Water Quality Monitoring Races Natural Gas Development

This column is presented weekly by the Public Education sub-committee of the Clinton County Natural Gas Task Force in an effort to provide accurate, up-to-date information on activities surrounding the Marcellus Shale formation and the natural gas exploration industry. For more information on Task Force activities, visit the Task Force page on the Clinton County government website at www.clintoncountypa.com.

As the natural gas industry increases its activities in Pennsylvania, considerable public debate continues over the impact these efforts will have on the environment. Much of this concern focuses on water. Questions have been raised regarding water withdrawals from rivers, streams and wells, as well as how the gas drilling process might impact surface and ground water systems.

Beginning with the first European settlements, the Susquehanna River drainage basin reflects a long history of environmental degradation. Agriculture, logging, coal mining, oil and gas extraction, and urban growth have taken their toll on the commonwealth's waters. Millions of dollars and countless hours have been committed to righting the wrongs of the past, and these efforts are yielding rewards. The Susquehanna River Basin Commission's (SRBC) *2010 State of the Susquehanna Report* concludes that "… the quality of the Susquehanna watershed has been transformed in many ways, including an overall improvement in water quality and an engaged citizenry dedicated to protecting the basin's environment."

Today, at the beginning of this new, transformative period of fossil-fuel extraction in the commonwealth, a vocal citizenry expects accurate information and focused, objective analyses. Increasingly, water-quality-related resources are becoming available to the public through a broad array of outlets (e.g., Penn State Cooperative Extension offices). Scientists provide practical, pro-active steps necessary to generate valid baseline data. As a result of a clarion call from these experts, many citizens are testing their private water supplies and helping to monitor surface water quality.

In our area, one such volunteer water-quality monitoring effort began in 2010. Representatives from Lock Haven University's (LHU) geology program, the Centre County Pennsylvania Senior Environmental Corps (CCPaSEC), the Centre County Conservation District, and the Beech Creek Watershed Association met and forged a partnership to establish a baseline water-quality-monitoring program in the Beech Creek watershed in Centre and Clinton counties.

Investigators set two goals for this monitoring program: (1) identify streams where Marcellus Shale gas wells are permitted, spudded (meaning drilling has begun), or producing, and locate sampling sites upstream and downstream of those deep wells, and (2) collect monthly visual and geochemical field data and water samples for laboratory analyses from each of these sites in order to generate baseline water-quality data for each of these streams.

During field reconnaissance, both LHU faculty and CCPaSEC teams identified a total of 12 sampling sites in the Beech Creek watershed meeting these criteria. Recognizing that this watershed is heavily impacted by abandoned mine drainage (AMD), the LHU geochemist selected chemical parameters that would indicate impact to the stream's water quality from contamination by fracing, flowback, and production fluids from natural gas exploitation.

This study was conducted from May 2010 to November 2010. Throughout this period, faculty, student interns, and senior citizen teams monitored streams as the shadows of Marcellus

development lengthened. Project members conducted routine visual assessments of the streams and watersheds they monitored. Problematic impacts could include earth disturbances (e.g., possible violations of erosion and sedimentation plans); discharges and spills (e.g., foams, odors, discolored fluids, broken pipes); illegal water withdrawals; and gas leakages (suspicious bubbling).

At each of their monitoring sites, volunteers gathered water-quality data and collected water samples. CCPaSEC members received training in the use of specialized monitoring equipment, with a variety of chemical kits to measure water-quality parameters in the field, and on the precise protocols for water sampling.

The site-specific field data included measurements of the water's temperature, flow rate, pH, total dissolved solids (TDS), conductivity, dissolved oxygen (DO), and oxidation-reduction potential (ORP).

Temperature and flow rate vary seasonally.

The regional geology and source of the water determine a stream's initial pH (a measure of the water's acidity (range 0-7) or alkalinity (range 7-14) relative to neutral 7). Minor variations in pH are typical; extreme changes are unusual and therefore suspect.

TDS measures the amount of ions dissolved in water.

Conductivity, the ability of water to pass an electrical current, is directly related to TDS. Natural gas extraction and production fluids contain large volumes of natural brines from rock units at depth, proven to be several times "saltier" than average sea water. Both of these measures are sensitive to salinity and are therefore key parameters to use in this monitoring effort.

DO concentration, one of the most important parameters, provides aquatic life with necessary oxygen. And, ORP is a measure of chemical interactions and therefore ecologic health in streams. Like proverbial canaries in coal mines, both parameters are sensitive to changes in water chemistry and will be adversely affected by fluids derived from natural gas drilling and production.

Once collected, water samples were kept in iced coolers and carried to LHU's geochemical laboratory where student interns analyzed them under faculty supervision. Laboratory analyses yielded data on many parameters including: barium, calcium, copper, chloride, iron, magnesium, manganese, and sulfate. These chemicals, among others, commonly occur in oil- and gas-field brines. Suffice it to say that concentrations of these parameters exceeding a site's baseline dataset would initiate more intense sampling and a call for action.

Preliminary results indicate no apparent adverse impact on water quality in streams sampled during this past summer. Clearly, this was a modest attempt to assess water quality throughout the Beech Creek watershed. However, the prospects for additional funding to continue and possibly expand this monitoring project appear bright. Currently, planning is underway to increase the number of sample sites, add parameters to the list, and solicit and train more volunteers.

This Beech Creek watershed study is one of many underway in the state. Across the commonwealth, numerous groups, agencies, organizations, and individuals are assisting in the effort to help assure the preservation of our natural resources. Many are focusing on water: safeguarding drinking water; preserving, protecting, and restoring rivers, streams, lakes, and wetlands; and promoting responsible stewardship of these indispensable, life-giving resources.

The Susquehanna River Basin Commission (SRBC) is currently implementing a monitoring network that continuously measures and reports water quality conditions of smaller rivers and

streams located in northern tier Pennsylvania and southern tier New York. These data help agency officials track existing water quality conditions and any changes in them on an ongoing, real-time basis. The stations are operating in areas where drilling in the Marcellus Shale is most active, as well as other locations where no drilling activities are planned so SRBC can collect control-data.

The SRBC's monitoring network provides constant data collection with instruments sensitive enough to detect subtle changes in water quality on a frequency that will allow background conditions and any changes to them to be documented throughout the year. The following five water quality parameters are being measured at each station: temperature, pH, conductance, dissolved oxygen, and turbidity.

Recognizing that governmental agencies charged with environmental oversight have limited manpower and resources, individuals and watchdog groups are stepping forward to take action. Not only do these additional eyes and ears on the ground provide important field surveillance assistance, but individuals trained to use basic monitoring equipment can generate valuable preliminary water-quality data. Establishing these benchmark datasets document the status of water quality prior to drilling. Any subsequent changes in the test parameters raise red flags and signal the need for immediate, more intensive data collection and analyses.

What can you do? Consider serving as a volunteer monitor and collaborator. We encourage interested individuals, groups, and organizations to contact us for further information about local water-quality monitoring efforts.

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Lock Haven University students collect a stream sample for water-quality testing along the Middle Branch of Big Run in the Beech Creek watershed.

Volunteers from the Beech Creek Watershed Association, Lock Haven University, the Centre County Conservation District and the Centre County PA Senior Environmental Corps join this proactive monitoring initiative to collect water samples at Monument Run, Beech Creek watershed.

Volunteers from the Centre County Pennsylvania Senior Environmental Corps prepare to take a flow measurement in Hayes Run as part of this Beech Creek watershed water-quality monitoring project.