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Preparing for Today's and Tomorrow's Water-Resources Challenges in Eastern Long Island, New York

Freshwater is a vital natural resource. Although New York is a water-rich State, the wise and economical use of water resources is needed to ensure that there is enough water of adequate quality for both human and ecological needs—both for today and for tomorrow. Nowhere in New York is this more evident than in Nassau and Suffolk Counties on Long Island, where the public water supply is obtained from the sole-source aquifers located directly beneath the nearly 3 million people who live there. In 2023, in eastern Long Island's Suffolk County, groundwater was pumped from these aquifers by more than 1,100 public water-supply wells to meet the needs of about 1.5 million people.

Groundwater on Long Island is the water beneath the land surface in pore spaces between grains of clay, silt, sand, and gravel, and it supplies freshwater to streams and rivers at points where the surface of the land intersects the water table. Areas where groundwater can be extracted in large quantities are referred to as aquifers. On Long Island, groundwater is primarily stored in three such water-bearing units: the upper glacial, Magothy, and Lloyd aquifers (fig. 1). Collectively, these three aquifers—along with several smaller, more localized water-bearing units and the intervening layers of poorly permeable sediments (referred to as confining units)—are known as the Long Island aquifer system.

Long-term hydrologic monitoring is needed to understand how to best manage Suffolk County's groundwater resources. Fortunately, the Suffolk County Water Authority (SCWA), an independent public-benefit corporation that is one of the Nation's largest suppliers of groundwater, and the Suffolk County Department of Health Service (SCDHS) have supported the collection of hydrologic information in Suffolk County for more than 50 years. It cannot be overstated how important these long-term data are in helping to guide the sustainable management of the county's water resources and to forecast and prepare for the potential effects of climate change.

The U.S. Geological Survey (USGS), the Nation's premier earth science organization, works with partners to monitor, assess, conduct targeted research on, and deliver information on a wide range of water-resources issues and conditions. In Suffolk County, the USGS partners directly with SCWA, SCDHS, New York State, and several towns and local water districts to monitor streamflow, groundwater levels, water quality, and water use.

In 2023, these partnerships support monitoring at 6 streamgages, 2 lake-level stations, 1 precipitation gage, and about 340 groundwater-monitoring wells that characterize conditions in the Long Island aquifer system (fig. 2). Measurements of streamflow (6 sites), lake level (2 sites), precipitation (1 site), and groundwater elevation (35 sites) are taken every 15 minutes and are electronically transmitted in near-real time directly to the USGS's National Water Information System (NWIS) database and National Water Dashboard (USGS, 2023). At the remaining groundwater sites, water levels are measured by USGS hydrographers, either monthly or annually, and entered into NWIS manually. Data in NWIS are stored and made available to the public in perpetuity.

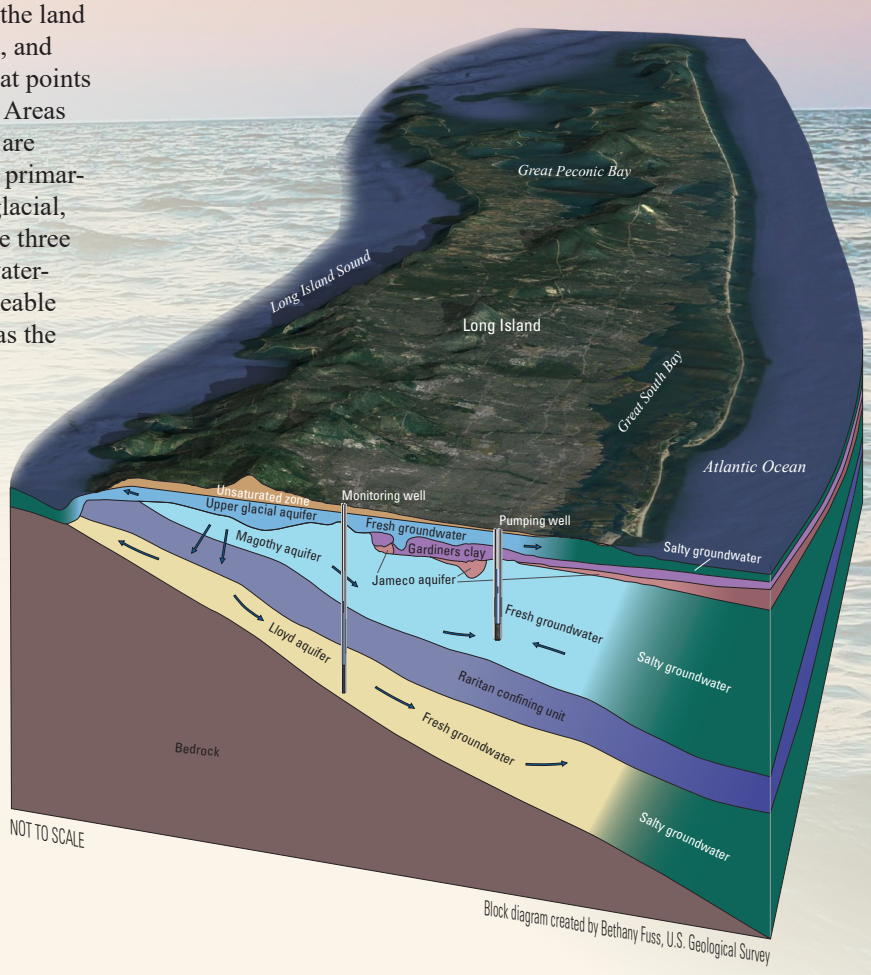


Figure 1. Block diagram showing groundwater from the aquifer system on Long Island, New York, which provides all the drinking water for Suffolk County's nearly 1.5 million residents and supports an ecology of groundwater-fed ponds, streams, wetlands, and coastal waters. All life on Long Island depends on this single vital resource. Figure from Masterson and Breault (2019).

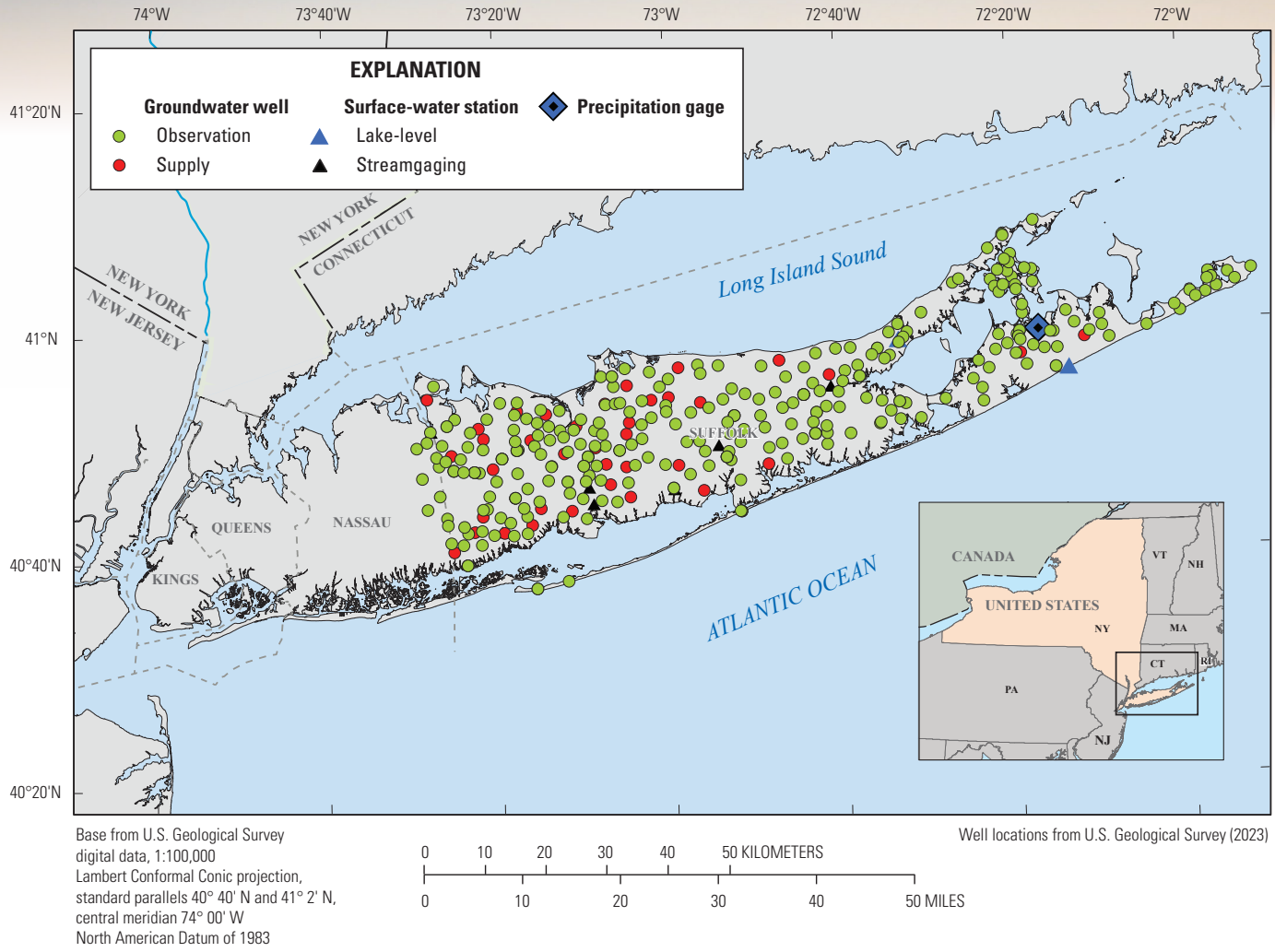
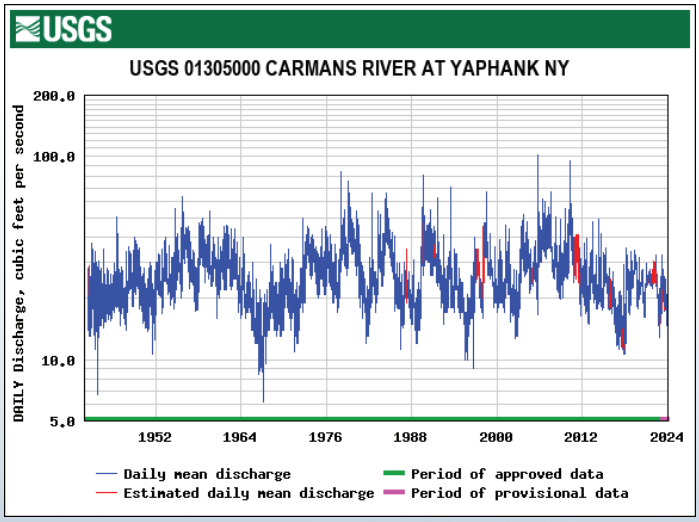


Figure 2. Map showing U.S. Geological Survey network of groundwater and surface water monitoring stations in Suffolk County, New York, in 2023.

A



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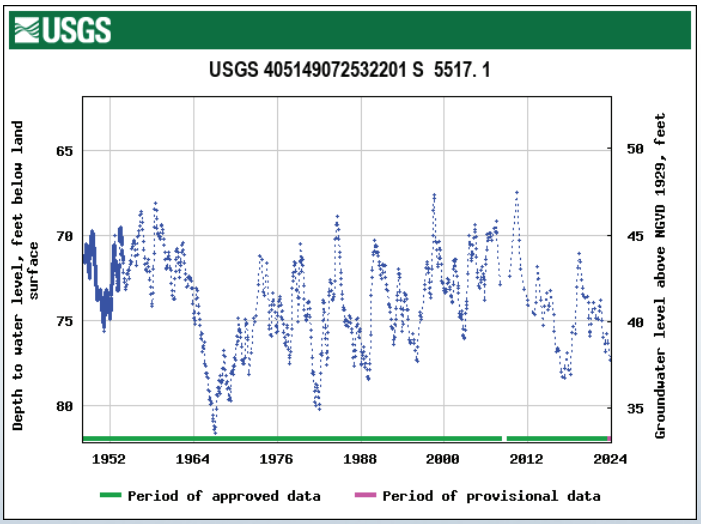

Figure 3. Hydrographs showing *A*, streamflow for the period of record (1942–2023) at Carmans River at Yaphank, New York (U.S. Geological Survey [USGS] station 01305000), and *B*, groundwater levels in the upper glacial aquifer for the period of record (1948–2023) at well S 5517.1, Upton, N.Y. (USGS station 405149072532201). The drop in streamflow and groundwater levels during the 1960s on both hydrographs has been attributed to the severe drought that affected Long Island during that decade. Screen captures from the USGS National Water Information System (USGS, 2023).

Although the number of monitoring stations and the frequency of data collection have varied over the past 50 years, the continuous collection of water-resource information using scientifically rigorous and nationally consistent methods by trained USGS hydrographers has remained the same. Figure 3 shows hydrographs of long-term data collected by the USGS at a stream and groundwater well in Suffolk County.

The maintenance of long-term data-collection networks requires tremendous effort to ensure data are collected to the highest standards in order to be accurate, comparable, and representative. This involves multiple tasks that, taken together, result in a high level of confidence in the data collected by the USGS. These tasks involve calibrating electronic and mechanical equipment by means of manual measurements; surveying the elevation of reference marks to ensure current and historical data are comparable; and reviewing and updating, if necessary, long-term data records to account for any environmental changes that may have affected historical data.

The collection of data by highly trained USGS staff using proven methods provides essential data needed to evaluate water-resource changes over time, to develop groundwater-flow models and forecast trends, and to design, implement, and monitor the effectiveness of groundwater management and protection programs (Taylor and Alley, 2001). An excellent recent example of the value of long-term groundwater-level data—that could not have been anticipated decades ago when this program started—was their use in 2022 in the development of a state-of-the-science, island-wide groundwater-flow model. This model can reproduce (or simulate) past and current hydrologic conditions (including groundwater levels and streamflows) and can be used to predict the most likely outcomes from changes in pumping and sewering and other potential changes in the environment, such as sea-level rise and prolonged droughts (Masterson and Breault, 2019).

Other possible uses of long-term surface-water and groundwater data include

- estimating long-term changes in groundwater recharge and storage,
- assessing the effects of climatic variability,
- estimating the regional effects of groundwater development,
- statistical analyses of water-level trends,
- measuring changes in groundwater-flow directions,
- characterizing groundwater and surface-water interactions, and
- mapping the depth to the groundwater below land surface.

This last example—mapping the depth to the groundwater—has been an important part of the ongoing USGS-Suffolk County partnership. Each year during April and May, the USGS conducts a synoptic survey of water levels across Long Island to map the geometry of the water-table and potentiometric surfaces within the three main water-bearing units in the Long Island aquifer system. These data are also used to construct depth-to-water maps that are used in hydrogeologic investigations throughout Long Island and by water-resource managers and public water suppliers for aquifer management and planning purposes (Como and others, 2018). Hydrologic-conditions maps have been created for Long Island since the turn of the last century (Burr and others, 1904). Figure 4 shows an island-wide representation of the depth to the water table during April 2010, with the darker red shading indicating areas where the water is closest to the land surface. More depth-to-water maps can be found online on the USGS depth-to-water viewer (USGS, 2019).

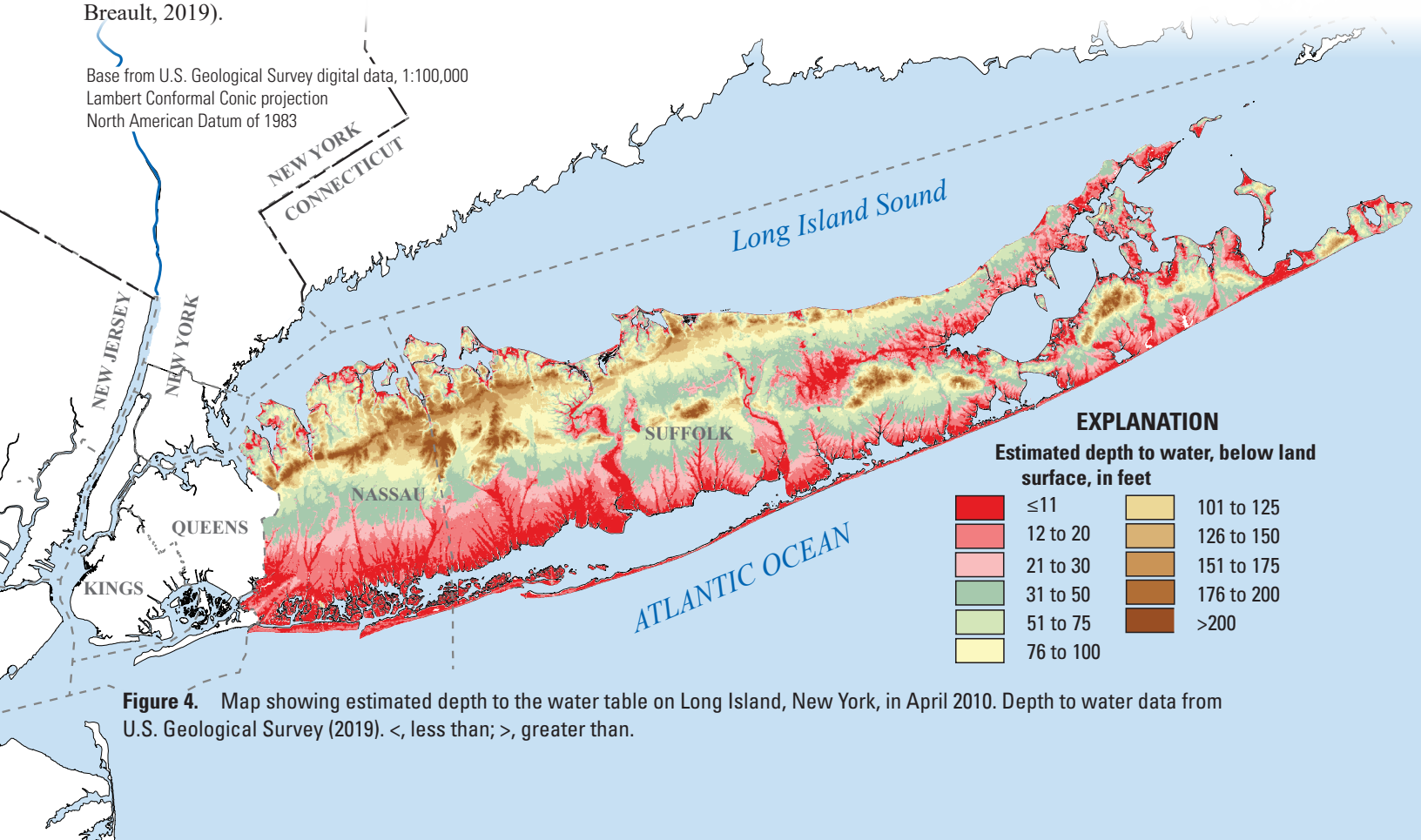

Figure 4. Map showing estimated depth to the water table on Long Island, New York, in April 2010. Depth to water data from U.S. Geological Survey (2019). <, less than; >, greater than.

In addition to monitoring streamflow and groundwater levels, the USGS, in partnership with Suffolk County, has been monitoring long-term trends in water quality. This is particularly important in places like Suffolk County with many legacy sources of pollution and sandy soils that allow pollutants to move readily into the aquifer system. Many new classes of pollutants are present at low levels and are detectable only by specialized equipment and sampling methods. The USGS has a long history of monitoring and documenting the presence of pollutants in Long Island groundwater using cutting-edge data collection and analytical research methods. Documenting such pollutants, introduced at the land surface and detected in the groundwater system, is essential so that water-resource managers can plan for, or respond to, water-quality threats to drinking water supplies.

Unbiased, high-quality, scientifically defensible hydrologic-data collection and analysis is the trademark of the USGS. Unbiased data are of particular importance when multiple needs are competing for the same limited water resources. Figure 5 shows USGS scientists collecting various hydrologic data in Suffolk County, New York.

On Long Island, the quantity and quality of water is affected by human activities not only in Suffolk County but also in neighboring Nassau, Queens, and Kings Counties. It would not be possible to address many of the most pressing societal issues facing Suffolk County's elected officials, planners, and water-resource managers without the foresight and dedication of those who came before us and faithfully supported the long-term collection of water-resource data for Suffolk County.

Figure 5. Scientists collecting *A*, streamflow, *B*, groundwater-level, and *C*, water-quality data in Suffolk County, New York. Photographs by the U.S. Geological Survey.

By Ronald Busciolano, John P. Masterson, and Robert F. Breault

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Much of the text in this fact sheet is modified from Breault and others (2023).

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