Great Lakes Edition

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

A Message from Ward Freeman

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Beach Health | **Water & Bed Sediment Toxicity** | **Wastewater Contaminants** | **Tributary Stream Water-Quality** | **Hydrologic Conditions**

Developing and Implementing Predictive Models for Estimating Recreational Water Quality at Great Lakes Beaches

The Great Lakes Restoration Initiative (GLRI) in cooperation with 23 local and state agencies expanded the use of predictive modeling at 45 beaches throughout the Great Lakes. Local agencies measure fecal-indicator bacteria such as Escherichia coli (*E. Coli*.) along with easily obtained environmental variables used as surrogates to estimate concentrations of fecal-indicator bacteria through a predictive modeling approach.

The predictive modeling is being developed by the use of linear regression and/or partial least-squares techniques. The models use software developed by the U.S. Environmental Protection Agency (EPA) known as "Virtual Beach". Each beach model is based on a combination of explanatory variables, most commonly, turbidity, day-of-year, change in lake level over 24 hours, rainfall, wave height, and wind direction and speed.

The New York Nowcast website (in development) will provide near real-time information on water-quality conditions at recreational swimming areas in New York. Specifically, the Nowcast website estimates the probability of exceeding the EPA bathing-water standard of 235 colony forming units per 100 milliliters (CFU/100 mL) based on the value of explanatory variables, which are entered into the Nowcast website by 9 AM each-and-every morning during the summer-swimming season. Explanatory variables are entered via a secured website and approved by each beach manager prior to uploading. Then using the result of the predictive models and the probability of exceeding the bathing-water standard, beach managers can make informed decisions on whether or not to close a beach.

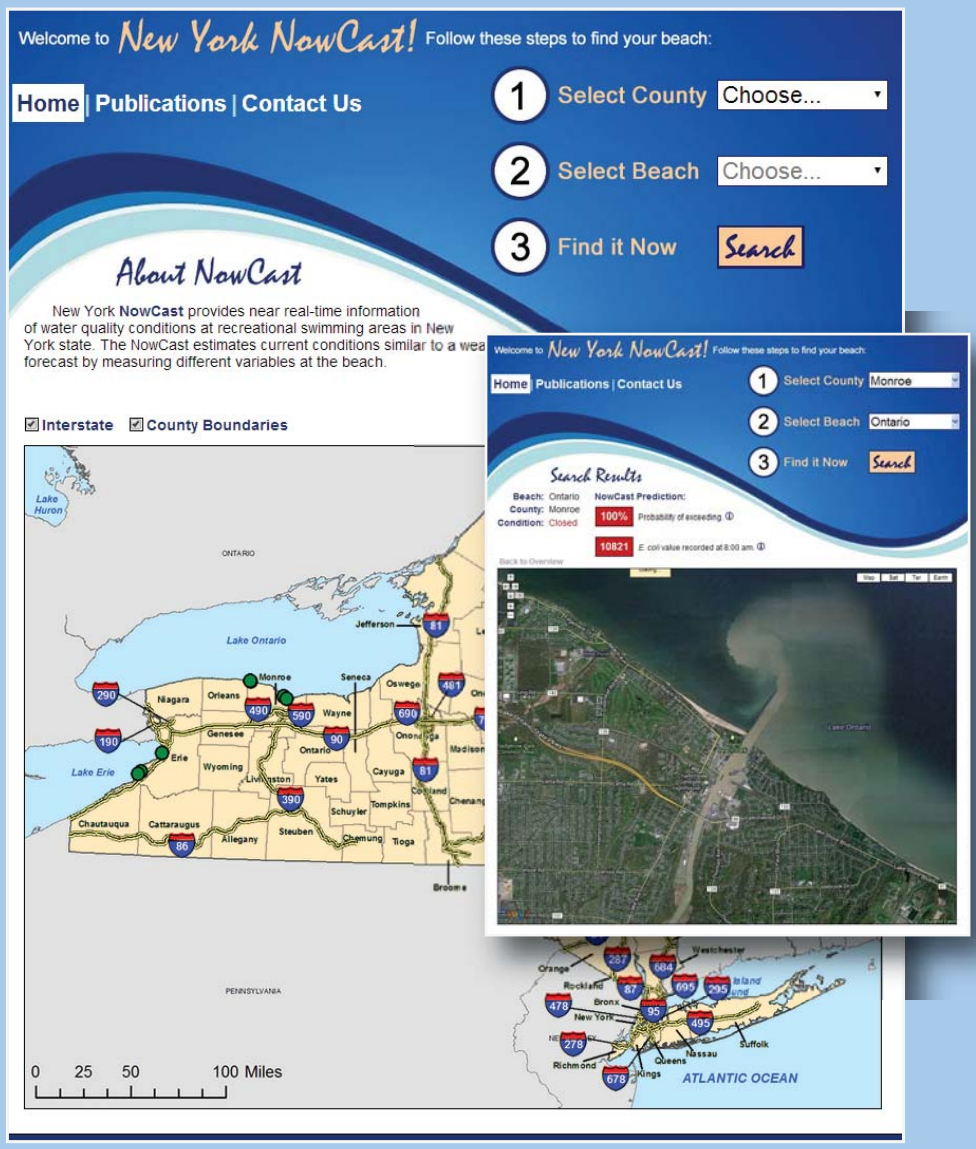


Figure showing a DRAFT version of the New York NowCast web page. New York NowCast provides near real-time information of water-quality conditions at recreational swimming areas in New York state. The NowCast estimates current conditions similar to a weather forecast by measuring different variables at the beach.

Toxicity of Water and Bed Sediment from the St. Lawrence River at Massena, and other Great Lakes Areas of Concern in New York State

Past water-quality issues in the St. Lawrence River at Massena, NY resulted in a determination that selected beneficial uses could be impaired in a surrounding Area of Concern (AOC). Benthic macroinvertebrates (benthos) and plankton (phytoplankton and zooplankton) assemblages were designated as two Beneficial Use Impairments (BUIs) because relevant data were unavailable or indicated the communities were degraded. Recent investigations, however, suggest that water quality has improved and both communities may have recovered substantially. Thus, both BUIs may be outdated in all, or parts of, the St. Lawrence River in the Massena AOC. The primary goal for the Massena Remedial Action Plan (RAP) [developed by the NY State Department of Environmental Conservation (NYSDEC), the Massena Citizen Advisory Committee (CAC), and the St. Regis Mohawk Tribe at Akwesasne] is to "restore, protect, and maintain the chemical, physical, and biological integrity of the St. Lawrence River ecosystem and in particular the Akwesasne, Cornwall-Lake St. Francis and Massena Area of Concern in accordance with the Great Lakes Water Quality Agreement and other agency laws, regulations, and policies". The RAP established specific criteria in the St. Lawrence River at Massena AOC for removing (restoring and protecting) the 15 BUIs, including one for “degradation of plankton populations” and another for “degradation of benthos”. These criteria essentially stipulate that respective BUIs may be removed when: (a) community structure at AOC sites does not differ significantly from that found at unimpacted control sites of comparable physical and chemical characteristics, and (or) in the absence of community structure data (b) bioassays (toxicity tests) confirm no impact (i.e., no mortality or inhibition of growth or reproduction) occurs in test organisms when exposed to waters or sediments from AOC sites as compared to responses in media from control sites.

The U.S. Geological Survey (USGS), NYSDEC, and the St. Regis Mohawk Tribe at Akwesasne conducted two studies (2011-13) to determine if the plankton and benthos beneficial use was presently impaired in parts, or all of the St. Lawrence River at Massena New York AOC. Acute and chronic toxicity of AOC waters at AOC and control sites were assessed using the: (a) growth of the green algae Selenastrum capricornutum, and (b) reproductive capacity and survival of the water flea *Ceriodaphnia dubia* and standard US Environmental Protection Agency (EPA) testing guidelines. The sediment quality at AOC and control sites was assessed by the condition of benthic macroinvertebrate communities and the growth and survival of the midge (*Chironomus dilutus*) exposed to sediment following standard EPA testing guidelines. In a comparable study, the USGS, NYSDEC, and several collaborators are currently (2013-14) assessing sediment and water toxicity and health of macroinvertebrate assemblages in the Rochester Embayment Area of Concern, to evaluate the benthos and plankton BUIs. Additional investigations of sediment toxicity and health of macroinvertebrate assemblages are being planned for the Eighteenmile Creek Area of Concern during 2014-15 and for the Niagara River Area of Concern during 2014-16.

Results of the St. Lawrence plankton study indicate that ambient waters from most AOC sites (and across three seasons) were generally not toxic to both plankton species (Baldigo and others, 2012). The St. Lawrence benthos study determined that macroinvertebrate assemblages and bioassessment metrics did not differ significantly between AOC and control sites of the same sediment class and that median growth of *Chironomus dilutus* at all sites and their survival in sediments from three of the four river systems did not differ significantly between AOC and control sites (Duffy and others, in review). These results generally support the inference that water and sediments in the St. Lawrence River at Massena AOC are currently not toxic, and should not significantly impair the health of resident plankton and benthos (macroinvertebrate) communities.

USGS Scientists collecting bed-sediment samples.

Baldigo, B. P., B. T. Duffy, C. J. Nally, and A. M. David. 2012. Toxicity of waters from the St. Lawrence River at Massena Area-of-Concern to the plankton species Selenastrum capricornutum and Ceriodaphnia dubia. Journal of Great Lakes Research 38(4):812-820.

Duffy, B. T., B. P. Baldigo, A. J. Smith, S. D. George, and A. M. David. in review. Assessment of macroinvertebrate communities and bed sediment toxicity in the St. Lawrence River at Massena Area-of-Concern, New York, USA. submitted to the Journal of Great Lakes Research, February 2014.

Tracking Wastewater Contaminants in Red Creek

The USGS New York Water Science Center has begun a pilot program to locate sources of leaking sewage from imperfect infrastructure and misconnection within the sewer system at three locations Milwaukee Estuary, Clinton River and the Rochester Embayment. As wastewater collection infrastructure (sanitary sewers) ages in the Great Lakes region, leakage of wastewater into nearby streams poses a contamination threat from pathogens and toxic contaminants. Locating sources of these leakages is a constant challenge for local wastewater utilities, and in collaboration with Monroe County, USGS will systematically track sources in a small urban basin within the Genesee River basin called Red Creek basin. We will be developing new optical sensor technology for tracing sanitary sewage leakage to the source, and take the next steps to collaborate with local wastewater utilities to plan and implement restoration, and monitor effectiveness of solutions starting at these small tributaries within these larger dynamic systems.

Red Creek is a small tributary with influences from multiple urban and commercial developments and agriculture within a 22.4 square mile basin. There are multiple stormwater influences throughout which will be sampled for wastewater, pathogens, virus, and optical signatures. Near the mouth, USGS has installed a virus and water properties sampler and gaging station to collect storm event flow-weighted composites in an attempt to sample slugs of wastewater influence from the entire basin. In addition, every other month we will collect 24 hr baseflow composites.

Sample anaysis will include optical properties, dissolved organic matter, eight human viruses, nine bovine viruses, three protozoa, and three pathogens related to fecal contamination, among other consituents.

Microplastics Sampling

USGS NYWSC will begin sampling the Genesee River, Tonawanda Creek, and the Buffalo River for microplastics by deployment of a Neuston net as part of a pilot program. First sampling will begin this April (2014). The sampling configuration will be suspended from a boat through an extension pole and two extension chains attached to a cable and a series of pulleys to allow the sampler to track the nets upper support bar just above the water surface. A SeaGear flow meter will provide velocity data into the net to determine total discharge through the net for the total time of deployment.

Microplastics come from the degradation of plastics, and are often additives in cosmetic and cleaning products. USGS is currently in discussions with EPA Region II and the Canadian Ministry to begin sampling the Niagara River for microplastic.

Material collected will then be washed from the net and capture into a sock at the bottom.

Water Quality Data for Tributaries to Lake Ontario in New York--Great Lakes Restoration Initiative, Lakewide Impairment Study

The U.S. Geological Survey (USGS) in cooperation with the U.S. Environmental Protection Agency (EPA) Region 2, in 2012 and 2013 is conducting an ongoing program to sample nine tributaries to Lake Ontario, to help determine phosphorous loading from major watersheds as a part of the Great Lakes Restoration Initiative (GLRI) in support of a Lakewide Management Plan (LaMP). The program began in 2012 at six sites and was expanded in 2013 to include an additional three sites. At each tributary site, the collection of water temperature, specific conductance, total phosphorus, orthophosphate or soluble reactive phosphorus (SRP), total dissolved solids (TDS) and total suspended solids (TSS) began on a seven-week interval.

Tributary sites are sampled the first Monday of each month. During the agricultural growing season (April to October) samples are collected on the first and third Monday of each month,. Samples are collected using an equal-width-increment sampling protocol across the stream and are composited to provide estimates of loading to Lake Ontario. Instantaneous discharge data are available from real-time USGS streamgages on each tributary.

In addition to the interval sampling at each site, the Genesee River at Ford Street Bridge and Oswego River at Lock 7 at Oswego have secondary sampling schedules which occur monthly at selected intervals, and also include storm-event sampling. These additional samples are analyzed for: (1) dissolved solids also termed total-dissolved solids (TDS) which is a measure of combined inorganic and organic substances in a dissolved state, (2) total-suspended solids (TSS) which includes inorganic and organic particulates not in solution, (3) suspended-sediment also termed total concentration (TC) which is the abundance of inorganic and organic constituents and includes suspended sands and silts, (4) Total phosphorus (P), unfiltered, which represents the sum of all the phosphorus components, and (5) Orthophosphate, also termed soluble reactive phosphorus (SRP).

For the entire period of data (October 2011 through January 2013), Oak Orchard Creek near Shelby had the highest concentration of dissolved solids (1,870 mg/L). Honeoye Creek at Honeoye Falls had the highest concentration of suspended solids (363 mg/L). Eighteenmile Creek at Burt had the highest concentrations of orthophosphate (SRP, 0.191 mg/L). Genesee River at Ford Street Bridge had the highest concentration of Total Phosphorus (0.697 mg/L). Both Salmon River at Pineville and Black Creek at Watertown had the lowest concentrations with the greatest number of non-detects for suspended solids, orthophosphate, and total phosphorus. Primary sources for dissolved and particulate solids are normally erodible soils; agriculture, residential runoff, and discharge from industry or sewage treatment. The contribution of phosphorus is often from fertilizer and manure runoff or discharged from industry and sewage treatment.

USGS water-quality data for New York can be accessed online through the U.S. Geological Survey's National Water Information System. Data from field sites and laboratory analysis can be retrieved for current and historical data, and for real-time and discrete water-quality measurements.

1. 04219768 EIGHTEENMILE CREEK AT BURT, NEW YORK
2. 04220045 OAK ORCHARD CREEK NEAR SHELBY, NEW YORK
3. 04231600 GENESEE RIVER AT FORD STREET, AT ROCHESTER, NEW YORK
4. 04249000 OSWEGO RIVER AT LOCK 7, AT OSWEGO, NEW YORK
5. 04250200 SALMON RIVER AT PINEVILLE, NEW YORK
6. 04260500 BLACK RIVER AT WATERTOWN, NEW YORK

Additional Tributary Sites Added October 2012

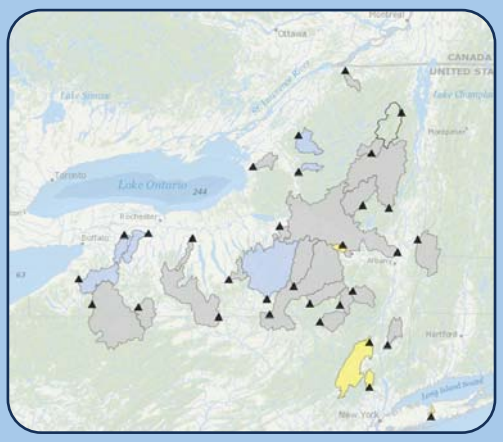
7. 04229500 HONEOYE CREEK NEAR HONEOYE FALLS, NY
8. 04232050 ALLEN CREEK NEAR ROCHESTER, NY
9. 0422016550 OAK ORCHARD CREEK NEAR KENYONVILLE, NY

Locations of nine major tributary sampling sites on Lake Ontario, New York

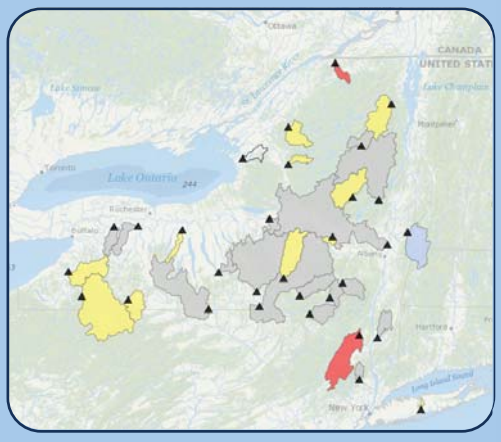
Surface Water and Groundwater Conditions in New York

Monthly and seasonally (shown below), hydrologists at the New York Water Science Center synthesize and summarize streamflows and groundwater levels for New York: Visual representation of the streamflow and groundwater conditions are shown on the NY WSC's Hydrologic Conditions Mapper. For October, December, and January, streamflow was generally wet to normal whereas streamflow was in the dry to very dry range for November, February, and March, on average. Groundwater levels were about normal from November 2013 to March 2014. Groundwater levels in October, however, varied around the State from wet to very dry with nearly as many wells in the dry or very dry ranges as there were wells in the normal or wet ranges.

A. Streamflow

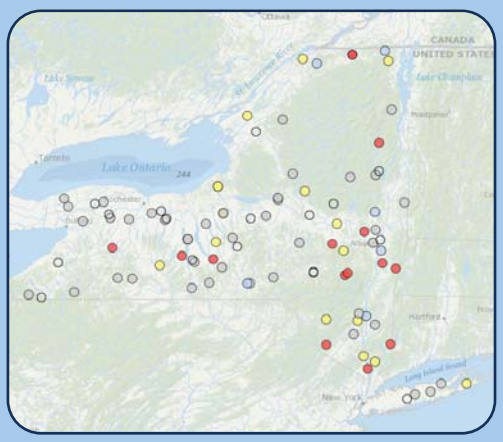


Autum 2012 (October, November, December)

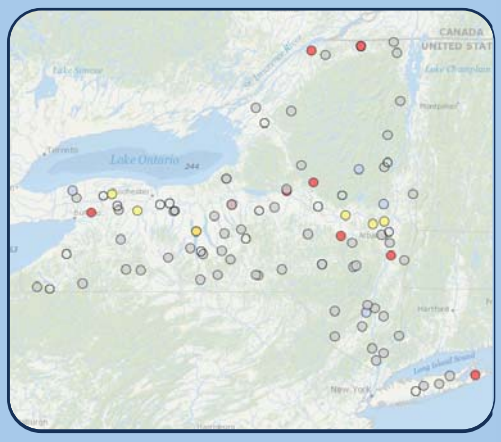


Winter 2013 (January, February, March)

B. Groundwater



Autum 2012 (October, November, December)



Winter 2013 (January, February, March)

EXPLANATION

Basin boundry — Drought Region — Streamgage — Groundwater well

Percentages of Monthly Means (Period of Record)

WET — NORMAL — DRY — VERY DRY

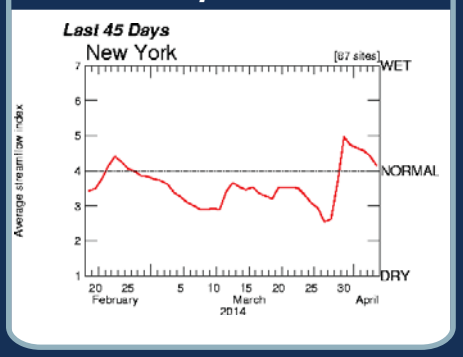
Seasonal conditions at selected (A) streamgages and (B) groundwater wells in New York. USGS maintains and operates most streamgages and groundwater wells in cooperation with various federal, state, and local agencies. Winter (January, February, March), Spring (April, May, June), Summer (July, August,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

New Reports from the New York Water Science Center

Riva-Murray, K., Bradley, P.M., Scudder Eikenberry, B.C., Knightes, C.D., Journey, C.A., Brigham, M.E. and Button, D.T., 2013, Optimizing stream water mercury sampling for calculation of fish bioaccumulation factors: Environmental Science & Technology, 47 (11), p. 5904–5912

Siemion, J., Lawrence, G.B. and Murdoch, P.S., 2013, Use of soil-streamwater relationships to assess regional patterns of acidic deposition effects in the northeastern USA: Hydrological Processes.

Schwab, W.C. and others, 2013, Geologic evidence for onshore sediment transport from the inner continental shelf: Fire Island, New York Journal of Coastal Research, Vol. 29 (3), p. 526-544.

Yager, R.M., 2013, Environmental consequences of the Retsof Salt Mine roof collapse: U.S. Geological Survey Open-File Report 2013-1174, 10 p.

Hayhurst, B.A. and Kappel, W.M., 2013, Natural heat storage in a brine-filled solar pond in the Tully Valley of Central New York: U.S. Geological Survey Open-File Report 2013-1266, 14 p.

Masterson, J.P., Pope, J.P., Monti, Jack, Jr., Nardi, M.R., Finkelstein, J.S., McCoy, K.J., 2013, Hydrogeology and hydrologic conditions of the Northern Atlantic Coastal Plain aquifer system from Long Island, New York, to North Carolina: U.S. Geological Survey Scientific Investigations Report 2013-5133, 76 p.

Heisig, P.M. and Scott, Tia-Marie, 2013, Occurrence of methane in groundwater of south-central New York State, 2012--Systematic evaluation of a glaciated region by hydrogeologic setting: U.S. Geological Survey Scientific Investigations Report 2013-5190, 32 p.

Heisig, P.M. and Scott, Tia-Marie, 2013, Methane occurrence in groundwater of south-central New York State, 2012--Summary of findings: U.S. Geological Survey Fact Sheet 2013-3118, 2 p.

Risser, D.W., Williams, J.H., Hand, K.L., and others, 2013, Geohydrologic and water-quality characterization of a fractured-bedrock test hole in an area of Marcellus shale gas development, Bradford County, Pennsylvania: Pennsylvania Geological Survey, 4th ser., Open File Report OFMI 13-01.0, 49 p., 4 appendices.

Francy, D.S., Brady, A.M.G., Carvin, R.B., Corsi, S.R., Fuller, L.M., Harrison, J.H., Hayhurst, B.A., Lant, J., Nevers, M.B., Terrio, P.J., and Zimmerman, T.M., 2013, Developing and implementing predictive models for estimating recreational water quality at Great Lakes beaches: U.S. Geological Survey Scientific Investigatioins Report 2013-5166, 68 p.

Kappel, W.M., 2013, Dissolved methane in groundwater, Upper Delaware River Basin, Pennsylvania and New York, 2007-12: U.S. Geological Survey Open-File Report 2013-1167, 6 p.

Cross, V.A., Bratton, J.F., Kroeger, K.D., Crusius, J., and Worley, C.R., 2013, Continuous resistivity profiling data from Great South Bay, Long Island, New York: U.S. Geological Survey Open-File Report 2011-1040 (online only)

Monti, J., Jr, Como, M., and Busciolano, R., 2013, Water-table and potentiometric-surface altitudes in the Upper Glacial, Magothy, and Lloyd Aquifers beneath Long Island, New York, April-May 2010: U.S. Geological Survey Scientific Investigations Map 3270, 4 sheets, scale 1:125,000

Carswell, W.J., Jr., 2014, The 3D elevation program: summary for New York: U.S. Geological Survey Fact Sheet 2014-3006, 2 p.

Levine, C.R., Yanai, R. D., Lampman, G.C., Burns, D.A., Driscoll, C.T., Lawrence, G.B., Lynch, J.A., and Schoch, Nina, 2014, Evaluating the efficiency of environmental monitoring programs: Ecological Indicators, v. 39, p. 94-101.

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The USGS Water Mission Area (WMA) 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. WMA 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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