New York Water Science Center News Volume 12, April 2011

U.S. Geological Survey, New York Water Science Center Newsletter

Threatened gages and wells | Hydrologic conditions | Marcellus shale | OXY-PAHS | Great Lakes Restoration Initiative

Potential Funding Cuts May Lead to Loss of Critical Streamflow and Groundwater Information for New York

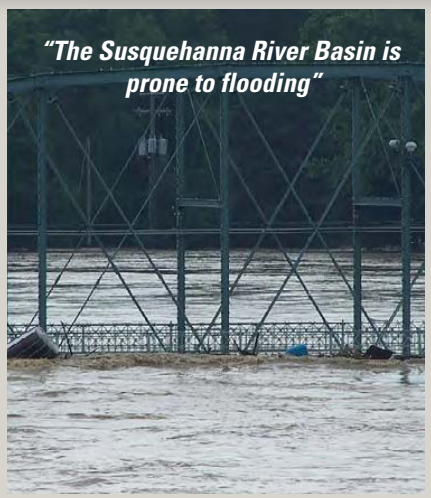
The U.S. Geological Survey (USGS) has been notified that the Congressionally earmarked funding that supports some of the Susquehanna River Basin Flood Forecast and Warning System and much of the USGS streamgaging program in the Lake Champlain basin will not be available in Federal fiscal year 2011 and beyond. As a result, critical services at 29 streamgages in New York are likely to be discontinued on May 1, 2011. In addition, funding that supports one streamgage in Cayuga County and almost the entire surface- and groundwater monitoring network in Nassau County are uncertain at this time. In all, 36 lake-level or streamgages and 53 groundwater monitoring wells have been or may soon be discontinued. Funding for 2012 is even more uncertain.

The USGS continues to work with Federal, State, and local government agencies to seek alternative funding sources so that operation of these gages can continue.

Many of these sites are used by the National Weather Service to calibrate models, develop flood forecasts, and issue flood warnings. Most of the surface-water sites and several of the groundwater sites provide information on a real-time basis on the Internet at:
http://waterdata.usgs.gov/ny/nwis/rt/

Streamgages provide information on the quantity and timing of streamflow in the Nation's rivers to help ensure adequate water resources for a healthy environment and economy and to assist in planning for future floods and droughts. Similarly groundwater records are used for monitoring groundwater flooding, contaminant movement, over pumping, and saltwater intrusion. Loss of the Nassau County network will result in a large gap in the information needed to manage the sole-source aquifers of Long Island. Loss of the Lake Champlain gages, which are used to monitor the chemical quality of tributar streams may hamper lake restoration efforts.

Long records of monitoring for both streamflow and groundwater levels (more than 30 years of record) are vital to the characterization of regional hydrologic conditions (for purposes of water supply planning and flood hazard assessments) as well as for documenting and understanding changes that occur due to changes in land use, water use, groundwater development, and climate. Eighteen of the 36 streamgages and 19 of the 53 groundwater wells in New York that may be discontinued on May 1, 2011, have more than 50 years of record and all but five streamflow and five groundwater wells have more than 20 years.



Susquehanna River floodwaters overflow Washington Street pedestrian bridge, Binghamton, NY, on June 28, 2006. (Suro, T.P., Firda, G.D. and Szabo, C.O. 2009, Flood of June 26–29, 2006, Mohawk, Delaware,and Susquehanna River Basins, New York: U.S. Geological Survey Open-File Report 2009–1063, 354p.)

A Message from Ward Freeman

New York Water Science Center Director

"Since our last newsletter the USGS has been faced with budget uncertainties that threaten the operation of many of the streamgages in the New York portion of the Susquehanna River and Lake Champlain Basins as well as Cayuga and Nassau Counties. Presently, funding to support 19 streamgages through September 30, 2011 for the Flood Forecast and Warning System looks very promising. That still leaves 17 streamgages that are currently unfunded, 6 have already been shut down. Additionally 53 groundwater monitoring wells in Nassau County have also been shut down. The funding that will hopefully be secured to support the 19 streamgages in the Susquehanna basin is just a stop-gap measure and all 36 of these threatened streamgages may be shut down after September 30, 2011, if no additional funding is identified. Although historic data will remain accessible, no new data will be collected unless one or more new funding partners are found.

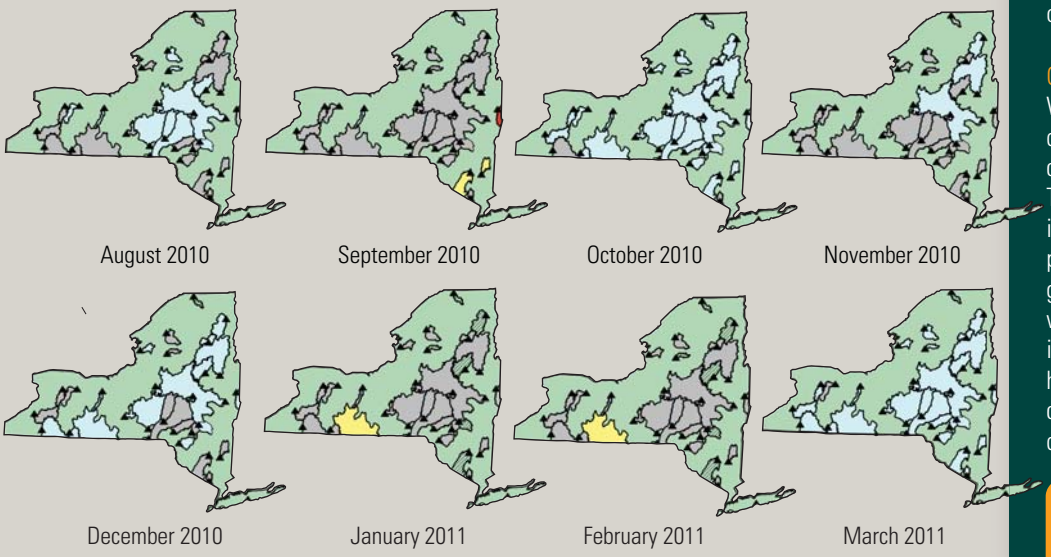
Also since our last news letter Rob Breault has joined the New York Water Science Center. Rob will fill the Associate Director position that I held for many years. Rob comes to us from Massachusetts, where he worked as the Deputy Director of the Massachusetts Water Science Center. Rob has over 19 years experience with USGS and has really hit the ground running (including taking over the newsletter). Please join me in welcoming Rob to New York!"

Visit the New York Water Science Center Web site at:
http://ny.water.usgs.gov
Or contact
(518) 285-5665
dc_ny@usgs.gov

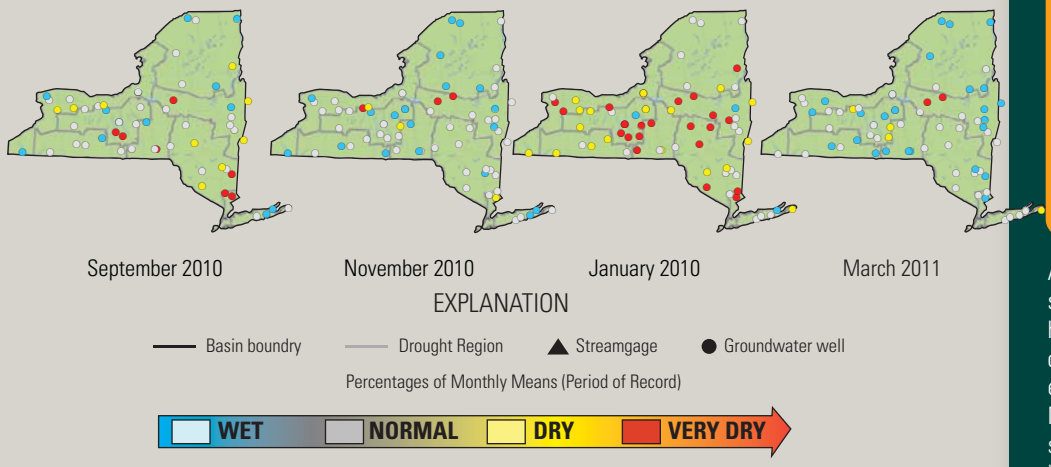
Surface Water and Groundwater Conditions in New York

Monthly, hydrologists at the New York WSC synthesize and summarize streamflows and groundwater levels for New York. Monthly hydrologic condition reports are available at http://ny.water.usgs.gov/infodata/conditions.html. Average monthly streamflow conditions across New York have been in the normal or wet ranges over most of the last 8 months. High streamflow in September and October was due to the remnants of Tropical Storm Nicole which produced heavy rainfall that ranged from 3 to 9 inches on September 30th and October 1st. Groundwater levels varied over the last 8 months, with several areas showing dry to very dry conditions in January. For the most part, groundwater levels returned to normal in February and above normal in March 2011.

A. Streamflow



B. Groundwater



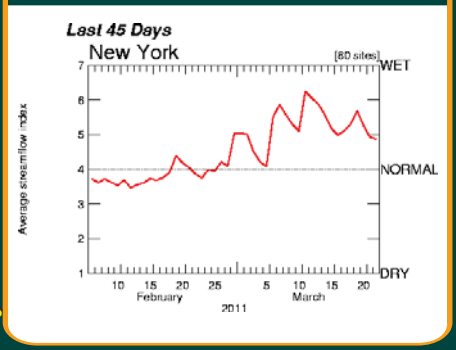
Average monthly conditions at selected (A) streamgages and (B) groundwater wells in New York. USGS maintains and operates most streamgages and groundwater wells in cooperation with various federal, state, and local agencies.

USGS Water Water & 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 is 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 in March was well above the normal whereas streamflow in February was at or slightly below normal conditions for New York.

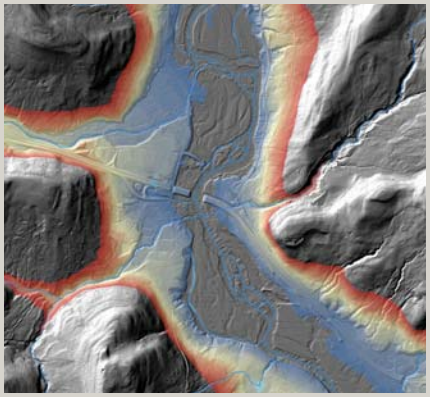
Hydrogeology of Selected Valley-Fill Aquifers in the Marcellus Shale Gas-Play Area in Southern New York State

The increased price of energy and new developments in horizontal drilling and hydraulic fracturing have made the Marcellus Shale gas play the newest exploitable natural gas resource in the Northeastern U.S. The major fairway of mature source rock of the Marcellus Shale in the Appalachian Basin extends into Southern New York with the greatest thickness and most productive areas in Pennsylvania and New York.

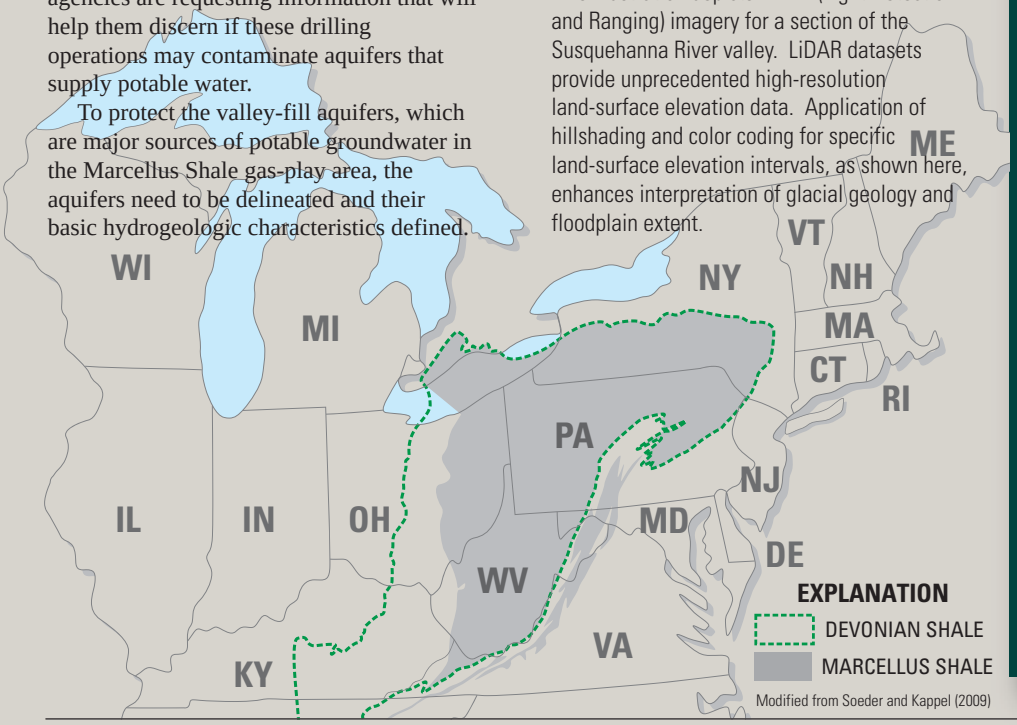
Formation fluids from the Marcellus Shale along with large volumes of drilling fluids and drill cuttings will be produced. These fluids and solids include fresh drilling water, drill cuttings, and hydrofrack and flowback waters as well as saline formation water, and each will have unknown geochemical and radiochemical qualities that will have to be addressed at the drill site, during transportation, and at disposal. State, county, and municipal governmental agencies are requesting information that will help them discern if these drilling operations may contaminate aquifers that supply potable water.

To protect the valley-fill aquifers, which are major sources of potable groundwater in the Marcellus Shale gas-play area, the aquifers need to be delineated and their basic hydrogeologic characteristics defined.

The objective of an ongoing study is to map and define the characteristics of four major valley-fill aquifers in the Marcellus Shale gas-play area in New York that have not yet been investigated as part of the USGS-NYSDEC aquifer mapping program. The study will improve the understanding of the hydrogeology of the sand and gravel aquifers in the Southern Tier of New York and will provide the following information: (1) extent of the aquifers, (2) hydraulic conditions in the aquifers— whether the units are confined (artesian) or unconfined, and (3) general direction of ground-water flow.



This illustration depicts LiDAR (Light Detection and Ranging) imagery for a section of the Susquehanna River valley. LiDAR datasets provide unprecedented high-resolution land-surface elevation data. Application of hillshading and color coding for specific land-surface elevation intervals, as shown here, enhances interpretation of glacial geology and floodplain extent.



Modified from Soeder and Kappel (2009)

What is Marcellus Shale?

The Marcellus Shale is a fine-grained sedimentary rock formation deposited over 350 million years ago in a shallow inland sea located in the eastern United States where the present-day Appalachian Mountains now stand (de Witt and others, 1993). This black shale contains significant quantities of organic material and natural gas. New developments in drilling technology, along with higher wellhead prices, have made the Marcellus Shale an important natural gas resource. (From Soeder and Kappel FS 2009-3032)

The Marcellus Shale is present in much of western New York, but the Southern Tier of New York is considered most favorable for natural gas production. Depth to the Marcellus Shale in the study area is between 3,500 ft in Chenango County to 5,500 ft in southern Broome County.

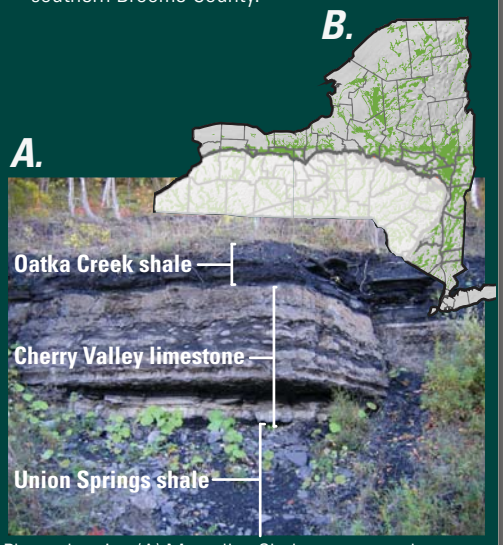


Photo showing (A) Marcellus Shale outcrop and (B) Area of Marcellus Shale in New York (**white transparency**). The Oatka Creek shale and the Union Springs shale are the gas bearing formations.

Detection and Quantification of Oxygenated Polycyclic Aromatic Hydrocarbons (oxy-PAHs) in Groundwater Near the Former Manufactured Gas Plant in Bay Shore, N.Y.

As a result of storage and disposal practices at a former Manufactured Gas Plant (c. 1880 – 1978), or MGP, in Bay Shore, NY, a variety of polycyclic aromatic hydrocarbons (PAHs) have been detected at high concentrations in the surficial, upper glacial aquifer of Long Island. Levels of PAHs initially detected over 10 years ago were in the parts-per-thousand range within a groundwater contaminant plume. The plume extended over a half-mile from probable MGP-related sources to discharge at a local estuarine tributary, Lawrence Creek, resulting in malodorous hydrocarbon sheens in this tributary and nearby storm drains. These signs of contamination revealed a larger underlying problem and prompted calls by state and local government for extensive remediation.

Former Manufactured Gas Plant (MGP)

To date, most of the source-materials (known as NAPLs, or non-aqueous phase liquids) responsible for creosote leachates, such as PAHs, have been excavated. In addition, both chemical treatments (to promote chemical oxidation) and oxygen-gas injection (OGI) lines (to spur microbial growth) have been employed to breakdown the PAHs within the plume. One breakdown product of PAHs —oxy-PAHs— may originate in part from incomplete combustion during gasification operations at the MGP or weathering of the coal-tar by-product during storage. However, several studies near other MGPs have shown that biological degradation products of PAHs can also result in the formation, and in some cases accumulation, of oxy-PAHs in soils (Lundstedt and others, 2007). Little is known about the fate and transport of oxy-PAHs in shallow, coastal aquifers and in estuarine environments, although structurally, oxy-PAHs are more soluble (and potentially more mobile) than PAHs. Available toxicity data indicate that some oxy-PAHs may be harmful to aquatic ecosystems, and possibly even more toxic than their parent PAH compounds (Lundstedt and others, 2007). Currently, a local university collaborator has begun to study the effects of various concentrations of some oxy-PAHs (found during this project) on fish larvae.

Recently, an analytical method was developed at the USGS National Water Quality Laboratory (NWQL) in Denver, Colo. for detecting the oxy-PAHs. This method has been used by the NWQL to analyze samples collected by the Suffolk County Department of Health Services (SCDHS) and USGS from the vicinity of the Bay Shore plume for 14 oxy-PAHs, with detection limits as low as 0.04 µg/L. Each of the oxy-PAHs in the analytical method has been successfully identified in at least one sample. Recent samples indicate concentrations (when detected) of oxy-PAHs in the parts-per-trillion range in both groundwater and surface waters. The method is an extension of the current NWQL PAH method (which corresponds to the EPA "priority list" of 16 PAHs of concern) and includes seven parent-daughter compound pairs whose ratios are being used to compare before and after OGI-line treatment. Screening for additional oxy-PAHs to add to the method is also being investigated.

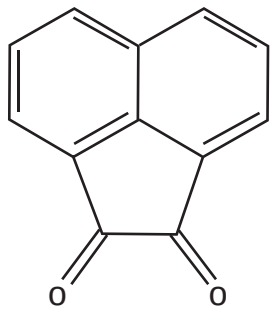
The USGS has been working closely with the SCDHS to document and better understand the fate and transport of these emerging contaminants as the PAH plume is remediated via the OGI system and other technologies. Proposed future work will continue monitoring of oxy-PAH levels in existing groundwater wells to assess the effectiveness of the OGI treatment system, as well as potential discharges into seabed pore waters and surface waters of the adjacent estuary.

What is an oxy-PAH?

In the simplest sense, oxygenated Polycyclic Aromatic Hydrocarbons (or oxy-PAHs) are a group of PAHs that have oxygen as part of their molecular structure, typically in place of one or more hydrogen atoms. Substitution of hydrogen atoms with oxygen atoms generally makes oxy-PAHs more soluble in water than other PAHs. Increased solubility likely means that oxy-PAHs are also more mobile in the environment.

There are many potential sources of oxy-PAHs. They can be formed as a direct by-product of biological oxidation of PAHs in the environment. There is also a potential for oxy-PAHs to form chemically by reaction with certain remediation chemicals and through combustion of coal and other PAH-containing fossil fuels. Some PAHs can be irradiated by direct sunlight to form oxy-PAHs as well.

Acenaphthenequinone



Acenaphthenequinone, an oxy-PAH, has been detected in most of the samples collected as part of the USGS study. Concentrations as high as 1.7 parts per billion, have been measured.

NY-WSC helps monitor restoration progress in the Great Lakes

To support the President's Great Lakes Restoration Initiative (GLRI) program goals, the U.S. Geological Survey is involved in a number of projects aimed at providing data for resource managers to make sound decisions based on impartial science. The New York Water Science Center (NY WSC) is involved in collecting inorganic and organic water-quality data from four of fifty-nine sites previously designated as the National Monitoring Network for Coastal Waters (NMN) in the Great Lakes Basin. These data will provide a baseline metric to assess restoration goal progress. Four sites in New York include the St. Regis River, tributary to the St. Lawrence, the Oswego and Genesee rivers, tributary to Lake Ontario, and the Cattaraugus River, tributary to Lake Erie.

The sites are equipped with automatic-sampling systems and multi-parameter sensors for measuring inorganic water-quality. The auto samplers will collect water-quality from storm events to supplement monthly base flow samples. Continuous sensor measurements will be used as surrogates to produce real-time concentration and load estimates of additional chemical constituents such as sediment, chlorides, and nutrients. Regression models will provide (1) the potential for inexpensive, long-term, water-quality monitoring approaches in the future and (2) estimates of real-time loading for the major Great Lakes tributaries. Additionally, at all NMN sites (nine total in NY) passive, integrative samplers have been deployed to sample hydrophilic and lipophilic environmental contaminants. The Oswego River will also be sampled for "chemicals of emerging concern" (CECs), including pharmaceuticals and personal care products. The Genesee River site will also employ sediment traps to measure PAHs, total PCBs, and pharmaceuticals.

All data will be captured in standard USGS databases with on-line access, and also using common data formats and exchange interfaces to support the Great Lakes Observing System (GLOS) database effort. The database will also be designed to facilitate a variety of planned state-of-the-science watershed modeling activities throughout the Great Lakes. The network is currently funded through the EPA Great Lakes Restoration Initiative program until September 30, 2011, with hopes of additional funding in future years through this program.

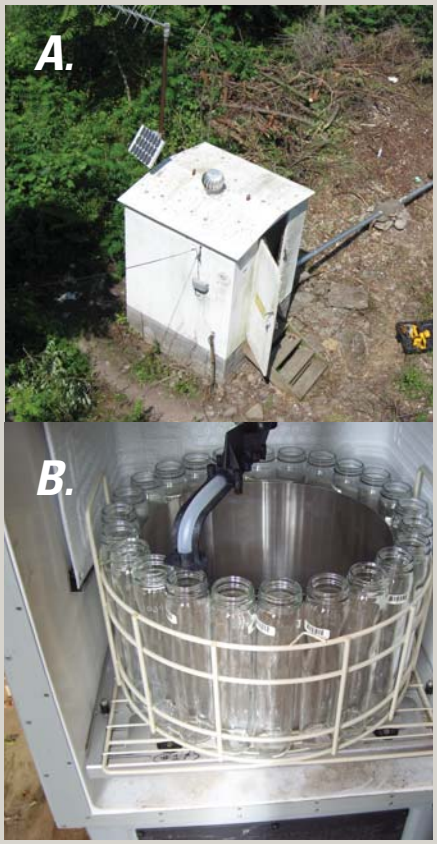


Photo shows (A) a typical USGS gaging station outfitted with (B) automatic-sampling systems. Samples are anayzed for a suite of constituents, including total nutrients, filtered phosphorus and chloride, and suspended sediment.

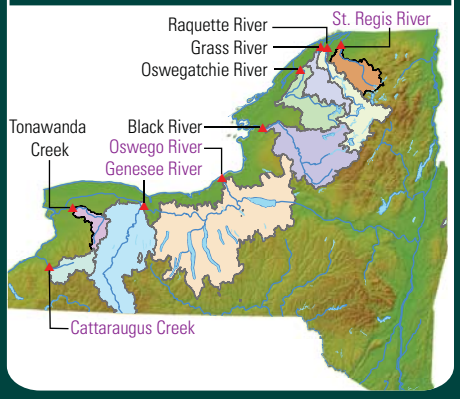
How is the NY WSC helping the Great Lakes Restoration?

The Great Lakes Restoration Initiative is the largest investment in the Great Lakes in two decades. A task force of 11 federal agencies developed a plan to put the president's historic initiative into action. This action plan covers fiscal years 2010 through 2014 and addresses five urgent focus areas:

- Cleaning up toxics and areas of concern;
- Combating invasive species;
- Promoting nearshore health by protecting watersheds from polluted run-off;
- Restoring wetlands and other habitats; and
- Working with partners on outreach.

For more information about The Great Lakes Restoration Initiative visit http://epa.gov/greatlakes/index.html

USGS GLRI Monitoring Sites



The New York Water Science Center (NY WSC) is involved in collecting inorganic and organic water-quality data from four (purple) of fifty-nine sites previously designated as the National Monitoring Network (NMN) for Coastal Waters in the Great Lakes Basin (not shown). Selected USGS streamgages that are part of the the NMN, which were sampled once for hydrophilic and lipophilic environmental contaminants by means of passive samplers are also shown (red triangles).

New Reports from the New York Water Science Center

Abbene, I.J., 2010, Shallow groundwater quality in the Village of Patchogue, Suffolk County, New York: U.S. Geological Survey Scientific Investigations Report 2010-5132, 19 p.

Eckhardt, D.A.V. and Anderson, J.A., 2010, Geophysical logs of selected wells at the Diaz Chemical Superfund Site in the Village of Holley, New York, 2009: U.S. Geological Survey Data Series-500, 16 p.

Hayhurst, B.A., Coon, W.F., and Eckhardt, D.A., 2010, Water resources of Monroe County, New York, water years 2003-08 --Streamflow, constituent loads, and trends in water quality: U.S. Geological Survey Scientific Investigations Report 2010-5216, 34 p.

Heisig, P.M., 2010, Water resources of Rockland County, New York, 2005-07, with emphasis on the Newark basin bedrock aquifer: U.S. Geological Survey Scientific Investigations Report 2010-5245, 130 p.

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., 2010, Studying the muddy waters of Esopus Creek: Esopus Creek News, Summer 2010, p. 5.

Muvihill, C.I., 2010, USGS streamgages provide valuable information: Esopus Creek News, Fall-Winter 2010, p. 6-7.

Nystrom, E.A., 2010, Groundwater quality in the Lower Hudson River Basin, New York, 2008: U.S. Geological Survey Open-File Report 2010-1197, 39 p., online only.

Randall, A.D., 2010, Low flow of streams in the Susquehanna River basin of New York: U.S. Geological Survey Scientific Investigations Report 2010-5063, 57 p.

Reddy, J.E. and Kappel, W.M., 2010, Hydrogeologic and geospatial data for the assessment of focused recharge to a carbonate-rock aquifer in Genesee County, New York: U.S. Geological Survey Scientific Investigations Map 3132, 17 p., 20 sheets.

Reynolds, R.J. and Calef, F.J., III, 2010, Hydrogeologic data update for the stratified-drift aquifer in the Sprout and Fishkill Creek valleys, Dutchess County, New York: U.S. Geological Survey Scientific Investigations Map 3136, 4 sheets, 1:24,000.

Riva-Murray, Karen, Riemann, R., Murdoch, P., Fischer, J.M. and Brightbill, R., 2010, Landscape characteristics affecting streams in urbanizing regions of the Delaware River basin (New Jersey, New York, and Pennsylvania, U.S.): Landscape Ecology, v. 25, no. 10, p. 1489-1503.

Szabo, C.O., Coon, W.F., and Niziol, T.A., 2010, Flash floods of August 10, 2009, in the Villages of Gowanda and Silver Creek, New York: U.S. Geological Survey Scientific Investigations Report 2010-5259, 23 p.

Williams, J.H., 2011, Evaluation of well logs for determining thepresence of freshwater, saltwater, and gas above the Marcellus Shale in Chemung, Tioga, and Broome Counties, New York: U.S. Geological Survey Scientific Investigations Report 2010-5224, 27 p.

Williams, J.H., Reynolds, R.J., Franzi, D.A., Romanowicz, E.A., and Paillet, F.L., 2010, Hydrogeology of the Potsdam Sandstone in Northern New York: Canadian Water Resources Association, v. 35, no. 4, p. 399-416.

Yager, R.M. and Ratcliffe, N.M., 2010, Hydrogeology and simulation of groundwater flow in fractured rock in the Newark basin, Rockland County, New York: U.S. Geological Survey Scientific Investigations Report 2010-5250, 139 p.

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The USGS Water Resources Discipline (WRD) has the principal responsibility within the Federal Government to provide the hydrologic information and interpretation needed by others to achieve the best use and management of the Nation's water resources. WRD actively promotes the use of its information products by decision makers to:

- 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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USGS New York Water Science Center, Senior Staff:

Ward O. Freeman, Director,
(518) 285-5658
Robert F. Breault, Associate Director,
(518) 285-5661
Edward Bugliosi, Ithaca Program Office Chief,
(607) 266-0217 ext 3005
Stephen Terracciano, Coram Program Office Chief,
(631) 736-0783 ext 102
Cheryl Music, Administrative Officer,
(518) 285-5656