Recent Long Island Water Resource Studies and Databases

2017

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WaterTraq Water Quality Mapping and Database

Introduction

In September 2016, Long Island Commission for Aquifer Protection (LICAP) officially launched the historic mapping and database website known as WaterTraq. The program, the first of its kind in New York State, revolutionized the way public water providers tracked potential threats to the water supply, and provided web-accessible information to both the general public and regulatory officials. With WaterTraq, this information about groundwater and drinking water quality became readily available to the public via the LICAP website (www.liaquifercommission.com).

Development of WaterTraq

The idea for WaterTraq was proposed through the LICAP Water Quality Management Group subcommittee. One of the most frequently cited concerns during the early meetings of this LICAP subcommittee was the lack of a coordinated regional water quality monitoring and reporting program. The primary objectives of the Water Quality Management working group were to determine the water quality parameters most critical to monitor and report, to develop a universal data reporting format, and to identify the most appropriate platform to store, analyze and share the water quality data. Earlier attempts by New York State to implement standardized electronic data deliverable formats utilized environmental information management systems, such as the database software application EQuis^{TM}, and the EPA storage and retrieval data warehouse (STORET). Some of the advantages of these programs were their capability in handling multiple sample types and their usability by other agencies to visualize data in specific geographical areas. While these programs had success with requiring certain types of data to be submitted electronically, the data had to be formatted to meet the guidelines specified by the reporting agency. In addition to the added complexity of formatting datasets, multiple versions of the same program existed and were incompatible with each other. The substantial costs associated with training laboratory staff and hiring consultants to process the data also proved to be a disadvantage.

The ESRI ArcGIS (Geographic Information System) platform was deemed by the working group to be a more user friendly platform, due to the availability of the program across the various utilities and agencies. Because most organizations leverage GIS, or have GIS staff available, cost savings would result from greater efficiency in the logistics of transferring data. Since GIS maps provide an ideal platform to visualize and interpret datasets, using this platform in conjunction with water quality data would allow for increased decision making and improved communication. While the ESRI ArcGIS could provide a mechanism to store and visualize the data, the greater concern was how to make the information easily accessible to the public. ArcGIS requires users to have a license with ESRI, the maker of ArcGIS, which would be costly. In addition users would have to learn how to use the desktop version of the program in order to search through the water quality data.

The Challenge of Sharing Water Quality data

The challenge of sharing the data to various agencies and public was ultimately solved through the introduction of the ArcGIS online platform. ArcGIS online is a cloud-based collaborative mapping platform that provides the ability to use, create and share maps, analytics and data. Because this online program required minimal implementation steps and no programming ability, the costs of implementation would be substantially reduced. In addition the program could be made available to anyone with a web browser or mobile device and does not require a download.

With the GIS platform established as the tool to visualize the data, the next challenge focused on the data type that would be shared and exported to GIS. The initial concerns centered on the coordination efforts in having over 50 water districts agree to share well data, and have the respective laboratories in Nassau and Suffolk export water quality data. Water suppliers were requested to provide both the Latitude/Longitude coordinates for all of their public supply wells as well as the well attributes (such as well depths, aquifer type and district served). The laboratories were requested to supply raw water quality information for the calendar year 2015.

Excel was then utilized as the tool to export the data, because it is a universally accessible program used by both the water utility agencies and laboratories. The ease of use of Excel, and the program's functionality allowed the data to be shared by all parties with minimal formatting. Since Excel allows for the analysis large amounts of data, the data provided by the individual suppliers could be combined and analyzed efficiently with the existing filtering, sorting and search tools. The common identifier used to link the water quality sample data provided by the laboratory with the corresponding well location data was the DEC issued "S" or "N" (Suffolk or Nassau) State identification number uniquely assigned to each well. Combining the water quality data for each well with the well attribute data provided a mechanism to search for a compound and have the results visually displayed by concentration range and location. In addition, compounds could be searched based on well depth, aquifer type, water district and sample data. This allowed the water quality data to be displayed both in spatial dimensions and time. The framework of ArcGIS, linking the water quality data with public supply wells, provided an unprecedented view of water quality data on Long Island.

Both Nassau and Suffolk water suppliers sample for more than 200 compounds, more than required by federal health regulation. Through this platform, water quality parameters can be immediately searched for and made visually accessible. WaterTraq was also able to attach existing aquifer-related datasets created by the USGS, including depth to water and hydrogeologic units. These additional overlays allow for water quality samples to be contrasted with regional geology and water level variations. Borehole geophysical logs maintained by the USGS water science center in Coram, NY were also attached to WaterTraq to create an interactive map that links the borehole database points to the corresponding hydrogeologic data.

How WaterTraq Works

WaterTraq blends interactive maps with data from spreadsheets in an effort to paint a clear picture of what exactly is in our drinking water for health officials, industry professionals and the general public. Users can set search parameters that will allow them to look up specific contaminant levels for any New York State drinking water parameter. These parameters include inorganic compounds (such as iron or chlorides), volatile organic chemicals (typically industrial solvents or gasoline constituents), emerging contaminants (such as pharmaceuticals) and a myriad of other compounds and chemicals for which drinking water purveyors are required by law to sample. WaterTraq users can then see if a given untreated water sample is at or below safe drinking water standards for a particular well or set of wells.

WaterTraq also allows the user to overlay aerial photography, geological boundaries and contours that illustrate the depth to groundwater. The data provided through WaterTraq includes both untreated (raw) water test results and treated water that is sent to customers. The success in WaterTraq is the ability for the tool to share information with regulators and the general public at the click of a button. Unlike previous

datasets that focused on a specific location or compound, WaterTraq gives users the chance to visualize all sampled data from an island-wide perspective. WaterTraq allows for water professionals to draw conclusions based on the patterns of the dataset they see.

Positive Results of WaterTraq's Development

Upon the launch of WaterTraq in September, 2016 a public outreach campaign was initiated to educate the public about the program. Through this outreach, residents of Long Island were able to have open conversations about potential threats to drinking water and the importance of water conservation. A WaterTraq user can now easily click on interactive maps to see data about water in a particular area, or search for information by entering an address. In addition, a user can search among chemicals or compounds tested by water suppliers to determine their presence in groundwater. The WaterTraq site also contains links on how to read drinking water reports, water quality standards set by state and federal officials, and listings of top compounds detected on Long Island. Instructional videos were also made available to show the public how to navigate WaterTraq, conduct address searches, search for untreated aquifer samples and search for compounds by aquifer, range, well depths and sample dates. The public was also educated about the state of the aquifer and the differences between groundwater and drinking water. The outreach campaign also discussed drinking water standards in New York State which are considered some of the highest in the nation.

WaterTraq has been cited by public officials as being an outstanding accomplishment and a valuable tool that allows water suppliers to share information with regulators and the general public. The increased knowledge gained through WaterTraq has empowered residents to be proactive in advocating to regulators for additional groundwater supply protection. The initiative has also been able to help advance a critical regional approach to Long Island water resources. WaterTraq has also been used to help the New York State's water quality rapid response team identify and respond quickly to drinking water issues. At colleges throughout Long Island, WaterTraq has been used to gather, map and display water quality data to help identify risks to drinking water sources. WaterTraq has also served as a mechanism for State officials to better coordinate and analyze water quality samples.

During the 2017 State of the State address, Governor Andrew Cuomo offered a proposal to further develop WaterTraq, noting the considerable resources invested in cleaning up spills, remediating superfund and Brownfield sites, all of which require considerable testing. Acknowledging the lack of integration with existing data statewide, he recognized the need to better combine the datasets to predict threats to public health and the environment and better facilitate interagency cooperation. Similar to WaterTraq's methodology, , the State hopes to use the data it collects to pioneer a leading technology platform to manage sustainability, risks, and potential contamination to drinking water supplies across the state.

UNITED STATES GEOLOGICAL SURVEY LONG ISLAND SUSTAINABILITY PROJECT

Background

Long Island is entirely dependent on the underlying sole-source aquifer system which currently supplies over 400 million gallons a day (MGD) of freshwater from more than 1,200 public-supply wells to over 2.8 million people in Nassau and Suffolk Counties. As the name implies, Long Island's sole-source aquifer system is the only source of water available to meet the needs of Long Island's population.

In addition to its value for drinking and irrigation, groundwater is also the primary source of freshwater in streams, lakes, and wetlands, and maintains the saline balance of estuaries. When large volumes of groundwater are withdrawn, the water table is locally depressed, and this reduces the quantity of

groundwater available to discharge to streams and estuaries. Large-scale sewering practices have also reduced groundwater levels and discharge to surface receiving waters. In some areas of Long Island groundwater pumping has resulted in saltwater intrusion into the aquifer system and has also impacted streams, ponds, and coastal areas that rely on groundwater discharge to sustain them. In addition to these quantity-related impacts, additional factors such as urban runoff and the widespread use of septic systems have also affected the water quality of the aquifer system. Therefore, development and use of groundwater on Long Island is constrained by ecohydrological (i.e. the interactions between groundwater and surface-water ecosystems) and water-quality concerns.

Long Island's aquifer system is comprised of several aquifers, generally ranging in increasing depth from the upper glacial, North Shore, Jameco, Magothy, and finally the Lloyd aquifer. Several major clay layers are also present including the Gardiners and Raritan, which overlie most but not all of the Magothy and Lloyd respectively. These clay units influence the aquifer system in several ways. 1) They act to confine and isolate the underlying freshwater zones, 2) Limit the rate of recharge to units below, 3) Protect underlying freshwater from surface contaminants, and 4) In coastal marine environments, they also influence formation of seaward extended freshwater aquifer wedges under natural discharge conditions and conversely, formation of inland saltwater intrusion wedges under pumping conditions.

In 2016, Governor Andrew Cuomo announced a partnership between New York State, USGS, Nassau County and Suffolk County to study the effective management of Long Island's groundwater resources. Nassau and Suffolk Counties get their water solely from groundwater that is pumped from its aquifers (subsurface sands and gravels that store and transmit water). The quantity and quality of groundwater can be affected by natural processes such as drought, or human activities such as groundwater pumping and urbanization. For that reason, decreases in groundwater levels, saltwater intrusion**,** and groundwater contamination have led to concerns about the future availability of groundwater on Long Island.

Groundwater sustainability can be defined as the development and use of groundwater in a manner that can be maintained for indefinite time without causing unacceptable environmental or socioeconomic consequences. Informed management of the Long Island aquifer system can help ensure a regionally sustainable groundwater resource. This study will evaluate the sustainability of Long Island's groundwater resource, now and for the future, by geologic mapping**,** water-quality and water-level monitoring**,** and groundwater-flow modeling this critical aquifer system.

Groundwater Flow modeling

Groundwater models represent our knowledge of how groundwater-flow systems work, and they provide tools that water-resources managers can use to effectively plan for sustainable aquifer development. However, existing models lack the necessary geologic information to fully assess the sustainability concerns of the Long Island aquifer system. To improve the existing model the USGS will map new geologic information by drilling groundwater wells throughout the island. The extent of saltwater intrusion will be identified by monitoring these new wells. Mapping and monitoring results will be used to improve existing models.

A groundwater-flow model will be developed using the USGS MODFLOW computer program (Harbaugh, 2005). Additional computer programs will be used to track groundwater flowpaths from recharge to discharge and model the saltwater-freshwater interface (Pollock, 1994; Bakker and others, 2013). The model will utilize updated geology and information about the observed location of the freshwater-saltwater interface in the Magothy and Lloyd aquifers. The groundwater-flow model will be calibrated to match observed field data including chloride and water-level information. The model will be used to simulate various scenarios, including changes in groundwater withdrawals, aquifer recharge management, and climate change. These scenarios will be developed in collaboration with the New York State Department of Environmental Conservation and the Steering Committee.

Hydrogeologic Mapping

A network of Lloyd and Magothy groundwater wells will be installed at about 30 locations throughout the Island to fill in substantial data gaps. The existing groundwater well network consists mostly of shallow and deep wells in Nassau County, some wells in Suffolk Counties, and some shallow wells in Kings and Queens Counties. The locations of the proposed groundwater wells will be selected by reviewing geologic, hydrologic, and water-quality, information from the existing network. Geologic information obtained from newly installed groundwater wells will be used to improve existing maps (Smolensky and others, 1990) of Long Island's geology, and included in newly developed groundwater models. During and after completion of the newly drilled wells, rock and sand core samples will be collected and analyzed to improve the understanding of Long Island's geology. Core samples will be analyzed at specific depths in wells to determine the presence of saline groundwater. Continuous geologic and water-quality information will also be collected using geophysical methods along each well's depth.

Water quality monitoring

Land-based and waterborne geophysical surveys will be used to map geologic features including aquifers and confining units. Results from these surveys will help guide site selection for new groundwater wells and fill data gaps where drilling new wells may not be feasible. Geophysical logging and chloride well sampling will also be used to monitor saltwater intrusion in the Magothy and Lloyd aquifers. Periodic and continuous water level measurements will be collected to define aquifer water levels (such as the elevation of the water table) that will be used to calibrate groundwater flow models.

CONCLUSION

Hydrogeologic data on Long Island, pertaining to both water quality and water quantity (or availability), has been collected and archived for more than 70 years by a variety of public agencies and private firms. These data collection efforts have evolved over time in a rather piecemeal fashion, and have been executed for specific purposes or projects. Until recently, there has been little coordination among agencies to share the data or to make it more publicly accessible. The two initiatives described in this section represent a change in this paradigm. The WaterTraq data base allows anyone to obtain water quality data from wells across Nassau and Suffolk Counties for all aquifers. The USGS Sustainability project will fill in some of the data gaps that have developed over time and will provide fresh insight into data analysis and predictive modeling moving forward. It is hoped that both of these initiatives will foster a new era of data sharing and cooperative problems solving among public officials and private citizens.