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National Water-Quality Assessment Program

The Southeast Stream Quality Assessment

In 2014, the U.S. Geological Survey (USGS) National Water-Quality Assessment Program (NAWQA) is assessing stream quality across the Piedmont and southern Appalachian Mountains in the southeastern United States. The goal of the Southeast Stream Quality Assessment (SESQA) is to characterize multiple water-quality factors that are stressors to aquatic life—contaminants, nutrients, sediment, and streamflow alteration—and the relation of these stressors to ecological conditions in streams throughout the region (fig. 1). Findings will provide communities and policymakers with information on which human and environmental factors are the most critical in controlling stream quality and, thus, provide insights about possible approaches to protect or improve stream quality.

The SESQA study will be the second regional study by the NAWQA program, and it will be of similar design and scope as the Midwest Stream Quality Assessment conducted in 2013 (Van Metre and others, 2012).

Objectives

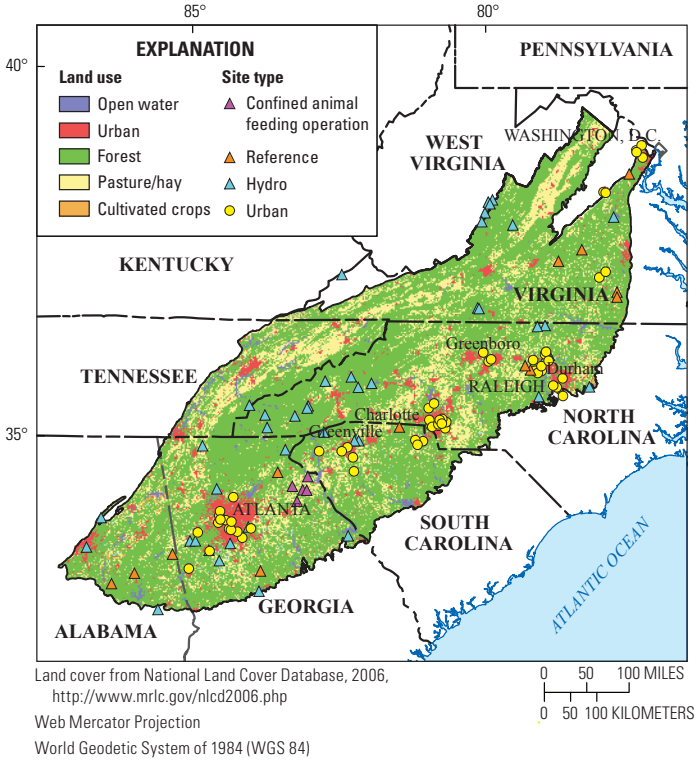
1. **Assess the status of ecological conditions; the spring-summer seasonal concentrations of contaminants, nutrients, sediment, and streamflow; and associated toxicity of sediment in wadeable streams in the region.**
2. **Assess relations among concentrations of contaminants, nutrients, sediment, and flow conditions; toxicity of sediment; and ecological conditions in the sampled streams.**
3. **Identify and evaluate the effects of natural and anthropogenic factors in the watersheds of the sampled streams on the occurrence of stressors and ecological conditions in the streams.**
4. **Develop statistical models to predict concentrations of contaminants, nutrients, and sediment, and, if possible, ecological conditions in perennial streams in the region.**

Approach

One hundred twenty-one sites will be sampled across the region for as many as 10 weeks during April, May, and early June 2014 for contaminants, nutrients, and sediment (fig. 1). This water-quality "index" period will culminate with an ecological survey of habitat, algae, benthic invertebrates, and fish at all sites. Sediment will be collected during the ecological survey for analysis of sediment chemistry and toxicity testing. The sites will be distributed so as to capture changes in water quality in response to changes in the principle stressors. Two of the most important anthropogenic factors affecting water quality in the region are urbanization and streamflow alteration. The targeted design of the assessment used streamflow and land-use data to identify and select sites that reflect a range in the amount of urbanization and streamflow alteration. The design concept is that sampling across these variations in environmental settings will yield data spanning ranges of many specific stressors (for example, contaminants), which will in turn allow us to better understand the effects of those stressors on stream ecology.

Of the 121 sites (fig. 1), 59 are on streams in watersheds with varying degrees of urban land use, 5 are on streams with numerous confined animal feeding operations (CAFO), and 13 are reference sites with little or no development in the watersheds they represent. Weekly water sampling at most of these sites will span 10 weeks, and sampling at reference and sparsely developed rural sites will span 4 weeks. The remaining 44 "hydro" sites are on streams in watersheds with relatively little agricultural and urban development but with hydrologic alteration, such as a dam and reservoir. Sampling at these sites will indicate the effects of hydrologic alteration on aquatic organisms, such as fish and invertebrates, without the confounding influences of other stressors. The hydro sites will be sampled for water and sediment chemistry once, coincident with the ecological survey.

In combination, the sites sampled will provide the data necessary to assess the water quality and ecological conditions of streams and to support computer modeling of factors affecting those conditions. The results of the modeling may indicate the condition of unsampled streams in the region.



Land cover from National Land Cover Database, 2006, http://www.mrlc.gov/nlcd2006.php
Web Mercator Projection
World Geodetic System of 1984 (WGS 84)

Figure 1. The Southeast Stream Quality Assessment study area. Study area boundary is based on selected level 3 ecological regions (ecoregions) of the United States (*http:/www.epa.gov/wed/pages/ecoregions.htm* accessed March 6, 2014).

Study Components

Specific study components are described in more detail below, including additional special sampling activities conducted at selected subsets of sites.

Ecological Condition—Algae, benthic invertebrates, and fish communities will be sampled and physical habitat assessed once at all 121 sites during the summer of 2014. Samples will be collected along multiple transects within the stream reach following USGS NAWQA protocols (Moulton and others, 2002).

Water Sampling—By use of depth- and width-integrating methods, water samples will be collected weekly at each site for up to 10 weeks preceding the ecological sampling (U.S. Geological Survey, 2006). Water samples will be analyzed for nutrients, suspended sediment, major ions, and about 240 dissolved pesticides and pesticide degradates. Selected samples will be analyzed for mercury, pharmaceuticals, wastewater indicator compounds, volatile organic compounds, and hormones.

The tangerine darter (*Percina aurantiaca*) inhabits clear, cool streams in the Southern Appalachian Mountains. Photo courtesy of Conservation Fisheries, Inc.

Integrated Samplers—Passive polar organic chemical integrative samplers (POCIS) samplers (Alvarez, 2010) deployed in streams for extended periods will be used to collect dissolved chemicals from stream water at all 77 urban, CAFO, and reference sites. The POCIS samplers are designed to accumulate chemicals such as water-soluble pesticides and degradates. In addition to pesticides, POCIS samples from urban and CAFO sites will be analyzed for pharmaceuticals and wastewater indicator compounds.

Sediment Sampling—Streambed sediment will be sampled coincident with the ecological sampling at all 121 sites. Stream bottom sediment will be collected from depositional areas, composited, and sieved. Sediment samples will be analyzed for about 25 trace elements, about 40 polycyclic aromatic hydrocarbons (PAHs), and about 60 halogenated organic compounds (compounds containing chlorine or bromine atoms, such as DDT).

Sugar Creek, Charlotte N.C., is typical of many urban streams with extensive modification of the channel and flood plain. Photo by Celeste Journey.

Toxicity Testing—Bed sediment samples from the 59 urban sites will be tested by using standard whole-sediment toxicity tests conducted with amphipod crustaceans (*Hyalella azteca* 28-day exposures), midge larvae (*Chironomus dilutus* 10-day exposures) and freshwater mussels (*Lampsilis siliquoidea* 28-day exposures) to measure potential effects of contaminants on survival and growth. Amphipods, midge, and mussels are sensitive to many contaminants, notably metals and organic contaminants including insecticides in current use, and a number of species of freshwater mussels and fish, such as the Carolina heelsplitter (*Lasmigona decorata*), spotfin chub (*Erimonax monachus*) and Etowah darter (*Etheostoma etowahae*) are threatened or endangered in Southeastern streams (*http://www. fws.gov/endangered/*).

Continuous Monitoring— Streamflow and temperature are being monitored continuously at all 121 sites, and continuous water-quality monitoring will be employed at about 20 sites across the region. Continuous monitoring for characteristics such as the amount of dissolved oxygen in water (all 20 sites) and nitrate concentration (6 sites), in conjunction with periodic sampling of nutrients and the attached-algal biomass, can provide useful information on the effects of nutrients in streams.

Daily Pesticide Sampling—Small-volume automated pesticide samplers will be deployed at 7 urban streams to assess temporal variations in about 240 pesticides and pesticide degradation products. The samplers will collect daily and weekly composite samples, which will be analyzed by the U.S. Environmental Protection Agency (EPA), Office of Pesticide Programs. Results are expected to provide useful information for determining short-term acute exposure of aquatic organisms to pesticides and for optimizing temporal sampling strategies.

References

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Van Metre, P.C., Frey, J.W., and Tarquinio, Ellen, 2012, The Midwest Stream Quality Assessment: U.S. Geological Survey Fact Sheet 2012–3124, 2 p., available online at *http://pubs.usgs.gov/fs/2012/3124/*.

For Additional Information

Visit the NAWQA Web site to access reports, water-quality data, and maps: *http://water.usgs.gov/nawqa*

For information on the NAWQA Regional Stream Quality Assessments, visit: *http://water.usgs.gov/nawqa/studies/msqa/*

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