

# **Hydrologic Assessment of the Shallow Groundwater-flow System beneath the Shinnecock Nation Tribal Lands, Suffolk County, New York**

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## **Abstract**

Defining the distribution and flow of shallow groundwater beneath the Shinnecock Nation tribal lands in Suffolk County, New York, is a crucial first step in identifying sources of potential contamination to the surficial aquifer and coastal ecosystems. The surficial or water-table aquifer beneath tribal lands is the primary source of potable water supply for at least 6 percent of the households on tribal lands. Oyster fisheries and other marine ecosystems are critical to the livelihood of many residents living on tribal lands, but are susceptible to contamination from groundwater entering the embayment from the surficial aquifer. Contamination of the surficial aquifer from flooding during intense coastal storms, nutrient loading from fertilizers, and septic effluent have been identified as potential sources of human and ecological health concerns on tribal lands.

The U.S. Geological Survey (USGS) facilitated the installation of 17 water-table wells on and adjacent to tribal lands during March 2014. These wells were combined with other existing

wells to create a 32-well water-table monitoring network that was used to assess local hydrologic conditions. Survey-grade, global-navigation-satellite systems provided centimeter-level accuracy for wellhead-positioning surveys. Water levels were measured by the USGS during May (spring) and November (fall) 2014 to evaluate seasonal effects on the water table. Water-level measurements were made at high and low tide during May 2014 to identify potential effects on the water table caused by changes in tidal stage (tidal flux) in Shinnecock Bay. Water-level contour maps indicate that the surficial aquifer is recharged by precipitation and upgradient groundwater flow which moves from the recharge zone located generally beneath Sunrise Highway, to the discharge zone beneath tribal lands, and eventually discharges into the embayment, and tidal creeks and estuaries that bound the tribal lands to the east, south, and west.

Water levels in many of the wells in the network fluctuated in response to precipitation, upgradient groundwater flow, and tidal flux in Shinnecock Bay. Water-level altitudes ranged from 6.66 to 0.50 feet (ft) above the North American Vertical Datum of 1988 (NAVD 88) during the spring measurement period, and from 5.25 to -0.24 ft (NAVD 88) during the fall 2014. Historically, water levels in well S-8836, a long-term-index well located in the Town of Southampton, increased during years when annual precipitation exceeded the average-annual precipitation, and water levels decreased during years of below-average precipitation. To place the study period in perspective, calendar year 2014 was the 32<sup>nd</sup> wettest year on record with annual precipitation totaling 48.1 inches (in.), a 2.6 percent increase from the annual average (46.9 in.), based on 81 years of complete record at the National Oceanographic and Atmospheric Administration, National Weather Service cooperative meteorological station at Bridgehampton, New York.

Tidal flux caused water-levels in wells to fluctuate from 0.30 to -0.24 ft during May 2014. Water levels in wells located north of Old Fort Pond and beneath the southernmost extent of the tribal lands were most influenced by tidal flux. During June 2014, hydrographs indicate that tidal flux influenced water levels by 0.48 ft in a well located near the southernmost extent of the tribal lands approximately 0.3 mi north of Shinnecock Bay, and was zero at a well located approximately 0.5 mi south of Montauk Highway, and 0.4 mi west of Heady Creek, near the geographic center of the tribal lands. Tidal-influence-delay time (time interval between peak high-tide stage and corresponding peak high-water level) ranged from 1.75 hours at the well located near the southernmost extent of the tribal lands, to more than four hours at a well located north of Old Fort Pond, near the northwest part of the tribal lands.

Estimated hydraulic conductivity values derived from the results of specific capacity tests that were performed at 9 observation wells during March 2015 were used to calculate average linear velocity (Darcy). Darcy velocity along conceptualized flow-path segments of the upper glacial aquifer located beneath tribal lands were estimated using an assumed effective porosity value, and hydraulic conductivity and hydraulic head values that were interpolated from measured values. Groundwater-travel times were estimated by dividing the length of the flow-path segment by the average linear velocity along the flow-path segment. Total estimated groundwater travel time along a conceptualized flow path, beginning near Sunrise Highway and terminating at Shinnecock Bay, is approximately 46 years using a porosity value of 30 percent.

A surficial-silty unit was identified from approximately 0 to 10 ft below land surface at multiple locations beneath tribal lands. The lithology of the surficial unit was verified by interpreted gamma log results obtained from select wells, and auger-rig drill cuttings from an observation well located near the geographic center of the tribal lands. The altitude of the unit

varies with topography and was delineated along a cross section line that trends north-south along the approximate centerline (spine) of the tribal lands. The altitude of the hydrogeologic contact between the upper glacial and the Magothy aquifers generally decreases from northwest to southeast, occurs at a depth ranging from about 150 to 200 ft beneath tribal lands, and was identified at 2 locations north of the tribal lands, near Sunrise Highway and Sebonac Road. Results of electrical geophysical surveys indicate that the depth to the freshwater-saltwater interface decreases from north to south with decreasing water-level altitude, and the Magothy and upper glacial aquifers contain saltwater at varying depths along the north-south trending section. Results of the surveys also indicate that the Magothy aquifer beneath tribal lands contains brackish and salty water and is not considered a source of potable water supply. In general, depth to the interface increases with increasing geographic distance from the coastline. Low water-table altitudes can result in increased saltwater encroachment into the surficial aquifer beneath tribal lands. This upward movement and shallow depth of the freshwater-saltwater interface can jeopardize water quality in wells that supply water for domestic use.