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New York Water Science Center News Volume 15, October 2012

U.S. Geological Survey, New York Water Science

Methane in Domestic Wells | More Marcellus | Beach Monitoring | Fire Island Hormones | Hydrologic conditions

U.S. Geological Survey Testing for Naturally-Occurring Methane in Local Water Wells in the Southern Tier of New York State

A new study started this spring to test for baseline concentrations of naturally occurring methane in groundwater at about 60 water wells in parts of Delaware, Broome, Tioga, Chemung and Chenango counties in the Southern Tier of New York. The study is being carried out in cooperation with the New York State Energy Research and Development Authority (NYSERDA).

Teflon sampling hose (arrow) connected to a domestic water well system.

Methane contamination of water wells in several areas of Pennsylvania have been linked to migration of natural gas at shale-gas drilling sites due to poor well construction. However, testing of domestic wells in Pennsylvania prior to shale-gas drilling has indicated that methane is naturally occurring in many areas. These results highlight the usefulness of understanding where and under what

Gas bubbles released from groundwater as it is pumped to a bucket at land surface.

conditions methane naturally occurs in groundwater.

The aim of this USGS study is to sample wells in different topographic and geologic settings in an effort to determine which factors favor methane occurrence in groundwater. The study will sample and analyze the dissolved gas content in well water including methane and other hydrocarbons. Water samples that contain sufficient methane concentration will undergo more specialized analysis in an effort to determine the source of the methane. Water wells selected for sampling were gleaned from the New York State Department of Environmental Conservation (NYSDEC) water-well database, which has records of all wells drilled since 2000.

Letters were mailed to homeowners and businesses in May and June 2012 requesting information about their well and permission to collect water samples. A report of the water-quality results will be given to each well owner. A report summarizing the results of this study will be available in 2013.

For further information, contact Paul Heisig at 518-285-5648 or pmheisig@usgs.gov or visit the project website: http://ny.cf.er.usgs.gov/nyprojectsearch/projects/LK00-METH-00.html.

A Message from Ward Freeman

New York Water Science Center Director

"As you all know the 1-year anniversary for Hurricane Irene and Tropical Storm Lee just past. The USGS is still working hard on repairs and improvements and getting closer to fixing all the damage to our infrastructure caused by these storms. The USGS New York Water Science Center staff have met internally as well as getting together with other agencies (National Weather Service, U.S. Army Corps of Engineers, FEMA, and many State agencies) to discuss what we did right and what we can improve on. The USGS is "hardening" selected streamgages that were inundated during these storms – that is raising their elevation and making them stronger to withstand the force of the record breaking flooding that we seem to be experiencing more frequently.

Scientists from the USGS NY Water Science Center (NY WSC) are also preparing for the possibility of horizontal high volume hydrofracturing (hydrofracking) for natural gas extraction beginning in New York. In preparation, we've been collecting water-quality samples from selected areas in the Southern Tier that are likely to be an early focus in drilling should it occur. For example, groundwater samples have been collected to determine how geology controls the occurrence and distribution of naturally-occurring methane in water wells. Specific Conductance has been measured in select streams in areas where hydrofracking may occur to provide knowledge of baseline conditions. Some of our streamgages have been outfitted with Specific Conductance probes – these sentinel stations can warn of changes in near real-time. Specific Conductance is a measure of how well water conducts electricity and is a surrogate for dissolved solids in water. Any change, for example, like that caused by spilled hydrofracking fluids, would be seen as a spike in Specific Conductance. These data are available on our web page.

Scientists from the NY WSC have also been monitoring constituents of emerging concern like pharmaceuticals and personal care products in a number of environmental settings as well as evaluating parameters that may be used as surrogates for estimating bacteria concentrations at some beaches along the shorelines of the Great Lakes. You can read about these projects here and more information about these and other projects are available on our web site. Please do not hesitate to contact me or my staff if you have any questions or concerns we might be able to help address.

Visit the New York Water Science Center Web site at:
http://ny.water.usgs.gov
Or contact
(518) 285-5665
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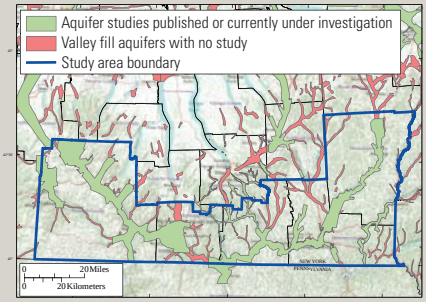
Proposed Study: Delineation of the Spatial Extent of Valley-Fill Aquifers in Five Counties in South-Central New York State

Unconventional shale-gas resources are being extensively developed in northeastern and southwestern Pennsylvania and northern West Virginia through a combination of horizontal drilling and high-volume hydraulic fracturing. It is anticipated that development of shale gas may soon begin in south-central New York, specifically in Steuben, Chemung, Tioga, Broome, and Chenango Counties. Concern has been expressed over the potential effect of shale-gas development on groundwater resources in this five-county area. Proper management of water resources in this area requires a detailed knowledge of the spatial extent and hydrogeologic characteristics of the valley-fill aquifers that are widely used for water supply.

Detailed aquifer maps are available in digital form at a scale of 1:24,000 for many valley-fill aquifers in the five-county area. These detailed aquifer maps have been generated over several decades by the USGS in cooperation with NYSDEC and local governments using consistent techniques, and form the basis of a reliable source of information on the spatial extent and hydrogeology of valley-fill aquifers throughout much of this area. However, there are approximately 375 linear miles of valley-fill aquifers in the five-county area that are not mapped at a scale of 1:24,000. Thus, a substantial portion of the area lacks basic hydrogeologic information.



Location of valley-fill aquifer mapping completed or in progress by the USGS (in green) and locations of unmapped valley-fill aquifers (in red) within the five-county study area of New York State.

To help protect groundwater resources in the five-county area, there is an immediate need to delineate the spatial extent of the valley-fill aquifers that are currently unmapped at the 1:24,000 scale.

Currently this is only a proposal, but if funded the spatial extent of the valley-fill aquifers would be delineated through analysis of existing data including soils maps, topographic data, LIDAR data, published reports, and selected well records from the NYDEC water-well database. The aquifer boundaries constructed for this study would be merged with aquifer boundaries from previously published maps to produce a single GIS dataset, thereby producing a uniform aquifer boundary dataset for the five-county study area. If funded, a USGS webpage would document the project and provide a link to the map, which would also be produced as a GIS dataset available through the NYS GIS Clearinghouse.

This proposed project will be limited to providing a consistent 1:24,000 scale boundry of the spatial extent of valley-fill aquifers within the five-county study area. The delineation of aquifer boundaries in this manner is intended as a preliminary means to provide the spatial extent of valley-fill aquifers necessary for the protection of groundwater resources in the five-county area and allow the NYSDEC or others to determine whether more detailed investigation of the valley-fill aquifers, that is critical to assessing groundwater-resource potential and aquifer vulnerability to contamination, is warranted.

Dissolved Methane in New York Groundwater

Kappel, W.M., and Nystrom, E.A., 2012, Dissolved methane in New York groundwater, 1999—2011: U.S. Geological Survey Open-File Report 2012-1162

A recent study that looked at groundwater samples from more than 200 wells across New York State found levels of naturally-occurring methane high enough to warrant monitoring or other actions in nine percent of the water samples tested, according to U.S. Geological Survey research.

While 91 percent of samples tested found no dissolved methane, or levels below the threshold that would require monitoring, seven percent of these wells tested at levels above 10 milligrams per liter, the level at which well owners should contact local health departments for information on monitoring or remediation. An additional two percent tested at levels above 28 milligrams per liter, a level that requires removal of any potential ignition source and venting the gas away from confined spaces to avoid possible explosive conditions.

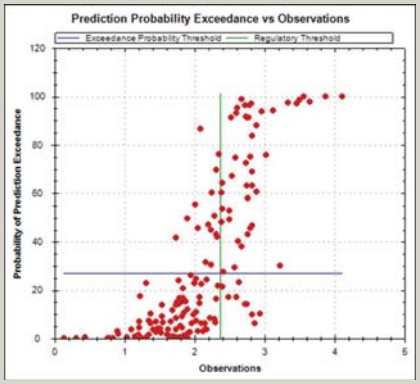
The findings are based on randomly selected water wells that draw their water from either bedrock or unconsolidated aquifers. The samples were collected and analyzed by USGS from 1999—2011 across the state as part of several groundwater-quality studies. The findings for New York are similar to those seen in studies of other northeastern U.S. states.
In the state of New York, an estimated six million people get their drinking water from groundwater. The findings of this study highlight the importance of well owners understanding the source and quality of their drinking water.

Great Lakes Beach Health

Pathogenic bacteria can impact the health of people swimming and wading at swimming beaches. To minimize the exposure of swimmers to pathogenic bacteria, swim advisories and (or) beach closings can be issued. Swim advisories and beach closings are frequently based on concentrations of Escherichia coli (E. coli), which are used as an indicator of the presence of other harmful bacteria and viruses. Current methods of quantifying E. coli require about 18-24 hr. Because water-quality conditions that can affect a swimmer's safety can quickly change, basing beach closures on E. coli analysis results in large uncertainties. One way to improve the reliability and timeliness of beach closure decisions is by means of a multi-variable predictive model. These models use environmental variables to estimate the probability that allowable E. coli standards are met. These variables can be measured each morning, and can be used to guide decisions for that day. The results of these predictive models can be seen on the web by beach goers and managers. For example, Ohio beachgoers can go to www.ohionowcast.info for up-to-the minute beach closings; it is envisioned that New Yorkers will have a similar site they can go to.

As part of the USGS' role in the Great lakes Restoration Initiative (GLRI), predictive models were developed and evaluated for five New York, Great Lakes beaches: Erie Beach, Evans Town Park Beach, Woodlawn Beach, Eastman Durand Beach, and Ontario Beach. At each beach, lake levels, rainfall amounts, wind direction and speed, parallel- and long-shore lake currents, turbidity, wave height, water and air temperature, categories of debris and algae accumulation, and bird counts were measured during the 2010-2011 swimming seasons (June, July, and August). In addition, water elevation and turbidity were measured in rivers and streams that may influence beach water quality. These measurements were made at select USGS streamgages in accordance with USGS protocols.

Virtual Beach software –developed by the Environmental Protection Agency– was used to develop a model using these data. Model accuracy was compared to the accuracy of previous-day E. coli samples for each beach. These comparisons show that the use of a predictive model could reduce the overall number of false positives and false negatives: a false positive refers to a day the beach was closed but the water-quality was considered good and inversely, a false negative refers to a day the beach was open during an exceedance of the E. coli standard (235 colony forming units

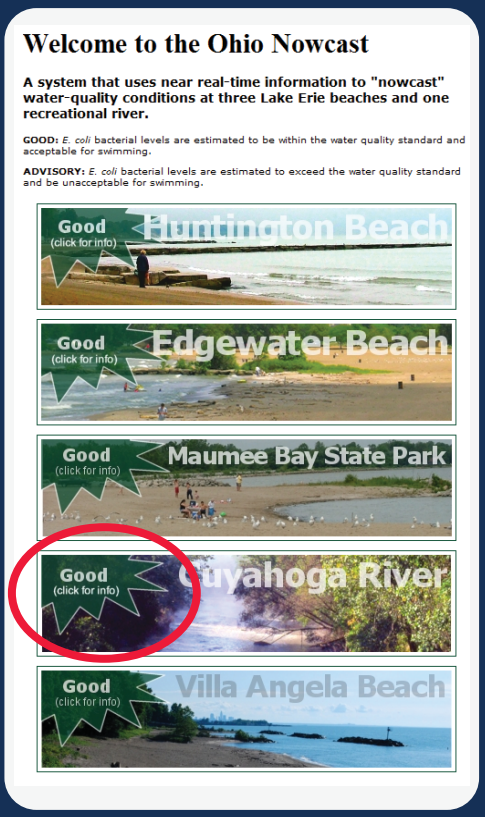


Prediction equations developed as part of this project show that beach closings can be done with a high degree of confidence.

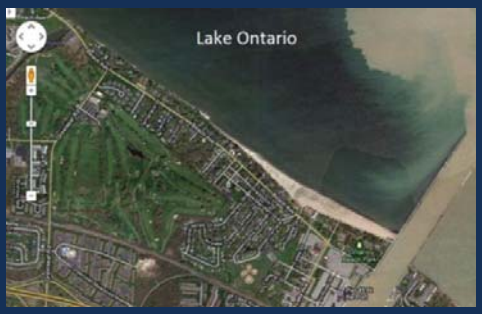
per liter) and should have been closed. From a human health perspective, false negatives are the greatest concern. These types of modeling approaches can be useful in insuring that timely advisories of water-quality conditions can be provided to the public at New York beaches.

Posted advisory based on conditions observed before 9:30 am

NOWCAST
www.ohionowcast.info/index.asp



The future New York Nowcast will use near-real-time water quality conditions to estimate E.coli bacterial levels at a beach. The estimations are then used to post an advisory of whether bacterial levels will exceed the E.coli standard of 235 CFU and be acceptable for swimming. Each beach location may be accessed on-line with posted advisories and public access to prior day E.coli concentrations similar to the Ohio Nowcast system (http://www.ohionowcast.info)



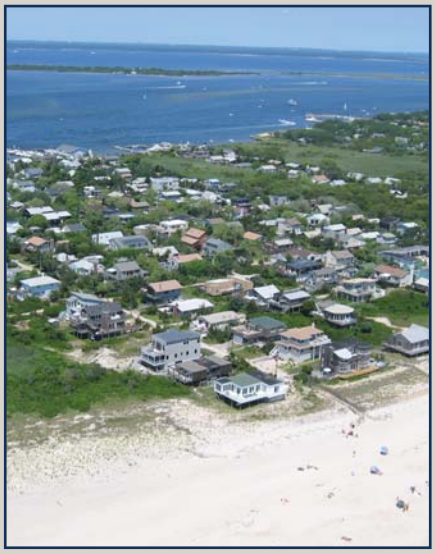
Genesee River

Fire Island Hormones

Recent research has shown that septic-system discharges can be an important source of micropollutants (including pharmaceuticals, personal care products, and endocrine active compounds [EACs]) to adjacent groundwater and surface-water systems. Micropollutants from septic systems can migrate to groundwater and receiving surface water, affecting drinking water and aquatic life. Despite these concerns, research on micropollutants has focused more on surface-water systems than groundwater systems.

To assess micropollutant concentrations in groundwater adjacent to septic systems, water samples were collected from the shallow aquifer system on Fire Island, N.Y. This sampling focused on the numerous small septic systems used seasonally on a densely populated portion of this barrier island. The proximity of sensitive coastal waters of Great South Bay (GSB) to septic-system discharges has led to concern over the discharge of micropollutants, including hormones from these systems.

Two types of wells were sampled as part of this study: 1) upgradient wells, which include five wells in upgradient portions of the surficial aquifer, and 2) shoreline wells, which include three wells in a shoreline area where groundwater affected by septic systems discharges to the GSB estuary.



Residential density in the Kismet area of Fire Island.

The highest micropollutant concentrations on Fire Island are present in the shoreline wells. The sample collected from the shoreline well closest to the highest residential density had the highest micropollutant concentrations, and was the only sample with detections for the hormones estriol and estrone. Most micropollutant concentrations (including hormone concentrations) increased with increasing total nitrogen concentrations for the shoreline well samples. The proximity of these sampling points to GSB indicates that septic systems in this portion of Fire Island are potential sources of micropollutants to the adjacent estuary. Although the limited temporal and spatial scope of this study make it difficult to extrapolate these findings to other areas on Fire Island, the correspondence between micropollutant concentrations and nitrogen concentrations indicate that efforts to reduce the migration of nitrogen from septic systems to GSB may also aid in diminishing the transport of EACs to GSB.

Sampling temporary well S-K2 at Fire Island National Seashore, November-December 2011

Analytical Method Development

Water samples collected in this study were analyzed at the USGS National Water Quality Laboratory (NWQL) using three different methods: 1) a method for organic wastewater compounds (the OW method), 2) a method for pharmaceutical compounds (the PH method) and 3) a method for hormone compounds (the HO method). Although the OW method has been available for several years, the PH and HO methods have recently been developed by the NWQL. All of these methods are available for use by USGS cooperators through the cooperative water program.

- The OW method includes analysis of 59 micropollutants associated with domestic and industrial wastewater as described by Zaugg and others (2007). Samples are extracted using solid phase extraction and are analyzed by capillary gas chromatography/mass spectrometry. Reporting limits for the OW method analytes range 0.01 to 5 µg/L (micrograms per liter).

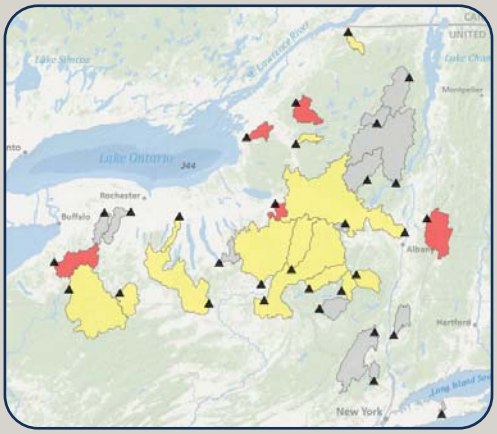
- The PH method uses the same method preparation and analysis steps as the OW method and is described in Zaugg and others (2012). The PH method includes analysis of 42 compounds, most of which are commonly used pharmaceuticals; reporting limits are around 0.01 µg/L. This method is available on a custom basis at the NWQL, and is currently undergoing peer review with publication expected in late 2012.

- The HO method uses an isotope-dilution quantification method for analysis, which is performed using gas chromatography with tandem mass spectrometry. The HO method includes 20 analytes including estrogens, androgens, and additional micropollutants, with reporting limits generally in the ng/L (nanogram per liter) range. This method has been approved by the USGS, and is available to all USGS cooperators and is described in Foreman and others, 2012.

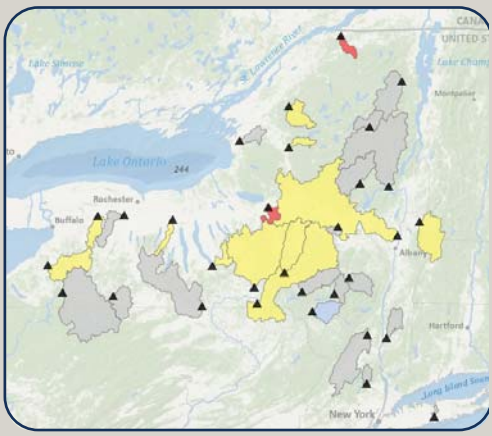
Surface Water and Groundwater Conditions in New York

Monthly and seasonally (shown below), hydrologists at the New York Water Science Center synthesize and summarize streamflows and groundwater levels for New York. Hydrologic condition reports are available at http://ny.water.usgs.gov/infodata/conditions.html. Streamflow conditions across New York were relatively dry for Spring and Summer 2012 whereas groundwater was above normal in the Spring and normal in the Summer. The Hydrologic Conditions Mapper can be accessed at: http://ny.water.usgs.gov/projects/eom/

A. Streamflow



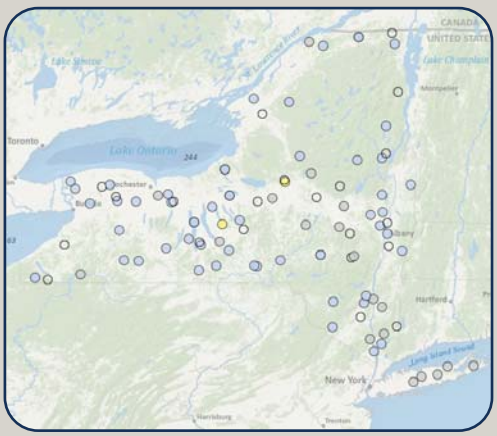
Spring 2012 (April, May, June)



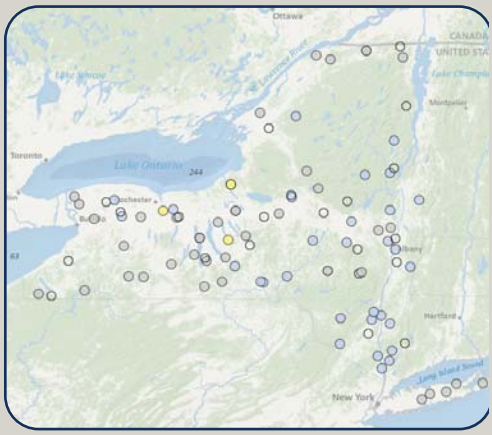
Summer 2012 (July, August, September)

CLICK EACH MONTH FOR MONTHLY CONDITIONS

B. Groundwater



Spring 2012 (April, May, June)

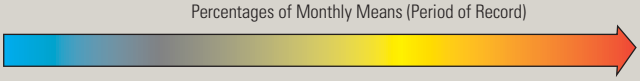


Summer 2012 (July, August, September)

EXPLANATION

Basin boundry | Drought Region | Streamgage | Groundwater well

Percentages of Monthly Means (Period of Record)



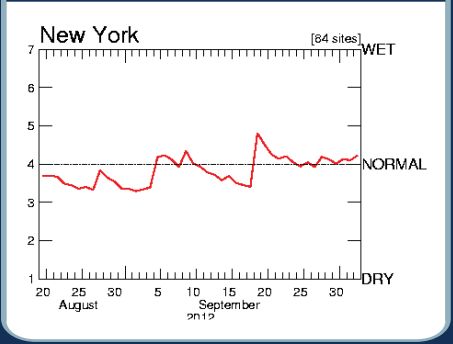
Seasonal conditions at selected (A) streamgages and (B) groundwater wells in New York. USGS maintains and operates most streamgages and groundwater wells in cooperation with various federal, state, and local agencies. Winter (January, February, March), Spring (April, May, June), Summer (July, August, September), Autum (October, November, December).

USGS Water Watch & Groundwater Watch

WaterWatch is a USGS World Wide Web site that displays maps, graphs, and tables describing real-time, recent, and past streamflow conditions for the Nation. Real-time streamflow information (stage and flow) generally is updated on an hourly basis. WaterWatch provides maps that show the location of more than 3,000 long-term (30 years or more) USGS streamgages.

Groundwater Watch is a USGS World Wide Web site that displays maps, graphs, and tables describing groundwater level data from wells currently in a regular measurement program. Three types of water-level data are displayed, including periodic, continuous data that are periodically retrieved, and real-time data generally updated on an hourly basis. Groundwater Watch contains water levels and well information from more than 20,000 wells that have been measured by the USGS or USGS cooperators at least once within the past 365 days.

45 Day Index Plot



Among other things, WaterWatch summarizes streamflow conditions in a region (state or hydrologic unit) in terms of the long-term typical condition at streamgages in the region. For example, this plot shows that streamflow over the last 45 days was at or above normal conditions for New York.

New Reports from the New York Water Science Center

Ernst, A.G., Warren, D.R., and Baldigo, B.P., 2011, Natural-channel-design restorations that changed geomorphology have little effect on macroinvertebrate communities in headwater streams: Restoration Ecology, doi:10.1111/j.1526-100X.2011.00790.x

Beaulieu, K.M., Button, D.T., Scudder Eikenberry, B.C., Riva-Murray, Karen, Chaser, L.C., Bradley, P.M., and Burns, D.A., 2012, Mercury bioaccumulation studies in the National Water-Quality Assessment Program-Biological data from New York and South Carolina, 2005-2009: U.S. Geological Survey Data Series 705, 13 p.

Beier, C.M., Woods, A.M., Hotopp, K.P., Gibbs, J.P., Mitchell, M.J., Dovcial, M., Leopold, D.J., Lawrence, G.B., and Page, B.D., 2012, Changes in faunal and vegetation communities along a soil calcium gradient in northern hardwood forests: Canadian Journal of Forestry Research, v. 42, p. 1141-1152

Burns, D.A., Riva-Murray, Karen, Bradley, P.M., Aiken, G.R., and Brigham, M.E., 2012, Landscape controls on total and methly mercury in the upper Hudson River basin, New York, USA: Journal of Geophysical Research, v. 117, G01034: doi: 10.1029/2011JG001812

Coon, W.F. and Breaker, B.K., 2012, Flood-inundation maps for the West Branch Delaware River, Delhi, New York, 2012 U.S. Geological Survey Scientific Investigations Map 3216, 9 p. pamphlet, 10 sheets, scale 1:20,000.

Kappel, W.M., and Jennings, M.B., 2012, Water resources of the Iroquois National Wildlife Refuge, Genesee and Orleans Counties, New York 2009-2010: U.S. Geological Survey Scientific Investigations Report 2012-5027, 53 p.

Kappel, W.M., and Nystrom, E.A., 2012, Dissolved methane in New York groundwater, 1999—2011: U.S. Geological Survey Open-File Report 2012-1162, 6 p., at http://pubs.usgs.gov/of/2012/1162.

Lawrence, G.B., Sullivan, T.J., Weathers, K.C., Cosby, B.J., and McDonnell,T.D., 2011, Comparison of methods for estimating critical loads of acidic deposition in the western Adirondack region of New York: New York State Energy Research and Development Authority, Final Report 11-13

Masterson, J.P., Pope, J.P., Monti, Jack, Jr., and Nardi, M.R., 2011, Assessing groundwater availability in the North Atlantic Coastal Plain aquifer system: U.S. Geological Survey Fact Sheet 2011-3019, 4 p.

Mulvihill, C.I., and Baldigo, B.P., 2012, Optimizing bankfull discharge and hydraulic geometry relations for streams in New York state: Journal of the American Water Resources Association, 15 p. doi: 10.1111/j.1752-1688.2011.00623.x

Phillips, P.J., Chalmers, A.T., Gray, J.L., Kolpin, D.W., Foreman,W.T., and Wall, G.R., 2012, Combined sewer overflows: an environmental source of hormones and wastewater micropollutants: Environmental Science and Technology, v. 46, no. 10, p. 5336-5343, doi:/10.1021/es3001294

Reddy, J.E. and Risen, A.J., 2012, Groundwater quality in the Upper Susquehanna River Basin, New York, 2009: U.S. Geological Survey Open-File Report 2012-1045, 29 p.

Reddy, J.E., 2012, Groundwater quality in the Genesee River Basin, New York, 2010: U.S. Geological Survey Open-File Report 2012-1135, 29 p.

Schelker, J., Burns, D.A., Weiler, M. and Laudon, H., 2011, Hydrological mobilization of mercury and dissolved organic carbon in a snow-dominated, forested watershed: Conceptualization and modeling: Journal of Geophysical Research, v. 116, 17 p., doi:10.1029/2010JG1330.

Yager, R.M., Miller, T.S., Kappel, W.M., Langevin, C.D., Parkhurst, D.L., and de Vries, M.P., 2012, Simulated flow of groundwater and brine from a flooded salt mine in Livingston County, New York, and effects of remedial pumping on an overlying aquifer: U.S. Geological Survey Open-File Report 2011-1286, 16 p.

Topic Key: Surface Water Groundwater Water Quality Ecology Hazards

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- Minimize loss of life and property as a result of water-related natural hazards, such as floods, droughts, and land movement.
- Effectively manage groundwater and surface-water resources for domestic, agricultural, commercial, industrial, recreational, and ecological uses.
- Protect and enhance water resources for human health, aquatic health, and environmental quality.
- Contribute to wise physical and economic development of the Nation's resources for the benefit of present and future generations.

If you have an environmental or resource-management issue in which you would like to partner with the USGS to investigate, please contact any of our senior management staff (listed below). Projects are supported primarily through the Cooperative Water Program. This is a program through which any State, County, or local agency may work with the USGS to fund and conduct a monitoring or investigation project.

★ ★ ★ ★

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