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PROJECT SPOTLIGHT

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Monitoring of both land treatment and water quality is necessary to document the effectiveness of nonpoint source pollution controls in restoring water quality. The Section 319 National Monitoring Program, administered by the U.S. Environmental Protection Agency, is designed to support watershed projects throughout the country that meet a minimum set of project planning, implementation, monitoring, and evaluation requirements. The requirements are designed to lead to successful documentation of project effectiveness with respect to water quality protection or improvement. The National Monitoring Program projects comprise a small subset of nonpoint source control projects funded under Section 319 of the Clean Water Act Amendments of 1987.

Swatara Creek Watershed (Pennsylvania) Section 319 National Monitoring Program Project

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Project Synopsis

Coal mine drainage (CMD) from abandoned mines has affected more than 2,400 miles of streams and associated ground water in Pennsylvania. Approximately half the discharges from bituminous and anthracite coal mines in Pennsylvania are acidic, having pH <5. Acidic CMD typically contains elevated concentrations of dissolved sulfate (SO_4^{2-}), dissolved and particulate iron (Fe), and other metals produced by the oxidation of pyrite (FeS_2). Elevated concentrations of sulfate and metals in mine drainage and receiving streams make the water unfit for most uses. Such is the case for the northern Swatara Creek watershed, which occupies a 43-mi² area in the headwaters of the 576-mi² Swatara Creek Basin in Schuylkill, Lebanon, Berks, and Dauphin Counties, Pennsylvania (see Figures). The mining of coal

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in the watershed has had a significant effect on watershed hydrology, affecting both the flow and quality of surface and ground water.

CMD is the leading cause of degraded water quality in the Swatara Creek Basin, impairing uses of Swatara Creek to its mouth on the Susquehanna River 70 miles downstream from the mined area in the Southern Anthracite Coalfield. Acidity and high levels of sulfate and metals have created conditions that are toxic to some aquatic organisms. Conse-

quently, the Swatara Creek Basin is designated as a “high priority watershed” for reducing nonpoint-source pollution. The Pennsylvania Department of Environmental Protection (PaDEP), Bureau of Mining and Reclamation (BMR) has recently developed a watershed remediation plan to improve water quality and restore the streams in the northern Swatara Creek Basin to recreational and fishable waters.

Although several surface and underground anthracite mines are presently active, most mines in the Swatara Creek Basin were abandoned before 1960. Barren, steep banks of spoil and culm and fine coal debris in siltation basins are sources of sediment (suspended solids), sulfate, iron, aluminum, and other metals in water that infiltrate or run off the surface during storms. The abandoned underground mines have flooded and collapsed locally causing subsidence. Surface flow is diverted through subsidence pits, fractures, and mine openings to the underground mines where the water becomes contaminated with acidity, sulfate, and metals. In downstream reaches, the contaminated water resurges as CMD contaminating Swatara Creek and its tributaries, while contributing substantially to baseflow.

A substantial proportion of the total streamflow of Swatara Creek originates as CMD. This source is most important during baseflow conditions. In contrast, during stormflow conditions, as much as 95 percent of the total streamflow for Swatara Creek at Ravine (at the base of the northern Swatara Creek watershed, see Figure 2) originates as surface runoff. The surface runoff typically has lower pH and lower concentrations of dissolved solids than the baseflow at Ravine.

To neutralize the acidic CMD and reduce the transport of dissolved metals in the Swatara Creek watershed, innovative passive-treatment systems are being implemented and monitored in the 43 mi² northern Swatara Creek Basin. These treatments systems include limestone-sand dosing, open limestone channels, anoxic and oxic limestone drains, limestone diversion wells, and limestone-based wetlands. The performance of the treatment systems is being evaluated using upstream/downstream and before/after monitoring schemes.

The Swatara Creek Project project was accepted by the U.S. Environmental Protection Agency into the Section 319 National Monitoring Program in the Fall of 1998; however, the project had been ongoing since 1995 with partial funding through PA 319 and 104(b)3 programs. The primary investigator for the study is USGS. Collaborators include PaDEP, Schuylkill County and US Department of Energy. USGS provides half the project funding, which is matched by PaDEP, PaDCNR and Schuylkill County.

The Watershed

Current land use in the northern Swatara Creek watershed is classified as 86.6% forested and 4.9% agricultural, with only

EDITOR'S NOTE

In this issue of *NWQEP NOTES*, our feature article describes one of two projects in Pennsylvania which recently were accepted to EPA's Section 319 National Monitoring Program (NMP). NMP projects typically focus on nutrient and sediment impacts associated with agricultural or urban land uses. The Swatara Creek project is unique in its focus on mining and coal mine drainage, which impaired surface and ground waters through acidity, sulfate and metals contamination. Innovative passive limestone treatment systems are being implemented and evaluated.

As a reminder, to those who haven't yet filled out our Reader's Survey, please take a few moments to do so. The survey can either be found in our previous issue of *NWQEP NOTES* or on our website at <http://www.bae.ncsu.edu/bae/programs/extension/wqg>. We greatly appreciate your input.

In addition, I would like to direct our readers' attention to the Call for Papers on page 9 of this newsletter, for the 8th National Nonpoint Source Monitoring Workshop, to be held September 11-14, 2000 in Hartford, Connecticut. This annual conference highlights progress of EPA's NMP projects as well as other watershed projects. The 2000 conference will focus on urban water quality impacts. **Abstracts will be accepted through February 29, 2000.**

As always, please feel free to contact me regarding your ideas, suggestions, and possible contributions to this newsletter.

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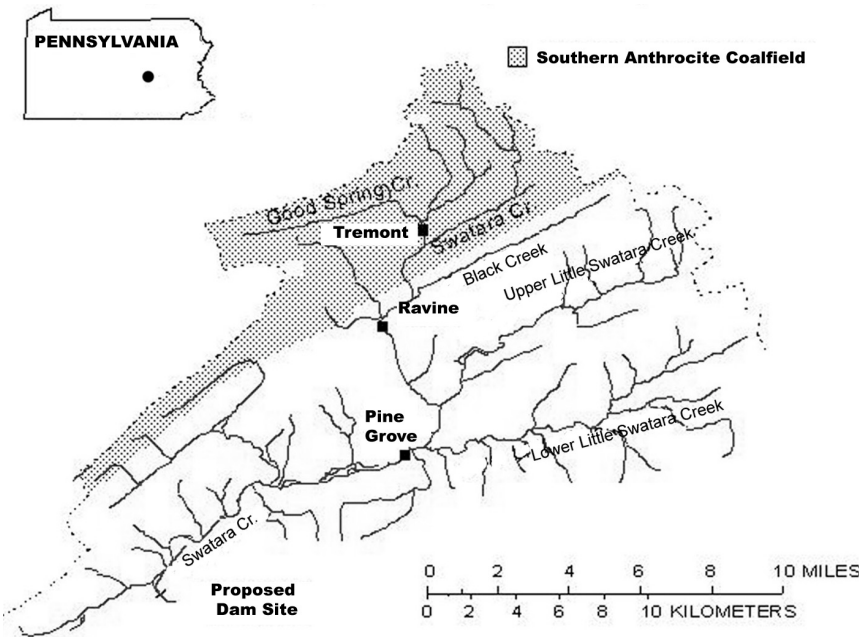


Figure 1. Swatara Creek Watershed (above proposed dam site). The Northern Swatara Creek basin is contained within the Southern Anthracite Coal Field.

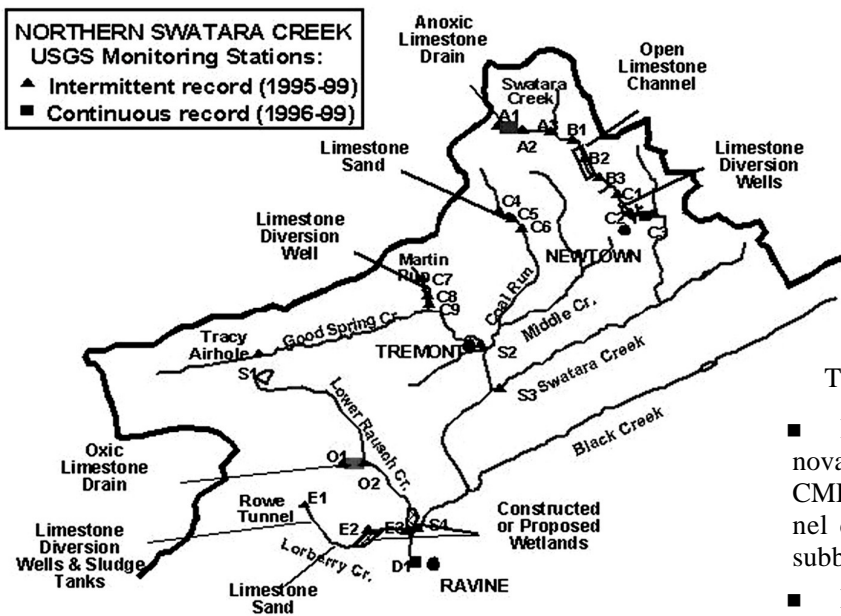


Figure 2. Northern Swatara Creek Watershed: Coal mine drainage treatment systems and monitoring stations within the Southern Anthracite Coalfield.

put-and-take trout waters. The streams will discharge to a proposed 775-acre water-supply reservoir located in Swatara State Park. The reservoir, proposed for construction in 2000, will support recreational activities as well, including boating, fishing, and swimming. The water quality of source streams must be improved for the proposed reservoir to support all its designated uses.

Project Time Frame

1998 - 2001

Pre-Project Water Quality

Water quality data collected at 49 stations from previous investigations were used to help document stream conditions and identify problem areas prior to installation of passive treatment systems. Data from these previous investigations included analysis of typical CMD; metals, major ions, acidity, and alkalinity. The data indicated that a substantial proportion of the total streamflow originates as CMD. The majority of the *aluminum* load to the stream originates from the eastern areas of the watershed near Newtown. The majority of the *iron* load originates from western areas of the watershed, including the Rowe Tunnel and Tracy Airhole, which are significant sources of water to Lorberrry Creek and Good Spring Creek, respectively (see Figure 2).

Water Quality Objectives

The objectives of the project are:

- Design, install, and evaluate the performance of innovative passive-treatment systems for neutralization of CMD and removal of iron from an anthracite mine-tunnel discharge feeding the 4.01 mi² Lorberrry Creek subbasin.
- Evaluate the long-term effects on stream water quality from a combination of limestone passive-treatment systems designed to neutralize CMD and remove aluminum in a 2.8 mi² headwaters area of Swatara Creek, above Newtown.
- Determine the long-term cumulative effects of a variety of CMD treatments on stream water quality resulting from the remediation of approximately 25 miles (67 percent) of degraded streams in the coalfields of the 43 mi² northern Swatara Creek watershed.

Nonpoint Source Control Strategy

Nonpoint source controls in the Northern Swatara Creek watershed are focused in the headwaters and further downstream in the Lorberrry Creek subbasin.

6.4% classified as barren, mined; however, the land-use classification for this extensively mined area is misleading because underground mines extend beneath much of the surface and "natural" reforestation conceals large tracts of unreclaimed spoil. Agricultural development predominates downstream from the mined area.

The northern Swatara Creek watershed contains approximately 37 miles of cold-water streams, some which are managed by the Pennsylvania Fish and Boat Commission as

During 1996, BMR and volunteers constructed five limestone-based passive-treatment systems with technical assistance from the USGS to begin the cleanup of several major pollution sources in the headwaters of Swatara Creek. These treatment systems included limestone sand dosing, open limestone channels, limestone drains, and limestone diversion wells, with the intent to raise the pH and alkalinity, and facilitate the precipitation of dissolved iron, aluminum, and associated metals. Each passive treatment system has different advantages and disadvantages; however, all suffer from possible complications associated with variability in flow rates, chemistry of the CMD and stream water, and from uncertainties about efficiency and longevity of the treatments. An evaluation of chemical and physical factors affecting reactions within passive treatment systems is needed to resolve uncertainties about the optimum designs and appropriate uses of these systems.

Limestone sand dosing and *open limestone channels* are the simplest treatment systems where limestone fragments are added directly to the stream channel semi-annually or less frequently. Concerns with these treatments include slow dissolution rates, armoring, burial, and transport of limestone from the channel during high flows. A *limestone drain* is another relatively simple treatment method, which involves the burial of limestone in airtight trenches that intercept acidic discharge water. Keeping carbon dioxide within the drain can enhance limestone dissolution and alkalinity production. Furthermore, keeping oxygen out of contact with the discharge water minimizes the potential for oxidation of dissolved iron and the consequent precipitation of solid iron hydroxide [$\text{Fe}(\text{OH})_3$], which could armor the limestone and clog the drains. In a *limestone diversion well*, acidic water is diverted from upstream points and the hydraulic force of the piped flow is deflected upward through limestone fragments inside 4-ft diameter “wells.” Hydraulic churning abrades the limestone, forming fine particles and preventing the buildup of hydroxide armoring.

In the Lorberry Creek subbasin, results from monitoring and dosing field tests (which are ongoing) will be used to design a large-scale passive-treatment system to neutralize the CMD and reduce the iron loads to Lorberry Creek. A combination of underground and above ground treatment alternatives will be considered. The combination will include physical, chemical, and biological treatments. Examples of potential underground treatments include fly ash or limestone injection and aeration; while above ground treatments may include diversion wells, settling ponds, wetlands, clarifiers, and biological treatment. During the spring of 1999, two limestone diversion wells and three sludge removal tanks were installed in an effort to evaluate different pilot-scale techniques for promoting the oxidation and removal of iron from Lorberry Creek and receiving water bodies.

Water Quality Monitoring

Monitoring is critical in evaluating the overall success of watershed-scale implementation of nonpoint source pollution controls within the Swatara Creek watershed.

A combination of upstream-downstream and before-after sampling schemes is being utilized within the northern Swatara Creek watershed. Within stream reaches where passive treatment systems have been established, upstream and downstream monitoring stations have been installed to evaluate the effectiveness of these treatment alternatives. Monitoring stations have also been established on streams within the project area where treatment systems will be implemented in the future. Samples collected from these stations before the implementation of BMPs will be used to assess existing water quality conditions and determine appropriate treatment designs. After treatment systems have been installed, samples will continue to be collected to assess changes in water quality over time due to BMP implementation.

To characterize untreated mine drainage and treatment-system performance, data on flow rate and water quality at 54 stations in the Swatara Creek Basin are collected during base-flow and stormflow.

Three USGS streamflow gages on Swatara Creek at Newtown (upstream), Ravine (midstream, draining the coalfield) and Pine Grove (downstream) are used as continuous streamflow and water-quality monitoring stations. These three stations are sampled periodically by the USGS to document and evaluate both the efficiency of a combination of limestone passive-treatment systems and the long-term water quality changes in the Swatara Creek watershed that result from upstream coal-mine discharges and CMD remediation.

At the upstream (Newtown) and midstream (Ravine) USGS gages, water-quality samples have been collected monthly for base flow, approximately quarterly for stormflow, and annually for biological data as part of this project. Sampling will determine the long-term cumulative effects from a variety of treatments of CMD discharges from degraded streams in the coalfields of the northern Swatara Creek subbasin. Stormflow samples are collected using automatic pumping samplers. Annual load and trends in transport of suspended sediments, sulfate, metals, and nutrients will be estimated using a multivariate regression model. Data for continuous water-quality and flow records at the Ravine and Newtown stations will be compared with data for synoptic base-flow and high-flow samples to verify that samples represent the range of flow and water-quality conditions. Statistical methods will be used to characterize the flow and water-quality data and to determine intercorrelations among the hydrological and chemical variables.

Water quality for Lorberry Creek is being evaluated using continuous water-quality monitoring stations, monthly water-quality sampling, and annual fish and benthic macroinvertebrate sampling. Continuous water-quality monitors have been installed above and below the pilot-scale treatments and at a downstream location. The downstream station also includes flow measurements that will be correlated with long-term flow measured at a continuous streamflow record gaging station at the Rowe Tunnel entrance.

Concurrent with water-quality sampling, measurements of streamflow, temperature, pH, specific conductance (SC), dissolved oxygen (DO), redox potential (Eh), acidity, and alkalinity are conducted by USGS. Water-quality samples are analyzed for major ions and metals in filtered and whole-water fractions by the PaDEP Bureau of Laboratories facility in Harrisburg. In addition to the synoptic sampling, flow rates, temperature, pH, and SC are continuously monitored at the Ravine and Newtown gage stations by the USGS for the three years after BMP implementation (1998-2000). Statistical correlations will determine if SC and pH can be used as surrogates for laboratory chemical measurements of sulfate, metals, acidity, and alkalinity.

Findings to Date

Preliminary results indicate that the constructed treatment systems installed in the headwaters of Swatara Creek in 1996 and 1997 function well during baseflow conditions. The anoxic limestone drain has the greatest benefit, producing significant improvement in pH and alkalinity that are measurable several miles downstream. The diversion wells have greatest potential to treat stormflow, which generally is more acidic than baseflow; however, these systems require maintenance to ensure that they contain sufficient limestone through the duration of a stormflow event and that they do not become clogged with leaves and other debris. At near-neutral pH, the transport of dissolved iron, aluminum, and trace metals including cobalt, copper, lead, and zinc typically is attenuated due to precipitation and adsorption. Nevertheless, substantial transport of dissolved and suspended metals persists in Swatara Creek because of the accumulation of $\text{Fe}(\text{OH})_3$, $\text{Al}(\text{OH})_3$, and associated materials within the streambed during baseflow, and the scour and transport of accumulated metal-rich streambed deposits during the rising stage of stormflow events.

Biological sampling indicates that the stream ecology of Swatara Creek is recovering. The number of fish species at Ravine has increased from 0 in 1985 to 21 in 1999. However, the situation is complicated by metals accumulation in fish tissue. Concerns over acute toxicity have now shifted to chronic toxicity, as the potential for release of metals into solution from streambed sediments continues.

Information, Education, and Publicity

The project will document: 1) the surface-water quality of Swatara Creek and its tributaries within and downstream from the Southern Anthracite Coalfield, 2) aquatic habitat recovery and biological diversity in reaches downstream from treatment, and 3) the operational performance of the treatment systems. Knowledge about factors affecting the performance of passive treatment systems in CMD environments will help in designing cost-effective treatment systems for a variety of situations. The information and technology will be immediately transferable to groups such as the Eastern Coalition for Abandoned Mine Reclamation to treat 50 to 100 additional mine pools located in the anthracite region. This group would benefit from the fact that several treatment scenarios and a wide range of flow-rate and water-quality conditions will be studied at Swatara Creek. Project results will be applicable to natural and man-made hydrologic systems in which limestone is an important reactant, particularly with respect to neutralization of acidic surface water or ground water.

Documentation of progress is ongoing, and will be distributed to interested groups, local and national. Information of particular interest to local groups includes the methodology used in improving surface-water quality within the watershed (degree of success with treatment systems), remediation of aquatic habitat and biological diversity both within and downstream of the affected area, and the project's extensive degree of flow-rate and water-quality studies. Data will be published annually, and a final interpretive report will be published in 2001. Preliminary results will be presented annually at the National Monitoring Program workshop.

The Schuylkill County Conservation District (SCCD) has been the main coordinator in constructing the abatement measures for the mine drainage pollution, as well as nutrient management and stream-bank stabilization in the farming areas. The SCCD has helped local citizens organize the Northern Swatara Creek Watershed Association to implement passive-treatment and surface-stabilization projects to clean up the coal-mine pollution in the northern portion of the watershed. The Swatara Creek Watershed Association, a separate organization, has worked hand-in-hand with the Concerned Citizens for Clean Water, and has focused its efforts in the past in Lebanon County and the lower part of the watershed. Other local groups assisting with the project include Schuylkill County, fishing and sportsman's groups, and, in particular, the county's Waste Management Coordinator, who has been instrumental in seeking funding for stream improvement projects. Local industries have also been supportive of the project. Coal companies and limestone quarries have donated supplies and services in the cleanup effort.

For Further Information

Administration/General Information about the Project

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detecting water quality change, livestock exclusion, BMP evaluation, the Morro Bay National Estuary Program, and TMDLs. Two field trips were offered – a half-day tour of Montana de Oro State Park, and a full-day tour of the Morro Bay NMP Project watershed, which focused on rangeland management practices, riparian area and floodplain restoration, water quality monitoring in a “paired watershed” design, and environmental education.

Other conference activities included a kayak tour of Morro Bay, a barbecue sponsored by Friends of the Estuary at Morro Bay, a Morro Bay Harbor cruise, and a visit to historic San Luis Obispo’s Farmer’s Market.

The workshop was hosted by the Morro Bay National Monitoring Program, the Central Coast Regional Water Quality Control Board and California Polytechnic State University. Sponsors include Friends of the Estuary at Morro Bay, Morro Bay National Estuary Program, North Carolina State University, U.S. Environmental Protection Agency, the City of Morro Bay, University of California Cooperative Extension, University of Illinois, Duke Energy and Pacific Gas & Electric.

Thanks to Katie Kropp of the Central Coast Regional Water Quality Control Board and Chair of the conference steering committee, and to the rest of the steering committee members, workshop hosts and sponsors for putting together a successful event. Next year’s Nonpoint Source Monitoring Workshop will be held in Hartford, CT on September 11-14, 2000, and will focus on monitoring and modeling nonpoint source pollution in the rural-urban interface.

CONFERENCE REPORTS

7th National Nonpoint Source Monitoring Workshop

The 7th National Nonpoint Source Monitoring Workshop was held September 13-17, 1999 in Morro Bay, California. Over 200 attendees participated in this event, representing Federal, State and local government agencies, non-profit groups, academia, consulting firms and private companies.

The goal of this annual conference is to bring together land managers and water quality specialists to share information on monitoring and evaluating the effectiveness of Best Management Practices (BMPs) in improving water and habitat quality. The workshops typically focus on progress made and lessons learned from Section 319 National Monitoring Program (NMP) projects, but other nonpoint source watershed projects are also represented.

The conference theme was linking water and habitat improvements to land treatment. The conference brought in six plenary speakers and included break-out sessions on pollutant load estimation, stream restoration, statistical approaches for

2nd National Small Farm Conference

Over seven hundred participants, made up of key representatives of agencies and institutions who work with small family farmers and ranchers on a daily basis, attended the 2nd National Small Farm Conference during October 12-15, 1999 in St. Louis, Missouri. The conference was built on the foundation laid by the 1st National Small Farm Conference in 1996. It was designed to fulfill some of the National Small Farm Commission recommendations, specifically the need for land-grant colleges and universities, community-based organizations, foundations, and others, to provide more market development education and technical and production assistance to small farmers and ranchers through the exploration of new marketing avenues, like direct farm-to-consumer markets, local value-added processing, and farmer-owned cooperatives.

Another purpose of the conference was to develop closer partnerships between service providers to the small farm and ranch community among community-based organizations, land-grant university, federal, state, and local service providers, and leaders in farming and ranching communities. Enthusiasm was high among participants who included ranchers, small farm community leaders, Extension agents and

educators, representatives of federal, state, and local agencies, outreach personnel, and community-based organization staff. One hundred and sixty-six speakers, made up of farmers, ranchers, community leaders, scientists, Extension agents and administrators, and USDA personnel at all levels, represented a broad spectrum of ideas and expertise in 3 plenary sessions and 35 break-out sessions. Session content exposed participants to different models of small farm and ranch activities that work well in different areas of the country so they could decide to apply a model, where applicable, to their customers. Models included on-farm research, livestock alternatives for small farms or ranches, farmer-to-farmer networks, and collaboration building between local, land-grant institution, and other state and federal agencies.

Outcomes included plans to establish national and regional small farm databases and other networking formats to better exchange information about marketing strategies, value-added enterprises, meeting the needs of underserved clients, building institutional capacity to serve small farmers and ranchers, grant writing, business and entrepreneurial skills, and farmer-to-farmer and beginning-farmer programs. The conference was sponsored by USDA agencies, W. Kellogg Foundation, the Farm Foundation, and EPA. For additional information, contact USDA/CSREES National Program Leader for Small Farms, Dr. Denis Ebodaghe at (202) 401-4385.

—contributed by Stephanie Olson, CSREES
Small Farm Program, (202) 401-6544

WEB RESOURCES

Water Science for Schools

The U.S. Geological Survey has a Web site “Water Science for Schools,” which offers information on the many aspects of water, along with pictures, data, maps, and an interactive center where you can give opinions and test your water knowledge. The web address is <http://water.usgs.gov/drop-let>

INFORMATION

Guidance for Developing Nutrient Water Quality Criteria

EPA’s Office of Water has released drafts of guidance documents describing techniques for developing ecoregion-specific nutrient criteria for use in state and tribal water quality standards for lakes/reservoirs and rivers/streams. Comments on the draft documents are currently being accepted. The documents can be found on the web at <http://www.epa.gov/ost/standards/guidance>

Report on the Condition of U.S. Ecosystems Released

The prototype version of a USDA-led effort to develop a report on the condition of the nation’s ecosystems (covering crop, forest and coastal ecosystems) has now been released for public comment by the John Heinz III Center for Science, Economics and the Environment. Provision for making comments has been placed on the report home page. It is available on the web at <http://www.us-ecosystems.org/>

EPA Sets Up National Drinking Water Contaminant Occurrence Database

As a drinking water public right-to-know initiative, EPA has set up a National Drinking Water Contaminant Occurrence Database, containing information on regulated and unregulated contaminants in public drinking water systems and their source water supplies. The database, accessible through the Internet, will continue to be upgraded to provide current data on contaminants in drinking water. EPA believes the public should use this data cautiously since many of the contaminants occur below health effects or regulatory levels or are rarely found. The database is available at <http://www.epa.gov/ncod>. The general public can get additional information from EPA’s drinking water Web site at <http://www.epa.gov/safewater>, or by calling EPA’s drinking water hotline at 1-800-426-4791.

EPA Updates Annual List of Fish Advisories and Makes Advisories Available on the Internet

As part of the Administration’s right-to-know initiative, EPA is making it easier for the public to find out if the fish they catch is safe to eat. Local fish consumption warnings on any river, lake or stream can now be checked through EPA’s national list of fish advisories at: <http://www.epa.gov/ost/fish>. Each year, states and tribes provide EPA with a list of fish advisories they have issued. This information is compiled into a national listing of fish advisories and, for the first time, is now searchable on line. The advisories apply primarily to non-commercial fish and shellfish obtained through sport, recreation and subsistence activities.

A fact sheet with additional information is available at <http://www.epa.gov/ost/fish> or by calling EPA’s Fish Contamination Program at 202-260-1305. Those persons without Internet access may obtain a copy of the National Listing of Fish and Wildlife Advisories by calling the National Service Center for Environmental Publications at 1-800-490-9198.

USGS Report on Pesticide and Nutrient Patterns

The US Geological Survey released a report that calls for taking into account seasonal patterns of pesticide and nutrient concentrations, the detection of pesticide breakdown products, and interactions among different segments of the water system. The report, titled "The Quality of Our Nation's Waters, Nutrients and Pesticides," is available at <http://water.usgs.gov/pubs/circ/circ1225>

ANNOUNCEMENTS

NCSU Water Quality Group Staff Changes

We would like to extend our farewell to Terry Pollard, who worked as a Program Assistant with the NCSU Water Quality Group for the past year. Terry accepted a position as an English instructor at Central Carolina Community College in Sanford, NC, effective August 1999. He is teaching English composition, Professional Report and Research Writing, Argument-Based Research, and Humanities classes.

Terry made significant contributions to the efforts of the NCSU Water Quality Group. He served as office manager, editor, desktop publisher for all Group publications, and webmaster for the Group website. We are happy Terry found a position in his field and wish him the very best in his new job.

MEETINGS

Call For Papers

Atmospheric, Surface and Subsurface Hydrology and Interactions: November 5-8, 2000, Research Triangle Park, NC. For details on this international conference sponsored by The American Institute of Hydrology, visit the website <http://www2.ncsu.edu/ncsu/CIL/WRRRI/aihconf.html>

Ground Water: A Transboundary, Strategic and Geopolitical Resource: December 13-16, 2000, Las Vegas, Nevada. This conference, sponsored by the Assn. of Ground Water Scientists & Engineers Technical Program, will explore the technical, cultural, legal, economic, military, social and political facets of ground water as a transboundary, strategic and geopolitical resource. "Transbound-ary ground water" is broadly defined as ground water that moves across the boundary between any two or more political jurisdictions, be they states, counties, municipalities, provinces, government reservations, irrigation or conservancy districts, Indian reservations, etc.

A formal Call for Abstracts will be forthcoming. Individuals and organizations who wish to submit abstracts, or sponsor sessions, symposia or panel discussions, should contact Michael E. Campana, Chair, Tel: 505-277-3269, Fax: 505-277-3269, email: aquadoc@unm.edu, website: <http://www.ngwa.org>.

Meeting Announcements — 2000

JANUARY

4th International Conference on Diffuse Pollution: Jan 16-20, Bangkok, Thailand. International Association on Water Quality. Department of Land Development, Phaholyothin Road, Chatuchak, Bangkok 10900, Thailand, Tel: 662-579-0111 ext. 1386, Fax: 662-562-0732, email: idd@mozart.inet.co.th, website: <http://www.idd.go.th/iawq.htm>. In North America, contact Dr. Mike Burkart, USDA, at burkart@nsl.gov for information.

FEBRUARY

Tools for Urban Water Resource Management and Protection: Feb 7-10, Chicago, IL. Contact Bob Kirschner, Natural Resources Department, Northeastern Illinois Planning Commission, 222 S. Riverside Plaza, Suite 1800, Chicago, Illinois, 60606; Tel: 312-454-0401, ext. 303, Fax: 312-454-0411, email: bobkirs@nipc.org

MARCH

Agriculture and the Environment: A wake-up call for Iowans, Water Quality Conference 2000: Mar 7-8, Ames, IA. Web site: http://extension.agron.iastate.edu/aged/water_quality/wqconf.html

Protecting Lakes and Watersheds: Innovative Solutions to Point and Non-Point Source Pollution: Mar 22-25, Columbus, GA. NALMS: 9TH Annual Southeastern Lakes Management Conference. Contact Marty Williams, Wilcom Enterprises, 171 Sumter Dr., Marietta, GA 30066, Tel: 770-427-8794, email: wilcom1@juno.com, web: <http://www.nalms.org/indexf.htm>

APRIL

Management of Swine and Poultry Waste: Apr 18-19, Jackson, MS. Web site <http://www.msstate.ars.usda.gov/1stcall.htm>

MAY

Second National Extension Natural Resources Conference – Excellence through Partnerships: May 16-18, South Lake Tahoe, NV. Contact Larry Biles, USDA/CSREES/NRE, Stop 2210, Suite 821, Aerospace Center, Washington, DC 20250-2210, Tel: 202-401-4926, email: lbiles@reusda.gov

JUNE

2000 Nutrient Management and Water Quality in Southeast United States Symposium: Problems and Solutions: Jun 4-6, Tallahassee, FL. Contact Dr. O. S. Mbuya, 119 Perry Paige Bldg., Center for Water Quality, Florida A&M University, Tallahassee, FL 32307-4100. Fax: 850-561-2221, email: ombuya@famuedu

Management Information Systems 2000 – Incorporating GIS and Remote Sensing: Jun 14-16, Lisbon, Portugal. Second International Conference. Contact Gabriella Cossutta, Conference Secretariat, Wessex Institute of Technology, UK, email: gcosutta@wessex.ac.uk

JULY

5th International Conference on Precision Agriculture and Other Precision Resources Management: Jul 16-19, Bloomington, MN. Contact Mary Kay Ferguson, Tel: 612-625-8215 or 800-367-5363, ext. 58215, Fax: 612-624-9221, email: mferguson@extension.umn.edu, web site: <http://www.precision.agri.umn.edu/2kconf>

Living Downstream in the Next Millennium: Reconciling Watershed Concerns with Basin Management. Universities Council on Water Resources Annual Meeting: Jul 31-Aug 4, New Orleans, LA. Contact Jeffery A. Ballweber, Water Resources Policy Analyst, Water Resources Research Institute, PO Box AD, Mississippi State, MS 39762. Tel: 662-325-3620, Fax: 662-325-3621, email: ballweber@engr.msstate.edu

AUGUST

The Millennium Wetland Event: Aug 6-12, Quebec City, Canada. Contact Ms. Elizabeth MacKay, Millennium Wetland Event Secretariat, Bureau 620, Le Delta II, 2875, boulevard Laurier, Ste-Foy, Québec, Canada G1V 2M2, Tel: 418-657-3853, Fax: 418-657-7934, email: cqvb@cqvb.qc.ca, web site: <http://www.cqvb.qc.ca/wetland2000/>

International Conference on Riparian Ecology and Management in Multi-Land Use Watersheds: Aug 27-31, Portland, OR. American Water Resources Association. Contact Mike Kowalski, AWRA Director of Operations, 4 West Federal Street, P.O. Box 1626, Middleburg, VA 20118-1626. Tel: 540-687-8390, Fax: 540-687-8395, email: mike@awra.org, web site: <http://www.awra.org/meetings/Portland/Portland.html>

SEPTEMBER

8th National Nonpoint Source Monitoring Workshop: Monitoring and Modeling Nonpoint Source Pollution in the Rural-Urban Interface: Sept 11-14, Hartford, CT. Contact John Clausen, University of Connecticut, Dept. of Natural Resources Mgt. & Engineering, 1376 Storrs Rd., U-4087, Storrs, CT 06269-4087. Tel: 860-486-2840, Fax: 860-486-5408, email: jclausen@canr.uconn.edu, web site: <http://www.ce.uconn.edu/nps.html>

Coastal Environment 2000 – Environmental Problems in Coastal Regions, Third International Conference: Sept 18-20, Las Palmas de Gran Canaria, Spain. Contact Sally Walsh, Conference Secretariat, Wessex Institute of Technology, Ashurst Lodge, Ashurst, Southampton, SO40 7AA, UK. Tel: + 44 (0) 238 029 3223, Fax: + 44 (0) 238 029 2853, email: slwalsh@wessex.ac.uk

NOVEMBER

International Conference on Atmospheric, Surface and Sub-surface Hydrology and Interactions: Nov 5-8, Research Triangle Park, NC. Sponsored by the American Institute of Hydrology. For details visit web site: <http://www2.ncsu.edu/ncsu/CIL/WRRI/aihconf.html>

Meeting Announcements — 2001

JANUARY

International Symposium on Integrated Decision-Making for Watershed Management: Jan 7-9, Chevy Chase, MD. Contact Dr. Darrell Bosch at Tel: 540-231-5265, email: bosch@vt.edu, web site: <http://www.conted.vt.edu/watershed.htm>



CALL FOR PAPERS/POSTERS

**8th National Nonpoint Source Monitoring Workshop
Monitoring and Modeling Nonpoint Source Pollution
in the Rural-Urban Interface**

September 11-14, 2000
Hartford, Connecticut

This workshop will bring together land managers and water quality specialists to share information on the effectiveness of best management practices in improving water quality, effective monitoring techniques, and statistical analysis of watershed data. The workshop will focus on the successes of Section 319 National Monitoring Program projects from throughout the United States as well as other innovative projects. Urban water quality impacts will be emphasized.

The agenda will include three days of indoor workshop sessions/presentations and a one-day field trip. A half-day workshop will focus on hands-on statistical analysis of project data. Presentations will be 20 minutes, followed by 10 minutes for discussion. Poster presentations are also encouraged. Presenters will submit a paper due the date of the conference for publication by the U.S. EPA-Office of Research and Development. Poster presenters may also submit a paper.

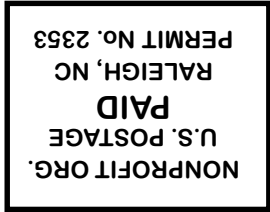
Presentations should focus on one of the following session topics: Detecting change in habitat and water quality from BMP implementation; Modeling applications of nonpoint source pollution; Application of National Monitoring Program data in TMDLs; Volunteer monitoring in Section 319 projects; Urban nonpoint source pollution and BMPs. Deadline for submission of abstracts is **February 29, 2000.**

Format: Abstracts are limited to 1 page, single spaced (or 300 words). Indicate your affiliation, session topic selected, and whether presentation will be oral or poster. Include phone, fax, and email with your mailing address. Submission of abstracts via e-mail or workshop website is encouraged. Preferred format is a MS Word or Text file.

Review and notification: Authors will be notified of receipt of their abstract. The workshop program committee will review abstracts. Accepted abstracts will be published in the workshop program. Authors will be notified by April 28, 2000 regarding the status of their abstract. Depending on space, some oral presenters may be asked to present posters. Publication specifications will then be sent to authors presenting papers. **Poster and paper presenters will be responsible for travel and registration costs.**

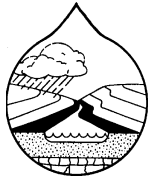
Submit abstracts to:

- Nonpoint source workshop web site:
www.ce.uconn.edu/nps.html
- Email: jclausen@canr.uconn.edu
- Mail (disk preferred):
Nonpoint Source Workshop
John C. Clausen
University of Connecticut
Dept. of Natural Resources Mgt. & Engineering
1376 Storrs Rd., U-4087
Storrs, CT 06269-4087



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Web Site: <http://www.bae.ncsu.edu/bae/programs/extension/wqg>

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