. Not only can significant water savings be achieved, leaks can be repaired in a planned manner rather than under emergency conditions that could involve overtime and damage to roads and other utilities.

A leak detection program also should be used in conjunction with a water main replacement program. At a minimum, water mains should be replaced on a 100-year cycle. It should be noted that many factors contribute to main breaks and failure that can drive the need for water main replacement. These factors can include pipe age, pipe material, soil conditions, pipe laying/bedding conditions, temperature (internal water and ambient soil), frost load (related to soil temperature), traffic loading conditions, surges, and higher than normal operating pressures.

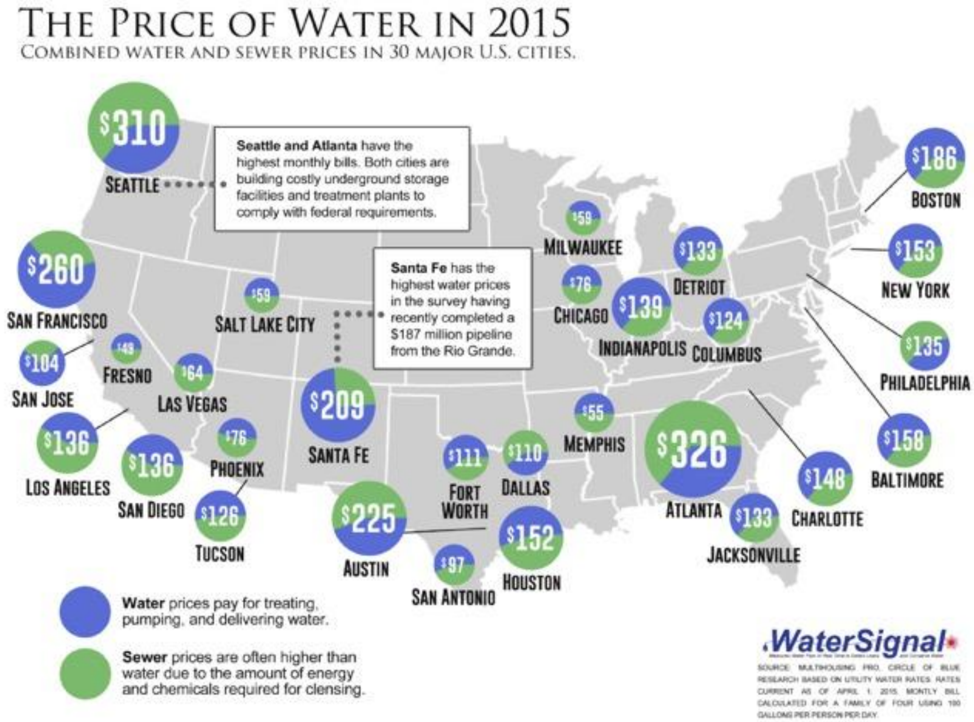
Accurate metering of source water (pumped from wells) and consumption (water service lines) are vital to obtaining an accurate understanding of water use and loss. Proper meter management will control apparent water losses and provide a better understanding of water use patterns. Metering strategies include the following:

- Meter management: This includes meter selection based on flow requirements, meter type & selection critical to accurate metering, as well as the development and implementation of testing and replacement schedules.

- Calibrate production/plant-site metering that includes venturi tubes, orifice plates and other metering devices. AWWA recommends testing and calibration every year.

- Customer meter testing/replacement program

Challenges to the successful implementation of sustainable measures include the potential loss of revenue. Reduced water use can result in lower revenue but can be offset by decreased operating, maintenance, and capital expenses associated with lower water production. In addition, effectively crafted water rate structures can also assist with maximizing revenues in the face of decreased water demand. Since water system customer bases vary, careful consideration of rates must be provided to determine the best application of uniform, inclining, and seasonal rates. Water tends to be undervalued and underpriced with rates that generally do not reflect the true cost of the resource and the need for infrastructure investment and/or replacement. The figure below provides an overview of the price of water across the United States depicting the monthly combined water and sewer prices in 30 major cities during 2015. Section 9.0 will review the "Value of Water" in further detail.



Other Conservation and Efficiency Practices

Indirect potable reuse is currently in place in many municipal water systems outside of Long Island in which wastewater is treated to remove pollutants and released into local bodies of water. Once the effluent is released and mixed with the local water bodies, the water is pumped out to a municipal water supply and redistributed to its customers. However, there are instances where the middle step that releases treated effluent into local bodies of water is skipped. This is called direct potable reuse, and, although it is less common, it has been part of a solution in response to the recent droughts that have riddled arid regions of the country such as California.

Water reuse for non-potable situations is commonplace in the United States. According to the USEPA, approximately 2.2 billion gallons of water are reused daily in the United States. Florida, California, the arid Southwest, and Virginia lead the way. The primary outlet for the reused or reclaimed wastewater is for irrigation purposes on golf courses, other green spaces, and on a variety of agricultural crops including both non-food and food products. Section 8.0 will discuss this in greater detail.

Industrial reuse is one of the more prevalent forms of wastewater reuse in large-sale operations, typically used for cooling purposes. Because industry can account for significant water demand, many large operations outside of Long Island have implemented their own private treatment plants. This avoids tapping into the municipal water supply to meet non-potable operational needs, such as cooling and washing.

On a residential scale, there are various options, based on local circumstances. For instance, if an area typically requires septic tanks, people in that area could incorporate their own wastewater treatment system. There is also the option to avoid reusing wastewater as whole and instead use the water from daily tasks like laundry, showering, and washing dishes. In this form, the reused water is called grey water and can be used for non-potable purposes such as laundry, toilets, and irrigation.

Using Reclaimed Wastewater for Irrigation-Water Reuse

Perhaps the most environmentally sound strategy for supplying water for the irrigation of landscaped properties, agricultural crops, and golf courses is through water reuse. This involves irrigation utilizing wastewater from either a regional sewage treatment plant or a homeowner's on-site sanitary system (with appropriate treatment) rather than using water pumped from Long Island's underground aquifers. An important benefit of using reclaimed wastewater for irrigation purposes is that it can improve water quality in the receiving waters into which the wastewater was formerly discharged. Perhaps, as importantly, reusing wastewater for irrigation purposes can supplant the consumptive use of groundwater from the Upper Glacial Aquifer, thereby reducing stress on the groundwater system due to reduced pumping.

Reclaimed wastewater from sewage treatment plants has been reliably and safely used for irrigation purposes for many decades throughout the United States, most notably in California, Florida, and the arid Southwest. The main recipients of the treated effluent have typically been golf courses, landscaped green spaces, and non-food crop agricultural areas. Other uses have included industrial cooling and wetland creation and supplementation. As of 2008, the United States used approximately 2.2 billion gallons of reclaimed wastewater per day for these purposes. Additionally, reclaimed wastewater has been used in a number of other countries, such as Israel, where 70% of the wastewater is reused for irrigation and other purposes. During this time a very extensive and comprehensive performance record has developed and no known human health problems have emerged from the use of and exposure to reclaimed water in these applications.

The general Long Island-wide benefits of water reclamation are significant. First, widespread reuse of highly treated wastewater, from the many publicly- and privately-owned sewage treatment plants, can achieve meaningful reductions in the total amount of nitrogen discharged directly to the Island's groundwater and coastal waters. This is accomplished by redirecting nitrogen-laden wastewater from these resources to beneficial reuse applications as mentioned above, some of which take up the nitrogen as a plant nutrient. Second, using reclaimed wastewater can reduce stresses on the Island's groundwater supplies since the reclaimed wastewater supplants use of groundwater, thereby reducing pumping by an equivalent amount.

NYSDEC data on reported pumpage for golf course irrigation wells for the years 2010 and 2014 show that a total of approximately 2 billion gallons per year of water is pumped by golf course irrigation wells each year (it should be noted that the estimates provided did not include every golf course as there are some with no available data). Additionally, there are some golf courses that also utilize potable water for at least a portion of their irrigation requirements. Golf course irrigation is considered to be purely consumptive use of water, since virtually all water utilized for this purpose is lost to the aquifer system via either plant uptake or evaporation. Little, if any, irrigation water is recharged back to the aquifer system

In this regard, there are several obvious benefits resulting from the reduction in the amount of water pumped from the Long Island aquifer system. From a water quality perspective, the less water pumped generally means a slower downward movement of contaminants through the aquifer system. Another key benefit has to do with water quantity: reducing pumpage minimizes water table drawdown, thus preserving surface water features such as lakes and streams and possibly preventing the landward movement of the freshwater-saltwater interface in certain areas. There are also potential energy savings and a reduction in quantity of fertilizer required.

The recently completed water recycling project between Suffolk County and the Town of Riverhead is illustrative of the specific potential benefits to the environment that can be achieved on Long Island by using water reuse strategies for irrigation purposes. This project (initiated in the summer of 2016) will redirect approximately 350,000 gallons per day of tertiary-treated wastewater from the Riverhead Sewage Treatment Plant (STP) away from the Peconic River to the adjacent Indian Island County Golf Course for irrigation of the turf grass.

Engineers involved with the project have determined that this single project will eliminate 2,000 pounds of nitrogen annually from entering the Peconic Bay/River system, and will eliminate the need to pump approximately 66 million gallons of water annually from the Upper Glacial Aquifer. An added benefit of the project will be (1) financial savings to the golf course from reduced energy costs as a result of less pumping and (2) lower fertilizer costs due to the elevated nitrogen concentration of the reused water which encourages plant growth. While the above-referenced example involves two adjacent properties (which represents the ideal situation economically and operationally), many water reuse projects may involve transmitting water over greater (but still feasible) distances. The Suffolk County Department of Planning has documented 26 golf courses within the County situated within one-half mile of a sewage treatment plant. Other potential recipients of treated effluent for irrigation include sod farms and other non-food agricultural crops such as nurseries, Christmas tree farms, floriculture, and hay fields.

Emerging sewage treatment technologies for on-site sanitary systems can potentially assist homeowners in irrigating their landscaping and lawns. In these systems, the treated wastewater is dispersed through narrow tubes situated about six to twelve inches below the ground, collectively known as the drain field. The shallow depth of the tubes allows for the water to be taken up by the roots of the turf grass. A significant advantage to this approach is that there is little to no opportunity for the wastewater to come into direct human contact. While these systems do not entirely replace the need for irrigating turf grass (since the drain field covers only a portion of the lawn area), they can reduce the amount of groundwater used for residential landscape irrigation.

On Long Island, two additional strategies need to be undertaken in order for the potential of water reuse to be fully realized. The first is for the NYSDEC to promulgate the enabling rules and regulations required to implement Title 6 of Article 15 – Water Efficiency and Reuse. The second is to undertake an Island-wide water reuse feasibility study which assesses the technical, logistical, financial, and social dimensions of water reuse so as to provide a roadmap and blueprint for its implementation Island-wide.

Suffolk County officials plan to use treated wastewater from a Riverhead STP to irrigate the County-owned Indian Island Golf Course. Beginning in 2016, the Riverhead Sewer District plant, located next to the golf course, will pump 350,000 gallons of water per day-- almost half the daily volume treated by the plant-- into the course's irrigation system during months when the course is watered. As previously mentioned, municipalities in arid states often reuse wastewater but the practice is rare in New York.

Throughout Long Island, water reuse has great potential to reduce pumping demand on the groundwater system for non-potable purposes while also reducing contaminant loadings and ecological impacts to the Island's surface water ecosystems. For example, Suffolk County has identified 26 golf courses that are within one-half mile of a sewage treatment plant. Use of treated effluent from all of these plants (rather than wells) for golf course irrigation could conserve millions of gallons of groundwater annually. Industrial reuse of treated sewage effluent also has some conservation potential. For example, the Port Jefferson Village STP is adjacent to the Public Service Enterprise Group (PSEG) power plant. Using treated wastewater to cool the plant rather than utilizing water from the Port Jefferson Harbor (as is the current practice), could have positive impacts on the ecosystem of the Harbor.

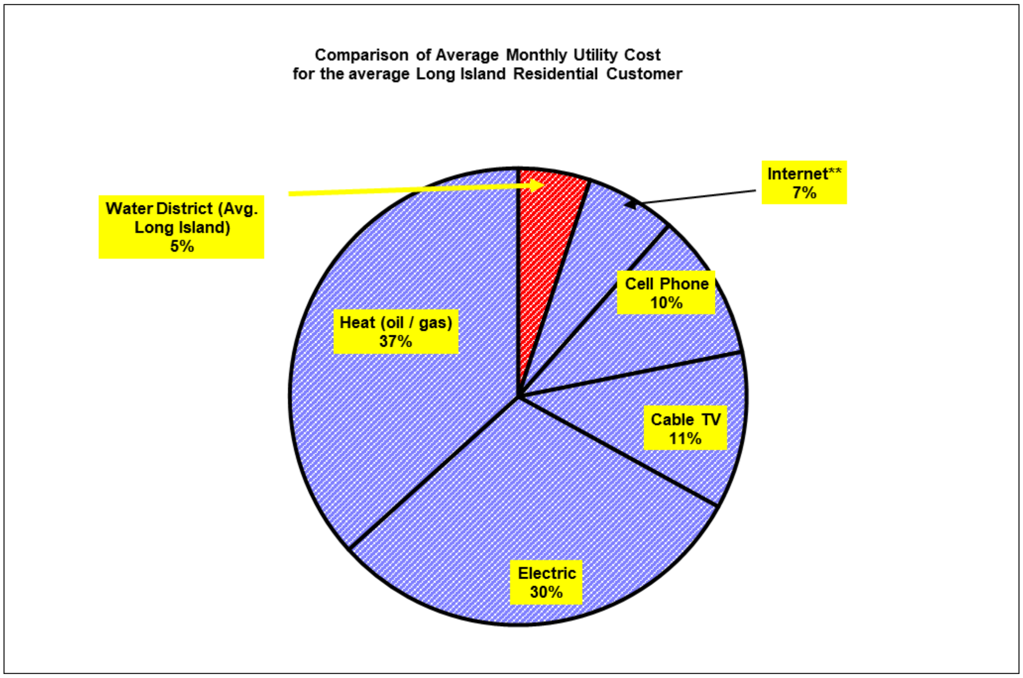
Other strategies that can be employed to achieve practical and sustainable water savings include:

- Water use audits for top users.
- Homeowner assistance programs to repair leaks and install water efficient devices.
- Plumbing code enforcement.
- Plumbing retrofit.

The Value of Water

Americans are not accustomed to paying and have been largely unaware of the true cost of treating and delivering clean, safe water to their taps. Americans pay less for water – about a penny per gallon on average – than do residents of most other developed nations. The historic underpricing of water is largely due to a perception that water is "free" – a fundamental human need supplied by the earth itself. The vast infrastructure required to treat and deliver that water where it is needed, however, is far from free.

Water rate structures should be designed to promote water efficiency and investment in water infrastructure replacement. In most instances on Long Island, water is the smallest part of any utility bill (refer to figure below). For many, if not all water districts, the monthly cost of water for the average residential homeowner (based on water rates and property taxes) is less than broadband Internet service, despite the fact that water is vital to public health. Full-cost pricing will not only help water utilities continue to provide customers with safe and clean water but will have the added benefit of encouraging more conservative use, ensuring a sustainable supply for future generations.



Summary and Conclusions

- Outdoor water use and water system leakage are the biggest contributors to water use inefficiencies and loss. On Long Island, average water use during the summer more than doubles compared to winter usage. Peak summer pumpage is more than triple average winter usage for a typical Long Island water system.

- Current warm weather water demand is significantly influenced by the installation and use of automatic underground lawn irrigation systems. Such systems are more prevalent as real estate values increase and residents and business owners place a higher emphasis on property beautification through landscaping. Therefore, water purveyors must continue to educate the public on efficient water use and enforce conservation ordinances relating outdoor landscape irrigation in order to mitigate future demand.

- A uniform (applied in a consistent manner to both counties) and more refined method for calculating safe yield must be developed. The current data shows that Nassau County needs to evaluate water use and implement progressive water efficiency measures based on current pumpage patterns and preliminary safe yield estimates. Although Suffolk County pumpage is below the estimated safe yield, water efficiency strategies should also be implemented to address regional saltwater intrusion concerns, reduce the likelihood of wetland loss, and reduce the rate at which contamination moves downward into the groundwater system.

- There is an abundance of groundwater beneath Long Island but judicious and efficient use of it is key to its sustainability. In addition, there are natural discharges or outflows from the aquifer system that need to be maintained with the “excess” water in storage. This includes discharge to streams and flow to deeper aquifers. Therefore, safe pumpage must be maintained at quantities far below recharge in order to preserve these outflows and keep the entire hydrogeologic system intact.

- Recent observations indicate that the rate of global sea level rise is accelerating. Therefore, sea level rise will increase the potential for saltwater intrusion on Long Island even if groundwater pumpage remained relatively constant, thus making water efficiency measures a vital resource management tool.

- The proper design and operation of automatic irrigation systems are vital to efficient use of the resource and irrigation industry professionals can be an invaluable asset in helping use water more efficiently. Therefore, certifying irrigation professionals promotes the protection of public health and safety; supports the environmental, economic, and social benefits of cultivated landscapes; and helps to ensure the efficient use of water resources.

- Implement water efficiency management practices prior to the onset of drought and emergency conditions. Effective water efficiency measures will provide numerous environmental, infrastructure, and economic benefits while helping to maintain a high quality supply of drinking water. Environmental and infrastructure benefits include protection of wetlands, prevention of saltwater intrusion, better water quality, less energy use, reduced strain on the electric grid, and improved drought and emergency response/preparedness.

- Potential loss of revenue due to reduced water use can be offset by decreased operating, maintenance and capital expenses associated with lower water production. Effectively crafted water rate structures can also assist with maximizing revenues in the face of decreased water demand. Careful consideration of rates must be provided to determine the best application of uniform, inclining, and seasonal rates.

- Other strategies to achieve practical and sustainable water savings include water use audits for top users, homeowner assistance programs to repair leaks and install water efficient devices, plumbing code enforcement, and plumbing retrofit.

- Water rate structures should be designed to promote water efficiency and investment in water infrastructure replacement. Full-cost pricing will not only help water utilities continue to provide customers with safe and clean water but will have the added benefit of encouraging more conservative use, ensuring a sustainable supply..

Recommendations

- Develop science-based permissive yield pumpage values for each county and regions subject to saltwater intrusion.

- Target lawn irrigation as a water-use practice in an attempt to prevent annual water demand from continuing to increase in the future.

- Expand Nassau County water conservation ordinance to Suffolk County standards (with appropriate modifications).

- Require irrigation contractors to be certified / licensed in New York State. Furthermore, require that these certification requirements adhere to the guidelines of a national professional organization, such as the national Irrigation Association. Additionally, require that these regulations follow standards established by the USEPA's "Water Sense" program.

- Require that certified contractors obtain continuing education credits by attending technical and business related classes. Use the certification process to establish and maintain a database for use in cooperation with public water supply systems.

- Request water suppliers to work with local planning boards to promote water-friendly landscaping and efficient irrigation system design.

- Require all Long Island water purveyors to adopt a rate structure that promotes water conservation and to implement a homeowner conservation assistance program.

- Have NYSDEC develop an Island=wide water reuse feasibility study, looking at the logistical, financial, technical, and social issues related to water reuse.
- Have NYSDEC develop the necessary rules and regulations so the legal framework is in place to fully implement water reuse as required by Environmental Conservation Law Article 15, Title 6.
- Promote conservation by requiring rain sensors, at a minimum, to prevent automatic sprinkling systems from switching on while it is already raining. This must include retrofitting existing systems. Require that rain sensors be tested annually and replaced every 5 years.
- Recommend that all commercial and large residential sprinkler systems have periodic landscape irrigation audits.
- Recommend that larger water purveyors consider funding water audits for larger commercial users and the implementation of recommended strategies found in the audits.

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