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Projects of
Excellence
National Water Program



Applying knowledge to improve water quality

National Water Program

A Partnership of USDA NIFA
& Land Grant Colleges and Universities



A network that responds to water resource issues by advancing knowledge through research, education and Extension projects.

The
Land-Grant
University
System

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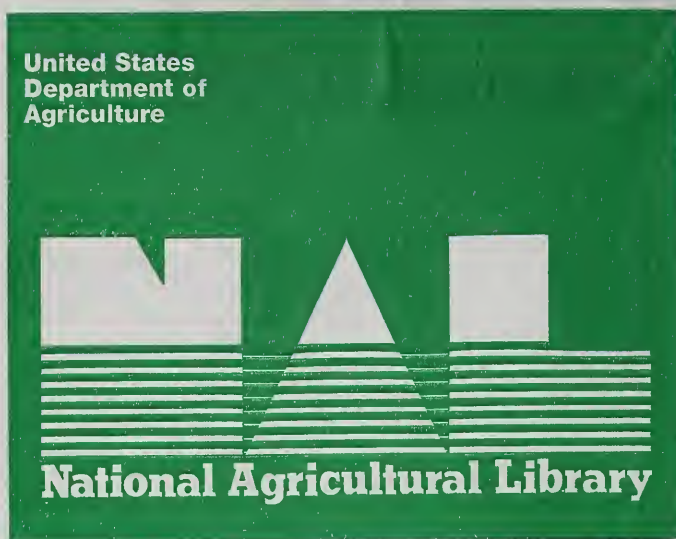
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Back cover: Forth graders from Cache County schools are learning how to collect macroinvertebrates in Logan River using a kick net. Photo courtesy of Laura Hines (Utah State University Water Quality Extension).

Written by Water Quality Coordinators and other Section 406 National Water Program Principal Investigators. Developed by Dr. Lisa Kordos and Dr. Mark McFarland, Department of Soil and Crop Sciences, the Texas AgriLife Extension Service, Texas A&M University. Editing by Linda Anderson, AgriLife Communications, the Texas AgriLife Extension Service. Graphic design by Karen Green, Insite Publishing, Bryan, Texas.

Note: Please submit all errors, omissions, or suggestions to lkordos@ag.tamu.edu.



United States
Department of
Agriculture
National Institute
of Food and
Agriculture

Contact the **NIFA**
National Water
Program:

National Program Leader
Co-Chair, Committee for
Shared Leadership (CSL)
Dr. Michael P. O'Neill

USDA-NIFA
Mail Stop 2210
1400 Independence Avenue, SW
Washington, D.C. 20250-2210
202-205-5952 Phone
202-401-1706 Fax
moneill@nifa.usda.gov

Co-Chair, CSL

Dr. Doug Parker

University of Maryland
Department of Agriculture
and Resource Economics
Symons Hall, Rm. 2122
College Park, MD 20742-5535
301-405-8042 Phone
301-314-9091 Fax
dparker@arec.umd.edu

Co-Chair Elect, CSL

Dr. Kitt Farrell-Poe

University of Arizona
Agricultural & Biosystems
Engineering
1177 E. 4th Street
Tucson, AZ 85721-0038
(520) 621-7221 Phone
(520) 621-3963 Fax
kittfp@ag.arizona.edu

1890 Representative, CSL

Dr. Cassel (Cass) Gardner

Cooperative Extension
Florida A&M University
202-J Perry-Paige Bldg., S.
Tallahassee, FL 32307
850-599-3546 Phone
850-561-2151 Fax
cassel.gardner@fam.edu

1994 Representative, CSL

Mr. Virgil Dupuis

Salish Kootenai College
Salish Kootenai College Extension
PO Box 70
(shipping 52000 Hwy 93)
Pablo, MT 59855
406-275-4899 Phone
406-275-4809 Fax
virgil_dupuis@skc.edu

<http://www.usawaterquality.org/>



NIFA National Water Program

This outcome report provides key examples of how water resource professionals at universities and colleges, in cooperation with NIFA, are working with citizens, communities and partner agencies to address critical water resource problems across the United States.

The goal of the National Institute of Food and Agriculture (NIFA) National Water Program is to protect or improve water resources throughout the United States, particularly in agricultural, rural and urbanizing watersheds.

The NIFA National Water Program brings university scientists, instructors, and Extension educators into more effective and efficient partnerships with Federal interagency programs to address priority water quality issues in U.S. agriculture. A key emphasis of the program is integration of Extension, research and education resources to solve water quality problems at the local level.

The program is guided by a unique model for shared leadership that includes representatives from each of the 10 regions, representatives from the 1890 and 1994 Land Grant institutions and the NIFA National

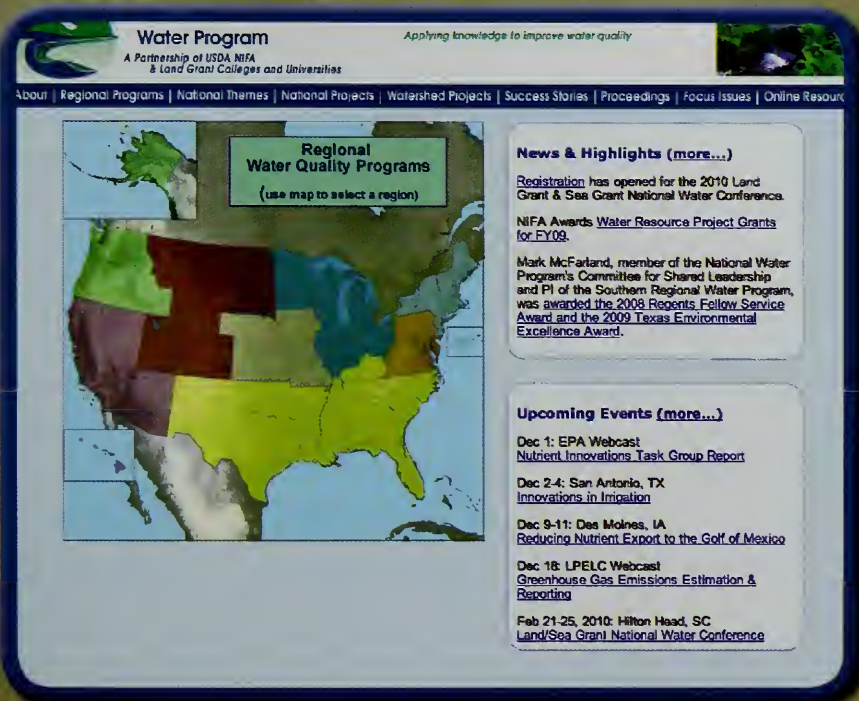
Program Leader for Water Quality. This group is called the NIFA Committee for Shared Leadership for Water Quality (CSL-WQ).

The NIFA National Water Program Web site (<http://www.usawaterquality.org/>) enhances communication and coordination within the NIFA/Land Grant network and with its national and regional partners. The Web site is designed for scientists, instructors, and Extension educators

to share and access information about successful water quality improvement programs from across the nation.

This impact report provides key examples of how water resource professionals at universities and colleges, in cooperation with NIFA, are working with citizens, communities and partner agencies to address critical water resource problems across the United States.

For more information about the NIFA National Water Program, please contact the National Program Leader, Dr. Michael P. O'Neill at moneill@nifa.usda.gov, 202-205-5952; Dewell Paez Delgado, Program Specialist, at dpaez@nifa.usda.gov, 202-401-4141; or Brian Gates, Program Specialist, at bgates@nifa.usda.gov, 202-401-6020.



<http://www.usawaterquality.org/>

Regional Coordination Projects · Integrated Research · Education and Extension Projects Extension Education Projects National Water Resources Projects

In the NIFA improved water resources through four types of projects addressing eight water resource themes.

The first four themes are highlighted in this Outcome Report:

- Animal Waste Management
- Drinking Water and Human Health
- Pollution Assessment and Prevention
- Water Conservation and Agricultural Water Management
- Nutrient and Pesticide Management
- Watershed Restoration
- Watershed Management
- Water Policy and Economics

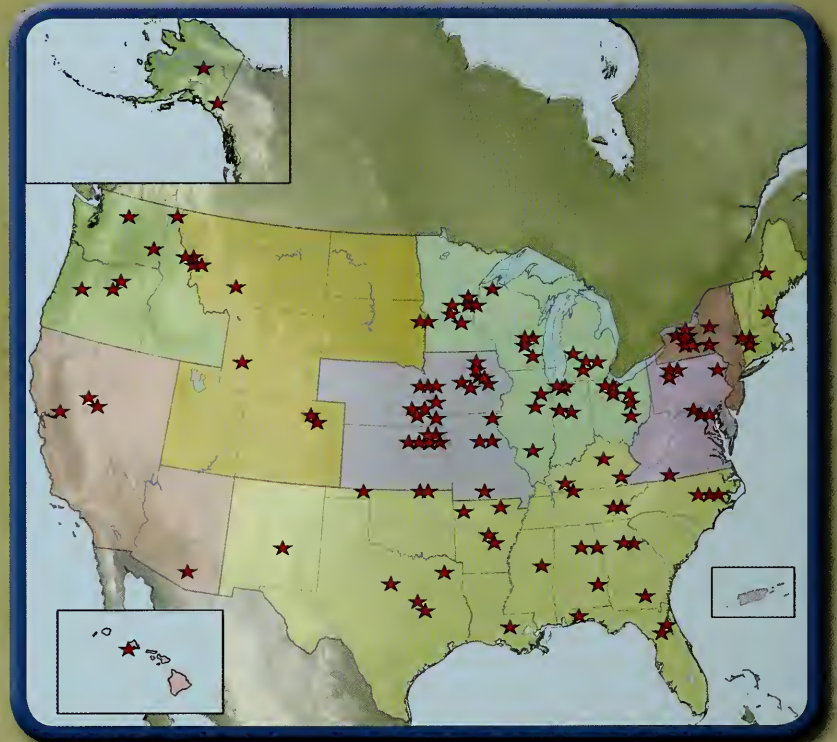
Regional Coordination Projects synthesize water resource efforts within each region and make research, education and Extension resources of the university system more accessible to Federal, State, and local water resources improvement efforts. In addition to Coordination Projects, three other types of projects are supported by the Agricultural Research, Extension, and Education Reform Act (AREERA) Section 406 competitive grants:

Integrated Research, Education and Extension Projects coordinate research, education, and Extension to solve water resource problems at the watershed level. These projects target a specific watershed and use an integrated approach to address an existing concern.

Extension Education Projects provide leadership and effective partnership for water resource education to help people, industry, and governments prevent and solve current and emerging water resource problems. Extension Education Projects focus on outreach to affect changes in knowledge and management which enhance and protect the nation's water resources.

National Water Resources Projects develop and initiate nationally coordinated programs that contribute to an increase in public understanding and involvement in community decision-making, facilitate the development of recommendations and tools to inform public policy, and evaluate impacts on water resources (e.g., decisions about land use, land management practices, and waste water management alternatives). The result is more citizen involvement, wider dispersal of information, and more rational analysis of environmental decisions in communities and across the nation.

The following National and Regional Projects of Excellence exemplify significant accomplishments and value from Extension-led water quality programs.



Integrated Research, Education and Extension Projects, Conservation Effects Assessment Projects and Extension Education Projects awarded in 2000-2009.

The National NEMO Network

A NIFA Project of Excellence Focusing on Community Land Use

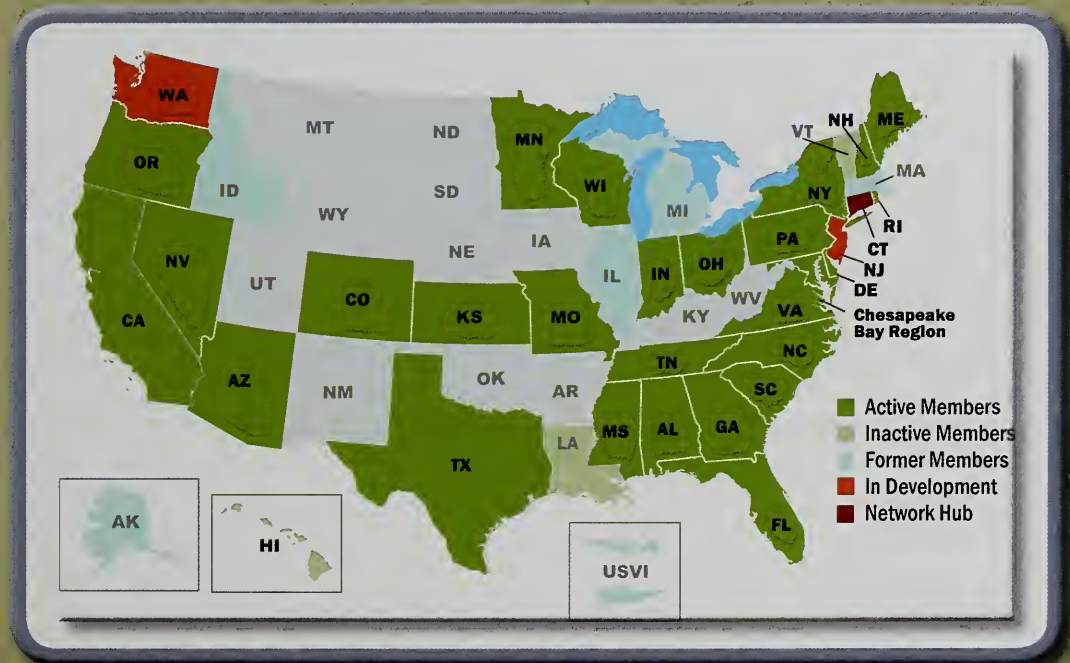
David Dickson and Chet Arnold, University of Connecticut

Situation: Communities must adopt strategies that allow growth while retaining their agricultural base and community character and protecting their water and other natural resources. To accomplish these goals, municipal and county land use officials need information, tools, and research-based education.

NIFA Response: The Nonpoint Education for Municipal Officials (NEMO) program is a land grant/sea grant collaboration providing education for community decision-makers on how land use decisions affect natural resources. With support from the NIFA Water Program as a national project, and through USDA/NOAA/EPA partnership, NEMO has spread from its development at the University of Connecticut (UConn) in 1991 to a National NEMO Network in 30 states. The network has, been in existence for about 10 years.

nationwide to assist collaborations in other states adapt the NEMO educational model.

to develop new educational strategies, collaborate, and share research. The seventh conference



Map of National NEMO Network.

NIFA support led to the creation of the NEMO Network coordinating hub at UConn. The early focus was on developing new NEMO projects around the country. Most NEMO programs are led by land grant and/or sea grant institutions, but involve a wide variety of partners. As the network evolved, the hub has focused on providing training, networking, and other resources to the member projects. Some examples:

- More than 100 "scoping" workshops have been conducted

- Tools created to support the network include a listserv, newsletter, and website (<http://nemo.uconn.edu/national>) that allow programs to share educational materials, report successes and impacts, and connect with resources.
- Seven network national conferences (NEMO University) have been held in the past 10 years. These conferences provide an opportunity for members

was held in Portland, ME, in 2010, and brought together more than 100 educators from national networks and organizations.

- Training workshops covering a wide range of technical and topical matter have been presented. Workshop topics include open space planning, use of the impervious cover analysis (GIS) tool, forest resource protection, and community Web mapping tools.

- Biennial Network Progress Reports, encapsulating both network-wide progress and individual NEMO projects, have been published. The fourth progress report will be released in 2011.
- Collaborative Web tools such as the National Low Impact Development (LID) Atlas and Online Community Resource Inventory were developed for decision-makers' easy access to community information on the Internet.
- A spin-off NIFA national project provides national geospatial training to water program researchers and educators, focusing on using earth browser technologies, such as Google Earth and Google Maps, to display information and data over the Web.

On-the-Ground Results: NEMO Network impacts can be documented on several levels.

At the national level, the NEMO Network has provided a "bottom-up" practice that has developed around a critical issue—the impacts of land use on water quality. The network



Low Impact Development (LID) practices such as this engineered grassed road swale in Old Saybrook, CT, help promote infiltration of stormwater and reduce runoff. LID is a focus area of the National NEMO Network.

is also a model of interagency collaboration: Not only land grant and sea grant universities, but also several branches of NOAA and EPA have been involved. NEMO has been a national leader in the use of geospatial technology for outreach and community assistance. NEMO has won national awards from the NIFA Water Program, the American Planning Association, and the National Environmental Education Training Foundation.

At the state level, several NEMO programs have been key in statewide changes to water quality programs

and regulations. For example, NEMO programs were critical in the development of statewide stormwater management manuals in Connecticut, North Carolina, and Rhode Island. In New Hampshire, Maine, Oregon, and Minnesota, NEMO is the vehicle for multi-agency collaboration on water quality issues. And in

Arizona, Texas, and Connecticut, NEMO programs have conducted watershed assessments or other research of statewide importance. NEMO has developed statewide Web tools to support land use decision-makers in Delaware, South Carolina, North Carolina, Minnesota, Nevada, Rhode Island, and Ohio.



Participants at NEMO University 5 learn to use the "Impervious Surface Analysis Tool" to help analyze the impacts of development on their communities.

At the local level, NEMO's work with communities in 30 states has resulted in changes to local comprehensive, open space, and watershed plans; zoning and subdivision regulations; and on-the-ground changes in development practices and open space protection. NEMO programs have led low impact development in communities across the country, helping to eliminate or reduce the impact of development on water resources. Representative impacts are compiled in the biennial Network Progress Reports.

Volunteer Water Quality Monitoring National Water Resources Project

Linda Green, Elizabeth Herron, Kristine Stepenuck,
Frank Finley, Ken Genskow, Arthur Gold - URI Watershed Watch

Situation: Volunteer monitoring is vital in understanding, protecting, and restoring waters. Volunteer water quality monitoring programs get people active and involved in real science. These programs provide tools to educate youth, improve understanding of local water resources, encourage individual and community involvement, and help communities make informed decisions in local protection and restoration efforts.

Response: Increasing the visibility, vitality, and viability of volunteer monitoring programs

This effort helps start new programs and builds existing ones. The

program works with statewide, tribal, or regional efforts to expand the collective impact. The program participants:

- Located and linked Extension-affiliated volunteer monitoring and citizen science programs throughout the country, building an Extension Volunteer Monitoring Network

- Produced a series of on-line factsheets on all aspects of monitoring, from getting started, to running efficiently and effectively, to turning data to information.

450 members, to exchange questions, suggestions and advice, information, and news

- Archive listserv discussions, 95 to date, to retain these exchanges, and use them to direct the factsheet series

- Co-chair national water quality conferences to

provide training and awareness of volunteer monitoring among federal and state agencies

- Developed relationships with Native American Tribal Colleges and universities to learn about their water programs and interests in youth education through volunteer monitoring

Volunteers monitoring local waters.
In New England, more than 1,800 volunteers in Extension programs monitored about 800 sites.

These "one-stop-shopping" modules highlight techniques of successful programs and link to other resources, including more than 300 websites.

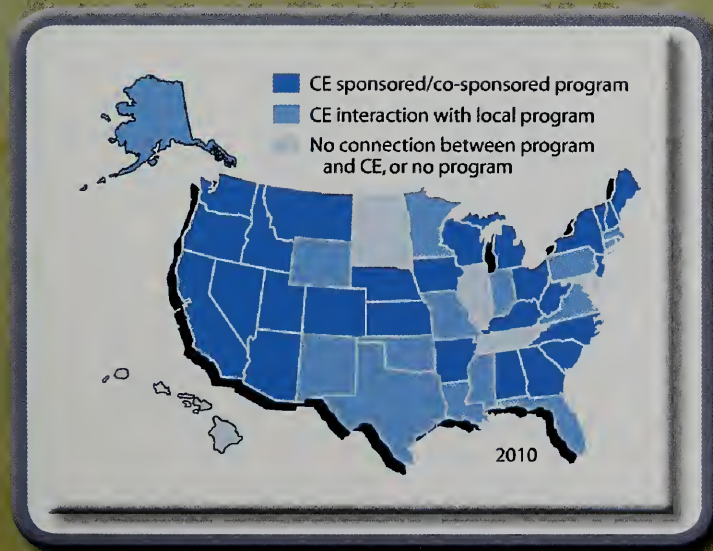
- Conduct training workshops at statewide, tribal, regional, and national venues, training leaders for volunteer water quality monitoring

Outcomes:

The USDA NIFA Cooperative Extension-based Volunteer Water Quality Monitoring National Facilitation Project is a top resource for volunteer monitoring, providing a comprehensive support for groups across the country. This program provides:

- Use the website www.usawaterquality.org/volunteer as the source and repository for its efforts
- Host a listserv CSREESVolMon@lists.uwex.edu, with about

- Improved communication, information sharing, and coordination among Extension



2010 Map of Extension Associated Programs

volunteer monitoring programs, researchers, and partners within states, tribes, and across regions and the nation

- Expanded volunteer opportunities
- Stronger partnerships within and between NIFA programs and other agencies
- Reduced effort to start or expand volunteer monitoring programs
- Organizational aid to developing programs
- Recognition as a principal resource for volunteer monitoring
- Enhanced recognition of volunteer monitoring efforts across the country
- Volunteers monitoring local waters. In New England, more than 1,800 volunteers in Extension programs monitored about 800 sites.
- Significant economic impact of volunteer effort; for example, in the Midwest Extension volunteers accrued more than 98,000 hours monitoring in 2009, valued at \$1.8 million.

Working together for stream health



Monitoring is a great family activity



Examining macroinvertebrates at Tribal College workshop

1890 Institutions National Facilitation Project For Water Resources

¹Sam O. Dennis* and ²Cassel Gardner
¹Tennessee State University; ²Florida A&M University

A strong interest for water resources education, Extension, and research is evident at 1890 land grant universities (LGUs). Scientists working in water resources within the 1890 LGUs established a network of education, Extension, and research personnel to engage 1890 LGUs scientists in the USDA-CSREES National Water Program and enhance water research at these institutions. In 2005, the 1890 National Facilitation Project was funded; prior to this funding only three of the 18 1890 LGUs participated in the national and regional water quality programs.

Currently, 12 institutions are active in both the national and regional water quality programs. Ten scientists from research and Extension are successfully engaged in regional programming coordination efforts. A 50 percent increase was seen in the number of 1890 institution attendees to the National Water Conference. Scientists and student presentations at this conference also increased as a result of the project.

The project provided up to \$10,000.00 as mini-grants for one year. Those who received the funding were to conduct research or Extension projects relating to water issues. Twenty-five mini-grants were awarded during the length of the project. Eleven of the 1890 LGUs were awarded mini-grants to enhance research that addressed water issues. Those institutions were: Alcorn State University, Florida A&M University, Kentucky State University, Langston University, Lincoln University, North Carolina A&T University, Tennessee State University, Tuskegee University, the University of Arkansas at Pine Bluff, the University of Maryland Eastern Shore, and Virginia State University.

Three universities leveraged the funding from the project to gain extramural funding of about \$1 million from USDA 1890 Capacity Building Grant award. Also in 2008, one 1890 institution was funded by the CSREES National Integrated Water Quality Grant Program (Section 406). The facilitation project help foster a

The project provided
up to \$10,000.00
as mini-grants for
one year.

partnership with 1862 and 1994 LGUs to solve local water resource-related issues. The project helped build water resource capacity at 12 of the 1890 institutions while using the diversity of resources and expertise at the 1862 institutions. The visibility of 1890 institutions in the mainstream of water quality research and Extension has been greatly enhanced as well.



2006 Watershed Academy Bio-Assessment

Building Tribal College Water Quality Education Capacity

W. Adam Sigler – Montana State University Extension
Virgil Dupuis – Salish Kootenai College

Need: The Tribal Colleges National Facilitation Project conducted a needs assessment in the area of water. Identified priorities are water quality and quantity, invasive species, climate change, protection of cultural values, and most important, water science education capacity. While teaching water quality is an interest, capacity to teach these courses is lacking. Faculty at tribal colleges often teach four or more courses per semester and have very limited time to prepare and develop new materials.

Teaching Material Development: The Salish Kootenai College worked with Montana State University (MSU) and the NIFA Northern Plains and Mountains (NPM) water team to produce a teaching package for tribal college faculty teaching a sophomore/junior level water quality course. Teaching package development was leveraged by concurrent work to develop a new water quality course at MSU and by the NPM team. The package includes 25 PowerPoint lessons with instructor notes, assignments, supplemental reading resource guides, tests, and two educational videos. The teaching package was presented to tribal college faculty from across the United States at both the 2009 and the 2010 Tribal Fellows Institutes organized by the National Partnership for Environmental Education.

2009 Tribal Fellows Institute: In August 2009 at Sitting Bull College in North Dakota, the teaching package was

presented to 20 educators from tribal institutions from nine states.

- Ninety-four percent of institute participants said the teaching package would increase their capacity to teach water quality, and 82 percent said they would use the package to teach water quality at their institutions.



Shandin Pete of Salish Kootenai College installs stream monitoring equipment with students during the filming of Tribal Waters

"As a relatively new instructor, it was extremely useful to see how an entire class in this area (including background material) was put together including PowerPoints."

"This is absolutely amazing!"

Tribal Waters: The Clean Water Act in Indian Country, is a film on the pursuit of clean water by tribal environmental water programs on three Montana Indian Reservations. It was filmed in collaboration with the Confederated Salish and Kootenai Tribes, the Northern Cheyenne Tribe, the Crow Tribe, and the Montana Office of the U.S. Environmental Protection Agency, and produced by the NIFA NPM water team, MSU, and Salish Kootenai College.

- Eighty-eight percent of the tribal college faculty surveyed said that before watching the film they did not have a good understanding of how the Clean Water Act is administered in Indian Country.



The first of a 2 part Tribal Waters video series exploring the pursuit of clean water by tribal environmental programs on three MT Indian Reservations

Tribal college faculty work through a hands on water quality exercise at the 2010 Tribal Fellows Institute at Salish Kootenai College in Pablo MT.



- All of the tribal college faculty surveyed said that the video would help to prepare students to explore water quality monitoring and management on their reservations.

"Very Powerful... really liked the cultural relevance.... will definitely use in my classroom."

"Quality and premise of the video is excellent."

2010 Tribal Fellows Institute: Based on feedback from the 2009 Fellows Institute, hands-on teaching exercises were

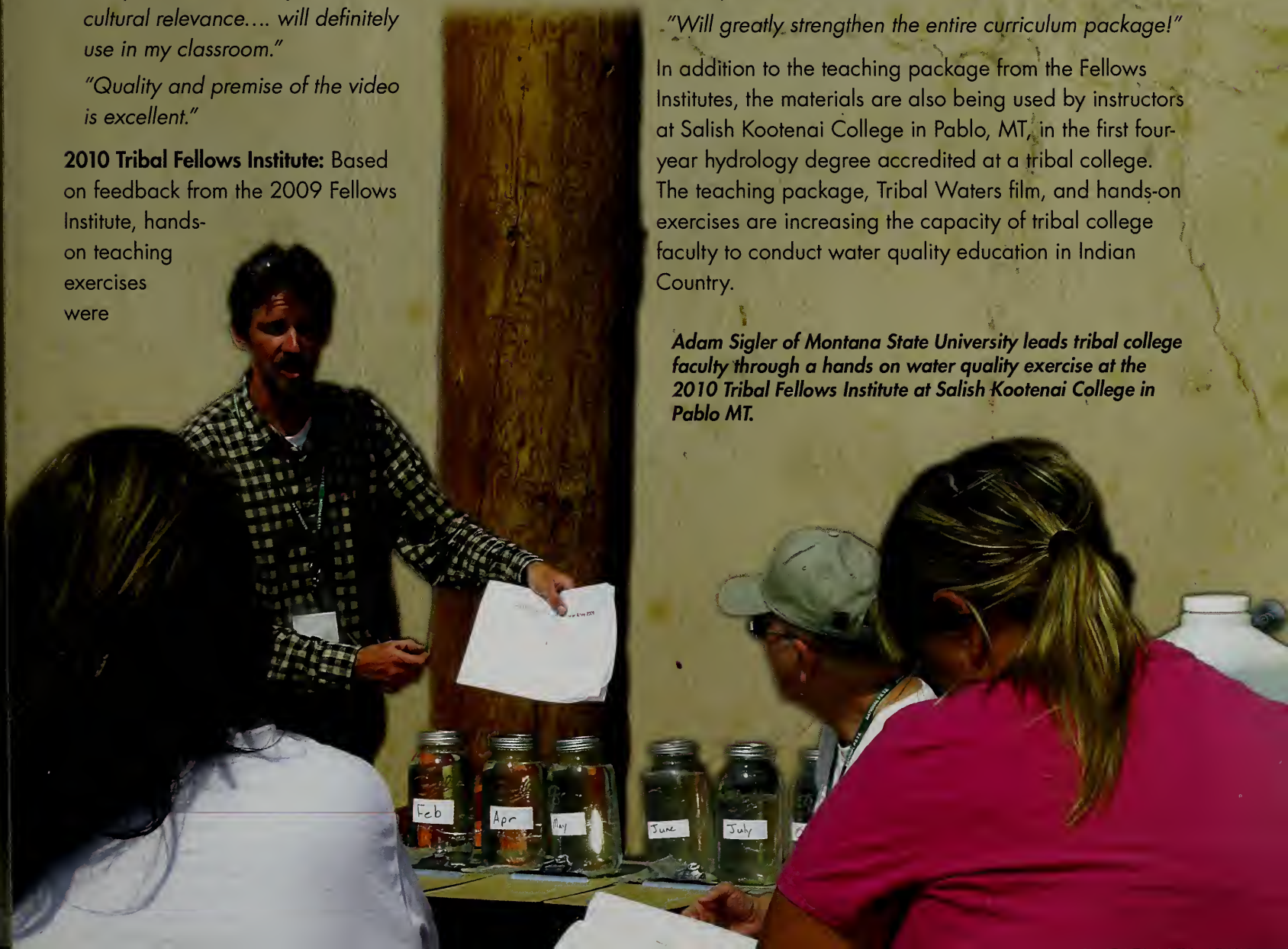
incorporated into the teaching package, and a pilot was presented to participants at the 2010 institute. The exercise was very well received:

"...easy to understand and implement... can grasp the concept better if hands-on,"

"Will greatly strengthen the entire curriculum package!"

In addition to the teaching package from the Fellows Institutes, the materials are also being used by instructors at Salish Kootenai College in Pablo, MT, in the first four-year hydrology degree accredited at a tribal college. The teaching package, Tribal Waters film, and hands-on exercises are increasing the capacity of tribal college faculty to conduct water quality education in Indian Country.

Adam Sigler of Montana State University leads tribal college faculty through a hands on water quality exercise at the 2010 Tribal Fellows Institute at Salish Kootenai College in Pablo MT.



The Livestock and Poultry Environmental Learning Center (LPELC): A National Network for Collaboration and Delivery of Research-Based Information

Mark Risse (University of Georgia), Joe Harrison (Washington State University), Rick Koelsch (University of Nebraska), Jill Heemstra (University of Nebraska)

The Livestock and Poultry Environmental Learning Center (LPELC) provides a nationally recognized delivery mechanism to connect researchers, regulators, extension, and education with animal producers and their advisors. The LPELC was funded in 2005 as a National Facilitation project. In 2006, it was approved as an eXtension (e-extension) community of practice. eXtension provides a permanent, accessible repository for content that allows contributors to access and improve the resources for current (and future) outreach efforts.

The LPELC engaged more than 100 experts to develop a comprehensive web presence (<http://www.extension.org/animal+manure+management>), launched in March 2008. Traffic has exceeded 250,000 page views in 2010. The LPELC is competitive among web search engines, accounting for more than 70% of our site visits. A significant effort is

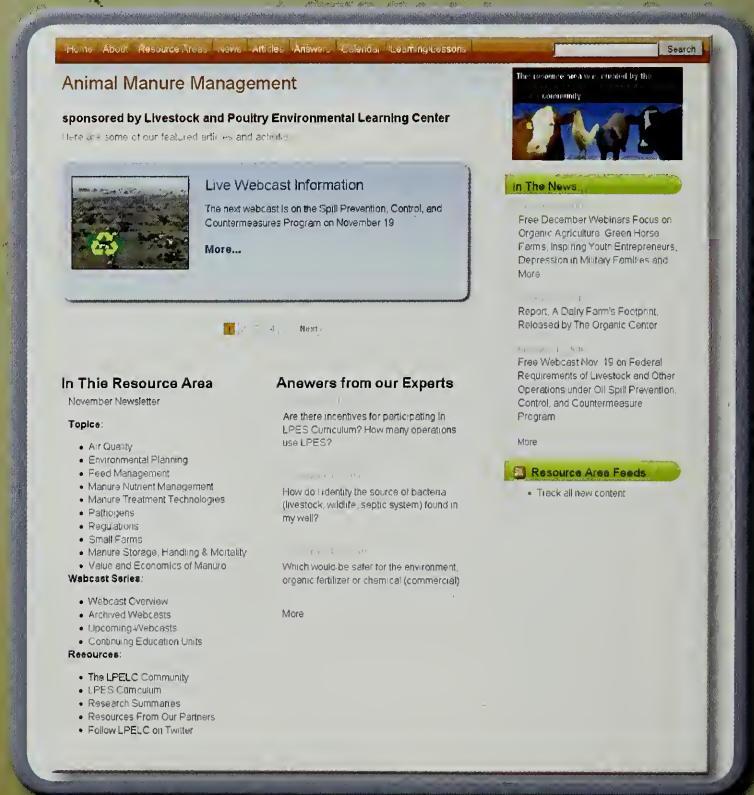
made to analyze web traffic and identify potential improvements.

The LPELC has attracted a large and diverse audience interested in animal environmental issues. Nearly 1500 people subscribe to the newsletter (http://www.extension.org/pages/Livestock_and_Poultry_Environmental_Learning_Center_Newsletter). The newsletter is forwarded to several relevant listservs, doubling its reach. In addition to this one-way communication, the LPELC is cultivating social media connections that facilitate a more engaged learning environment. The LPELC has more than 800 followers in Twitter (<http://twitter.com/lpelc>) most of whom have agricultural connections and are not subscribers

to the newsletter. The team also has placed a growing emphasis on video delivery through its YouTube channel (<http://youtube.com/user/lpelc>) and adding research-based information to Wikipedia articles about animal agriculture environmental topics.

The monthly webcasts, started in September 2006, are viewed live by more than 130 individuals and 1100 viewing the archive library each month. Webcast presenters have included Cooperative Extension faculty, researchers (land grant, USDA Agricultural Research Service

Figure 1. The Livestock and Poultry Environmental Learning Center home page, located at <http://www.extension.org/animal+manure+management>



and US Geological Survey), and private sector experts. The audience represents a national cross-section of animal agriculture advisors. The average viewer reports that they influence the environmental management decisions of 136 producers annually. Webcast viewers have received continuing education credit from several organizations, including the Certified Crop Advisers, American Registry of Professional Animal Scientists, Professional Engineers, and Technical Service Providers. Post-webcast surveys show that viewers used the information in: their own professional development (82%), recommendations to producers (51%), regulatory/policy development (36%), extension programs (28%), and farm management decisions (23%).

In surveys done in 2008 and 2009, newsletter subscribers reported that LPELC resources contribute to significant or moderate improvements in: application of emerging technologies (65%), increased value from manure utilization (57%), policy development (49%), and advice to animal producers (69%). They also reported that LPELC resources contributed directly to their work: 58% of private sector advisors made a recommendation that benefitted a client, 70% of extension agents/educators and 84% of extension specialists researched the answer to a

question, 42% of teachers printed web pages as handouts while 32% added new topics to their curriculum. 42% of regulatory agency staff used the information in permit reviews; the same percentage (42%) increased education/outreach efforts to producers.

The LPELC continues to collaborate with several projects and programs

in an effort to increase animal agriculture access to research-based information. Current efforts are creating educational curricula in air quality and for beginning farmer audiences. The newest effort within the LPELC is a project to create a comprehensive extension presence related to animal agriculture and climate change.

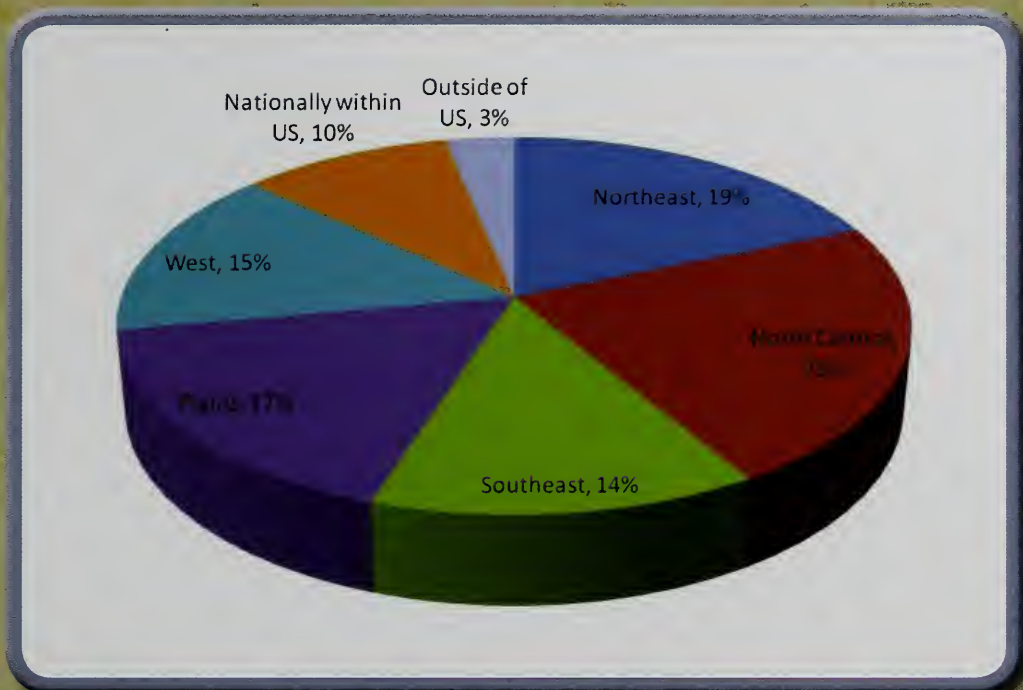


Figure 2. The Livestock and Poultry Environmental Learning Center has engaged a national audience in the live webcast series.

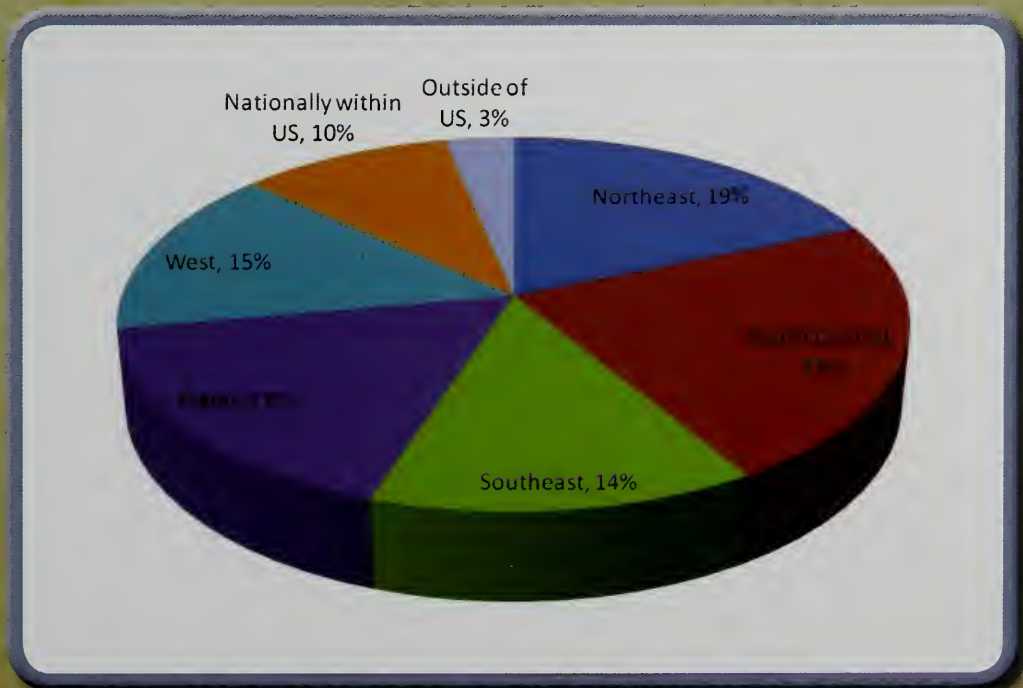


Figure 3. The Livestock and Poultry Environmental Learning Center live webcast audience represents a wide cross section of those that influence environmental management decisions on farms and ranches.

The Environmental Pathogens Information Network (EPI-NET.ORG)

Ronald Turco and Militza Carrero-Colon, Purdue University

Epi-Net.org was a national level internet-based organization that provided a centralized resource of information on the fate and behavior of important environmental microorganism. Epi-Net developed a nationally representative advisory structure consisting of members from government, academic, and the private sector. We organized the overall Epi-Net project around an interactive website that hosted a wealth of environmental microbiology data and information from both the refereed literature and state and federal sources creating an on-line information repository. In doing so we hoped to produce a level of common knowledge and create a foundation for discussions between the science and stakeholder groups. As part of the information resource we developed the EPI-Net library, which included the results of an extended literature search of both the gray and published literature related to pathogens in the environment. The purpose of this library was to centralize and

facilitate literature delivery to the environmental community including researches, students, faculty etc. We also developed a series of peer reviewed web based publications, outreach modules and a book chapter in the recently published book "The Fecal Bacteria" edited by Sadowsky and Whitman. Over the period of the project, EPI-Net also encouraged and supported information sharing and education by developing and hosting ten well attended symposium or workshops (total attendance in excess of 500). Our efforts connected stakeholders, regulatory officials, and technical experts and provided a reliable point of reference for methods and data interpretation. The target audience for these events was professionals working in the area

of water protection, particularly those actively involved in the areas related to health and water and included consultants, government officials, water scientists, ecologists, environmental scientists, beach coordinators, beach managers and many others in related areas. All of our symposiums included a case study session to encourage discussion among participants about the issue, possible solutions and ideas for reducing existing water quality concerns. The speakers selected as well as the participants were from different agencies (EPA, USDA, and USGS), universities and other non-profit environmental organizations. Topics for the symposium ranged from conversations on cyanobacteria and water quality to microbial source tracking to protozoa and water quality. The selection of topics reflected input from our advisory board and often addressed the topic areas they struggled with every day. The best example of adaption to changing needs was our symposium on cyanobacteria as it developed as a problem but was not represented in our original plan. However, our most popular events were workshops associated with a *hands-on experience* where groups first received classroom instruction about a procedure, then discussed its applications and limitations and then carried out that exact method in the lab. The overwhelming response to these programs clearly demonstrated a need for ongoing



Students in an EPI-Net workshop prepare to seal an IDEXX sample tray prior to as part of hands-on learning experience.

education in this important area and reflected to a large degree, the speed at which the technology is changing. Evaluations at the end of the workshops were great, participants found these workshops useful for their research, regulatory and their professional careers. In the end, the project established a foundation for collaborative education and outreach efforts to facilitate a widespread understanding of the environmental behavior of pathogenic microorganism in the environment.

A typical sample collection point for a water quality study.



Student in a EPI-Net workshop prepare samples for evaluation.



Students in an EPI-Net workshop inoculate a IDEXX sample tray as part of hands-on learning experience.



Students attend the lecture portion of an EPI-NET workshop held jointly with USGS in Columbus, Ohio.

Water Outreach – Enhancing stewardship actions through applying Best Education Practices

Elaine Andrews, University of Wisconsin

Community involvement is the key to successfully implementing plans for clean and safe water. During 2000 and 2010, the U.S. Department of Agriculture's Water Program funded two national facilitation projects to link community interests with stewardship outreach activities. The total federal investment was \$370,000. The University of Wisconsin, seven land-grant universities, three federal agencies, and seven national and regional non-government organizations and national facilitation projects supported the projects.

These projects, the Water Outreach Education Project and the Changing Public Behavior Project, connected Extension educators, natural resource professionals, and other professionals focused on water education with best education practices and skills to encourage the public to adopt environmentally friendly habits. Water educators focused on local interests and conditions when encouraging specific audiences, such as farmers, homeowners, and landowners, to take environmentally appropriate actions in their homes, businesses, organizations, or communities. Resources allow water professionals to incorporate those understandings into their outreach projects. The Changing Public Behavior Project built on

the work of the Water Outreach Project. Both projects, with national advisory teams and audiences, worked to support, assess needs, develop and test resources, and implement professional development opportunities. While neither project followed participating educators, researchers were able to establish specific educator needs and evaluate the ability of project resources to meet those needs.

A large number of professional audiences requested training, and many professional groups used the principles of this work in their published resources. Groups that requested training included: National Environmental Protection Agency Conferences for Nonpoint Source and Stormwater Outreach; American Fisheries Society; Ecological Society of America; North American Association for Environmental Education; National Environmental Education Foundation; Southern

Extension Foresters; USDA water conferences; American Educational Research Association; Americorps; and North Carolina, Wisconsin, and Washington Extension programs. Workshop evaluations from five Changing Public Behavior workshops, where participants worked with about 20 different target audiences, indicated that more than 80 percent of participants thought the workshop increased their confidence and abilities in using planning steps; increased their confidence in applying educator skills; increased their awareness of sources of information about educator skills; increased their confidence in applying social assessment skills; and increased their awareness of sources of information about social assessment skills.

Web site – <http://www.wateroutreach.uwex.edu/>



Featured resources created over the course of the two projects include:

- (1) The Essential Best Education Practices, that identify content for 11 disciplines and provide guidelines that educators can use to evaluate their skills and their programs
- (2) The BEP Decision Tree, to help natural resource professionals select outreach strategies and find related practices, tools, and information to meet the identified needs
- (3) Tools to enhance teaching and presentation skills
- (4) An online searchable database of educational findings from 250 research studies published between 1988 and 2007
- (5) The National Water Outreach Education Symposium in June 2004 where National Extension water quality coordinators, outreach professionals, and stakeholders shared BEPs and water outreach resources, made recommendations for promoting sound education practices among water management professionals, and suggested future action
- (6) A series of Changing Public Behavior Web information pages on topics such as Behavior Change Theories and Techniques, Community-Based Research and Outreach – Ethics Considerations, Participatory Action Learning
- (7) The Changing Public Behavior self-study module including seven units and a variety of planning and tracking guides

Groups building the recommendations into their strategies included the Recreational Boating and Fishing Foundation stewardship guides, which is now featured by the Association of Wildlife Agencies; the Southern Region Technology Transfer and Extension 2006 conference in a paper on target audiences by invitation; American Fisheries Society in the Fostering Aquatic Stewardship book chapter, 2007;

USDA water conference symposium planners in multiple years; USDA forest and range online course that uses the program's best education practices guidelines for module developers; the Great Lakes Regional Water Program social indicators project; US EPA 2009 and 2010 revisions of its publications, *Getting In Step: A Guide for Conducting Watershed Outreach Campaigns* and *Getting in Step: Engaging and Involving*

Stakeholders in Your Watershed; and the Ecological Society of America in its *Frontiers in Ecology* 2010 fall issue on science communication. The program's findings were also featured in *New Tools for Environmental Protection: Education, Information, and Voluntary Measures* (2002, National Academy Press, Chapter 10) and *Free-Choice Environmental Learning and the Environment* (2009, Alta Mira Press, Chapter 11).

Northeast NEMO: A Regional Program of Excellence Focusing on Community Land Use



David Dickson and Chet Arnold, University of Connecticut

Situation: Rural communities in the urban Northeast must adopt strategies to allow growth while retaining the area's agricultural base and community character and protecting water and forest resources.

NIFA Response: The *Nonpoint Education for Municipal Officials* (NEMO) NEMO is a longstanding land grant/sea grant collaboration that teaches community decision makers on the affect of land use decisions on the health of natural resources. With support from the NIFA Water Program and through

Support as a focus area of the USDA/NIFA Northeast States and Caribbean Islands (NESCI) Regional Water Center resulted in additional NEMO programs in the region and enhanced collaboration between existing programs. As of fall 2010, NEMO programs were available in Connecticut, Maine,

Northeast NEMO played a critical role in the adoption of Low Impact Development (LID) techniques in the region. NEMO organized statewide LID conferences in New Hampshire, Vermont, Maine, Connecticut, and Rhode Island for community leaders, researchers, regulators, and private sector experts. For instance, Connecticut NEMO, working with the state's Department of Environmental Protection, conducted LID workshops for planners, engineers, and commissioners within the Farmington River watershed, providing the basis for implementation grants for LID projects.

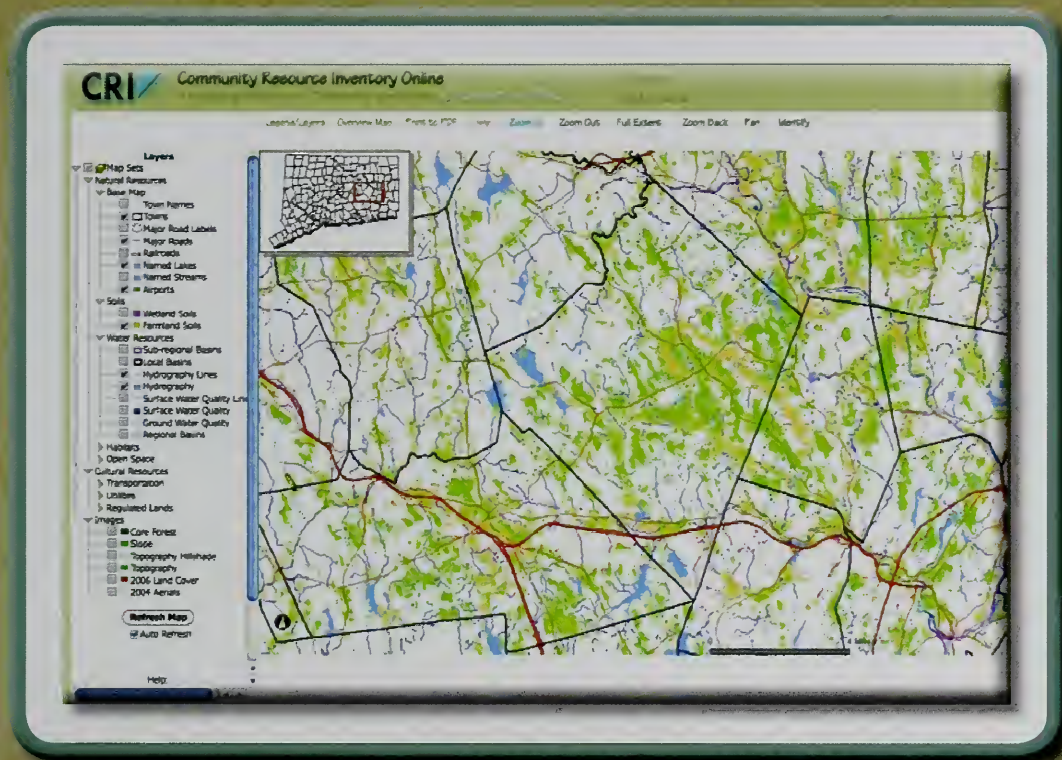
Northeast NEMO collaborates with several NESCI focus areas. NEMO worked with the award-winning NESCI volunteer monitoring programs to develop training and materials to improve the use of watershed assessment data. NEMO and the sustainable landscaping group are close allies. For instance, the LID practice of "rain garden" or bioretention that uses vegetation to help reduce and treat polluted runoff, is of common interest to the groups. Rutgers University and the UConn, in collaboration with the Environmental Protection Agency



Small contractors get hands-on training in the construction of "rain garden" vegetated stormwater practices.

USDA/NOAA/EPA partnership, NEMO has spread from its original development at the University of Connecticut in 1991 to a national network in 30 states.

New Hampshire, New York, Rhode Island, and Vermont, and in development in New Jersey and Puerto Rico.



Online mapping tools such as the community resource inventory allow community leaders to map and assess their town. Shown here is a map of the prime agricultural soils of Lebanon, CT.

Region One and state agencies, train contractors on building rain gardens, thereby creating opportunities for “green jobs.”

NEMO programs utilize geospatial technologies such as geographic information systems (GIS) and global positioning systems (GPS). Many programs both trained decision makers in using these technologies and developed easily accessed geospatial Web tools. These tools enabled communities to map, evaluate, and plan local and watershed landscape. These tools leveraged NOAA and additional USDA support to train other NIFA programs and their partners at the national level. For example, Connecticut NEMO is working with

the University of Rhode Island and Arizona State University in an NIFA-integrated project to develop and disseminate a watershed nitrogen decision support tool for NEMO programs in coastal watersheds.

On-the-Ground Results: Northeast NEMO’s work has resulted in changes to local comprehensive, open space, and watershed plans, zoning, and subdivision regulations, and on-the-ground changes in development practices and open space protection. NEMO programs have been on the leading edge of LID adoption beyond communities. For instance, NEMO programs have been critical in the development of statewide stormwater management standards and have spearheaded

the installation of pervious parking lots and other stormwater practices on the URI and UConn campuses. Northeast NEMO programs are nationally recognized in the use of geospatial technology in support of better land use planning and the protection of agricultural, water, and other natural resources.

Northeast Volunteer Water Quality Monitoring: Collecting Data to Educate Citizens and Aid Decision Making

Elizabeth Herron, University of Rhode Island Cooperative Extension; Linda Green, University of Rhode Island; Jeff Schloss, University of New Hampshire; Jerry Schoen, Marie-Francoise Walk and Scott Jackson, University of Massachusetts

Situation: Volunteer water quality monitoring programs allow residents to participate in watershed stewardship. These programs provide data on local water resources, educate residents, and encourage individual and community involvement in water quality protection and restoration efforts.

NESCI Response: With a history of often serving as the first link in watershed stewardship and local residents in the Northeast, the USDA/NIFA Northeast States and Caribbean Islands (NESCI) Regional Water Center supported volunteer

water quality monitoring as a focus area. The Northeast States Extension hosts well-established volunteer monitoring programs addressing local concerns, including bacterial contamination of shellfishing beds, lake eutrophication, and riverine health.

Effective watershed management requires locally relevant information. Agencies may lack sufficient resources to collect these data. Volunteer monitoring has bridged this gap in the Northeast by providing both short-term and long-term high quality data. These programs evaluated and improved field collection, storage, and analytical procedures to improve the data collected by volunteers. Volunteer monitoring training guides, resources, and workshops were adapted among programs in the region to facilitate program development, reduce

implementation costs, and maintain quality assurance and control of data. Nearly 4,000 Northeast volunteers monitored more than 900 rivers, streams, lakes, ponds, reservoirs, wetlands, estuaries, and marine sites.

Community buy-in is essential for effective watershed management activities. Heightened awareness and understanding of local conditions fosters water quality protection and restoration, and galvanizes local residents into action. These educated volunteers share their knowledge and assist decision-makers in enhancing the use of locally generated data supporting effective watershed management strategies.

Volunteer monitoring programs in the region are used in collaboration with Northeast Nonpoint Education for Municipal Officials (NEMO) programs. Together with NEMO, these programs developed training and materials to improve the use of watershed assessment data by local decision-makers. With NEMO, watershed groups and volunteers were trained to display their water quality data online with Google maps. Local programs, such as



Throughout the region, trained volunteers collect water samples to analyze water quality parameters. NESCI's volunteer monitoring programs provide these data to watershed associations, local governments, and state agencies.



Trained volunteers are a critical link in effective monitoring programs. Here a group of volunteers receive training in measuring dissolved oxygen.

Rhode Island's Wood-Pawcatuck Watershed Association, created a website to present and share data online. A regional volunteer monitoring workshop showed how to improve the accessibility and value of data for the public and decision-makers. One result was the Vermont Lakes program debut of an online Lake Score Card to report on the condition of local lakes.

With more than 42,000 volunteer hours worth about \$8 million of services since 2000, these Northeast programs leveraged more than \$1 million in direct support from state agencies, USGS, US EPA, NEIWPC, Sea Grant, local communities, foundations, and non-profits to expand and enhance monitoring and research. Regional expertise resulted in awards of a USDA/NIFA National Water Resource Project with multiple renewals supporting volunteer

monitoring nationally and a USDA/NIFA Integrated Project, the Northern New England Lake Education and Action Plan project. Several regional volunteer monitoring summits have identified needs for regional activities. Recent focus has been on developing regional materials to identify and assess harmful algal blooms, invasive species, and stream continuity, and help address potential climate change impacts.

On-the-Ground Results:

Data generated by trained participants in Northeast volunteer monitoring programs were used in statewide environmental status reports, for TMDLs and nutrient budgets, to assess best management practices and restoration effectiveness, and to develop local resource inventories for planning and other community purposes. These programs

improved the understanding of local water resources, encouraged individual and community involvement in water quality protection and restoration efforts, and helped residents make informed decisions that improved and protected water quality.



Program volunteers take weekly water clarity measurement using a Secchi disk. These easy-to-perform measurements can be used to assess seasonal and/or long-term trends in lake water clarity and indicate the same trends in water quality and eutrophication.

The Island Initiative: Collaboration to Adapt and Adopt Water Quality Programming

*ERafael Davila Lopes, University of Puerto Rico; Kofi Boateng, University of the Virgin Islands;
George Loomis, University of Rhode Island; and Christopher Obropta, Rutgers University*

Situation: Communities in Puerto Rico and the Virgin Islands face severe issues concerning drinking water and aquatic ecosystems. Customized water management strategies are required to meet the challenges posed by the climate, geography, and socioeconomic structures of these small Caribbean islands.

NESCI Response: The USDA/NIFA Northeast States and Caribbean Islands (NESCI) Regional Water Center created an Islands Initiative focus area to facilitate program exchange between the island and mainland land grant universities in the region. Leaders at the University of Puerto Rico (UPR), the University of the Virgin Islands (UVI), and participating northeast universities collaborate to adapt water management practices that fit the needs of Caribbean ecosystems.

The Island Initiative also links faculty and students at Hispanic Serving Institutions and regional and national projects based in the continental United States. The following NESCI focus groups worked together to address the Caribbean Islands' most critical water quality issues:

New England Onsite Wastewater Training Center

(NEOWTC) conducted training in the Virgin Islands and Puerto Rico to educate Island Extension staff and communities on septic system design, installation, and management to ensure wastewater can be safely treated. In 2010, NEOWTC launched a five-year comprehensive wastewater professional licensure program in partnership with UVI.

Nonpoint Education for Municipal Officials (NEMO) efforts are reflected in the pilot NEMO program, with University of Connecticut NEMO, on stormwater management in

Mayaguez, PR, with focus on sediment losses, mainly from dirt roads, and control of non-point pollution to coral reefs and mangrove ecosystems. Geographical information systems (GIS) and global positioning systems (GPS) trainings helped document critical water resources and watershed risks on the islands.

Sustainable Landscaping experts from Rutgers University trained staff at UPR and UVI on rain gardens and educational programs to control and treat runoff water. A pilot program for residents wishing to install rain gardens on their property is in development.

Small Farms Initiative focus area members are sharing their expertise with UPR and UVI to address the islands' 40 percent farmland, among the highest rates in the nation.

Proposals were submitted to evaluate the performance of small scale anaerobic digesters and study waste to energy options at small farms at UPR. Recommendations for horse

manure composting will be based on the work and guidelines developed at Rutgers University. These efforts will minimize bacteria and nutrient contamination to local water resources.

On-the-Ground Results: The Island Initiative enabled the creation of programs and pilot efforts to improve



With leveraging of resources with the NESCI Regional Water Center, UPR received a grant from to reduce pollution in Guanica Bay from septic systems and dirt road soil loss.



Sediment loss from the extensive network of non-paved roads on the islands threatens sensitive coral reef and mangrove ecosystems.

and protect water quality. The wastewater training plan will help local governments manage septic systems to preserve water quality and biodiversity. UVI and UPR leaders are being encouraged build regulations to improve water quality. These opportunities include: a draft storm water management plan in Puerto Rico; regulations in Puerto Rico for individual household septic systems; and the revision of regulations for composting animal waste. UPR and UVI programming has been

well received. With regional support, island efforts are being leveraged with additional funding. For example, UPR received a grant from the Puerto Rico Department of Natural and Environmental Resources to study septic system, dirt road soil loss, and pollution from greenhouses in Guanica Bay. With support from the Northeast states, the Caribbean Islands are addressing sediment, pathogen, and nutrient losses to improve and protect island resources.



UVI with New England Onsite Wastewater Training Center support launched a five-year comprehensive training program.

New England Onsite Wastewater Training Center: Protecting Communities and Water Quality

George Loomis and David Kalen, University of Rhode Island

Situation: In the continental United States, about 25 percent of households rely on onsite wastewater treatment systems, commonly called "septic systems." In island regions and less developed areas, a much larger portion of the population may rely on septic systems for domestic wastewater treatment. To protect surface waters and groundwater in these areas, best available practices and standards for septic system design, installation, and management need to be implemented to safely treat wastewater.

NESCI Response: The New England Onsite Wastewater Training Center (NEOWTC) is the hub for wastewater treatment innovation for the USDA/NIFA Northeast States and Caribbean Islands (NESCI) Regional Water Center. NEOWTC promotes research, development, and education in decentralized wastewater technology and management.

NEOWTC teaches a wide variety of wastewater practitioners, policy makers, and residents about septic system issues. Primary goals are: (1) safeguarding public health, (2) protecting water quality, and (3) encouraging sustainable development in the NESCI region. NEOWTC works closely with the Consortium of Institutes for Decentralized Wastewater Treatment to develop and deliver academic workshops, hands-on practical training sessions, and award-winning technical manuals. To facilitate hands-on training programs, NEOWTC experts wrote or co-authored training manuals, fact sheets, and Web-based modules. Two consortium flagship publications co-authored by NEOWTC staff— Residential Onsite Wastewater Treatment Systems Operation and Maintenance Service Provider Program and Analyzing Wastewater Treatment Systems – received the Blue Ribbon Award for outstanding educational materials from the American Society of Agricultural and Biological Engineers. These documents are used throughout the United States as standardized training texts.

By prioritizing needs assessment and technology transfer, NEOWTC developed best available practice wastewater treatment designs for geological and environmental conditions found in the NESCI region. Since 2004 NEOWTC developed and delivered 245 workshops and training sessions to more than 8,600 participants throughout the region. Nearly 550 onsite

Maintenance Training: NEOWTC offers professional training in septic system maintenance, an important best management practice to protect the region's valuable water resources.



wastewater system inspectors and service providers were trained, tested, and registered by NEOWTC during this period. In March 2010, a five-year training program administered in partnership with the NEOWTC and the University of the Virgin Islands was launched to prepare Virgin Island wastewater practitioners for licensing. Successful implementation of this training plan will raise the knowledge level of local wastewater practitioners and help local governments manage septic systems to protect water quality and biodiversity in these island ecosystems.



OWTC Field training: Field trainings at NEOWTC provide a first-hand look at the operation and maintenance of both conventional and advanced treatment technologies.

In 2010 NEOWTC received funding for a multistate hatch project, "Design, Assessment, and Management of Onsite Wastewater Treatment Systems: Addressing the Challenges of Climate Change." Researchers from 13 land grant institutions will work together to produce new septic system best management practices, with an eye toward climate change.

On-the-Ground Results: NEOWTC brings alternative wastewater treatment systems to communities, professionals, and regulators throughout the region. Thousands of professionals have been trained and certified by the NEOWTC, consequently applying their knowledge and skills locally. With assistance from NEOWTC, local wastewater management plans were developed and local ordinances changed. For instance, after the NEOWTC training, Puerto Rico conducted hearings in fall 2010 for first-time regulations for individual household waste disposal systems. NEOWTC efforts are reflected regionally and nationally by the improvement and protection of water quality from wastewater contamination.



Professional training in the Virgin Islands is preparing wastewater practitioners for licensing.

Sustainable Landscaping: Improving Landcare Practices to Minimize Pollution

Julia Peterson, New Hampshire Sea Grant Extension; Laura Wilson, University of Maine; Alyson McCann and Marion Gold, University of Rhode Island; Karen Filchak and Karl Guillard, University of Connecticut; Emma Melvin and Nancy Hewlett, University of Vermont; Chris Obrupta, Amy Boyajian and Lisa Galloway Evrard, Rutgers University

Situation: Waterways and waterbodies in New England are threatened or impaired by increasing levels of nutrients, sediments and other nonpoint source contaminants from residential, commercial and municipal properties in urbanizing areas.

NESCI Response: The USDA/NIFA Northeast States and Caribbean Islands (NESCI) Regional Water Center addressed nonpoint source pollution through its Sustainable Landscaping focus area over the last ten years. By collaborating across states and capitalizing on different strengths, the NESCI Sustainable Landscaping group increased their capacity to promote water resource protection locally.

Sustainable Landscaping programs promoted practices that decrease stormwater runoff and increase stormwater infiltration into the ground and filtration by healthy plants and soils.

Sustainable Landscaping activities and products, e.g., demonstration sites, rain garden installations, water quality friendly



Extension program participant installing a rain barrel at his home after the program.

landscape trainings, and store displays, encouraged the adoption of water quality and quantity-friendly practices. Individual program strengths were shared region-wide to efficiently transfer information on water quality to homeowners and landcare professionals. For example, research on rain gardens and water-friendly residential turf management conducted at the University of Connecticut was extended and incorporated into programs throughout the region. The "Stormwater Management in your Backyard" program from Rutgers has trained and delivered rain garden train-the-trainer programs in NY and NJ as well as outside the region in VA. These trainings for professional landscapers interested in green industry principles triggered collaborations with Universities of CT, NH, Puerto Rico and Virgin Islands.



Rain gardens are one of the landcare practices recommended by NESCI Sustainable Landscaping programs. University of New Hampshire Extension and New Hampshire lawn care professionals plan a rain garden installation with Rutgers University Extension.

Extension water programs worked with many partners, including federal, state, county and local agencies, municipalities, non-land grant institutions, professional associations, watershed and environmental groups.

Sustainable Landscaping drew internal partners across academic disciplines, focus areas, and Land and Sea Grant programs.

For example, focus area members partnered with NESCI Nonpoint Education of Municipal Officials (NEMO) programs to deliver several Northern New England Low Impact Development conferences for hundreds of

engineers, landscape architects, and other professionals. With agricultural Extension programs, including Master Gardeners and Integrated Pest Management programs, the Sustainable Landscaping group ensured that related opinion leaders were sharing common messages. Strong and broad partnerships helped NESCI Sustainable Landscaping expand their reach to promote better land management for water quality.

Regional efforts leveraged additional funding to support sustainable landscaping research, education and extension. Grants awarded from USDA/NIFA Extension-Education and Integrated Projects programs and other grant programs, e.g. EPA 319, expanded small efforts



University of New Hampshire and Rutgers University collaborative programming installed this rain garden in Portsmouth, NH.

within the region into projects with greater levels of investment, rigor, evaluation and impact. For example, individual state interests in water quality friendly lawn care were expanded into a multi-state, cross-disciplinary research, education and extension project. Results included science-based recommendations for lawn care practices based on water quality considerations, a soil-based nitrogen test for turf, and recommendations for framing and delivering lawn care outreach based on extensive social science.

On the Ground Results: The NESCI Sustainable Landscaping programs played important roles in educating opinion leaders (e.g. Master Gardeners, county Extension agents, professional landscapers and garden center staff) who help shape landowner practices. Pre-Post surveys from several programs around the region indicated an increase in Extension program participant knowledge of sustainable landcare practices to protect water quality, greater willingness or intent to adopt new practices, and greater willingness to share program information with others. A growing number of studies from Northeast Extension programs have documented that new sustainable landscaping practices by homeowners have slowly and steadily been adopted. In one study, 17% of yard care do-it-yourselfers who participated in programs reduced their use of lawn chemicals resulting in fewer chemicals in runoff to waterways. A number of states, including CT, RI and ME, are considering the adaptation of NESCI Sustainable Landscaping recommendations for water quality protection policies and as guidelines for their outreach.

Northeast Drinking Water and Human Health: Education, Testing and Drinking Safe Water

Alyson McCann, University of Rhode Island; Amy Galford, Cornell University; Ann Lemley, Cornell University; Laura Wilson, University of Maine

Situation: Volunteer water quality monitoring programs allow residents to participate in watershed stewardship. These programs provide data on local water resources, educate residents, and encourage individual and community involvement in water quality protection and restoration efforts.

NESCI Response: Twenty percent of the region's residents rely on private wells for their drinking water supplies. And in Northern New England, more than 40 percent of residents rely on private wells. Because these residents are responsible for their drinking water quality, they need to be aware of

NESCI Response: Protecting private drinking water supplies and human health is the purpose of the Northeast States and Caribbean Islands Drinking Water and Human Health focus area. Extension in the Northeast has a long history of effective programming in education and training for private drinking

water supplies. Support from the USDA/NIFA Regional Water Center has resulted in regional collaboration among Extension programs and partners in EPA, USGS, USDA's Healthy Homes Program,

state and local drinking water agencies, the Water Systems Council, the American

Ground Water Trust, state-based groundwater associations and professionals. Through research-based knowledge, education, and Extension, the region's residents can test and protect their drinking water supplies and their families' health.

The organization and its partners developed and delivered high quality, effective educational materials and programs for both private well owners and professionals in groundwater and drinking water protection. Regional collaboration led to the development and distribution of educational materials in print, video, and on the Web. Focus area members have helped develop the national eXtension Community of Practice website. Brochures and factsheets for private well owners were customized to individual states and distributed to well owners throughout the region. A series of homeowner factsheets developed in Rhode Island were modified and developed for use in Massachusetts and Connecticut. After attending community private well workshops, thousands of private well owners had their drinking water tested. In addition, private well owners took actions, such as properly disposing of household hazardous waste and maintaining their septic systems, to protect their drinking water supplies at home and in the community. Professionals and volunteers in organizations such as Master Gardeners and 4-H were trained in private well protection practices. Realtors, for example, can refer to



Private well owners attended an educational workshop to learn about the importance of regular testing, what to test for, and where to have their water tested. Follow-up evaluations indicate that more than 50 percent of participants had their water tested as a result of attending the programs

potential man-made and naturally-occurring contaminant risks and how to protect their water against such risks. Changing property laws and regulations have increased demand for well water testing and educational materials.

the resource guide, "What Every Realtor Should Know About Private Drinking Water Wells."

NESCI Extension played a critical role in the Northeast Private Well Water Symposium, a regional biennial event for professionals who want to share strategies for protecting private drinking water wells. Regional and interregional communication, cooperation, and collaboration, and joint programming activities in research, education, and Extension have resulted from this event. For example, the social marketing approach for developing a well

testing booklet for Maine was adapted for a Rhode Island publication developed in partnership with the Department of Health.

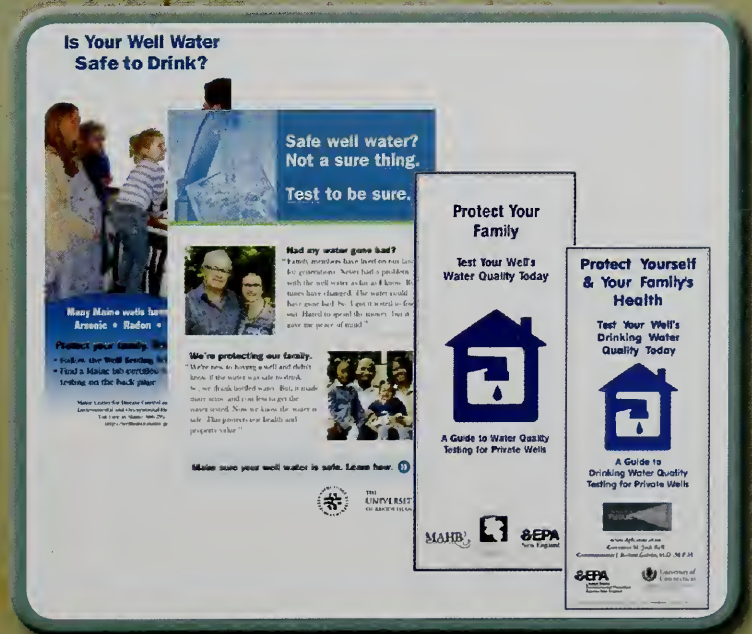
On-the-Ground Results: NESCI Extension's work with private well owners and professionals led to:

- Increased testing of private wells and maintenance of water treatment systems throughout the region
- More homeowners conserving water and making changes around their homes to minimize private well water contamination
- More knowledge and shared resources to develop state policies for private well testing
- Enhanced collaboration with partners and new opportunities that addressed water quality and watershed protection regionally
- Increased networking opportunities resulting in collaborative grant proposals and projects for both research and Extension projects
- Financial and professional leveraging of resources throughout the region
- More homeowners drinking safe water



The Northeast Private Well Water Symposium provides an opportunity for professionals to share strategies for protecting private drinking water wells.

Regional collaboration has resulted in the adaption of educational approaches across state lines. Educational brochures on well water testing have been customized for different states.



Northeast Water Quality and Production Agriculture: Tools, Technology and Training

Heather Darby, University of Vermont; Masoud Hashemi, University of Massachusetts; Debra Heleba, University of Vermont; John Jemison, University of Maine; Quirine Ketterings, Cornell University

Situation: Farms in the Northeast lie within compact, rural watersheds that contribute to drinking water supplies and an abundance of fresh and coastal water resources. The region's high population areas, high production costs, and limited land base have prompted regional farmers to intensify crop and livestock production. These producers are also considering alternative crops, markets, and practices, including organic production. Nutrient management challenges in these farming systems contribute to pollution risks to ground and surface waters.

NESCI Response: The USDA/NIFA Northeast States and Caribbean Islands (NESCI) Regional Water Center established a Production Agriculture Focus Area to help farmers adopt and/or intensify crop production, while protecting water resources from run-off and leaching of soil, excess nutrients, and pesticides. Programs include: applied research on cropping systems, development and implementation of farmer-friendly nutrient management tools, and education of consultants who guide regional farmers.

Collaborative, multi-year, and multi-location cover crop and corn hybrid research projects were conducted in Maine, Massachusetts, and Vermont. Research results were presented to more than 300 farmers at 15 annual regional field days and research group meetings. Farmers took new knowledge home and implemented these approaches on their farms. For example, use of cover crops in Vermont increased from 100 to 3,000 acres in four years. Farmers reported about two ton increases in corn silage yields per acre. Farmers also predicted savings of about \$30 per acre of nitrogen fertilizer and \$6 per acre on fuel. Acreage under cover crops eliminated more than 6,000 tons of soil loss into Vermont's watersheds. Cover crop adoption continues to increase, and many state and

federal cost-share programs for cover cropping were used to the fullest annually.

The University of Vermont Extension developed a course for livestock producers to create nutrient management

plans (NMPs) that meet state and federal standards. As of 2010, 106 of these farmers have successfully written, implemented, and updated their own plans. A manual with a companion user-friendly computer program was posted online for use throughout the region. The course now

includes turf farmers as well as organic and specialty crop producers. The University of Rhode Island adopted the course. Maine NRCS is evaluating its applicability for that state. Learning tools and applications for farmers in the region are being developed for cell phone technology. With these tools, record keeping on farms will be simplified, broadening the adoption and effectiveness of farmer-led NMP.



Extension program participant installing a rain barrel at his home after the program.

Effective cover cropping improves soil quality while reducing sediment, nutrient, and pesticide loss from fields to protect valuable water quality throughout the region.



Field day training offers an opportunity to convey research results and best management practices for water quality protection.



The University of Maine and Cornell University led efforts to provide regionally based training for Certified Crop Advisors (CCA), the professional certification program of the American Society of Agronomy. CCAs helped farmers reduce on-farm inputs, including fertilizers and pesticides. More than 90 percent of the participants at the 2010 conference said their ability to assist farmers in making decisions about nutrient management, crop production, seed selection, forage management, and insect and weed management had been enhanced. And 94 percent of participants predicted that their farmer clients will use the nutrient management information.

Farmers saved money after working with these trained CCAs, up to \$40 per acre and \$200,000 per farm per year.

On-the-Ground Results: Northeast Extension programs delivered current information on cropping system research and tools for nutrient management planning to farmers and CCAs. These farmers and CCAs are applying this knowledge and implementing these tools on local farms. Less sediment, nutrients, and pesticides are going into Northeast groundwater and surface waters.

Mid-Atlantic Regional Master Well Owner Network

*Erin James Ling, Brian Benham, Stephanie Clemens,
Corrie Cotton and Gulnihal Ozbay, Virginia Polytechnic Institute and State University*



More than 2.2 million homes in the Mid-Atlantic region rely on private water supplies for drinking water. Ground water contamination is a common concern for these residents. Unlike residents served by public water, a homeowner using a private water supply is responsible for all aspects of water system management, including routine maintenance, regular water testing and interpretation of test results, and water quality or quantity problems. Lack of knowledge about private water supply management and water quality issues may lead to system neglect and lack of regular water testing.

The Master Well Owner Network (MWON) is a free educational program initiated in Pennsylvania in 2003 and

subsequently used throughout the Mid-Atlantic region. This award-winning program uses a train-the-trainer approach: Volunteers learn how to maintain their water systems and protect or improve their water quality, then share this information with their neighbors. After the first few years of the Pennsylvania MWON, follow-up evaluations showed that a few hundred volunteers could reach thousands of people. These surveys also showed that 76 percent of well owners educated by a MWON volunteer took some action to better manage their water supplies.

In 2006 the Mid-Atlantic Water Program (MAWP) funded the MWON Coordinator to regionalize

the effort. By 2008 MAWP participants from Virginia Tech received funding from a CSREES (NIFA) 406 competitive grant to establish a formal MWON program for Virginia. Thus far, more than 600 MWON volunteers have been trained in the Mid-Atlantic, primarily in Pennsylvania and Virginia. These volunteers have reported making more than 27,000 educational contacts.

States without resident program coordinators—Delaware, Maryland, and West Virginia—have had limited

In August 2009, 23 volunteers were trained at a Virginia Master Well Owner Training Workshop. Volunteers follow their day-long training by sharing their newfound information with their neighbors through outreach, presentations to civic groups, articles for local newspapers, or agriculture fairs or home shows.
(Photo credit: Erin James Ling)



Many of the Virginia Extension educators who participate in a Master Well Owner Network Training have gone on to host drinking water clinics for the well-owners in their counties. (Photo credit: Erin James Ling)

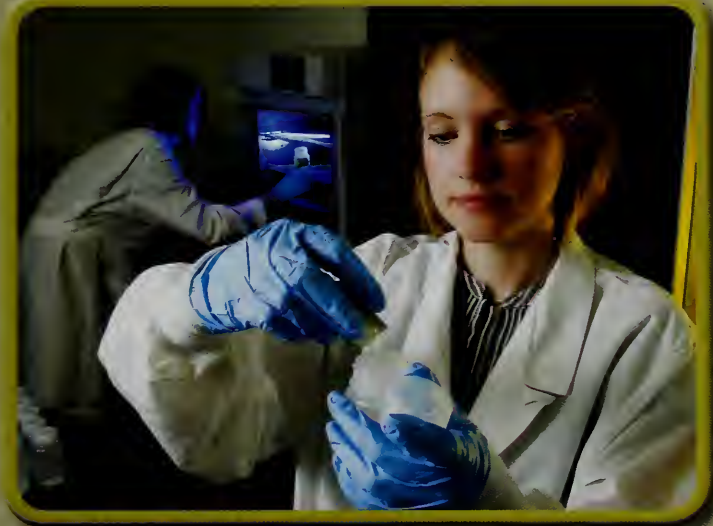


success, so MAWP members have tailored MWON resources toward one-day drinking water clinics for

said they would inspect their water systems

or take some action on their water supplies following the clinic. Similarly, Virginia's eight drinking water clinics conducted in fiscal year 2010 reached 527 people, with 69 percent of participants saying they planned to test their water every year or at least

The Master Well Owner Network received the National Ground Water Association 2006 Ground Water Protection Award and the 2007 Education and Public Service Award from the Universities Council on Water Resources. This prized effort is largely a result of the support from more than 20 partners, including the U.S. Department of Agriculture, universities in the Mid-Atlantic Water Program, states' health and environmental agencies, and groundwater organizations. Recognition for this program continues to grow, and the Mid-Atlantic Water Program hopes to enable sustained programming for the region's future.



Drinking water clinics give well owners an opportunity to analyze their water for 13 different parameters. (Photo credit: Virginia Tech).

homeowners. These clinics provide household water testing services, test result interpretation, and general information about private water systems for well, spring, and cistern users. In Virginia, 40 Extension agents have completed MWON training workshops and now work with the Virginia MWON coordinator to conduct county-based drinking water clinics for homeowners. From 2008 to 2010, drinking water clinics reached more than 2,000 participants across the region.

Evaluations administered at the end of drinking water clinics show the impact of MWON. For example, of 351 participants in the seven drinking water clinics conducted in Pennsylvania in 2010, 90 percent

every few years from now on; 30 percent planned to seek additional water testing; and 23 percent reported they would try to determine the source of pollution affecting their water supply.

Many electronic and print resources have been developed to support MWON's efforts. Well owners in Pennsylvania and Virginia can visit MWON websites to view upcoming events, newsletters, and instructional videos. MWON volunteers can access training manuals, reporting tools, and outreach materials.



Well owners can protect their drinking water by making sure their well is properly constructed and protected with a well cap. (Photo credit: Stephanie Clemens)

Enhancing Management, Coordination and Accountability of BMP Definitions and Effectiveness Estimates

Sarah Lane, Mid-Atlantic Water Program

In 2007 the Mid-Atlantic Water Program (MAWP) led a project, commissioned and funded by the Environmental Protection Agency's Chesapeake Bay Program (CBP), to develop definitions and effectiveness estimates of best management practices (BMPs). Before this project, the estimates for BMPs' effectiveness in reducing nutrient and/or sediment pollution were established through a combination of professional judgment and limited data from controlled research sites managed and maintained by BMP experts. As such, this approach did not reflect the variability of effectiveness estimates in real-world, operational conditions.

However, the CBP used these estimates to model reductions in nutrient loads and report progress in water quality improvement. Ultimately, the modeled progress overestimated actual progress. This inconsistency resulted in negative media coverage, which prompted a 2005 Government Accountability Office investigation that recommended the need for CBP to revise BMP effectiveness estimates.

This project was designed to introduce the gold standard for developing definitions and

effectiveness estimates that reflect operational conditions representative of the entire Chesapeake Bay Watershed. The MAWP devised a set of guidelines and criteria, and a scientific process for developing BMP definitions and effectiveness estimates. Teams of BMP experts from universities, agencies, and non-profit organizations evaluated and revised the BMPs to better reflect current research and knowledge. The final report provides definitions for each BMP, along with effectiveness estimates based on operational-scale

for developing BMP effectiveness estimates, which includes the MAWP's review panel, review of data applicability, and guidelines on data characterization. In addition, the CBP adopted the revised BMP definitions and effectiveness estimates for use in its Watershed Model. By applying reported BMP implementation levels and associated effectiveness estimates, the model can approximate progress toward meeting pollution loads.

Chesapeake Bay states have applied these effectiveness estimates in their efforts to meet recent load allocations established by the Chesapeake Bay Total Maximum Daily Load. These effectiveness estimates are a critical component in nutrient and sediment reduction strategies. Called Watershed Implementation Plans, these strategies use the MAWP's BMP effectiveness estimates to calculate pollution reductions based on specific BMP implementation levels.

With all land-use sectors looking for new solutions to control pollution, many in the Chesapeake Bay area consider water quality trading a potential option. Several organizations are devising tools to help establish this market for



Cover crops such as wheat, barley, and rye help remove the nitrogen that remains in the soil after farmers have harvested their summer crops. Cover crops are one of the most common agricultural BMPs implemented in the Chesapeake Bay watershed.

performance for reducing nutrient, phosphorus, and sediment pollution. A list of future research needs is included to help steer upcoming BMP studies. A complete recording of this process and individual BMP chapters is available at www.chesapeakebay.net/marylandBMP.aspx

Based on this work, the CBP adopted an approval process

nutrients. The World Resources Institute developed NutrientNet that incorporates the MAWP's effectiveness estimates and will act as the platform for Maryland's and West Virginia's trading programs. A forthcoming interstate credit calculation tool for Pennsylvania, Maryland, Virginia, and West Virginia will also incorporate these effectiveness estimates.

MAWP's revised effectiveness estimates are applied in other venues, including in the evaluation process for competitive grants that fund implementation of BMPs in Maryland. While the CBP now has

the tools to continue with its own revision process, the original effort was a landmark attempt to establish a process for reviewing and revising BMPs over a large scale. The recognition of the MAWP as a regional leader in applying science to the needs of decision-makers was key in winning the project, implementing the process, and widely applying the results.



Fencing in cattle and/or providing them with a watering source away from a natural water body helps reduce direct deposits of livestock waste and protects the streams substrate and habitat. (Photo Credit: Interstate Commission for the Potomac River Basin)



Stormwater control is a looming issue for developed areas. Infiltration trenches can be installed to collect stormwater. These basins trap sediment and allow water to infiltrate the soil.

Precision Feed Management in the Mid-Atlantic

*Virginia Ishler, Pennsylvania State University
and Richard Kohn, University of Maryland*

In 2007 Mid-Atlantic Water Program (MAWP) scientists applied the national feed management program to the needs of dairy consultants in the Chesapeake Basin. This program certifies consultants in precision feed management, a practice that reduces nutrient loads in animal wastes by minimizing phosphorus and nitrogen content in the feed.

Certified consultants in feed management assist dairy producers in improving herd nutrition and meeting new conservation requirements. The current regulatory and economic situation requires cost-effective measures to control nutrient pollution. Precision feed management has not been widely implemented, but has been accepted as a critical practice to help reduce nutrient pollution in the Chesapeake Bay region, largely due to the work of MAWP scientists.

After recognizing that few educational opportunities were available to prepare for the certification exam, and that the exam's \$100 processing fee could discourage participation, the project team developed trainings for consultants and offset the exam fee through funding from the MAWP. Partners in this effort include the American Registry of Professional Animal Scientists (ARPAS), which oversees the certification process, and the Chesapeake Bay Foundation, which financed manure sampling from herds on a feed management plan.

The first certification training, held in November 2007, attracted 105 registrants. About half passed the ARPAS exam. These nutritionists represented the major feed companies in the Mid-Atlantic Region. Since 2007, more trainings have been offered to both consultants and NRCS personnel, for a total of 214 participants. To date, the Chesapeake Bay states hosts 68 certified nutritionists, comprising 80 percent of the nation's certified nutritionists.

The project team offered follow-up workshops on feed management plans, teaching certified consultants how to write a plan. By attending workshops on actual farms, participants could ask questions of the producer and the nutritionist and gain the necessary information for an effective plan. Since feed, milk, and manure samples had been analyzed, participants had all the information to write the plan as if it were real. While the project team provided the training necessary to get nutritionists certified, they also helped nutritionists write the two plans needed to meet NRCS's requirement to become a technical service provider (TSP). In 2010, multiple plan-writing workshops allowed nutritionists to complete their two plans. Currently, 23 consultants are prepared to register as TSPs.

Implementing these efforts came at a critical time. With the recent release of the U.S. Environmental Protection Agency's Total Maximum

Daily Load for the entire Chesapeake Bay, the agricultural community needs the best practices to control nutrient pollution while minimizing impacts. Over the years, this project team has established precision feed management as both an economically and environmentally viable best management practice. As such, state watershed implementation plans include precision feed management as a method to meet load allocations.

Additional efforts have been implemented to educate consultants about the regulations and issues affecting dairy producers. Currently, the Pennsylvania team is working with producers to monitor income over feed costs and to develop a cash flow plan, which provides the opportunity to implement precision feeding practices while monitoring economic benefits.

Funding from the MAWP was critical to providing these trainings and establishing precision feed management practice that farmers can realistically utilize. The infrastructure is in place to address the demand for more feed management plans, and the MAWP will continue to meet the educational needs of this audience.



Travis Edwards, assistant manager at Penn State University, checks the particle size distribution of the total mixed ration to make sure length is correct so cows cannot sort feed. Certified consultants are critical in improving herd nutrition, so the Mid-Atlantic Water Program has targeted training for implementing precision feed management. (Photo Credit: Pennsylvania State University)



The Chesapeake Bay is facing a watershed-scale TMDL, with all sectors looking to reduce nutrient loads. By minimizing the phosphorus and/or nitrogen content in the feed, farmers can save money and reduce their nutrient pollution. (Photo Credit: University of Maryland)



Penn State University employee pushing feed up to the cows so they consume the allotted amount of feed programmed. (Photo Credit: Pennsylvania State University)

Development and Use of the Mid-Atlantic Nutrient Management Handbook

G.K. Evanylo, K.C. Haering, D.B. Beegle, W.L. Daniels, S.W. Duiker, D.J. Hansen, A.O. Abaye, T.J. Basden, R.W. Taylor, G.D. Binford and G.L. Mullins, Virginia Polytechnic Institute and State University

The Mid-Atlantic Water Program was established to provide science-based expertise and educational support for agencies and stakeholders who need access to current science-

Before 2006 the primary reference resource for nutrient management training in the Mid-Atlantic region was a handbook written in 1995. The advances in nutrient

a set of PowerPoint slides. Both the handbook and the slides are available for open access on the MAWP website. The Mid-Atlantic Nutrient Management Handbook has been adopted as the primary reference by all Mid-Atlantic agencies that oversee the state nutrient management certifying process.



Managing a farm's production requires consideration of several elements. Nutrient management plans are one tool that producers rely on for maintaining production while minimizing nutrient pollution. The Mid-Atlantic Nutrient Management Handbook has been adopted by all five states in the region as the main reference for programs training the specialists who write nutrient management plans and devise recommendations. (Photo Credit: University of Maryland)

based information necessary to reduce nutrient impairment from nonpoint sources of pollution in the region's water supply. Nutrient management planning is used by producers to reduce water quality nutrient impairment from agricultural fertilizers, manures, biosolids, and other soil. These plans are developed by certified nutrient management specialists who rely on training to receive their certifications.

management planning since 1995 meant a revision of the previous manual was required. Realizing this need, and the opportunity to develop a more user-friendly resource for the entire region, MAWP scientists started revising the outdated reference.

By leveraging MAWP funds with that of land grant universities, Extension and research faculty published an award-winning manual along with

In November 2006, the Mid-Atlantic Nutrient Management Handbook received a Certificate of Excellence for development of outstanding agronomic educational materials from the American Society of Agronomy. To date, thousands of certified nutrient management specialists and Extension staff in Maryland, Virginia, West Virginia, Pennsylvania, and Delaware use this text as a reference when writing nutrient management plans or developing recommendations. Portions of the manual have been incorporated into the U.S. Department of Agriculture Natural Resources Conservation Service's (NRCS) Agronomy Manual, a national reference for NRCS state and field level conservation planners and agronomists. Free and easy access to the online manual has allowed university teaching faculty to use chapters as reference materials in their courses.

Properly sampling the field for soil tests is critical in determining recommendations for fertilizer or other amendments. (Photo Credit: University of Maryland)



Regional Cropland Nutrient Budgets: Lessons Learned

*Jim Pease, Doug Parker, Alan Collins, Dave Hansen
and Doug Beegle, Virginia Polytechnic Institute and State University*

Crops and livestock need nutrients to grow and reproduce. In a closed system, farmers apply manure and fertilizer to cropland, then feed the harvested crops to their livestock. This process produces more manure and continues the cycle. Although crops absorb much of the nutrients from manure, excess nutrients are either stored in the soil or lost to the environment through volatilization, surface runoff, or groundwater leaching. A nutrient budget can be used to determine the potential for such losses through simple equations that determine the difference between the nutrients applied to cropland and the nutrients removed in crop harvests. The resulting balance indicates the potential for nutrients in the soil or lost to the environment.

In 2003 the Mid-Atlantic Water Program (MAWP) developed an online regional nutrient budget for phosphorus (<http://www.mawaterquality.ugecon.vt.edu/>) for Delaware, Maryland, Pennsylvania, Virginia, and West Virginia. The budget used publicly available livestock numbers, fertilizer sales, and crop acreages to determine county-level phosphorus supply and crop demand estimates, primarily for Census of Agriculture years 1987, 1992, 1997, and 2002. In 2008 the budget was updated to include nitrogen nutrients, and now incorporates 2007 Census of Agriculture data.

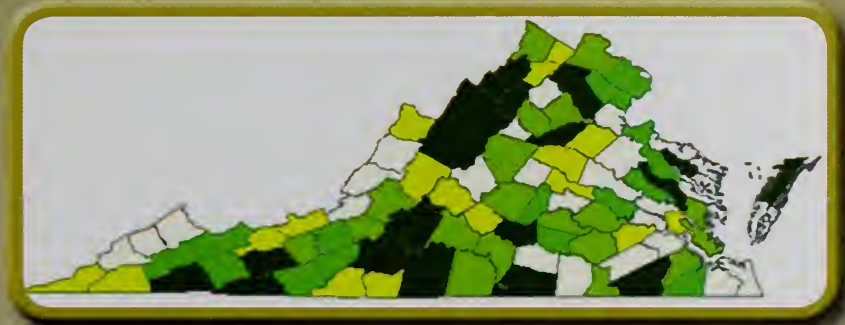
While inherent weaknesses in the data are incorporated into the budgets, the development of the phosphorus budget spurred others to determine regional nutrient budgets for other states and areas. On the Chesapeake Bay, the phosphorus budget also led to a new public focus on regional nutrient imbalances. By graphically representing nutrient flows and stores, the budgets show the potential for nutrient hot spots and the magnitude of nutrient imbalances. From a policy perspective, the budgets demonstrated opportunities for targeting nutrient control efforts toward specific areas.

The graphical nature of the budgets allows ease of use for teaching agricultural producers and organizations, public agencies, and concerned citizens about these nutrient "hot spots." Extension specialists developed educational programs on the need to consider environmental sustainability of continued nutrient imbalances within the Chesapeake Bay region, which is receiving increasing attention for its water quality problems. The MAWP nutrient budgets were displayed in the Environmental Protection Agency's "Guidance for Federal Land Management in the Chesapeake Bay Watershed," a report published in response to President Obama's 2009 Executive Order to restore the Chesapeake Bay. This report included the MAWP

nutrient budgets to show the need for focusing federal efforts. To meet the goals of this Executive Order, the EPA has established a bay-wide TMDL for the Chesapeake. While all sectors and lands are subject to meeting load allocations, the EPA has established priority areas to target.

Regional nutrient budgets that use only publicly available data sources have inherent weaknesses. Inaccuracies build with limited data and uncontrolled forces. For instance, chemical fertilizer sales in a county do not account for movement within and out of the county, or application to non-croplands. Since accurately monitored data is not available, assumptions are made on the amount of nutrients removed by harvested crops, which may not be constant across the region over time. Perhaps the most important shortcoming of regional nutrient budgets is jurisdictional data collection, which occurs at a county scale, while the nutrient imbalances that affect water quality follow hydrological boundaries. Nevertheless, the MAWP's regional nutrient budgets have proven to be valuable for educators and policy makers alike, both in support of water quality education programs and as evidence to consider when formulating water quality protection programs.

This example of nitrogen balance in Virginia's cropland indicates that the darker areas are at risk of having the highest amount of nitrogen left in the soil. By compiling data and displaying the output on a geographic basis for the region, the Mid-Atlantic Water Program helped demonstrate the need for targeting pollution control to areas with the highest nutrient loads. (Image Credit: Mid-Atlantic Water Program)



This example of nitrogen balance in Virginia's cropland indicates that the darker areas are at risk of having the highest amount of nitrogen left in the soil. By compiling data and displaying the output on a geographic basis for the region, the Mid-Atlantic Water Program helped demonstrate the need for targeting pollution control to areas with the highest nutrient loads. (Image Credit: Mid-Atlantic Water Program)



Educational Efforts on Water Quality Credit Trading Policies in the Mid-Atlantic Region

Doug Parker, University of Maryland; Charles Abdalla, Pennsylvania State University; Kurt Stephenson, Virginia Tech University; Tatiana Borisova, University of Florida

Since the US EPA began promoting nutrient trading programs as one way to address water quality impairments, programs around the region have started to evaluate how such programs could reduce pollution. Nutrient trading allows one source of pollution to meet its regulatory obligations by paying another source to reduce emissions beyond its own requirements – in concept, giving regulated sources more options to meet their obligations. While states in the Mid-Atlantic region sought to advance nutrient trading, many stakeholders did not fully understand nutrient trading programs and their inherent opportunities and obstacles.

Recognizing the need to educate citizens, policy-makers and agricultural, environmental, and municipal interest groups, members of the Mid-Atlantic Water Program (MAWP) began providing unbiased, science-based information through publications, workshops, and personal guidance. The effort that helped launch this initiative was “A Primer on Water Quality Credit Trading in the Mid-Atlantic Region,” a regional resource that explained trading systems and their potential benefits and consequences. MAWP members also developed state-specific inserts for Maryland, Pennsylvania, Virginia, and West Virginia, who were all in the process of considering or developing trading programs.

The MAWP has received feedback from audiences that the Primer has not only helped them better understand trading but has also helped them ask questions of policy-makers regarding water quality and nutrient trading. Policy-makers have also responded, stating that the information was useful for state-level policy design. The Chesapeake Bay Commission, a legislative body that provides recommendations to the Maryland, Virginia, and Pennsylvania General Assemblies, requested that the publication be dispersed to State legislative representatives.

Following on the interest of the Primer, the MAWP partnered with

the EPA Chesapeake Bay Program’s Scientific and Technical Advisory Committee to advocate for better accountability of trading programs and procedures, leading to the development of a policy evaluation protocol. These educational materials helped EPA meet their obligations under the Presidential Chesapeake Bay Protection and Restoration Executive Order.

With the evaluation protocol providing a framework for MAWP scientists to provide guidance on the intricacies of setting up trading programs, members have provided state-specific guidance to policy-makers in four states. In Maryland, the MAWP was a part of



In nutrient trading, water quality standards are achieved when one polluter pays another to reduce emissions beyond its own requirements. Ensuring that a program meets the ultimate goal of cleaner water, however, requires accountability from all parties involved in the transaction.

the advisory committee that wrote the state's nutrient trading program, and members continue to actively advise the state as the trading program is implemented.

Fostering greater dialogue has been critical for raising awareness of this issue. As such, the MAWP has hosted a national seminar and two regional workshops on trading programs. The largest of the three efforts was a regional workshop, which filled quickly and had to be expanded to accommodate the waiting list. Approximately 90% of the 120 registrants stayed through the final session to glean all they could about trading challenges and innovative trading options. Nearly 70% of participants rated the workshop as 'very good' or 'excellent'.

Promoting the educational strategies and their results has been a priority for the MAWP. At least 25 presentations have been provided at 21 conferences and workshops. A journal article based upon the primer won the 2008 Best Article of the Year Award for the American Agricultural Economics Association's Choices Magazine.

Due to above efforts, the MAWP is recognized as a national leader on water quality and nutrient trading programs. The USDA's new Office of Ecosystem Markets approached the MAWP for help in designing a national template for water quality trading program design. Working with other regions from the national program, the MAWP is planning to



Water quality restrictions, like Total Maximum Daily Loads, control how much pollution is allowed by each economic sector. For communities looking to revitalize or grow, nutrient trading programs can allow for development.



Nutrient trading may help agricultural producers finance water quality improving practices.

host regional workshops around the country to build a better understanding of how to develop effective water quality credit and nutrient trading programs for some of the nation's largest watersheds.

Down-Well Camera Team Protects Essential Aquifers and Human Health in the Southern Region



*Glynn Beck, Kentucky Geological Survey
and Diane Boellstorff, Texas A&M University*

More than 100 videos taken from within water wells have been recorded throughout the Southern Region. The videos show cracked casing, rust holes in steel casing, root growth, calcified well screens, and dead animals or other foreign debris in the wells. These water well defects cannot be diagnosed above ground and can lead to contaminated groundwater and pollution of aquifers, some needed by millions of residents.

High-quality groundwater resources are vital for meeting increasing water needs of the southern United States. To protect groundwater quality, well owners must be provided with information on the link between contaminated surface water and groundwater. Private well owners are responsible for monitoring the quality of their wells and are frequently at greater risk for exposure to compromised water quality. Down-well cameras enable researchers, Extension personnel, water well drillers, and well owners to go beyond the traditional above-ground inspection. The camera enables top-to-bottom well inspection from inside the well casing. The Southern Region Down-Well Camera Project enables Extension personnel and well owners to access visual information regarding domestic water well issues.

The down-well camera project has created



A well camera inspection in Georgia revealed a rust hole in the steel casing that allowed shallow groundwater to enter the well. The hole is well above the water table and is a potential avenue for contaminants to enter the well and local groundwater system. Because of this inspection the hole in the casing was fixed and the local groundwater was protected from potential degradation.

a team of experts from seven states in the Southern Region—Georgia, Kentucky, Tennessee, Louisiana, Texas, Oklahoma, and Alabama—that uses down-well cameras to address water well issues. Personnel in each state have received training on using the camera to diagnose various water well issues. Down-well video footage is presented by Extension and state natural resource agency personnel during local meetings to inform rural water well owners on the condition of their wells and on well problems typical for the area. In addition, the video footage has been presented at state, regional, national, and international meetings.

Team members in Georgia and Kentucky edited the video footage to produce educational videos tailored to local hydrogeology. These videos describe water-well construction regulations, well maintenance, impacts on drinking water and groundwater quality, local hydrogeology, and risks to the aquifer, and are available to Extension personnel and well owners. The videos are also linked on the Southern Region website at <http://srwqis.tamu.edu/program-information/success-stories/regional-down-well-camera-video>.

In addition to the well education video, team members from Kentucky created a well education website that features video footage collected from the project and additional footage collected by other Kentucky agencies. The website contains information on well types and construction, and simplified descriptions of water-well construction regulations. The site provides video and photo examples of problems that may occur in wells and recommendations for remediation. The website is a pilot project to be used as a model to create Southern Region Water Well and Aquifer Web pages, which will be used during Southern Region Well Owner Network training.

Project outcomes include improvement of private well management leading to enhanced protection of aquifers, key groundwater resources, and rural drinking water

supplies. More than 100 down-well videos created to date have led to improved water quality for 136 families

and elimination of 136 direct points of contaminant conveyance to critical aquifers.

The well camera is used to inspect a cement-tiled well in Kentucky. In the picture are, left to right, Lincoln Martin, Marshall County Extension Agent; Glynn Beck, Kentucky Geological Survey; Megan McMeans, Kentucky Geological Survey; and Bill Thom, University of Kentucky. Photo by Paul Vendrell, University of Georgia.



Texas A&M University team members (Monty Dozier, John Smith, Diane Boellstorff, and Mark McFarland) receive training from Paul Vendrell of the University of Georgia. Photo by Glynn Beck, Kentucky Geological Survey.

Watershed Academy – Principles of Water Monitoring, Planning, and Restoration

*Eve Brantley, PhD, Auburn University, Alabama Cooperative Extension System;
Cal Sawyer, PhD, Clemson University, South Carolina Cooperative Extension Service;
Greg Jennings, PhD, North Carolina State University, NC Cooperative Extension Service; and
Mark Risse, PhD, University of Georgia, Georgia Cooperative Extension Service*

Watershed Academy offers trainings in watershed management, including monitoring, planning, and restoration, to Extension agents, local, state, and federal representatives, nonprofit and watershed stakeholders, and natural resource professionals. Watershed Academy trainings introduce diverse watershed topics such as hydrology, natural resource-based planning, stormwater management, erosion and sediment control, ecosystem restoration, stakeholder involvement, and project funding. Regional Extension water professionals deliver effective and engaging presentations to agents, watershed nonprofit representatives, local, state, and federal agency contacts, and natural resource professionals. Multi-state partnerships tailor trainings to be uniquely relevant for each location.

Participants identify actions, on-the-ground projects, and opportunities to make changes that will improve local water quality in their communities. To date, more than 200 natural resource professionals have been trained in Watershed Academies in the Southern Region. Ten Watershed Academies have been held since 2004:

- Fairhope, AL
- Asheville, NC
- Clemson, SC (two)

- Athens, GA
- Duck, NC
- Nashville, TN
- Georgetown, SC
- Pine Bluff, AR
- Mentone, AL

Classroom lectures are followed by field tours where students get their feet wet and have hands-on experiences in streams. Watershed science basics such as hydrology and stream ecology are introduced to improve understanding of complex ecosystem interactions. An overview of natural resource-based planning emphasizes case studies and lessons learned. Solutions and on-the-ground practices for stormwater management and watershed restoration provide examples of watershed protection, improvement, and restoration. Effective communication and education tips encourage and empower participants to use the knowledge they gain during this training. Watershed Academy is a multi-state partnership of the Southern Region Water Quality Extension Program, funded in part by the U.S. Department of Agriculture's National Institute of Food and Agriculture.



Watershed Academy in partnership with Tennessee State University



Watershed Academy in Fairhope, AL

Extending Information Developed by the Nutrient Management Team: P Index

*D. Osmond, NC State University; M. Cabrera, University of Georgia;
S. Feagley, Texas A&M; G. Hardee, USDA-NRCS; C. Mitchell, Auburn University;
P. Moore, USDA-ARS; R. Mylavarapu, University of Florida; J. Oldham, Mississippi State University;
J. Stevens, Louisiana State University; W. Thom, University of Kentucky;
F. Walker, University of Tennessee; and H. Zhang, Oklahoma State University*

In 1980, the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) revised its nutrient management conservation standard (NRCS 590), which included a provision that all states were required to address soil phosphorus (P) buildup from animal manure applications. Most states chose to develop individual phosphorus risk assessments to meet this standard; a few states, however, developed standards in concert with neighboring states. The P-Index ratings from 12 southern states—Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, New Mexico, North Carolina, Oklahoma, South Carolina, Tennessee, and Texas—were compared on fields representing three dominant southern agricultural systems: upland pasture, upland corn field, and artificially-drained field. The structure of each P Index varied enough to produce widely divergent ratings when applied to similar scenarios where individual factors such as soil test phosphorus, poultry broiler litter application rate, or buffer absence or presence were adjusted across a broad range of P-Index input values. Variation in P-Index ratings was, rather, the unique combination of each state's selected factors, factors weighting, and factor combination (added, multiplied, or a mixture of both). Although the flexibility of and differences between

the southern states' P-Indices result in diverse P-Index ratings for the same set of conditions, the diversity in P-Index construction allows for indices designed to match individual state conditions and concerns. The substantial differences in P-Index results highlight the need for close coordination between states in revising P-Indices to be applied across state lines. The Southern NIFA-Water Project Nutrient Management team, in an attempt to align P Indices more closely, compared P Indices against runoff data from pastures in Georgia to which poultry litter was applied. Phosphorus runoff amounts were compared to state P Indices. Measured phosphorus losses from the Georgia pastures ranged from about 6 to 32 kg ha⁻¹, which is an extremely rate of loss for phosphorus. For each pasture plot analyzed using each state's P Index, only four or five states of the 12 predicted phosphorus losses of very high. These results suggest that many P Indices are underestimating actual phosphorus runoff, and therefore, state P Indices should be nominally validated.

Comparing ratings of the southern phosphorus indices

D.L. Osmond, M.L. Cabrera, S.E. Feagley, G.E. Hardee, C.C. Mitchell, P.A. Moore Jr., R.S. Mylavarapu, J.L. Oldham, J.C. Stevens, W.O. Thom, F. Walker, and H. Zhang

ABSTRACT: The use of site assessment indices to guide agricultural phosphorus (P) nutrient management has been widely adopted in the United States. This study compares P-index ratings from 12 southern states (Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, New Mexico, North Carolina, Oklahoma, South Carolina, Tennessee, and Texas) on fields representing three dominant southern agricultural systems: upland pasture, upland cornfield, and artificially drained field. The structure of each P-index varied enough to produce widely divergent ratings when applied to similar scenarios where individual factors (such as soil test P, poultry broiler litter application rate, or buffer absence or presence) were adjusted across a broad range of P-index input values. Variation in P-index ratings was the unique combination of each state's selected factors, weighting of the factors, and factor combination (added, multiplied, or a mixture of both addition and multiplication). Although the flexibility of differences among the southern states' P-indices result in dramatically diverse P-index ratings for the same set of conditions, the diversity in P-index construction allows for indices designed to match individual state conditions and concerns. The substantial differences in P-index results identified in this survey highlight the need for close coordination between states in revising P-indices if they are to be applied across state lines.

Keywords: P-index, Southern CSREES region

Nutrient management policy in the United States is framed by the U.S. Department of Agriculture (USDA)—Natural Resources Conservation Service (NRCS) Code 590 (USDA/NRCS, 1999). This policy, stemming from a joint agreement between the U.S. Environmental Protection Agency

and the intent of the P-index is that conservation and nutrient management planners will use it to identify critical sources of P loss in agricultural watersheds, and to evaluate alternative management options to reduce these risks (Lemunyon and Gilbert, 1993). Nearly all states have embraced the P-index approach.

loss, soil test P and P application rate, quantified (Sharpley et al., 2003). In addition, some states, such as Georgia, Arkansas, Iowa, and North Carolina have developed "predictive" P-indices, or loading models that calculate edge-of-field P loss in $\text{ha}^{-1} \text{yr}^{-1}$.

Other factors, such as resources available in individual states and priorities of states involved in P-index development committees, helped to shape each state's P-index. For example, Alabama adopted a very simple P-index that could be communicated on paper (Charles Mitchell, personal communication), whereas North Carolina placed a priority on ensuring that their P-index reflected the most advanced scientific standing of P transport (Carroll P. Moore, personal communication). Elsewhere

Deanna L. Osmond is professor of soil science in the Department of Soil Science at North Carolina State University in Raleigh, North Carolina. **L. Cabrera** is professor of agronomy in the Department of Crop and Soil Sciences at the University of Georgia in Athens, Georgia. **Sam E. Hardee** is professor of soils in the Department of Crop Science at Texas A&M University in Station, Texas. **Gene E. Hardee** is an agronomist in South Carolina's U.S. Department of Agriculture, Natural Resources Conservation Service in Columbia, South Carolina. **Charles Mitchell** is a professor of soil science in the Department of Agronomy and Soils at Auburn University in Auburn, Alabama. **Rao S. Mylavarapu** is an associate professor of soil and nutrient management in the Soil and Water Science Department at the University of Florida in Gainesville, Florida. **P.A. Moore, Jr.** is a soil scientist in

Our Landscape, Our Stream, Our Watershed: A Multi-State Advanced Master Gardener Program Addresses Urban Water Issues

*E. M. Bauske, E. Brantley, T. Davis, Fonseca, K. F. Henning,
R. M. Seymour, K. Smith and C. Tanner, University of Georgia*

Abstract: Teams of Master Gardener coordinators, Extension agents, and specialists from Georgia, Alabama, and South Carolina developed an advanced training on urban water issues for Master Gardener (MG) volunteers. The training, "Advance Concepts in Water Smart Landscape Design," includes many aspects of watershed management not generally covered in MG training, such as nonpoint sources of water pollution, the effect of impervious surfaces and infiltration on water quality, the role of sediment as a pollutant, and stream habitat and water quality assessment. Each state team developed one 2.5-hour training and delivered it to 293 MG volunteers in 22 locations and four states. The trainings used Internet-based live classroom technologies. Extension professionals in each location offered hands-on activities, assuring the trainings were locally relevant and encouraging active participation. MG volunteers often deal directly with homeowners, and homeowner activities impact both water quality and quantity in urban watersheds.

Outcome Report Narrative:

From drought to flood, urban Extension agents are on the front line dealing with urban water issues. Agents deliver water messages to the public and frequently use Master Gardener (MG) volunteers to assist them. MG volunteers are uniquely positioned to deliver water quality and quantity information to homeowners. In working with Extension, MG volunteers educate the public. They answer telephones, give presentations, write newsletters, and conduct many other educational activities. They also apply their knowledge in their landscapes, neighborhoods, and communities, expanding the impact of their educational outreach. The impact of many landscape practices on urban water quality and quantity is well defined. Currently, this information is not included in the MG training curriculum. Developing the knowledge base of these volunteers strengthens the delivery of water quality and quantity messages.

Teams of MG coordinators, agents, and specialists from Georgia, Alabama, and South Carolina met to pool their resources. The result was an advanced MG training on urban water issues entitled "Advanced Concepts in waterSmart Landscape Design." The goal was to define

the landscape's impact on the watershed and empower MG volunteers to think beyond the yard, to local streams, and ultimately, to the watershed.

The teams developed a three-day training with each state leading for a day. The training included the seven steps of waterSmart landscape design and the conversion of a high water use landscape to a low water use landscape. Topics included identification of landscape pollution sources, their transportation, and treatment; infiltration and impervious surfaces; irrigation audits; rain gardens; and rain harvesting. Volunteers were taught to identify healthy streams by focusing on visual, chemical, physical, and biological stream assessment.

All trainings were conducted using Internet Distance Education Technology. Local agents hosted the trainings in libraries, county offices, and other meeting rooms. Host agents selected hands-on activities that complemented their local programs and needs. Participants installed rain gardens, designed waterSmart landscape retrofits, did irrigation audits, made rain barrels, and assessed stream health, as well as many other activities.

Master Gardener in Cherokee County, GA, plants a rain garden.



A total of 293 MG volunteers were trained in the four states. Fifty-two volunteers from Alabama, 181 from Georgia, 51 from South Carolina, and nine from Tennessee participated in the trainings, which were delivered to 22 locations simultaneously. Pre- and post-training assessments demonstrated the groups were more knowledgeable about the subject matter after training. Assessment scores increased by 14 percent to 22 percent. MG participants reported they contacted 16,135 homeowners each year and estimated that 12,021 of these homeowners would benefit from this training.

Participants were given a six-month follow-up survey, and 41 percent responded. According to survey results, the project strengthened the delivery of water quality and quantity messages to homeowners.

- 53 percent changed an aspect of their home

landscape because of this training (Examples given: redesigned planning beds, switched to drip irrigation, collected rainwater collection, added more plants to stabilize creek banks, switched to low water use plants, reduced irrigated turf, and created dry creek beds to redirect water)

- 91 percent planned to make changes in their landscape because of this training
- 84 percent had shared this training information (Examples given: delivered waterSmart presentations, created exhibits, wrote newsletters on rain barrels, and began an Adopt-A-Stream group)
- 74 percent changed their recommendations, considerations, or activities as a result of this training



Master Gardeners in Greenville, SC, learn about stream health assessment.

This project was coordinated by the University of Georgia Center for Urban Agriculture and funded by a grant from the Southern Region Water Coordination Project.

Master Gardeners in Coweta County, GA, receive training use Distance Learning Technology.



Louisiana Yards and Neighborhoods Program

Bobby Fletcher, Louisiana State University AgCenter and Barbara Doll, North Carolina State University

This Louisiana Yards and Neighborhoods (LYN) program encourages homeowners to create and maintain landscapes in ways that minimize environmental damage. This includes investigating water quality and conservation, reducing storm water runoff, decreasing nonpoint source pollution of surface water, enhancing desirable wildlife habitats, and creating functional, attractive landscapes.



The program, which is implemented through the Louisiana State University Agricultural Center Cooperative Extension Service parish agents with the support of Louisiana Master Gardener™ volunteers, provides education and outreach activities to help residents reduce pollution, conserve water, and improve home and landscape management.

This integrated approach to landscaping emphasizes seven interrelated principles: using the right plant in the right place, watering

efficiently, maximizing mulch and recycling yard waste, fertilizing appropriately, managing yard pests, protecting surface waters and wetlands, and providing beneficial wildlife habitat.

This LYN handbook provides helpful ideas, information, and techniques to create and maintain an environmentally friendly landscape. In 2007, 55 Louisiana Master Gardeners were certified in at least one of these principles in Lafourche and Terrebonne parishes. In addition, since 2008, more than 700 Master

Gardeners-in-training have received a copy of the handbook as part of the volunteer training. The LYN program was selected as the 2008 Southern Region Extension Communicators Award winner by the American Society for Horticultural Science.

In 2010, LYN principles were highlighted through outdoor signs at Louisiana House and landscape on eight acres near the LSU campus. Each year, more than 1,000 residents visit the grounds of Louisiana House and landscape.



LaHouse

Home & Landscape Resource Center

Sustainable Landscape

Welcome to the LaHouse sustainable landscape. This landscape demonstrates the seven principles of gardening that minimize environmental damage — putting the right plant in the right place; watering efficiently; maximizing mulch and recycling yard waste; fertilizing efficiently; managing yard pests; protecting surface water and wetlands; and providing beneficial wildlife habitats.



- ① Annual Plants Display
- ② Butterfly and Hummingbird Garden
- ③ Daylily Display
- ④ Ornamental Grasses
- ⑤ Herb Garden
- ⑥ Crimson Azalea Display
- ⑦ Bog Garden
- ⑧ Perennial Garden
- ⑨ Drought-Tolerant Plants Display
- ⑩ Rain Garden
- ⑪ Rose Garden
- ⑫ Knock Out Rose Display
- ⑬ Louisiana Iris Display
- ⑭ Encore Azalea Display
- ⑮ Vegetable Garden
- ⑯ Fruit and Berry orchard
- ⑰ Iris Garden

The ideal Louisiana-Friendly Yard is an environmentally friendly landscape.

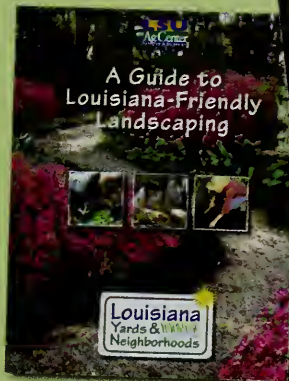
Louisiana Yards & Neighborhoods



The ideal Louisiana-friendly landscape is an environmentally friendly landscape.



The LYN guide provides helpful ideas, information and techniques to create and maintain a more environmentally friendly landscape. You will learn the basics of designing a landscape using carefully selected plants suited to Louisiana growing conditions.



www.LSUAgCenter.com/LYN



Right Plant, Right Place
Populate yards with plants suited to Louisiana growing conditions



Water Efficiently
Conserve water and reduce stormwater runoff



Maximize Mulch & Recycle Yard Waste
Improve soil and reduce landscape maintenance



Fertilize Effectively
Apply the right amount — the right way



Manage Yard Pests
Choose natural controls and practices instead of chemicals



Protect Surface Waters and Wetlands
Limit, filter stormwater runoff with well-designed, managed landscape



Provide for Beneficial Wildlife Habitat
Preserve the beauty of Louisiana's natural habitats and ecosystems

Louisiana Yards & Neighborhoods program is developed by the LSU AgCenter and supported by Louisiana Master Gardeners.

Community-Based Restoration Initiatives

Eve Brantley, Auburn University Department of Agronomy and Soils, Alabama Cooperative Extension System and Charlene LeBleu, Auburn University College of Architecture, Design, and Construction

Demonstration projects, community outreach, college student involvement, and natural resource professional trainings were all a part of this successful Extension-Education U.S. Department of Agriculture 406 grant. Five communities in different regions of Alabama—Alexander City, Brewton, Eufaula, Pike Road, and Auburn— were selected to serve as community partners for the Auburn University Landscape Architecture program and the Alabama Cooperative Extension System Water Program.

The students considered these spotlight communities as clients and spent time in each community learning the water quality concerns, issues, and stakeholders. County Extension agents, local watershed groups, and local government representatives participated in charettes conducted by the college students. These charettes were visioning tools that helped the community set priorities and assisted the students in creating and presenting innovative solutions to water resource concerns.

Each client had a unique concern that challenged the students to be creative and inventive. Solutions

included on-the-ground and educational practices, and suggestions for updated regulations and ordinances. As a result of this project, five bioretention areas were installed, two stream improvement projects were undertaken, and a stormwater wetland was created. In addition, the students gave each community a planning document that outlined potential solutions for local water improvement and community planning.

The outcome was increased knowledge in three important areas: watershed management, stormwater management, and stream improvement. The students were able to build their portfolios from the exposure to real world situations and made contacts that served them well after graduation. Alabama benefited from the increase in new, young professionals with different perspectives on watershed management and community planning. Most important, water quality and stream health were improved in the communities where the program's on-the-ground projects were installed.



Construction of the Benjamin Russell High School rain garden in partnership with the Clean Water Partnership and the Boys and Girls Club of Alexander City, AL July 2004



Picture of the rain garden 5 years later!

Sediment Fingerprinting: A New Approach for Muddy Stream

*D. Radcliffe, R. McKinley, R. Mukundan
and L.M. Risse, University of Georgia*

Many streams in the southern United States turn a muddy brown during storms. Too much sediment degrades water quality, and states have programs to reduce the sediment in streams. The source of this sediment is not clear. The traditional assumption is that the sediment comes from eroding farm fields, construction sites, forest where timber is being cut, and unpaved roads. However, the real source may be erosion from stream banks.

In this project, funded by the U.S. Department of Agriculture (USDA) National Institute of Food and Agriculture (NIFA) Integrated Water Quality Program, a new technique called sediment fingerprinting was used to determine the source of the stream sediment in a typical Southern Piedmont watershed. With this technique, flowing sediment is collected from a stream during storms, when most of the sediment is transported, and analyzed for chemical tracers attached to the sediment. These tracers can sometimes be used to tell the source of the sediment.

One of the tracers was cesium-137. This compound was dispersed in the atmosphere during the nuclear bomb tests of the 1950s and 1960s and deposited as fallout on the earth's surface. Cesium-137 is adsorbed tightly to soil and doesn't move from the soil surface. Because it has no natural sources in the environment, cesium-137 serves as a unique tracer for erosion of surface soils.

A truck-mounted mobile centrifuge and pump were used to collect samples during storms. This equipment was needed because a large sample of sediment is required

for analysis of cesium-137. Stream sediment was found to be low in cesium-137, indicating that the major source was sediment that had not been at the surface in the last 50 years. This could have been sediment eroded from stream banks, but could also have come from unpaved roads or construction sites where the topsoil is gone. To distinguish banks from these other sources, another tracer, delta N-15, a heavy isotope of nitrogen, was used. This tracer is high in areas where nitrogen cycling is intense.

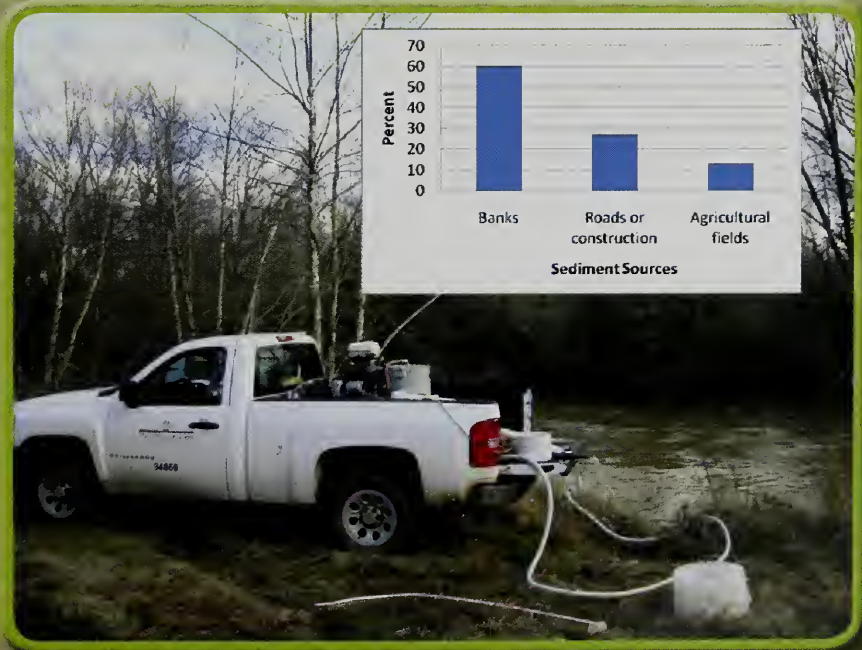
Using the two tracers, researchers determined that about 60 percent of the sediment came from bank erosion, 27 percent from unpaved roads or construction sites, and 13 percent from agricultural fields. These results showed agricultural fields are not the primary source for this typical rural watershed.

Current efforts are aimed at reducing the costs for sediment fingerprinting so state agencies can use this method. The major costs are due to analysis of cesium-137 at about \$100 per sample, and use of the truck-mounted centrifuge, at \$20,000 for the centrifuge and pump. Researchers are testing to see if delta N-15 and carbon can be used to identify the sources, at \$20 per sample, and automated stream samplers can be used to collect sediment during storms. Large samples are not required for carbon or delta N-15. If this approach works, the way states approach muddy streams could change dramatically.



Robert McKinley, University of Georgia graduate student working on the fingerprinting project, views an area of recent bank erosion on the North Fork Broad River in Georgia. Cesium-137, a nuclear fallout tracer, is low in banks but high in surface soils.

Truck-mounted centrifuge and pump sampling from North Fork Broad River during a storm. Most of the sediment came from banks, but unpaved roads or construction sites were also sources.



Development of a Web-based Training Tool for the Regional Watershed Steward Program

*J. Peterson, M. McFarland, N. Dictson
and D. Boellstorff, Texas A&M University*

Significant changes in watershed hydrology and land use in the South have contributed to impaired water quality, diminished water supplies, and degraded fisheries.

In Texas alone, more than 50 percent of the assessed waterbodies, including streams, rivers and lakes, are do not meet their designated uses for contact recreation, fish consumption, or drinking water. The projected doubling of the state's population by 2040 further fuels concerns of insufficient water quality and quantity. More important, this problem is not limited to Texas. Across the Southern Region, states are facing significant water quality and quantity challenges, as well as population growth and land use changes that will continue to degrade the water and environmental resources.

State and federal resource management agencies have adopted a watershed approach to assess potential causes and sources of impairment, develop and implement watershed management plans, and monitor changes across the landscape. However, individual and community actions are essential to restore, protect, and conserve the region's water resources.

In response to this need, the Southern Regional Watershed Steward Program was created to inform, educate, and engage residents and stakeholders in water resource management. Key goals of the program are to promote healthy watersheds by increasing citizen awareness, understanding, and knowledge about watersheds, and to establish watershed protection strategies that improve water quality and minimize nonpoint source pollution in the region's watersheds. The program also aims to increase residents' involvement in local water resource management and protection activities.

The comprehensive, day-long training has had significant impacts. In Texas, more than 1,350 residents have

become trained Watershed Stewards. In addition, the program is being adapted in other states, including New York and New Jersey.

Workshop participant surveys show that participant knowledge regarding watershed function, pollutant sources and best management practices (BMPs), water quality, and regulatory agency responsibility is increased by more than 31 percent. Almost 99 percent of participants report the training has enabled them to be better stewards of their water resources. Furthermore, results from six-month delayed post-test evaluations indicate that 80 percent of workshop attendees have more closely monitored individual actions that could impair water quality, and 80 percent have adopted and/or maintained water quality BMPs on their property. Overall, participant satisfaction with program content and delivery has been overwhelmingly positive, and as measured by participant surveys stands nearly 100 percent.

To enhance interactive learning opportunities for watershed education across the region and to establish a larger, more well-informed resident base, a Web-based version of the regional Watershed Steward Program has been developed. The online course contains five units on watershed systems, water quality and quantity, watershed impairments, water quality laws and regulation, and community activities. The online course material is supplemented with interactive videos, demonstrations, and activities including a virtual Google Earth watershed tour. The course has no time restrictions, allowing each user to complete the content at his or her own pace. The course is accessible on the national eExtension Moodle website (<http://campus.extension.org/>).

What is a Watershed?

MODULE 2 | Section 1 | Page 1 of 4

What is a Watershed?

Watersheds in Texas

How Do Texans Use Watersheds?

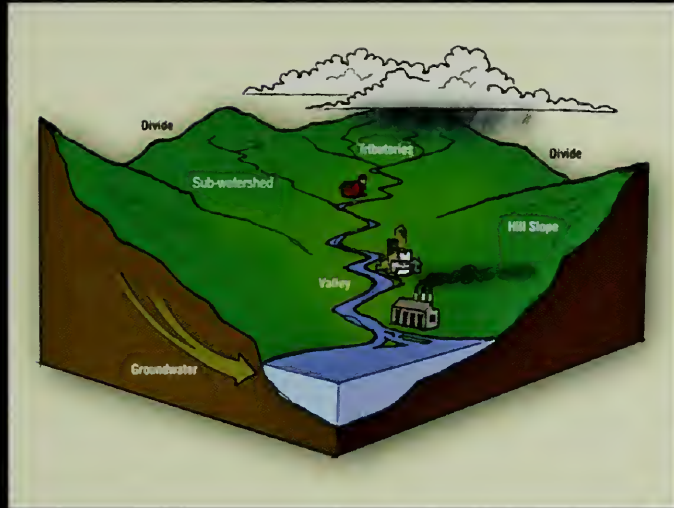
Principles of Watershed Hydrology

Natural Watershed Functions

Natural Watershed Features

Key Points

Resources

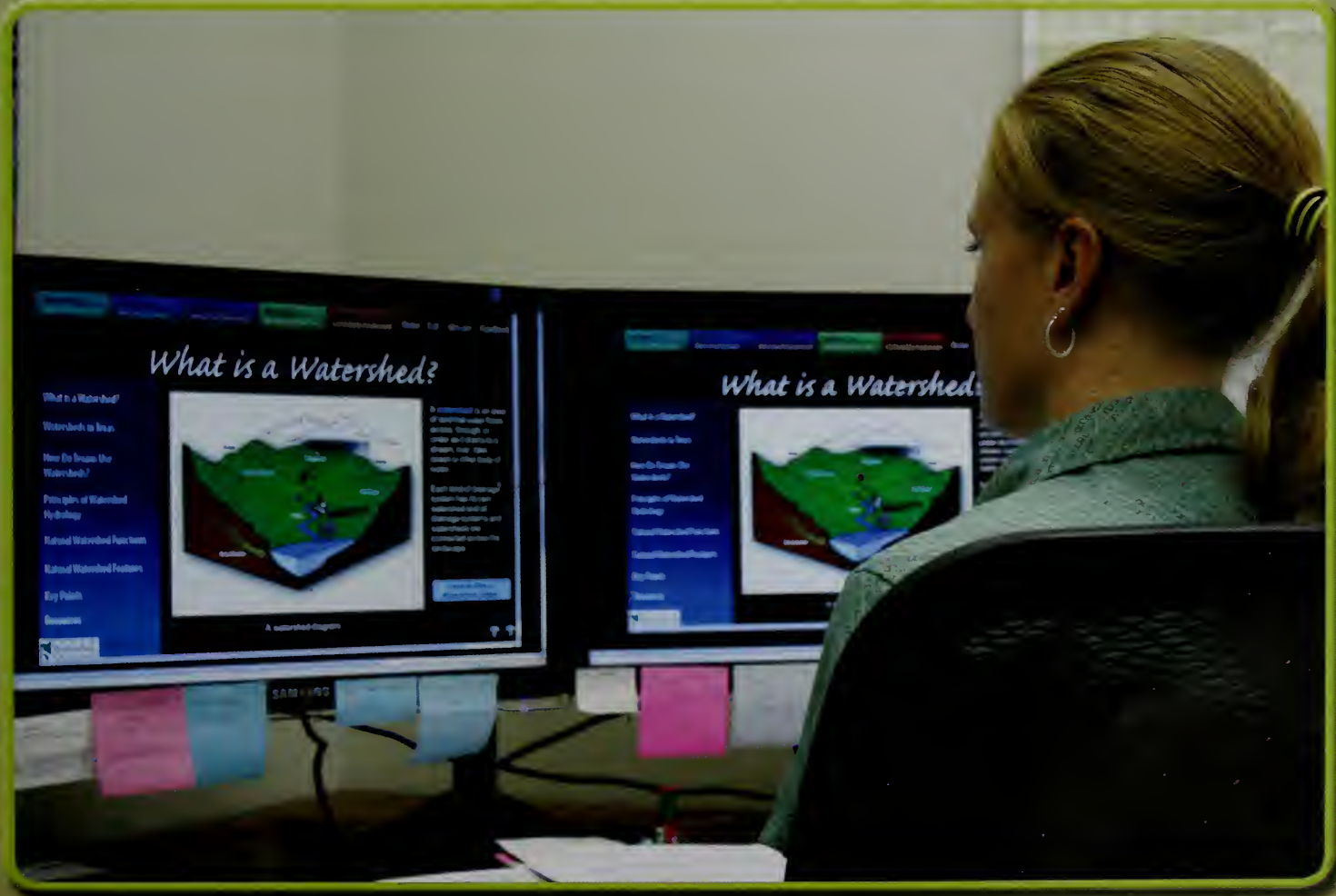


A watershed diagram.

A watershed is an area of land that water flows across, through, or under as it drains to a stream, river, lake, ocean or other body of water.

Each kind of drainage system has its own watershed and all drainage systems and watersheds are connected across the landscape.

[Click to Play a Watershed Video!](#)



Dissemination of Water Quality Educational Materials to Under-served Communities

*Maifan Silitonga, Mississippi River Research Center -
Alcorn State University*

Lack of information leaves many underserved communities facing challenges in addressing water quality and environmental problems. Educational materials developed by government agencies and other academic institutions are available; however, for many underserved communities, these materials are difficult to obtain, contain too much information, or are too technical.

Alcorn State University is a community of about 500 transients and non-transients. Prior to dissemination of educational materials, a questionnaire was developed to learn about their level of knowledge on water quality and the environment. The questionnaire was initially distributed to 10 percent of the population by 15 students from the Plant and Soil Science program at the Department of Agriculture. Almost 95 percent of the participants are not aware of the source of Alcorn's drinking water or the sources of potential pollution that can adversely affect it.

To address these issues, the Mississippi River Research Center at Alcorn State University developed educational materials for small and limited resource farmers, underserved communities, and minority students. Educational materials developed include "Water Quality and Your Livestock," "What's in Your Water," "How to Protect Your Water Resource," "Storm Water Management," and "Drinking Water and Human Health."

This information was distributed through workshops such as Ag Field Day, hosted by the School of Agriculture, Research, Extension, and Applied Sciences (AREAS). During the year of this project, about 350 farmers and residents of rural communities were reached. Since that year, these educational materials have reached more than 1,500 people. In addition, minority students learned about water quality through other methods such as table top displays. Enviroscope non-point

source pollution and groundwater models were used to demonstrate the environment and water pollution and its prevention. Desktop models were used for Summer Apprenticeship Program and Ag Day for high school students. In addition, students from high schools and college undergraduate and graduate students engaged in several environmental stewardship activities to gain a better understanding about protecting the environment. About 55 of these students in the Storm Water Protection project identified more than 100 storm drainage systems throughout the community in Alcorn and labeled them with signs reading "DO NOT DUMP, DRAINS TO RIVER." Other students were involved in the recycling competition as part of Alcorn's Earth Day Celebration. During this event, about 600 pounds of plastic bottles, cans, and papers were collected. The amount of recycle materials increased to more than 850 pounds collected the following year.

This project initially provided educational materials and tools for interactive learning, reaching about 100 students in grades kindergarten through 12th, and college undergraduate and graduate students, and more than 350 residents of rural communities. To date, more than 1,500 individuals have learned about water quality and related environmental concerns. More than 90 percent of these individuals gained awareness through this education. Students learned how water and the environment become polluted, and that daily activities can contribute to water pollution. Through this knowledge, they could become stewards of the environment.

Educational materials and tools are used beyond the period of the project to reach more students and residents of underserved communities. These efforts make Alcorn the academic institution that is building trust in underserved communities.



Storm water protection project.



Minority students learn about the environment, water quality, and pollution.



High school students learn about the environment, water quality, and pollution.



High school students learned about watershed, non-point source pollution and prevention, and environmental science.



Groundwater model was used on Ag Day for high school students.



People from nearby communities acquired information about the water from an environmental science graduate student.

Stream Restoration in the Southeast: Connecting Communities with Ecosystems

*Greg Jennings, Barbara Doll, and Karen Hall, North Carolina State University;
Eve Brantley and Jessica Roberts, Auburn University;
William R. English and Cal Sawyer, Clemson University;
Mark Risse and Frank Henning, University of Georgia;
Carmen Agouridis and Amanda Gumbert, University of Kentucky; and
Mike Smolen, Sharla Lovern, and Jason Vogel, Oklahoma State University*

In many watersheds, natural stream functions and stability are threatened by changes in hydrology and land use. This causes eroding stream banks, unsafe water supplies, reservoir siltation, impaired habitat, fish kills, and loss of floodplain functions, resulting in unstable streams with poor habitat and water quality. Causes of stream impairment include channelization, stormwater runoff, road crossings, sediment loads, cattle access, and loss of riparian vegetation. Resource management agencies in many states are now promoting a natural channel design approach for restoring and enhancing degraded stream systems. This region's stream restoration team has collaborated with local, state, and federal organizations to implement a comprehensive education program involving field demonstrations and hands-on workshops for designers, contractors, funding agencies, and regulators. The goal is to teach resource professionals how to restore impaired stream and floodplain systems for improved water quality and restored habitats.

The education program uses more than 30 stream restoration demonstration projects that have been implemented since 2000 in rural and developed watersheds. Streams are from 10 to 100 feet wide and are located in coastal plain, piedmont, and mountain settings. Projects include these elements designed to address the underlying causes of degradation:

- Channel and floodplain morphology re-shaping to provide a naturally stable dimension, pattern, and profile for long-term stream health
- In-stream vane structures such as boulders and/or logs to direct stress away from stream banks, improve bed load sediment transport, provide grade control, and improve habitat
- Stream bank bioengineering stabilization with native plants to reduce erosion while permanent riparian forest vegetation becomes established

- Native riparian trees, shrubs, and wetland plants established along stream banks and on floodplains to provide stability, shade, and food, and improved aesthetics
- Treatment of stormwater outfalls to minimize erosion and water quality impacts of stormwater runoff entering the restored stream system

Training workshops associated with these projects are designed to increase understanding of natural stream processes and provide tools for assessing and restoring natural stream functions. Workshops meet specific needs of participants and include hands-on stream measurements and participation in stream restoration activities. More than 2,000 natural resource professionals, including engineers, biologists, geologists, landscape architects, planners, and environmental scientists, have participated in workshops. Many of these participants have used knowledge gained to design and implement successful restoration projects throughout the Southeast.

The biennial Southeast Stream Restoration Conference provides a forum for sharing ideas, information, and experiences among natural resource professionals to improve the science and practice of stream restoration. Since 2000, attendance has ranged from 300 to 500, with more than 20 states represented. The theme of the 2010 conference in Raleigh, NC, was "Connecting Communities with Ecosystems." Many presentations and discussions addressed community-focused ecosystem restoration, public involvement, ecological function assessment, regulatory approaches, and education promoting watershed stewardship. This and future educational programs will continue to emphasize the need for ecosystem restoration as a major component of sustainable communities.



Water Ripples – Southern Regional Interactive Youth Education

Elaine Andrews, Patrick Torres, Craig Runyan, Ashley Osborne and Brian LeBlanc

Water Ripples is on-line interactive youth education game developed for 4th to 7th grades. Two games are available for one or more players to test their knowledge of water in agriculture, science and general categories. They are designed for teachers to engage students with fun and challenging activities that support environmental curricula. One game is based on the popular Jeopardy television game show. The other is a board game with progress made toward winning with correct answers.

The lead PI for Water Ripples is a veteran Extension 4-H Agent in Santa Fe County, New Mexico. Environmental education is an integral part of Santa Fe Extension programming. Recognizing the need for age appropriate teaching materials to educate school children on water use and conservation, the author secured fiscal support from the 406 Southern Regional Water Program to

develop interactive digital games. A project team was recruited including the author, Santa Fe County Program Director, NM Extension Water Resources Specialist, colleagues from Kentucky and Louisiana, and computer graphics experts at NMSU.

Development of the games included generating questions, testing graphics, configuring digital pathways and score-keeping, and pilot testing drafts. Final versions of Water Ripples were announced nationally and are housed on NMSU Agricultural Communications servers. Links to the games were initiated on the Southern Regional web site. Access has since been provided by numerous educational web sites, and conservation organizations. The games are designed for fourth to seventh grade students and can be played competitively with others or by oneself.

Water Quality Collaborative Conference – 1862, 1890, 1994 Land Grant Institutions Working for the Nation

*M. D. Smolen, Oklahoma State University; Cassel Gardner, Florida A&M University;
and Virgil Dupuis, Salish Kootenay College*

Water Professionals and administrators from the Southern Region met July 10-12, 2004, in Atlanta, Georgia, to identify opportunities for greater collaboration among 1862, 1890, and 1994 Land Grant Institutions. The 1862 institutions had a 17-year history of working together, but participation of the traditionally black, 1890 universities, had been relatively limited and inconsistent. The 1994, Tribal Land Grant Institutions were included to share with them the experience of the older programs and offer opportunities for partnership.

Attendance of 105 included representatives from 17 Historically Black 1890 Land Grants Institutions, 11 Tribal 1994 Land Grant Institutions, and 12 1862 Land Grant Institutions. An USDA-NRCS team provided facilitation for work groups to tackle the conference objectives:

1. Facilitate the sharing of water quality resources and expertise among participating groups.
2. Establish multi-institutional water quality work teams.
3. Improve collaboration and linkages among and between 1890, 1994 and 1862 institutions.
4. Increase awareness of water quality work at 1890/1994 institutions.
5. Strengthen linkages between USDA-NFA and minority institutions.

The outcome of the conference was a new commitment by 1890, 1862, and 1994 attendees to join together in water research, teaching, and extension activities. Since the conference, the 1890 institutions have become full partners in the Southern Region Water Resources Project and the 1994 institutions have become partners in the Northwest Region Project. Outcomes include development of two new Centers of Excellence, focused minority education programs on drinking water and human health involving partnership of 1890 and 1862 institutions, and a program of system-wide in-service training on technologies like GIS/GPS for watershed education. The 1890 institutions, in particular, have expanded their research and extension with new commitment to the Regional Water Program.

The conference was supported by USDA-CSREES (now known as NIFA) through Section 406 funding, USDA-NRCS, Region 4 and Headquarters EPA, the 1890 Research and Extension Directors, and the 1862 Southern Extension Directors.

**Commitment,
Collaboration, and
Action**



Drinking Water and Human Health FAQs – Southern Regional Water Program Database

*James E. Hairston, Eve Brantley and Donn Rodekoher,
Auburn University*

Development of the Drinking Water and Human Health (DWHH) frequently asked questions (FAQs) database was initiated in July 2001, just after a U.S. Department of Agriculture-sponsored National Water Program Conference in San Antonio, Texas. Representatives of Auburn University agreed to chair the DWHH Theme Team (later changed to program area team) for the Southern Regional Water Program states. Representatives from all 13 participating southern region states agreed to collaborate in the effort. The DWHH FAQs are sub-categorized under 12 subtitles. More than 20 people contributed to development of this index system. The subtitle index aids visitors in finding answers to particular questions while they are on the website, but today most people locate answers using a key word(s) search through the templates available with the common Internet-based search engines. A separate on-site key word(s) search mechanism that does not look outside the FAQs database is also provided.

The first phase of the DWHH FAQs database, a primary component of the Alabama State Water Program website, went on line in June 2003. Since then, the database has been expanded because of two separate actions. First, many people have asked additional questions that were answered and added to the database. Second, much information traditionally placed in relatively short publications has been re-structured as questions and answers to fit this database. The entire FAQs database contains about 4,600 FAQs, of which 2,200 are DWHH-related.

Total website visits to the FAQs database have increased each year through 2006, averaging 352 visits

per day for 2006. At least 15 percent of all visitors are looking for information from the DWHH FAQs database. Individuals accessing this database come from more than 160 countries and more than 60 states, provinces, and territories. International visits have increased over the years, from 18 percent in 2003 to just over 25 percent in 2010. States with the greatest number of visitors has fluctuated some from year to year. California was the leading state for the first five years, but in 2010 the most visits came from individuals residing in Washington, Virginia, Alabama, California, Georgia, and Texas, respectively. Four other southern region states—Florida, North Carolina, Tennessee, and Louisiana—were among the top 20 states in visits in 2010. Visitors access information 24 hours per day every day. Spring and fall tend to be the peak periods. Over the years, numerous suggestions for additional information and requests for use of information from the database have been received, as have many compliments. Since the DWHH FAQs database is public domain information, educators from university systems, water resource associations, or other groups in seven or more countries have requested permission to print materials from the database for personal use. Such printed materials have been compiled and used in various training and education efforts in at least four countries—Australia, Egypt, China, and Italy. Information currently in the DWHH FAQs database is equivalent to about 600 printed pages of information if printed at 12-point font with 400 words per page. The information is updated daily.

Go To: 10 20 50 100 Query

Countries	Visits	%
1. United States (US)	65,725	74.48%
2. United Kingdom (UK)	3,789	4.29%
3. Bulgaria (BG)	2,919	3.31%
4. Canada (CA)	2,070	2.35%
5. China (CN)	2,016	2.28%
6. India (IN)	959	1.09%
7. Germany (DE)	772	0.87%
8. Australia (AU)	672	0.76%
9. Netherlands (NL)	634	0.72%
10. Mexico (MX)	494	0.56%
11. France (FR)	475	0.54%
12. Italy (IT)	463	0.52%
13. Spain (ES)	347	0.39%
14. Japan (JP)	342	0.39%
15. South Korea (KR)	331	0.38%
16. Taiwan (TW)	288	0.33%
17. Hong Kong (HK)	286	0.32%
18. Singapore (SG)	286	0.32%
19. New Zealand (NZ)	233	0.26%
20. South Africa (ZA)	205	0.23%
21. Russia (RU)	83,306	94.40%
22. All Other Countries	4,945	5.60%
Total	88,251	100.00%

Go Forward 1 Next 20 Last 20

Go To: 10 20 50 100 Query

States and Provinces	Visits	%
1. California	24,276	33.44%
2. Georgia	4,519	7.95%
3. New York	3,559	6.43%
4. Texas	3,522	5.72%
5. Virginia	3,496	5.67%
6. Alabama	2,956	4.84%
7. Tennessee	2,888	4.76%
8. Missouri	2,888	4.76%
9. Ontario	2,888	4.76%
10. Florida	2,888	4.76%
11. Colorado	2,888	4.76%
12. North Carolina	2,888	4.76%
13. Ohio	2,888	4.76%
14. D.C.	2,888	4.76%
15. New Jersey	2,888	4.76%
16. Illinois	2,888	4.76%
17. Pennsylvania	2,888	4.76%
18. Washington	2,888	4.76%
19. Massachusetts	2,888	4.76%
20. Louisiana	2,888	4.76%
21. Minnesota	2,888	4.76%
22. Maryland	2,888	4.76%
23. Delaware	2,888	4.76%
24. Arkansas	2,888	4.76%
25. Indiana	2,888	4.76%
26. South Carolina	2,888	4.76%
27. Arizona	2,888	4.76%
28. Michigan	2,888	4.76%

Go To: 10 20 50 100 Query

States and Provinces	Visits	%
1. Washington	10,841	18.03%
2. Virginia	6,881	11.41%
3. Alabama	6,080	10.13%
4. California	4,488	7.46%
5. Georgia	3,381	5.62%
6. Texas	3,021	5.02%
7. D.C.	2,616	4.35%
8. Florida	2,337	3.89%
9. New Jersey	1,785	2.97%
10. New York	1,695	2.82%
11. Illinois	1,280	2.13%
12. North Carolina	1,214	2.02%
13. Pennsylvania	963	1.60%
14. Michigan	832	1.38%
15. Ohio	795	1.32%
16. Indiana	774	1.29%
17. Missouri	756	1.26%
18. Maryland	677	1.13%
19. Delaware	670	1.11%
20. South Carolina	652	1.08%
21. Arizona	51,726	86.02%
22. All Other States	8,410	13.98%
Total	60,136	100.00%

Showing 1 - 20 of 62



- Themes
- Publications
- FAQs
- Web Links
- Glossary
- Resources
- Water Testing
- GIS Data
- WQ Teams
- Directory
- Contact Us
- Sitemap
- National Site
- Southern Site

— Drinking Water and Human Health FAQs —

The following database of Frequently Asked Questions (FAQ's) are sub-categorized under Drinking Water and Human Health titles. For more information you can search our Drinking Water and Human Health Publications and/or the Drinking Water and Human Health Links sections.

Listed below are two ways to find Questions and Answers to many Drinking Water and Human Health Related Issues!

#1 Select a sub-topic to find FAQs on that sub-

1. General Information
2. Community (Public Access) Systems
3. Private (Individual Household) Systems
4. Domestic Animal Supply Systems
5. Bottled/Packaged Water Supplies
6. Drinking Water Contaminants
7. Drinking Water Disinfection
8. Drinking Water Standards
9. Drinking Water Testing
10. Drinking Water Treatment
11. Identifying Problems and Solutions
12. Source Water Assessment and Protection

#2 Conduct a quick search by using keywords

Enter a keyword or keywords


If the information you are seeking is not located you would like to see it added, please inform us

2003

Newsline

A Service of the News and Public Affairs Unit, Alabama Cooperative Extension System

Launching Website and Drinking Water FAQs



Above: Dr. Jim Hairston, Alabama Cooperative Extension System water quality scientist, discusses the Alabama Water Quality program's Web site. Hairston, who serves as water quality program coordinator for Alabama, says the site covers all aspects of water quality, with a special emphasis on drinking water and its relationship to human health.

Annex, June 18, 2003 — As part of a nationwide initiative to educate Americans about water quality-related issues, the Alabama Cooperative Extension System's water quality team has created one of the nation's most comprehensive sources on water quality information.

The site, www.aces.edu/waterquality, was developed to serve as the primary Web-based source of water quality information for Alabama residents and to complement the USDA's Cooperative State Research, Education and Extension Service's (CSREES) Water Quality Program web site.

Social Indicators for Nonpoint Source Management



Ken Genskow, University of Wisconsin

Nonpoint Source (NPS) pollution results from a combination of individual actions across the landscape. Effective management of NPS water pollution requires addressing both environmental conditions and the choices people make that affect the environment. Historically, NPS programs have had difficulty evaluating and documenting clear linkages between project activities and measurable progress toward water quality goals. Because of the short time-frame of most projects, few are able to demonstrate direct impacts on water quality. An assessment of the environmental Protection Agency's (USEPA) NPS program administered through Section 319 of the Clean Water Act (the 319 Program) indicated a need to demonstrate results through the use of clear efficiency measures, targets and baselines for measures, and regular, independent program reviews.

In an effort to improve its 319 Program, USEPA Region 5 and the Region 5 state water quality agencies are working together to develop and implement an evaluation framework for NPS intended to more clearly link program activities to water quality outcomes. In addition to capturing traditional administrative measures (e.g., funds awarded and spent, workshops held, projects implemented) and environmental indicators (e.g., physical and

biological measures of stream health), the NPS evaluation framework for Region 5 includes social indicators of progress toward water quality goals. USEPA and state water quality agencies drew upon existing partnerships through the Great Lakes Regional Water Program to establish a project team to create and test social indicators for NPS as interim measures of progress and accomplishment.

Over the course of this five-year project, state agency personnel and watershed project staff and volunteers have increased their knowledge and skills related to 1) targeting outreach activities where they will have the greatest environmental impact, and 2) assessing whether their outreach efforts are accomplishing changes expected to improve and protect water quality. This project has also provided more than 10 graduate students with direct experience in applied research in water resource management. Students have been involved with data management and analysis, worked with local watershed groups, and helped develop frameworks for communicating and using social information at the watershed level.

Beyond direct training related to testing the system with pilot projects, experiences from this project supported half-day or full-day professional development

programs for resource management professionals and educators at eight national conferences from 2007 through 2010. In addition, the team has developed a handbook for the Social Indicator Planning and Evaluation System (SIPES) and an on-line data management and analysis tool. A key component of the system is a suite of social indicators for NPS management that can inform project managers about awareness, attitudes, constraints, capacity, and behaviors of target audiences that are expected to lead to water quality improvement and protection. The products of this project are being pilot-tested in all Great Lakes Region states, and the indicator system has influenced watershed management actions in projects across the country.

Project Goals:

- develop a system for integrating social indicators into nonpoint source (NPS) planning, implementation, and evaluation;
- provide this system to NPS project managers so they may integrate social indicators into projects addressing NPS issues;
- help water quality managers target outreach activities where they will have the greatest environmental impact; and
- help water quality managers assess whether their outreach efforts are accomplishing changes to improve and protect water quality.

■ Conservation Professional Development and Training Program Ensuring rural landowners receive research-based advice from trained agency staff and private sector consultants

Kevin Erb and Ingrid West, University of Wisconsin

The Great Lakes Regional Water Program, working in partnership with Extension and other partners in Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin (USEPA Region 5 states), created with the Conservation Professional Training Program to provide a base level of training for conservation staff. States in the region now employ a variety of strategies to provide statewide and multi-state conservation training. The Program serves Extension staff, private sector consultants, co-op agronomists, Certified Crop Advisors (CCAs), Technical Service Providers (TSPs), state natural resources staff, Land/Soil and Water Conservation Districts (SWCDs) and Natural Resource Conservation Service (NRCS) staff. The Program provides training in areas such as pest

management, comprehensive nutrient management planning, and forestry. For a full listing of available courses, visit (<http://conservation-training.wisc.edu/>).

Since 2004, more than 550 public and private sector conservation professionals from participating states have taken part in training programs. Private sector Conservation and CNMP Planners report using the skills learned in the site assessment training to make suggestions for implementing environmentally beneficial practices on each farm they have written a CNMP or Conservation Plan for. In some cases, the newly reached farms implement practices without cost sharing, in other cases, they are better prepared to apply for state or federal cost share dollars to assist with implementation. More than 130

595/Pest Management plans have been written by planners trained under the program. More than 200 CNMPs have been written by planners trained under the program

The program continues to add new courses and reach broader audiences. In 2010, a new training partnership was developed with states outside the region, new courses in organic transition were developed, and new distance delivery modes we implemented. The Program has leveraged over \$223,904.00, including a strong commitment from NRCS.

For a comprehensive list of partners see the National Water Impact Exchange at <http://www.uwex.edu/ces/regionalwaterquality/nationalreporting/>.

Volunteer Monitoring of *E. coli*

Kris Stepenuck, Lois Wolfson
and Jerry Iles, University of Wisconsin

Bacterial contamination of surface waters is a common public health concern. Laboratory analyses can be expensive, yet such monitoring is important to ensure safe recreational opportunities and to produce effective watershed management plans. This initiative has been very successful in building individual, community, and organizational capacity related to volunteer monitoring. This initiative has been highly integrated, including student research and development of course curricula and labwork focused on *E. coli* sampling, analysis and interpretation.

The *E. coli* Volunteer Monitoring initiative focuses on the ability and preferences of volunteers using "home test kits" to evaluate their local streams and rivers using *E. coli* as an indicator of stream health. The original research engaged volunteer monitoring programs in six upper Midwestern states in the evaluation of six test methods for monitoring *E. coli* bacteria suitable for home use. Two methods selected were further assessed to determine which most closely matched results of USEPA-approved laboratory analyses. Analysis of Covariance results indicated that when used by volunteers to monitor surface water, 3M™ Petrifilm™ results were more similar to laboratory analyses than Coliscan Easygel®. Both test

methods had similar overall accuracy of predicting if a sample was above or below the 235 cfu/100 ml EPA body contact standard for recreational surface waters. Two-thirds of volunteers preferred 3M™ Petrifilm™. In 2008-09, additional research studying variability in holding times was implemented. Samples were analyzed using four different media, including 3M™ Petrifilm™ and Easygel®, at 2, 6, and 24 hours after collection to examine the potential time differences in sample processing between volunteer and professional analysis. The two hour field tests were compared to the 24 hour laboratory tests to determine the similarity between the results. No statistical significance between the two time periods was found with any of the tests.

Outreach efforts have included conducting 35 training workshops reaching 140 volunteers. In addition over twenty presentations have been made at regional and national conferences. Evaluations indicate that 92% of volunteer participants responding to pre and post training knowledge tests improved their individual scores following training. Approximately 80% of trainees in 2008 and 2009 workshops indicated workshop & materials helped bring credibility and/or visibility to volunteer monitoring in

their community. Sixty-two percent of respondents to the follow up survey in 2009 indicated that the research findings, which showed the ease and reliability of the test methods, helped them to prioritize *E. coli* monitoring as a viable parameter to be monitored by volunteers to a great extent. About 76% (75% in 2008; 77% in 2009) of respondents to follow up surveys 6 months after training indicated they have conducted *E. coli* monitoring, trained others to do so, or shared the information they learned at the training with others.

Current efforts involve training people in underserved communities on volunteer water quality monitoring techniques, and building a regional network of teachers and community leaders with the capacity to train and coordinate volunteer monitors within their communities. In the last year over 100 new volunteers were trained in water monitoring techniques. Evaluations were positive and pre-post tests indicated an increase in knowledge.

This initiative is built on a strong partnership between Michigan, Ohio and Wisconsin, with additional organizations in those states. A series of webinars are also being held to provide advanced training and allow for connectivity among the participants within the three states.

Midwest Cover Crops Council

*Dean Baas, Dale Mutch
and Eileen Kladvko, Michigan State University*

As the public grows increasingly aware of our collective ecological footprint and its relationship to climate change and water quality, so does the interest in adding living cover to our landscape. Cover crops can generate new sources of renewable energy, mitigate greenhouse gases, reduce the use of agricultural chemicals and provide income for rural communities. In an era where the Mississippi River Basin and Great Lakes watershed suffer from serious environmental degradation, this shift in agricultural systems can play a significant role in revitalizing and restoring our lakes, rivers, fields, and communities.

The MCCC is a Great Lakes regional project connecting eight states and Canada (Ontario). The MCCC has partnered with Universities in the region, NRCS, OMAFRA (Ontario), Departments of Agriculture, Leopold Center for Sustainable Agriculture, Conservation Technology Information Center, Practical Farmers of Iowa, Ontario Soil and Crop Improvement Association and Green Lands Blue Waters. The Council's primary goal is to address soil, water, air, and agricultural quality by increasing the use of cover crops throughout the Great Lakes and upper Mississippi River basins. Specifically, the Council aims to improve the ecological and environmental functioning of the predominant annual cropping systems in the region by incorporating cover crops on 30 percent of agricultural

acres in 15 years. The Council has five major priority areas that each support activities in service of the primary goal. The priority areas include: policy, communications, research, education/outreach, and fundraising.

In recent years, the Council has extended its impact by engaging and disseminating to broader audiences. In 2010 the number of regional cover crops workshops grew to 16, from 8 in 2009. New webinars and internet-based videos have increased reach, including: the 3-Part University of Illinois Extension Telenet Series Utilizing Cover Crops in Conventional Cropping Systems (2009), Cover Crop Selection Webinar (2010) and the Cover Crop Slurry Seeding video (2010).

The MCCC website (www.mccc.msu.edu) continues to grow and includes over 65 Extension publications, 31 scientific abstracts, 41 innovator profiles, 23 presentations, 13 posters and 33 links to related sites. Between October 2009 and September 2010, the website had 6,503 visits with 14,559 page views. The site was visited from 80 countries and from all 50 states. Top state visits rank as 1-Illinois, 2-Indiana, 3-Iowa, 4-Michigan, 5-Minnesota. The MCCC listserv has increased from 130 to 251 subscribers in 2010.

Additional impacts include changes in behavior and environmental conditions. Currently, data on

behavior change relating to cover crop usage is being gathered from workshop and farmer surveys and NRCS cost sharing data. A major cover crop seed supplier reported that cover crop seed sales have increased by nearly 1 million pounds from 2009 to 2010. Indiana and Ohio cover crop distributors report that their seed sales have increased between 20% and 100% in 2010. In 2008, the Council contributed to an NRCS policy change in Indiana that allows cover crops to be bundled with other conservation practices, and in 2009 this resulted in a substantial increase in cover crop cost shared acres in that state.

MCCC has leveraged more than \$192,000 for cover crops research, education and outreach. With support from the MCCC, Practical Farmers of Iowa received a NCR-SARE Research and Education grant entitled "Farmer field school approach to increasing cover crop adoption in Iowa and Minnesota" for \$174,000. In 2010, a collaboration between the Conservation Technology Information Center, Michigan State University Extension, Purdue University and Ohio State University Extension submitted a proposal that was funded to the EPA Great Lakes Restoration Initiative for \$986,298. This project will implement 18 workshops over three years in the Lakes Michigan, Huron and Erie watersheds to increase cover crop acreage by 5,000 acres per watershed.

■ Building Capacity to Address Tribal Water Resource Issues in the Great Lakes Region

Patrick Robinson, Rebecca Power, Scott Herron, Deborah Anderson, Barbara Barton, Melissa Cook, Roger LaBine, William Paulson, Susan Thering and Deborah Zak, University of Wisconsin

Water resources are sacred to tribal communities and central to their growth and development. Tribal communities and 1994 land grant institutions have needs and contributions to make to water resource management. Given the diversity of needs across the Upper Midwest, the Great Lakes Regional Water Program has worked with tribal land-grant institutions and tribal communities on several initiatives during the past six years. In its first collaboration, the program funded students from the Lac Courte Oreilles (LCO) Ojibwa Community College to attend a summer session on conservation design and "green" housing taught jointly by University of Wisconsin and LCO faculty. This class was one component of a trans-disciplinary partnership between LCO and UW-Madison founded to enhance educational opportunities, job training, and small business development for Native Americans, while implementing conservation development and new home construction practices that meet community needs and preserve/improve the water quality necessary to sustain the traditional wild rice.

In 2006, the program shared leadership in a regional wild rice conference hosted by the Lac Vieux Desert Band of Lake Superior Chippewa. The conference addressed wild rice issues across the Upper Midwest. The conference

combined culture, science, and communication to address the diversity of issues that wild rice presents in the region. Conference planning included six tribes, four non-governmental organizations, eight universities including 1862 and 1994 land grants, four tribal organizations, and one federal organization. More than 100 people attended the conference, with 94 percent learning a significant or great amount about the cultural values of wild rice and 80 percent learning a significant or great amount about the ecological values of wild rice. In 2007, the program shared leadership for a regional wild rice strategic planning session hosted by the College of Menominee Nation. The regional strategic planning session identified regional ecocultural restoration needs related to wild rice. Based upon session recommendations, the program continues to fund and work with partners to plan and host wild rice camp learning events that incorporate traditional ecological knowledge and the ecocultural importance of wild rice in the Great Lakes Region.

To set the stage for a new series of collaborations, the Great Lakes Land Grant Institutions Tribal Water Resources Summit was held at the College of Menominee Nation in October 2010. More than 40 representatives of 1862 and 1994

land grant institutions, tribal water resource departments, state and federal agencies, and other partners attended. The result was a summary of regional tribal water resource issues of greatest importance in the Great Lakes Region, and research, education, and Extension strategies for addressing the most common issues. The planning committee included representation from both 1862 and 1994 land grant institutions. This summit has already promoted new collaborations and communications between land grant institutions in the region. Responses to the summit evaluation indicated that participants' knowledge of partnership opportunities related to tribal water resource issues was increased. In addition, respondents, on average, indicated a high number of opportunities to exchange information with people from different states and/or tribal communities. During the past six years, efforts to connect the resources of 1862 and 1994 land grant institutions and partners have increased the capacity of both to have a positive impact on water resources in the region. These successes would not have occurred without funding from the National Integrated Water Quality Program and the program's focus on collaborative, multi-state approaches to water resource issues.



Mapping the Future: Youth-Water Programming for the 21st Century

Jennifer Kushner, University of Wisconsin

It has been said that “No problem can be solved from the same consciousness that created it” (Albert Einstein). Indeed, the impetus for new directions in youth water education aligns with the need to adapt and thrive in increasingly complex times. The success of these efforts is contingent on people who understand complex systems, who can translate across disciplines, cultures, and geographic locations, and who understand the interconnectedness between humans and the environment. As well, these efforts must not simply focus on knowledge, but on fostering relationships between young people and water. USDA-NIFA is strategically positioned to lead a national reform focused on cultivating this new consciousness related to water.

Mapping the Future is a national project designed to investigate the problem of limited youth engagement with water, in spite of significant investment. The project solicited the ideas, perspectives and experience of youth, water professionals and education experts in order to better understand the current paradigm, as well as inform a new paradigm. Building on past work, *Mapping the Future* began with a critical analysis and literature review of current and recent past programming. Listening

sessions and interviews were hosted in various locations around the country, and with diverse audiences, to also explore current and future frameworks. Data from these sources were coupled to create a roadmap (Water Equals) for new directions in youth water education.

The analysis of data led to the identification of several root causes of the problem: 1) we have not adequately listened to the experts and stakeholders, 2) we have not identified the simple rules for effecting change or the organizational learning and systems needed to manage this change, 3) we teach youth about water almost exclusively through science and 4), we build environmental education on a set of faulty assumptions that presume a linear causal relationship: Instruction → Knowledge → Caring → Engagement. Water Equals addresses these root causes by offering a set of simple rules for manifesting different outcomes. If implemented effectively, they should deliver engaging content and thinking skills taught together, leading to kids having a deep understanding and sustained relationship to water.

Water Equals is a roadmap for paradigmatic change, developed to bring about this future state of youth water education. Water Equals

is designed to foster Knowledge, Caring and Engagement, as well as the relationships between these. Here are the elements that are essential to bringing about this future state...

- *Experiential outdoor component; cognitive affective, kinesthetic*
- *Informal and formal education; integrated between home, school and community*
- *Multimedia and social media elements*
- *Values component; stewardship and sustainability*
- *Interdisciplinary, multicultural, historical and systems perspectives*
- *Pedagogy balances content with development of thinking skills*
- *Public awareness component and/or infused in popular culture*
- *Evaluation and professional development*
- *Initiatives co-led by experts in youth, water, education, evaluation and media*
- *Local issue-based; real-life application; water footprint*
- *Generation-focused; youth-to-youth, and youth-elder*
- *Tie to youth education standards and core curriculum*



■ Designation of a New National Estuarine Research Reserve on the Lake Superior Coast

*Patrick Robinson, Thomas Blewett
and Robin Shepard, University of Wisconsin*

Great Lakes freshwater estuaries provide a vast array of resources and services. The freshwater estuaries are an interface between the land and water. Providing food, fuel, flood regulation, nutrients, habitat, recreational opportunities, soils, aesthetics, and other values, freshwater estuaries have long been a focal point of human activity in the Great Lake region. As a consequence, throughout history they have been heavily exploited for natural resources, commerce, tourism, and other economic activities. Nationally, 43 percent of the U.S. population resides close to coastal and estuarine areas. Population and development on the coasts, as well as economic activity, have left these areas subject to continuous degradation. An assessment of the nation's coasts and estuaries by the U.S. Environmental Protection Agency found that the ecological condition of the Great Lakes as a region was poor to fair. Lake Superior, however, is the largest and most pristine of the Great Lakes.

The National Estuarine Research Reserve (NERR) System is a nationwide network of protected coastal estuaries designated and supported through the National Oceanic and Atmospheric Administration (NOAA). The NERR

program integrates research, outreach, and stewardship activities related to estuary resources, including Great Lakes freshwater estuary resources. NERR sites represent a partnership between federal and state governments that leverage additional resources. The objectives of this project were to 1) designate a National Estuarine Research Reserve on Lake Superior and 2) develop a regional platform for collaborative research and outreach related to Great Lakes freshwater estuaries and coastal systems.

The project was successful in both of its objectives. A Lake Superior NERR was officially designated in October 2010. Nearly \$1 million has been leveraged from NOAA, Wisconsin Coastal Management Program, the University of Wisconsin-Extension, and other state, tribal, and local partners. In the future, this project will capture about \$500,000 each year for Great Lakes coastal research, education, and Extension activities, and create opportunities for additional sources of funding. Tribal partners have been central to this effort, with the Fond du Lac Band of Lake Superior Chippewa serving on the NERR Advisory Board and Lac Courte Oreilles Ojibwe Community College faculty helping

to identify research, education, and Extension priorities for the NERR. In addition, partners in the management planning process were closely involved through a steering committee and three advisory committees related to research, education, and citizen involvement. A total of 113 individuals from 52 organizations or municipalities have participated in this project. The project includes representatives from research-, education-, and Extension-focused institutions, which helps future collaborative research and outreach. This project also influenced the University of Wisconsin Sea Grant Institute and Minnesota Sea Grant College Program to issue 2010-2012 and 2012-2014 joint proposal solicitations that focused on the NERR site and required collaborative Minnesota and Wisconsin university research. In addition, the Lake Superior NERR is partnering with Ohio's Old Woman Creek NERR on four Great Lakes Planning for Climate Change workshops in Minnesota, Wisconsin, Michigan, and Ohio. Finally, in 2009 the project received the Willard Munger, Sr. Environmental Stewardship Award from the St. Louis River Alliance.



Wisconsin's Governor Doyle Signing the NERR Nomination Package (photo by Lynelle Hanson)



Dr. Marv Van Kekerix, Interim Chancellor of University of Wisconsin Colleges and University of Wisconsin-Extension, with Dr. Larry Robinson, NOAA Assistant Secretary of Commerce for Conservation and Management, at the Lake Superior NERR Designation Ceremony (photo by Michael Anderson)

Regional Manure Applicator Voluntary Training Initiative Using Market Based Incentives to Increase Nutrient Management Implementation.

Kevin Erb, University of Wisconsin

Proper manure application is key to implementation of nutrient management plans. Up to 40 percent of the manure applied in the Great Lakes States in 2000 was completed by for-hire applicators, most of whom had received little or no training in environmental protection, spill response, or regulatory requirements.

In Wisconsin, the newly formed Professional Nutrient Applicators Association (PNAAW) asked Extension to create a voluntary training and education program to meet this need. As Extension examined existing programs, a similar request in Michigan was

identified, and using 406 funding, Michigan and Illinois were invited to join the effort.

Extension and applicator stakeholders in the three states examined the needs identified by the industry, and created a way to ensure wider access to business liability insurance while incorporating insurance premium reductions. Firms participating in the training program are eligible for discounts of 10-40 percent on their liability insurance and 50 percent on their pollution insurance. Discounts range from \$700 to more than \$5,000 per year.

In 2010, more than 70 percent of Wisconsin's applicators participated in the training program, 60 percent in Michigan, and about 25 percent in Illinois. Participating firms report their employees are more engaged, operate in a safer manner, and are prepared to respond quickly when accidents happen. Regulatory agencies report an increase in spill reporting compliance, and insurance auditors report an 85 percent drop in claimable incidents for firms completing Level 3 certification.

Partnerships developed as a result of the program have leveraged about \$750,000 in funds for research and allowed curriculum sharing to



Commercial manure applicators from 9 states attended the Manure Expo, learning about the latest technology in manure handling and application. Training at the Expo is a critical component of the certification program.

other states, including Pennsylvania, Ohio, and Minnesota. Initiatives such as Manure Expo and manure spill demos are being replicated in six other states. This successful voluntary program has reduced the need for a mandatory certification program in the participating states.



Farmers and manure applicators watch as Extension staff demonstrate tile inlet protection and temporary dams as techniques to properly respond to a manure spill.



Farmers and manure applicators learn the steps to respond to a manure spill and how to create a spill response plan during an Extension-sponsored field day and live action manure spill demonstration

Measuring Success of a TMDL Implementation Plan: Land, Stream, and Economic Responses to Targeted Stakeholder Actions



D. L. Devlin, K. R. Douglas-Mankin, P. L. Barnes, T. D. Keane, M. Langemeier and W. L. Hargrove, Kansas State University

At the Little Arkansas River watershed in central Kansas, 97 percent of the land area is in agricultural production—78 percent in cropland and 19 percent in grazing land.

Total Maximum Daily Loads are required for 52 percent of stream segments and 50 percent of lakes. The most common pollutants are fecal coliform bacteria, excess nutrients, atrazine herbicide, and sediment and total suspended solids. A nine-element watershed plan was developed by local watershed stakeholders, who determined the top priority was to reduce atrazine herbicide and sediment delivery to surface waters.

Twenty educational meetings trained 617 farmers and pesticide dealers. An atrazine BMPs publication was developed and distributed. BMP demonstration and research sites at three farmer field sites were used to discover, demonstrate, and evaluate the effectiveness of BMPs for pesticides, sediments, and nutrients. The city of Wichita and Kansas state agencies provided \$190,000 in funding for incentive payments to farmers for implementing atrazine BMPs, based on the amount of pollutant reduction practices the farmers used. A Kansas State University Extension agronomist made 361 on-farm visits to get farmers' commitment to implement atrazine BMPs. Forty-one farmers in 2006, 72 in 2007, 95 in 2008, and 95 in 2009 implemented these practices on 51,525 corn and grain sorghum acres. An automated surface water monitoring system was installed in the streams at the base of the targeted watersheds and at the base of two adjoining watersheds. Water quality monitoring of treated and untreated watersheds found 66 percent lower atrazine concentrations in 2006, 40 percent in 2007, 65 percent in 2008, and 51 percent in 2009.

Sediment BMP Discovery and Implementation: Watershed geographic information system (GIS) maps and models were used to select Black Kettle Creek subwatershed for

targeted BMPs adoptions. Using ArcSWAT, 10 percent of the sediment yield was estimated to come from 1.9 percent to 4.4 percent of the watershed and 20 percent from 4.6 percent to 10.7 percent of the watershed. The results were used to develop a schedule of BMP cost per unit sediment reduction for targeted locations in the watershed. An education program that included



Atrazine BMP Discovery and Implementation: In 2005, three watersheds were targeted for rapid implementation of best management practices (BMPs) for atrazine herbicide, five in 2007, and six in 2008 and 2009. An education and demonstration program, a surface water monitoring plan, and an incentive program were developed and delivered to the targeted watersheds.

meetings and on-farm visits was presented to watershed stakeholders. Using funding from a NRCS CIG grant of \$450,000, researchers established a BMP

implementation incentive program to reduce sediment delivery from cropland. Through this program, 25 farmers committed to implementing BMPs on 138 crop fields, for a total of 4,810 acres, and reduced annual sediment delivery to streams in the watershed from 9,219 tons to 2,926 tons.

Improving Higher Education on Water Issues: New watershed sediment-process modules were developed and incorporated into six courses. New modules were developed for watershed management, fluvial systems I, and natural resources and environmental science capstone courses. The watershed modeling and agricultural resources and environmental management (AREM) introductory and

capstone courses were developed through efforts on this project and as part of an effort to increase system-level courses in watershed and stream process at KSU. Keane used data from the Little Arkansas project in his LAR 741 Fluvial Systems/Geomorphology Course. This project also allowed about a dozen graduate students to be trained in stream monitoring field techniques. More than 200 students in at least six classes were trained on the latest watershed sediment source and transport information and methods from this study.



Sources and Abatement of Fecal Bacteria in a High Priority TMDL Watershed in Northeast Kansas

Kyle R. Douglas-Mankin, George L. Marchin, Daniel L. Devlin, Philip L. Barnes, Joseph P. Harner, Joel M. DeRouchey, Will Boyer and William L. Hargrove, Kansas State University

Fecal bacteria contamination of U.S. surface waters threatens human health and safety. In Kansas, the Upper Wakarusa watershed has a bacteria impairment (total maximum daily loads or TMDL) and is ranked as a top priority watershed for restoration. This project supported a local stakeholder-driven effort to implement a Watershed Restoration and Protection Strategy. Project investigators provided integrated Extension leadership, new research results of bacterial movement and die-off, and detailed bacterial stream monitoring, source-tracking, and modeling over a four-year period.

Demonstration projects of improved management practices were funded and implemented at three mid-sized cattle operations. Stream monitoring by Kansas State University investigators showed that these practices reduced the peak bacterial loading compared to pre-project levels. Fecal bacterial levels were very low during baseflow conditions during all seasons throughout the watershed. Elevated levels of bacteria were observed in major runoff events in late spring and early summer 2005. Through research, the Upper Wakarusa River was shown to be impacted mostly by agricultural waste and to some degree by wildlife. All management practices that reduce direct deposition of cattle manure in streams were found to reduce or eliminate bacteria contamination. New bacterial lectures and modules were added to six KSU

courses and presented at state and regional workshops. Project-facilitated Extension education efforts and partnerships have expanded implementation of improved livestock waste and pasture management practices. The ultimate goal of the project is to have the watershed considered for bacterial TMDL delisting in the near future, which now appears likely.

Outcome Report Narrative

Objective 1: Bacteria Source Tracking.

The original TMDL fecal coliform bacteria standard (2000 colonies per 100 mL) was exceeded one or two times during the three-year monitoring period in each of the six major sub-watersheds, and five times in the Upper Wakarusa River mainstem. Data indicate exponential increase of mean E. coli concentrations with sub-watershed mean annual flow. Antibiotic resistance analysis concluded that the

enterococcus population in the Wakarusa comes from 17 percent human, 37 percent livestock, and 46 percent wildlife sources. All data point to diffuse sources of fecal bacterial, including both cattle and wildlife.

Objective 2: Fate and Transport of Bacteria.

(A) The tilting-table study found that bacteria runoff



Demo Site 1: Stream Sampler



Upper Wakarusa Watershed, KS



Demo Site 2: Feed/water moved away from stream

decreased by 88-99.9 percent, with successive runoff events spaced at three- to 11-day intervals. A two-week interval between manure excretion and a runoff event reduced fecal coliforms by 95 percent, enterococci by 99 percent, and *E. coli* by 99.9 percent. Removing cattle from stream-side locations before high-runoff periods could be an effective bacteria-reduction practice. (B) A study of feeding hay in ring feeders revealed that soil fecal bacteria concentrations increased over the feeding period and were greatest at close proximity (3 m versus 12 m, 21 m, and 30 m) to the feeders. Soil nutrient levels were likewise greatest at close proximity (3 m) to feeders, but generally no accumulation occurred at further distances. At three months post-feeding and cattle removal, no fecal bacteria were present in soil at 12 m, 21 m, or 30 m from the feeders; however, there were detectable levels at 3 m. (C) Results from four grass filter strips at working beef feedlots showed that bacteria and other pollutant removal had a polynomial relationship with filter-strip to source-area area ratio; a minimum area ratio of 0.5 was most effective.

Objective 3: Evaluation of Management Practices.

This study was the first to assess the bacterial submodel in the SWAT watershed model. Results indicate that SWAT produced good to very good agreement for measured in-stream flow (model efficiency, *E*, of 0.58 to 0.89) and suspended sediment (*E* of 0.55 to 0.78), and poor to fair agreement with fecal coliform bacteria (*E* of 0.14 to 0.46). These results are promising, but also indicate modeling limitations that should be addressed with further study. Analyses indicate that results were more sensitive to parameters and source allocations that



Demo Site 3: Cattle moved, grass buffer added.

relate to bacteria that are directly input, deposited, or discharged to a stream versus those that are land applied to upland areas. Attempts to model source-specific bacterial sources were limited by a low-resolution bacterial source tracking method (antibiotic resistance analysis).

Objective 4: Extension Programs.

This project has been a catalyst for enhancing working relationships among Extension and conservation districts from four counties. Project-funded implementation of improved management practices on three mid-sized cattle operations has led to measurable reductions in peak bacterial loading, which could lead to delisting the watershed's bacteria TMDL. Project Extension personnel have been integral in watershed plan implementation and increased awareness and implementation of numerous practice improvements.

Objective 5: Educational Programs.

Lectures and modules with bacterial source, transport, and management focus were incorporated into six KSU courses. Student feedback indicated a high level of interest in understanding connection between bacterial contamination in water and overland sources in agricultural watersheds; however, additional data and synthesis of existing and future data are needed to better quantify bacterial fate and transport processes.

Extension participatory education and leadership development engage watershed residents in performance-based environmental management

Chad G. Ingels, Jamie L. Benning, Susan S. Brown, Charles D. Wittman, Lois Wright-Morton, Iowa State University

Citizen-led programs promoting on-farm performance-based environmental management have been very successful in Iowa watersheds. Inputs from Iowa State University Extension (ISU Extension), supported by the NIFA National Water Program and U.S. EPA, have



Studying the watershed map.

been important drivers of these watershed groups' accomplishments. Among other contributions, extension has provided participatory education for individuals and groups, leadership development and organizational facilitation for councils, and administrative assistance for accountability to multiple public and private funding programs.

The watershed groups have formed long-lasting, voluntary associations with proactive local leadership. In a FY2000 406 Integrated Project "Use of Research and Modeling Information in Community-based

Watershed Planning," ISU Extension first combined community development and educational assistance as a strategy to facilitate citizen councils capable of substantive participation in watershed management. Researchers from Texas Institute of Agricultural and Economic Research and ISU generated scenarios from local data predicting the environmental (nonpoint source) impact versus economic costs of alternative BMPs to address the watershed's known problems. Citizens educated about the cost effectiveness scenarios were empowered by understanding the performance of alternative practices and by the flexibility this gave them to make progressive improvements. The council became directly involved in advocating practices for a local watershed proposal.

With the 2004 Extension Education 406 project, "Educational Program to Increase Citizens' Responsibility for Management of Agricultural Watersheds," the on-farm performance concept was further developed to promote voluntary adoption of water quality improvement practices. The performance approach

employs agronomic tests and model indexes for qualitative assessment of environmental improvement as farmers modify or add new practices in their operations. Environmental performance evaluation is no longer solely the responsibility of experts, but also includes tools useable at the farm level and linked to accountable management decisions. Participants are

rewarded for improved indexes

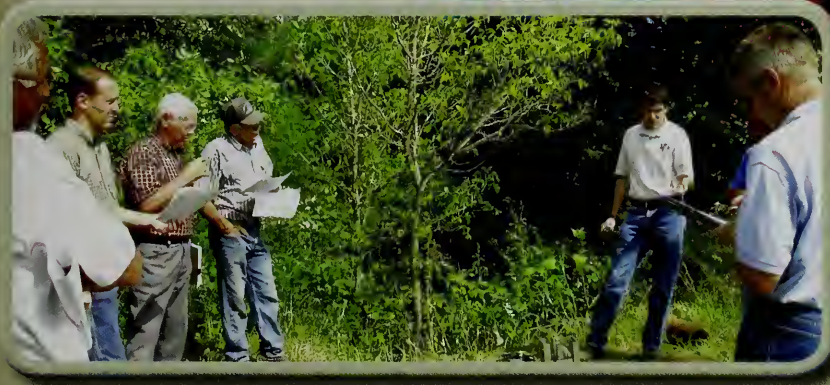
rather than for implementing specific practices.



Hewitt Field Day display macroinverts.



Hewitt Council leader talks at field day



Extension specialists assist the performance programs by annually calculating participants' indexes and aggregating data on a field, farm and watershed basis. Extension provides this information to participants and to the watershed councils, who use the results to manage and fine-tune their local incentives. The councils have successfully involved over 60% of all watershed farm operators and have leveraged over \$2 million from commodity groups and conservation programs for incentives. However, their initiative would have been impossible for a voluntary association without administrative assistance, which has also been provided by extension.

In five priority watersheds over a four-year period citizen-led performance-based environmental management, referred to as the "Hewitt Creek Model", has demonstrated that farmers will set and act voluntarily on personal environmental goals when they are convinced there is a problem and can measure

their progress in solving it. The performance programs have resulted in extensive adoption of BMPs, improved targeting, and continuous improvement in index results. Performance results shared neighbor-to-neighbor build local pride in watershed improvement and peer pressure for new participation. Cooperators' continue to be engaged in progressively

modifying their day-to-day management practices to further protect water quality.

In 2008 NIFA funded a 406 Extension project "Developing Local Leadership and Extension Capacity for Performance-driven Agricultural Environmental Management" to extend the Hewitt Creek Model to watersheds across Iowa. The project is developing a curriculum for field staff and local leaders and is working in multiple watersheds to pilot test the curriculum and expand the number of technical specialists and educators familiar with performance concepts. Additional performance measures are also being developed. As the availability of science-based, farmer-accessible performance measures is expanded, this successful approach can also be applied in an increasing number of impaired watershed situations. Connections with state and federal agencies in Iowa have been developed as a means to use performance measures within the existing framework of watershed improvement projects.

Northern Plains and Mountains Region Coalbed Methane-Regional Geographic Initiative



*James Bauder, Montana State University;
Ginger Paige, University of Wyoming; Troy Bauder, Colorado State University*

National energy independence and development of domestic energy are significant topics in the Northern Plains and Mountains (NPM) Region. The natural gas industry has developed processes for locating and extracting methane (natural gas) from coal deposits throughout the western-intermountain United States. This natural gas, referred to as coalbed methane (CBM), supplies about 7 percent of the country's natural gas requirement. Extraction of CBM often requires pumping and disposing of large volumes of water from coalbeds. This water ranges from nearly fresh to brackish and saline. Pumping and discharging water from CBM operations onto the landscape and into storage impoundments in Colorado, Montana, Utah, and Wyoming, and into the Cucharas and Purgatoire rivers in Colorado, and the Powder, Tongue, and Little Powder rivers in Wyoming and Montana has increased dramatically in the past decade. Each year CBM produces enough water in the region to completely fill the Minnesota Vikings Metrodome 100 times.

Until recently most CBM-produced water was disposed of by discharge into streams and rivers or into constructed ponds and impoundments. The discharge of CBM-produced water can alter the quality of streams and rivers and groundwater, and alter soil properties. Each of these circumstances threatens the quality of stream and river water used for irrigation, livestock watering, and rangeland and aquatic habitat.

Based on needs assessments, the NPM Region team investigated irrigation water quality impacts and management alternatives on semi-arid landscapes; developed educational resources and materials; and shared science-based information with the general public, media, policy makers, and landowners.

This regional team effort has been possible through financial support in excess of \$2 million. Partnerships have included numerous state Departments of Environmental Quality, U.S. Environmental Protection Agency Region 8, the National Energy Technology

Lab (NETL) of the Department of Energy, the Montana Department of Commerce, many local soil and water conservation districts, and private landowners. Outputs that the team developed or contributed to include:

- An award-winning, nationally recognized *"Land and Water Inventory Guide for Landowners in Areas of CBM Development."* This guide leads landowners through natural resource inventory, monitoring, and management on their own lands; and was funded by an EPA Regional Geographic Initiative, U.S. Department of Agriculture-National Institute of Food and Agriculture NPM Regional Water Program, Prairie County Conservation District in Montana, and the NETL
- *"Prairies and Pipelines,"* a public television documentary, with support from the Department of Energy, Montana State University Extension Water Quality Program, and the USDA-NIFA Water Program. The documentary addresses the science and social issues behind CBM recovery and water management. The documentary includes contributions from the Bureau of Land Management, private land owners, industry representatives, scientists, and policy makers
- Contributing authorship to a year-long study to U.S. Congress on CBM-produced water management in the region, culminating in a 200-plus page report on produced water management and effects in the western United States by the National Research Council
- A report on native and culturally significant plants of the Northern Cheyenne tribal reservation
- Eleven peer-reviewed science journal manuscripts, two published articles, two book chapters, 50 presentations, six Web-based curriculum modules, and 10 electronic fact sheets

Collectively, these outputs have generated about 83,000 viewings of CBM-related information from viewers in North America, Asia, Australia, Western Europe, the Middle East, and Eastern Europe.



CBM-produced water being discharged into constructed wetland/impoundment, northeast Wyoming. Pictured are Jim Bauder, Holly Sessoms, and Kristin Keith, Montana State University. Photo courtesy of Suzanna Carrithers, formerly MSU; currently USGS-Bozeman, MT

Jim Bauder, former MSU Extension Water Quality Specialist, and Holly Sessoms, former MSU Extension Water Quality Associate, measure infiltration at a CBM water spill site in southeast Montana. Photo courtesy of Suzanna Carrithers, formerly MSU; currently USGS-Bozeman, MT



Constructed surface storage ponds and impoundments for CBM-produced water along the Tongue River corridor, south central Montana. Photo courtesy of Jim Bauder, formerly MSU Extension Water Quality Specialist

water quality standards and water management regulations dealing with CBM-produced water. Wyoming regulators are establishing water quality standards, and Colorado regulatory agencies are investigating rule promulgation and permitting protocols specific to CBM-produced water. Wyoming and Montana Environmental Quality departments have modified their CBM-water discharge permit processes to protect existing beneficial water uses. Other significant impacts include judicial rulings and policy changes in water quality standards that provide landowners with mechanisms to protect their resources. Educational impacts include MSU's Land Resources

Impacts of the effort are evident at the local, regional and national levels. Landowners have taken steps to inventory and monitor natural resources and irrigation water qualities. The State of Montana, the Northern Cheyenne Tribe, and the EPA have adopted surface

and Environmental Sciences Program with seven master of science degrees awarded, and the University of Wyoming's Department of Renewable Resources with three doctoral and four master of science students trained.

Well and Septic Education in the Northern Plains and Mountains Region

Adam Sigler and Jim Bauder, Montana State University; Troy Bauder, Julie Kallenberger and Erik Wardle, Colorado State University

State regulatory agencies and county environmental health offices in EPA Region 8 have stated a need for private well and septic owner education to protect public health and water resources. In response, the Northern Plains and Mountains (NPM) Regional Water Program identified gaps in existing well and septic owner education resources.

These gaps were filled with an educational DVD, well and septic folders, and an online water quality interpretive tool. New materials, along with updated existing materials, were posted to a well and septic owner education site on the NPM regional website, www.region8water.org.

The NPM team produced an educational DVD, "Taking Care of yOur Ground Water," to teach homeowners about protecting drinking water resources by caring for their well and septic systems. The video is available on the Web, and more than 3,000 hard copies have been distributed so far. The videos have been presented at professional meetings in Colorado, Montana, North Dakota, and Utah, and 97 percent of water

system professionals surveyed after viewing the film said they would use it as an educational tool. County environmental health offices across the region are linking to the videos from their websites, and Jefferson County in Colorado purchased copies of the DVD for distribution with every new septic permit. Eighty-two percent of

homeowners returning surveys said the film increased their knowledge of their water systems, and 27 percent said they identified a problem with their wells or septic systems to address after watching the film.

Well and septic file folders produced by the NPM team

have been distributed to thousands of homeowners in the region. All of those returning surveys said they will use the folders to keep well and septic records. More than 85 percent said the folders increased their knowledge of their wells or septic systems, and more than 80 percent said the folders served as a reminder to maintain their water systems.

The NPM team created an online Water Quality Interpretive Tool for users to enter water quality results into and receive immediate feedback about suitability



Filming 1: Adam Sigler and David Keto, Montana State University, filming the process of shock chlorinating a well for the "Taking Care of yOur Ground Water DVD." Photo courtesy of Suzanna Carrithers, formerly MSU; currently USGS-Bozeman, MT

of water for drinking, livestock, or irrigation. The tool has had more than 1,000 users and is very well received. For example, here is one response: "... you have an excellent resource for people like me to get an interpretation of their water tests. Without this interpretation, the test results mean nothing to me. Thank you again!"

issues in the Valley. After participation in the program, 24 percent of participants identified a problem with their water systems, and 78 percent of those people said they plan to address the issue. More than 95 percent of participants started a well file using the NPM folders and said they were better able to monitor and maintain their wells and would retest in the future.

The NPM well and septic educational materials are being used across the region to reach thousands of homeowners. These homeowners are identifying and addressing issues with their water systems, maintaining their septic systems more regularly, and testing their water quality more frequently. These behavior changes not only have the potential to improve the quality of groundwater, but also to help protect public health.

"Taking Care of Your Ground Water" DVD

DVD contents

Taking Care of Your Ground Water

A homeowner's guide to well and septic systems (16:28)

Extra Video Sections

1. Water System Considerations for Buying or Building a New Home (10:11)
2. Protecting the Wellhead (10:25)
3. Septic Systems (9:30)
4. Sampling for Well Water Quality (6:25)
5. Interpreting Water Quality Results (8:35)
6. Chlorinating a Well and Water System (9:27)
7. Water Treatment Options (6:38)
8. Bloopers (3:41)

Text Files

State Specific Contact Information

In the San Luis Valley of Colorado, the NPM Team partnered with the San Luis Valley Ecosystem Council (SLVEC) to provide educational materials for a campaign that tested 300 wells and held public meetings. The videos and online Water Quality Interpretive Tool from NPM provided support for SLVEC to receive an Environmental Justice Grant to address well water quality



Stream Side Science: Hands-on Water Education that Makes a Difference

*Nancy Mesner, Utah State University; Adam Sigler, Montana State University;
Suzanne Carrithers, USGS; Andree' Walker Bravo, Utah Society for Environmental Education*

Stream Side Science (SSS) uses hands-on stream monitoring techniques to teach middle- and high school students about water pollution and watershed functions. The 11 lesson plans cover science, management, and policy aspects of water science and water quality. Because the curriculum engages students directly in their local watersheds, they also learn about stewardship through service and community outreach projects.

Stream Side Science was developed with the needs of educators in mind.

- SSS is aligned to national and state science standards.
- Each lesson plan is formatted for easy use, provides clear instructions and explanations for teachers, includes examples of data summary statistics and graphing, and includes frequently asked questions that can be used in classroom discussions.
- The lessons have been reviewed by scientists, policy makers, and educators to make sure the curriculum is scientifically accurate, age-appropriate, and unbiased.
- The curriculum is available online or by request. Materials needed for the lessons are inexpensive and easy to obtain or build.
- Focus groups showed that many educators felt they need more training in water science. SSS workshops are designed to provide educators with the knowledge and skills to teach water science to their classrooms.

Stream Side Science is flexible, fun for students, and promotes stewardship through service and community projects.

- The lesson plans are being used nationwide to teach such disciplines as agriculture and natural resource

education, biology, chemistry, math, geography, and other social studies.

- Informal educators are using SSS for 4-H, scouting, after-school, and summer activities.
- Student projects using SSS concepts include watershed-wide monitoring, riparian restoration, and community education on urban stormwater.



Fourth graders from Cache County, Utah, schools are learning how to collect macroinvertebrates in Logan River using a kicknet. Photo courtesy of Laura Hines, Utah State University Water Quality Extension.

Stream Side Science Impacts

- SSS increases students' knowledge in STEM disciplines through lessons focused on water science and management. A study of almost 1,000 students found significant increases in knowledge and awareness of water science and issues after using these lessons.
- Since 2004, more than 1,300 Utah educators have attended high quality training at one- to two-day workshops. An estimated 40 percent of these teachers

use SSS in their teaching.

- SSS is a text for a three-credit online graduate education course taught by Montana State University. Since 2006, about 150 educators from around the country and beyond have taken this class.
- SSS has been incorporated into other programs, including Community Mapping Projects, Adopt a Waterbody Programs, and Master Naturalist Programs.
- SSS materials are being used



High school teachers collect macroinvertebrates and measure dissolved oxygen in Farmington Creek as part of a Stream Side Science teacher workshop. Photo courtesy of Laura Hines, Utah State University Water Quality Extension.



Fourth-grade students from Weber County, Utah, identify and inspect macroinvertebrates. This lesson allows students to discover the various adaptations that allow macroinvertebrates to live in water. Photo courtesy of Laura Hines, Utah State University Water Quality Extension.

in developing training and course work at Tribal colleges and Hispanic Serving Institutions around the country.

Teachers say:

- "The curriculum reinforced concepts, builds on previous understanding of watersheds, and modeled how I can present to students."
- "Best workshop I have been to in 20 years!"
- "I am going to apply all of this to my class next year!"

In Utah alone, an estimated 80,000 students have increased their knowledge and awareness of water quality and water science through participation in Stream Side Science.

See Stream Side Science at: www.region8water.org

Watershed Monitoring and Management in the Northern Plains and Mountains Region

Ginger Paige, University of Wyoming; Nancy Mesner, Utah State University; Adam Sigler, Montana State University; and Roxanne Johnson, North Dakota State University

The issue: Managing watersheds to maintain working landscapes while protecting water quality and other watershed functions is critical in sustaining agriculture and natural resources in the West. Continued application of best management practices (BMPs) whose benefits have not been quantified impairs effective management of these resources. Although water quality monitoring protocols exist in every states and most agencies, they tend to be applied generically. Often little thought is given to the monitoring objectives for a specific project, sources and their variability, and long-term trends in changing land uses. Hydrology in western watersheds varies widely within and between years, with decades-long cycles of drought and flood. Water quality and natural resource management in the area is further challenged by urbanization, rapid expansion of small acreage housing, and energy development. These patterns are transforming large tracts from agriculture, rangelands, and wild lands, resulting in changes in water quality and quantity in these watersheds. Differentiating responses from BMP implementation from this variability requires careful thought and planning and improved monitoring approaches.

Team Actions and Outputs:

The Northern Plains and Mountains (NPM) Regional Water Team responded to stakeholder needs by:

1) investigating water quality and BMP monitoring programs and training needs in the region; 2) assessing the effectiveness of specific BMPs at mitigating water quality issues; and 3) developing educational resources, approaches, and materials to improve water quality monitoring programs. These actions have been implemented in collaboration with stakeholders at local, state, and national levels. Outputs that the team developed or contributed to include:

- Water quality monitoring training modules and certification programs
- BMP Monitoring Guidance Document for Stream Systems
- Website: "Best Management Practices: Guidance Information"
- Quantitative assessment of implemented BMPs including stream restoration, tile drains, and grazing management systems

- Trainings and symposia for local, state, regional, tribal, and national audiences

The Guidance Document and website present guidelines for designing and implementing effective monitoring approaches. They advocate careful consideration of the specifics of a particular implementation project, such as understanding the potential source, transport, and fate of pollutants of concern; watershed characteristics; and knowledge of other data sources and information. This leads to appropriate choices of monitoring or modeling techniques, frequency, and scale.

Leveraging:

This regional team effort has been possible through financial support of more than \$1.7 million. Partnerships included numerous state Departments of Environmental Quality, USDA CEAP, USDA NIFA, Wyoming Department of Agriculture, Discovery Farms Project, Tribal Colleges, USGS, and many state and local soil and water conservation districts.

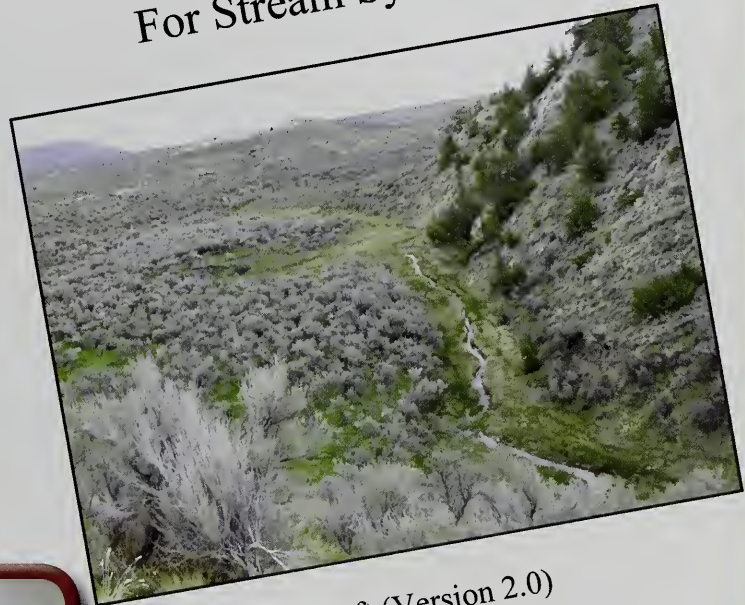
Impacts:



WQ Training: Doug Miyamoto and Liberty Blain measuring stream flow at Wyoming Association of Conservation Districts Water Quality Monitoring Training. Photo courtesy of Ginger Paige, University of Wyoming

Impacts of the regional team effort are evident locally, statewide, and nationally. Water quality monitoring training programs for volunteers and professionals have expanded. Wyoming and Montana have certification program, and Utah and North Dakota are expanding monitoring trainings and developing certification programs. More than 200 volunteers and professionals have been trained and/or certified in the region to collect credible water quality data. New monitoring strategies that detect and quantify change in water quality are being implemented, and credible water quality data are being collected. These data are being used to assess the effectiveness of implemented BMPs, develop TMDLs that are appropriate for the region, and assess the overall health of watersheds. The overall goals are the long-term improved stewardship of water bodies in the region based on understanding the links between actions on land and water quality, and improved water quality resulting from more effective placement of effective BMPs.

Best Management Practices Monitoring Guidance Document For Stream Systems



Draft (Version 2.0)

Developed by:
Nancy Mesner, Utah State University
Ginger Paige, University of Wyoming



BMP Guidance Document Cover: Best Management Practices Monitoring Guidance Document for Stream Systems



Tribal Waters Workshop: Adam Sigler (Montana State University) leading discussion at Tribal Waters Workshop: Effective Monitoring Strategies to Address Impaired Waters, held in Crow Agency, MT. Photo courtesy of Katie Kleehammer, Montana State University

Agricultural Water Conservation in the Northern Plains and Mountains Region

Troy Bauder, Reagan Waskom, Faith Sternlieb and Julie Kallenberger, Colorado State University; Jim Bauder, Montana State University

Agriculture consumes about 90 percent of available water resources in the western United States. Farmers, water managers, and policy-makers must understand and incorporate agricultural water conservation methodology, technology, and policy into their daily operations. Both climate change and population growth are adding pressures to water resources; private and public industry must learn to collaborate on long-term working solutions that are based upon sound, peer-reviewed science. Often this information is not readily available to water users, especially those outside of academic and government agencies.

The Northern Plains and Mountains (NPM) Regional Water Team has addressed the need for increased knowledge, understanding, and adoption of agricultural water conservation through two Web-based projects. The first, an Agricultural Water Conservation Clearinghouse (AWCC), was developed in cooperation with the Colorado Water Institute, Colorado State University (CSU) Libraries, and the Agriculture Network Information Center (www.agwaterconservation.colostate.edu).

The first AWCC accomplishment was to research, compile, and assemble accessible information and tools on agriculture water conservation. The centerpiece of this online clearinghouse is a comprehensive library that identifies resource materials regarding irrigation management, irrigation technology, efficient water delivery systems, agricultural water reuse and recycling, soil moisture and evapotranspiration measurement, cropping systems, agricultural economics, and water

law and policy. The clearinghouse library database encompasses agricultural water conservation topics in a variety of formats, including journal articles, books, fact sheets, bulletins, reports, theses and dissertations, and conference proceedings. The library contains more than 2,100 entries and has been searched by more than 10,700 users since it was unveiled in 2008.

The AWCC's success depends on partnerships. In addition to the collaborating

organizations, the NPM team has built relationships with the Central Plains Irrigation Association, the U.S. Committee on Irrigation and Drainage Association, and the California Agricultural Water Stewardship



AWCC home page: The Agricultural Water Conservation Clearinghouse - www.agwaterconservation.colostate.edu

Irrigating with Limited Water Supplies



A PRACTICAL GUIDE TO CHOOSING CROPS WELL-SUITED TO LIMITED IRRIGATION



Colorado State University
CSU Water Center
Fort Collins, CO

Utah State University
Extension Irrigation
Program—Logan, UT

Northern Plains &
Mountains Regional
Water Program

M MONTANA STATE UNIVERSITY | EXTENSION
Extension Water Quality Program • Bozeman

The NPM Regional Water Team has also focused on increasing the knowledge of private consultants and agency personnel who influence growers in the NPM region and around the country. To accomplish this, a series of on-line, self-study modules for the professional Certified Crop Advisor (CCA) recertification and proficiency program has been published. Using a pilot survey of CCA Boards in the NPM region, the NPM team focused on water conservation under limited irrigation and irrigation water quality. The modules were developed through collaboration with research scientists and university faculty from throughout the region and neighboring regions. Since the fall of 2009, more than 40 Certified Crop Advisors have correctly answered 70 percent of the questions in the modules. More than 75 percent of CCAs who

Cover page Irrigating with Limited Water Supplies: A Practical Guide to Choosing Crops Well-Suited to Limited Irrigation

completed post module surveys said they would use knowledge gained from the series while advising their farmer clients.

Initiative. Through these partnerships, access to grey literature published through these organizations has been increased. These include proceedings of regional and national conferences and special reports on irrigation water management. Until recently much of this literature was only available in hard copy, and was not available from traditional library or Web searches. Through the AWCC, these materials will be available at the click of a mouse.



SLV pivot: Center pivot irrigation in the San Luis Valley in south central Colorado. Photo courtesy of Karl Mauch, Colorado Department of Agriculture.

Alternative waste management solutions for small-scale piggery operations: Educational outreach, demonstration and adoption for Pacific Island communities.



Glen K. Fukumoto and Luisa F. Castro, University of Hawaii at Manoa; Lawrence J. Duponcheel, Northern Marianas College; Leilanie Rechelluul, Palau Community College; Jina David, College of the Marshall Islands; Jackson Phillip, College of Micronesia-FSM; Mark Walker, University of Nevada-Reno; Brian Rippey, American Samoa Environmental Protection Agency; and Don Vargo, American Samoa Community College

Pacific island nations face many challenges in providing food sources for their residents. Increasing populations with high food demands, limited agricultural production, and geographic isolation mean these U.S. protectorates face significant food security risks. The most obvious of these risks for Pacific Island communities is the extremely low level of available food for local populations in an emergency. But perhaps even more damaging is the lack of available fresh meats and vegetables, or the high cost of

these items when they are available. Expensive local produce and the ever-increasing cost of imported goods have pushed food costs above what many households can afford. This caused a major shift toward the consumption of more affordable processed and canned foods. As a result, healthy eating habits and overall health and well-being in Pacific Island communities have decreased over the last few decades, as levels of respiratory diseases, diabetes, heart disease, and cancer rise.

The United States employs federal programs in the Pacific, including the U.S. Department of Agriculture and land grant-cooperative Extension programs, that are charged with to improving or promoting agriculture production and creating a shift in eating habits. This is a daunting task for many federal programs and technologies that were developed for mainland production. Furthermore, federal programs have high turnover rates of employees, and no clear venue for communication between agencies and community programs



Combining natural elements. Dry carbon bedding, sloping pen floors, gravity, and natural hog behavior combine to stabilize and convert animal wastes into a soil amendment for use in cropping systems.

that are developing appropriate technologies and program delivery systems for Pacific Island ecosystems and societies. Fortunately, the National Water Program has a continued, long-term, and sustained focus on dialogue between agencies and communities to include the development of appropriate agriculture technologies for island producers, particularly in the area of animal waste management.

Animal waste management is a matter of life or death for Pacific Islanders. Hogs raised in small backyard systems are the primary source of fresh meats for local families. Without these small systems, families would rely on imported processed foods. However, these backyard production systems often create environmental pollution that adversely affects human health. The Region 9 Water Program provides options for producers through the development of sound alternatives for animal waste management that produce a by-product that can be used to improve

crop production for human or animal consumption. This has been accomplished through the education of producers, Extension personnel, and local and federal agencies over almost 20 years. By maintaining a high level of discussion throughout the region, directing funding from multiple sources, improving the level of appropriate educational materials

and programs, and continuing evaluation and improvements to the technologies, producers' attitudes have shifted in their views of animal waste as a resource rather than a problem. Improvements to water quality in communities such as Samoa have been embraced and promoted in order to protect water systems and individuals' self-reliance.



Closing the cycle. The integrated composting system is an important design element of the dry litter technology.



Out with the old and in with the new. Paradigms of long-established waste systems are changing from polluted waste and liability (fenced pit at left) to a simple and logical nutrient management system where nutrients are a resource and desirable asset of the piggery operation (covered unit on right).

Rainwater Catchment Safety

Leilanie Rechelluul, Palau Community College; Jackson Philip, College of Micronesia – FSM; and Jina David, College of the Marshall Islands

Rain is an essential freshwater source of drinking water in rural Hawaii and many other Pacific islands. Despite the widespread use of rain catchment systems in Palau, most rain catchments are not properly maintained for safe drinking water. Although experts said the rain catchment systems were improperly maintained, the general public seemed to believe that rainwater is naturally the cleanest water on earth. They not consider their catchments, roofs, and cutters could contaminate their drinking water.

By tradition, Pacific islanders consider rainwater catchments to be anything that can be used to catch rain, such as basins, drums, trash plastic trash cans, big pots, and swimming pools. The rainwater caught was used for drinking and cooking, and maintenance of the catchment was ignored. Some island resident still use such systems.

Region 9 Pacific islands, states, and territories initiated a regional project to educate residents and promote maintenance and proper components

of rainwater catchments, as well as conduct water testing.

Dr. Patricia Macomber from the University of Hawaii in Manoa visited the Republic of Palau, Chuuk in the Federated States of Micronesia, and the Marshall Islands to train the trainers in water testing and rainwater catchments maintenance. Household surveys and water testing were conducted during Dr. Macomber's visit. In addition Dr. Macomber made it possible for water quality representatives from Palau, the Marshall Islands, the Federated States of Micronesia, and Guam to attend the annual rainwater catchment conference in the Big Island of Hawaii.

Through the trainings and professional meetings, Region 9 water quality coordinators were able to hold several workshops, water education campaigns, community outreaches, demonstrations, and water testing activities throughout the Pacific islands. The activities were conducted and coordinated by the

water quality coordinators, assistant coordinators, and Extension agents throughout the region.

In Palau, a rainwater catchment maintenance manual has been modified from Hawaii's rainwater catchment's manual and published. The Marshall Islands produced a DVD as an awareness and promotional tool, and provided information about alternative methods of harvesting clean and quality water. The water quality coordinator of the Federated States of Micronesia—Pohnpei, Kosrae, Chuuk, and Yap—produced brochures and demonstrations of rainwater catchments systems.

Project coordinators, assistant coordinators, and Extension agents reported that more than 50 percent of the people who have been educated through these programs have changed their practices, attitudes, and conditions, and improved their knowledge on rainwater catchment maintenance and their personal health.



■ Unregulated water sources on the Navajo Nation: Opportunities for public health protection and student involvement in STEM disciplines

Mark Walker and Marnie Carroll, University of Nevada

Unregulated water supplies on the Navajo Nation are primary sources of household water for some rural areas. Although these sources might not provide water that is safe for human consumption, some residents of the area have no good alternative. Unregulated supplies were developed primarily for livestock. Accordingly, water quality, especially as it affects human health, has received little attention.

Dine College, the community college system of the Navajo Nation, has a total annual enrollment of about 4,000 students. The system has eight campuses in New Mexico and Arizona. The Dine Environmental Institute on the Shiprock campus offers students the opportunity for summer experiences with environmental data collection and interpretation. The summer classes and internships focus on issues

important to the Navajo people, including water quality.

The Region 9 water quality coordination project provided technical support and instruction for evaluating water quality in unregulated supplies in the northern Navajo Nation. The project paired faculty and students from the University of Nevada and Dine College. The project involved repeated sampling of unregulated water supplies for a range of contaminants, including *E. coli*, uranium, arsenic, and fluoride. Students from the two institutions travelled throughout the northern region of the Navajo Nation to locate unregulated supplies, measure physical characteristics of water, and inspect each site. The work began in 2007, and the teams have sampled about 98 wells in three sampling seasons. This provides a substantial

addition to information about quality in these supplies, especially because about 15 unregulated water supplies have been sampled in three consecutive years.

Sampling showed that water exceeded federal standards for arsenic (30 percent of those sampled), uranium (11 percent), and fluoride (3 percent). Also, 15 percent of supplies tested contained *E. coli*.

This information was used to support educational efforts and further testing, and to extend public water supplies to rural portions of the Navajo Nation. However, the most profound impact has been on the Navajo students involved in the program who have developed interests in STEM disciplines and skills that qualify them for technical work focused on water quality



Students from Dine Community College carry out field measurements at the discharge pipe for an unregulated water supply on the Navajo Nation, with Dr. Mark Walker.

Safe Application of Reclaimed Water Reuse in the Southwestern United States

Laosheng Wu, University of California, Riverside; Channah Rock, University of Arizona; and Evan Fulton, University of Nevada, Reno

Water reuse has become more common due to the scarcity of fresh water resources and competition for high quality water. However, knowledge gaps still exist regarding the behavior of containments from reclaimed wastewater in soil and water systems. Researchers, regulators, and users worked to identify the potential problems, research, and educational needs in promoting the safe use of reclaimed wastewater. Investigator studied the:

- 1) fate and transport of trace organic contaminants, such as pharmaceuticals and personal care products (PPCPs) and endocrine disrupting compounds (EDCs) in the soil and water receiving reclaimed wastewater. The mobility of most of the trace organic compounds was found to be low, and no groundwater contamination was observed. However, potential for adverse effects to soil and water cannot be overlooked.
- 2) presence and persistence of waterborne and water-based

pathogens remaining in reclaimed wastewater following disinfection, and the potential microbial and chemical changes possible after disinfection within reclaimed wastewater distribution systems. Significant microbial growth and re-growth was determined to occur post-disinfection of both system types, which suggests the importance of protecting public health by monitoring the reclaimed wastewater distribution system.

- 3) wastewater treatment levels and distribution systems that integrate reused water as a component of existing water systems

- 4) use of computer models to assess the salinity effect on crop growth. Several commonly used computer simulation models that assess the salinity effect on crop growth

were evaluated. The tested models are useful tools for planning water reuse projects.

In the public sphere, concerns remain over the real or perceived risks of reclaimed wastewater reuse, and as a result, municipal decision-making can be influenced more by public perception of risks rather than by



Purple pipe



City of Peoria (Arizona) irrigation covers in residential park

scientific assessments. Presentations, field day tours, and educational publications and technical journal articles have been made available to the general public. Community work

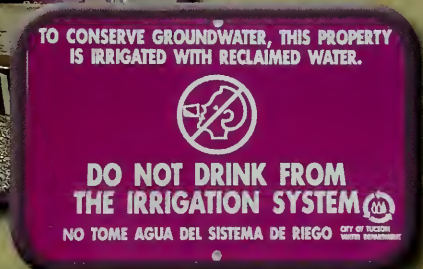
and water reuse conferences have been established. The increasing use of recycled wastewater in the southwestern states can at least partially be attributed to these efforts. Pollutant loads to surface and ground water are reduced due to increasing use of reclaimed wastewater for irrigation, and as a result, decreasing release of wastewater to surface water.

Preliminary research from this project has allowed project partners to leverage funding from several granting agencies and public and private partnerships

including the Arizona Department of Environmental Quality (ADEQ), the WaterReuse Association, and many utility partners.



City of Tucson distribution system



City of Tucson signage



Assessing and managing the health risks of irrigation water in the lower Colorado River basins

Jorge M. Fonseca, Charles A. Sanchez and Sadhana Ravishankar, University of Arizona

The goal of this four-year project funded by USDA NIFA was to determine potential risks to the chemical and microbial quality of the Colorado River. Findings obtained during the first two years of the study identified management alternatives to reduce risks. The microbiological quality of the Colorado River was evaluated each week. Great variability was found in the bacteria indicators in the water, such as fecal coliforms, total coliforms, and generic *E. coli*, with low populations



Plot watered with furrow irrigation.

coinciding with the production season of leafy green crops in Arizona.

Bacteria indicators increase during warmer months when

no production or harvest is

occurring in Arizona. No samples containing *Escherichia coli* O157:H7, a pathogen of great concern in the area, were found.

The risk posed by the different irrigation systems, including overhead sprinkle, furrow, and

drip irrigation, was assessed, and sprinkle irrigation was determined to be the method with the highest risk to deliver a contaminant to consumers. However, furrow irrigation produces the longest survival of *E. coli* in the soil, which may eventually serve as a cross contamination method at harvest. In survival studies using a non-pathogenic surrogate, the persistence of *E. coli* in commercial fields was found to be dependent on the time of the year. Factors such as temperature, moisture, and quality and intensity of light may play an important part in the survival of *E. coli*. Although the bacteria survived over two weeks in winter months, the persistence was not more than one week in summer months. In laboratory studies in Tucson, *Escherichia coli* O157:H7 and *Salmonella* sp. were subjected to survival studies in water collected from different sites along the Colorado River Basin. Survival was seen to possibly be affected by the concentration of salt in the water.

In studies surveying pharmaceuticals in the water, the treated Tucson wastewater effluent was found to contain the macrolide antibiotic azithromycin, the over-the-counter drug pseudoephedrine, the illicit drug methamphetamine, and an industrial compound, N,N-dimethylphenethylamine (DMPEA, an isomeric compound to methamphetamine). All contaminants evaluated were below detection in the control well water. No uptake

of the chemical compounds was found in any of the plant or root samples from field crops. Overall, the findings showed that highest risk is associated with potential microbial contamination when irrigation water is scheduled shortly before harvest.



Inoculation of water using a plastic container dripping onto the running water.

Growers have been informed and some have moved the schedule of the last irrigation as early as possible without harming final yield. Growers now know of a lower chance of having a pathogen

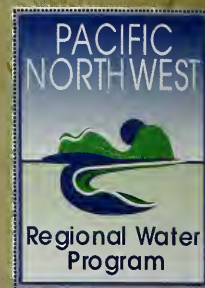
in the water during the coldest months. However, they also have learned that during the coldest months pathogens in commercial fields may survive longer than in summer months. More information is being generated on the impact of different survival rates in water collected from irrigation canals fed with the Colorado River water.



System connected to overhead sprinkle irrigation to inject *E. coli* in the water stream.



10 Years of Regional Progress: Drinking Water and Human Health



F. Sorensen (UAF-CES), R. L. Mahler, B. Simmons and M. Gamroth

The following are 10-year accomplishments of the Pacific Northwest Regional Water Resources Program:

Surveys:

Drinking water issues were included in the regional surveys in 2002 and 2007. Clean drinking water continues to be the highest identified priority of those surveyed—99 percent of respondents in both surveys. About 70 percent of the survey respondents said city water systems are their sources of water, with about 30 percent using wells, and 90 percent felt their water was safe to drink. But between 34 percent and 43 percent of respondents did not know if their water was contaminated or not.

Domestic Water Use: Resources Guide for Extension.

Extension offices throughout the region are contacted by residents who have questions concerning drinking water and other domestic water issues. No consistent region-wide resources were available to provide a central source for these common questions. To correct this lack, a resource guide of more than 400 pages in 14 chapters covering the common concerns on domestic water use was produced, and both a hard paper copy and a CD version were distributed to every county Extension office in the four-state region. Included in the guide were references to more than 70 publications from the Pacific Northwest and other regions.

Complete website references on materials used were also provided. The entire document was later included on the regional website. Requests for additional copies of the CD version were made from other agencies such as county health departments and the Environmental Protection Agency.

Fact Sheets:

Specific drinking water pollutants within the region were identified and addressed through fact sheets being developed and made available in both hard copy and a downloadable form on the regional website. Currently three of these fact sheets have been produced—on

iron, nitrates, and radon—and one on arsenic is in development. These documents are designed for eventual publication through the PNW multi-state publication series.

Regional Wells and Septic System Programming:

Thirty percent of those surveyed in the region identified wells as a source of drinking water. In almost all cases homes with wells have septic systems. Because of these septic systems tend to be located close to the drinking water wells, they are also a major cause of pollution. The physical closeness of water wells and septic systems makes them close in the minds of homeowners too. Therefore, tying together educational programming for both makes sense. Regional educational programming, resources (including hard copy and Web-based), and workshops have been developed and implemented. Separate regional Web pages on wells and septic systems are available. Single state and multi-state workshops on wells and septic systems have been presented to homeowners, realtors, and agency personnel.

Regional Expertise Directory: Drinking Water and Human Health:

A series of directories identifying experts within the region by state were produced and updated. Clientele can contact these experts on specific issues including drinking water and human health. These directories were developed for local, state, and federal partners, and listed research and Extension contacts within each state and the published resources available from the land grant institutions they serve.

Protecting Family Drinking Water in Rural Alaska:

One of the concurrent 406 projects supported by the regional team was a study of drinking water safety in a remote rural village in Alaska. Without central plumbing in the village, residents transfer drinking water and human waste through literally "buckets." This project studied the survival and transmittance of pathogens

10 Years of Regional Progress: Animal Manure Management

Michael Gamroth, Oregon State University

The last 10 years has been a decade of changing regulations for Confined Animal Feeding Operations (CAFOs) and other livestock owners. New national rules for CAFOs were released in 2003, and modifications continue today. The Pacific Northwest Water Quality Team provided education to help producers comply with the new rules. Face-to-face meetings, printed materials, and newer electronic technologies were used to get the latest information to livestock producers and their advisors.

The team sponsored a summit near Seattle to identify needs, assess current capabilities, and plan programs that would help producers use manure as a fertilizer while avoiding surface and groundwater pollution. The summit was attended by federal and state regulators and university educators who connect with producers. Each state has a slightly different regulatory program, so rules were not the topic of meetings in the region. The summit identified the need for more uniform nutrient management planning across the states, with special emphasis on phosphorus application and plant uptake.

An animal manure management expertise directory for Region 10 universities was developed. The fact sheet listed the 25 current Extension publications available for use in manure management and planning.

With more public attention and regulation of animal feeding operations, a national team with members from the Northwest began producing the Livestock and Poultry Environmental Stewardship (LPES) curriculum. This team produced 26 lessons related to manure management as short fact sheets and ready-to-use slide sets on an easy-to-use CD. The curriculum can be presented by any Extension educator to any size of livestock group. Topics covered manure management for all commercial livestock

species on any size of farm. The team held an orientation session on the curriculum to introduce it to users in the Pacific Northwest.

Later the LPES effort was posted on an eXtension website. All the curriculum materials are available, along with other fact sheets and articles related to manure management. Several years ago the site began producing live webcasts by experts that could be accessed by anyone who wanted to link in. The webcasts have covered a variety of topics and have been popular with both farm advisors and producers. The PNW Team used this expertise to sponsor a webcast live from the 2010 National Water Quality Conference. Information on poultry and horse manure management and farm composting was broadcast to 59 sites around the country. A program evaluation showed that the attendees intended to reach about 8,100 producers with the information.

Another team effort, led by Washington State University faculty, dealt with a new cost-sharing standard through the Natural Resources Conservation Service (NRCS). The standard would help pay the cost of a livestock producer using feed management to reduce excretion of nitrogen and phosphorus in manure. This team was funded by a multi-year grant from NRCS. The project started with the development of tools to be used by NRCS personnel and advisors to determine the possibility of using feed management and to identify the best management practices to reduce nutrient excretion. Then educational materials were developed and trainings were held throughout the Northwest and the country. Cost-sharing has begun, and the tools developed by the team are in use by nutritionists and NRCS personnel all over the United States.

GO T POOP?

Breaking News! What happens when you don't pick up after your pet? It contaminates the creeks and lakes our children play in. Watch the Channel 2 News Team and their four-legged friends grab a bag, scoop a pile and proudly declare, "Got Poop!"



SCOOPTHEPOOP.ORG

Anchorage Waterways Council • Municipality of Anchorage Parks and Recreation • University of Alaska, Fairbanks - Cooperative Extension Service
Alaska Department of Environmental Conservation • Bureau of Land Management - Anchorage Field Office • Anchorage Animal Care and Control
Alaska Department of Fish and Game • Anchorage Unleashed • Municipality of Anchorage Watershed Services

A poster used in the highly successful multiagency "Scoop the Poop" program in Alaska.



Example of a confined animal feeding operation (CAFO) in the Pacific Northwest.

10 Years of Regional Progress: Nutrient Management

Robert Mahler, University of Idaho

In the last 10 years the Pacific Northwest Regional Water Resources Team has worked with nutrient management scientists at the region's land grant universities to improve nutrient management in crop production. This improvement results in cleaner and safer surface and ground water.

Specific progress with nutrient management has been accomplished in: (1) better fertilizer guidelines for major crops grown in the region, (2) the development of regional fertilizer guides, (3) the development and implementation of nutrient management planning, (4) improved nitrogen use efficiency in crop production, and (5) improved fertilizer phosphorus management resulting in cleaner surface waters.

Fertilizer Guides

Throughout the last 60 years, land grant institutions in the Pacific Northwest have invested a significant amount of money conducting research in developing fertilizer rate guidelines for major crops grown in the region. These research-based guidelines, known as fertilizer guides, suggest nitrogen and phosphorus fertilizer application rates based on soil testing information and good science. These guidelines, if followed and combined with good agronomic practices, will result in maximum economic yields. In the last 10 years more than 40 university fertilizer guides—from Idaho, Oregon, Washington, and Alaska—for commonly grown crops in the region have been revised and updated, resulting in improved scientific fertilizer recommendations. In addition, regional fertilizer guides from Oregon, Washington, and Idaho have been developed for the rain-fed cereal crops of the Inland Pacific Northwest.

Improving Nitrogen Use Efficiency (NUE)

Urea, the most commonly applied nitrogen fertilizer, has increased in price from \$200 per ton in 2000 to \$448 per ton in 2010. This price increase of more than 110 percent led to a decline of about 6 percent in nitrogen application rates to crops. However, this application

rate decline has been offset by a 5 percent increase in nitrogen use efficiency. This increase is in part due to Extension-led programs that have promoted better timing of application and better placement of nitrogen fertilizers in soils. The combination of reduced nitrogen fertilizer use and improved efficiency of the fertilizer applied has reduced the introduction of nitrogen into both surface and ground water in many parts of the Pacific Northwest.

Protecting Surface Waters from Phosphorus

Phosphorus (P) fertilizers do NOT leach through soils and because of this cannot contaminate groundwater; however, phosphorus can run off the surface of soils through erosion or water runoff and contaminate surface waters. The net result of phosphorus introduction into surface waters is called eutrophication. Extension professionals on the regional team have conducted extensive programming to reduce this form of water pollution. A significant portion of this training has been conducted through the iSNAP Program. As long as phosphorus fertilizer is not put on the soil surface, but instead is placed into the soil through incorporation or banding, it does not run off in fields and therefore can't pollute surface waters. Even though phosphorus fertilizer application rates in the region have remained stable over the last 10 years, because of improved fertilizer placement, additional phosphorus in surface waters via runoff from croplands has declined by more than 10 percent.

Outcomes:

- Nitrogen fertilizer application rates have declined by about 6 percent on major crops in the Pacific Northwest over the last 10 years.
- Despite the decline in fertilizer nitrogen application rates in the region, nitrogen use efficiency (NUE) by the region's major crops has increased by at least 5 percent.
- Even though phosphorus fertilizer application rates in the region have remained stable over the last 10

The iSNAP program educated both crop consultants and growers about effective nutrient management in crop production.

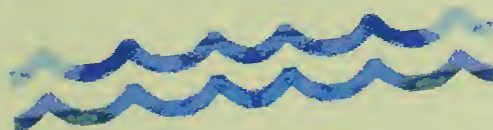
years, because of improved fertilizer placement, additional phosphorus in surface waters via runoff from croplands has declined by more than 10 percent.

- More than 40 university fertilizer guides—from Idaho, Oregon, Washington, and Alaska—for commonly grown crops in the region have been revised and updated, resulting in improved scientific fertilizer recommendations.
- Nutrient recommendations for cereal crops have improved these crops produced in the Inland Pacific Northwest because nutrient management scientists have updated and produced regional fertilizer guides that cross state lines.
- New planners have been trained to develop whole farm nutrient management plans.
- Producers are able to access NRCS cost-share funding for nutrient management practices that enhance water quality.
- Because of training programs, Certified Crop Advisors and Technical Service Providers provide better nutrient management advice today than they did in 2000.

iSNAP

Integrated Soil Nutrient and Pest

Water Quality Education



OSU, WSU, U Idaho, EPA and NRCS

Sponsored by the
National Integrated Water Quality Program



photo courtesy of: restorationday.noaa.gov

Nutrient runoff often leads to eutrophication of surface water bodies in the Pacific Northwest.

10 Years of Regional Progress: Integrated Pest Management

Ronda Hirnyck (University of Idaho), Linda Herbst and Robert Mahler

Pesticides used for agricultural production and landscaping can enter surface and ground waters through misapplication, movement of treated soils, return irrigation flows, runoff from agricultural fields, storm water runoff, and leaching through soils. The land grant universities of the Pacific Northwest (PNW) region conduct research activities, outreach, and educational programs to assist pesticide applicators and homeowners in managing pesticides for optimal crop production and environmental stewardship. With programs promoting carefully managing pesticide use and encouraging the use of integrated pest management (IPM), water quality can be maintained or improved.

The PNW Regional Water Program has long recognized the importance of IPM as a critical best management practice for water quality. For the past 10 years the program has carried out projects and educational programs to enhance the use of IPM. With the adoption of IPM, which uses a combination of chemical and biological tactics, harmful effects on water resources can be reduced. In combination with proper application and storage of pesticides, IPM can help prevent contamination of ground and/or surface waters because it reduces overall pesticide usage and encourages the selection of pesticides that will have less impact on the overall environment.

Partnership with the Western IPM Center

In order to more closely link IPM and water quality research and Extension activities, the PNW Regional Water Program developed a partnership with the USDA-NIFA Western IPM Center. The first joint activity was a brainstorming session to identify IPM and water quality program needs in the West. From that session, two symposia were developed for the western states. The first symposium was titled, "Water, Wildlife, and Pesticides in the West," and was held in Portland, OR. The 80 attendees identified IPM/water quality priorities for the region. Panels of experts addressed issues such as pesticide detections in water, public policy and how to

interpret the data, adopting solutions to prevent the entry of pesticides in waters, and protection of endangered species. The second symposium, held in Boise, ID, was titled, "Investigating the Connections between IPM and Water Quality." This symposium created a forum for the region's IPM and water quality researchers and educators to explore possible collaborations.

In addition to these two symposia, grant money from the Western IPM Center was leveraged to support two IPM projects, both in water resource protection: 1) the Idaho OnePlan IPM planning tool, and 2) research on using green manure crops to reduce synthetic soil fumigants in vulnerable cropping areas. Outreach efforts from both of these projects enabled NRCS—EQIP cost shares for pest management practices.

Professional Development Training

A professional development training workshop for Extension educators in the Pacific Northwest focused on implementation of IPM as a best management practice to help protect water quality. An added outcome of the workshop was development of multi-state and multi-disciplinary partnerships across the region for future IPM and water quality research and Extension activities. Another project, the Integrated Soil Nutrient and Pest Water Quality Education Project (iSNAP), was developed under the leadership of Oregon State University to deliver innovative education for agricultural professionals. Outcomes included agricultural professionals' increased ability assess and communicate potential water resource benefits to producers and determine management alternatives to reduce pesticide impacts to the environment. Both of these professional development projects were jointly funded by the Regional Water Program and the Western IPM Center.

Education and Outreach

The regional water team produced a directory of IPM and water quality specialists in the region, along with relevant Extension publications at the four PNW

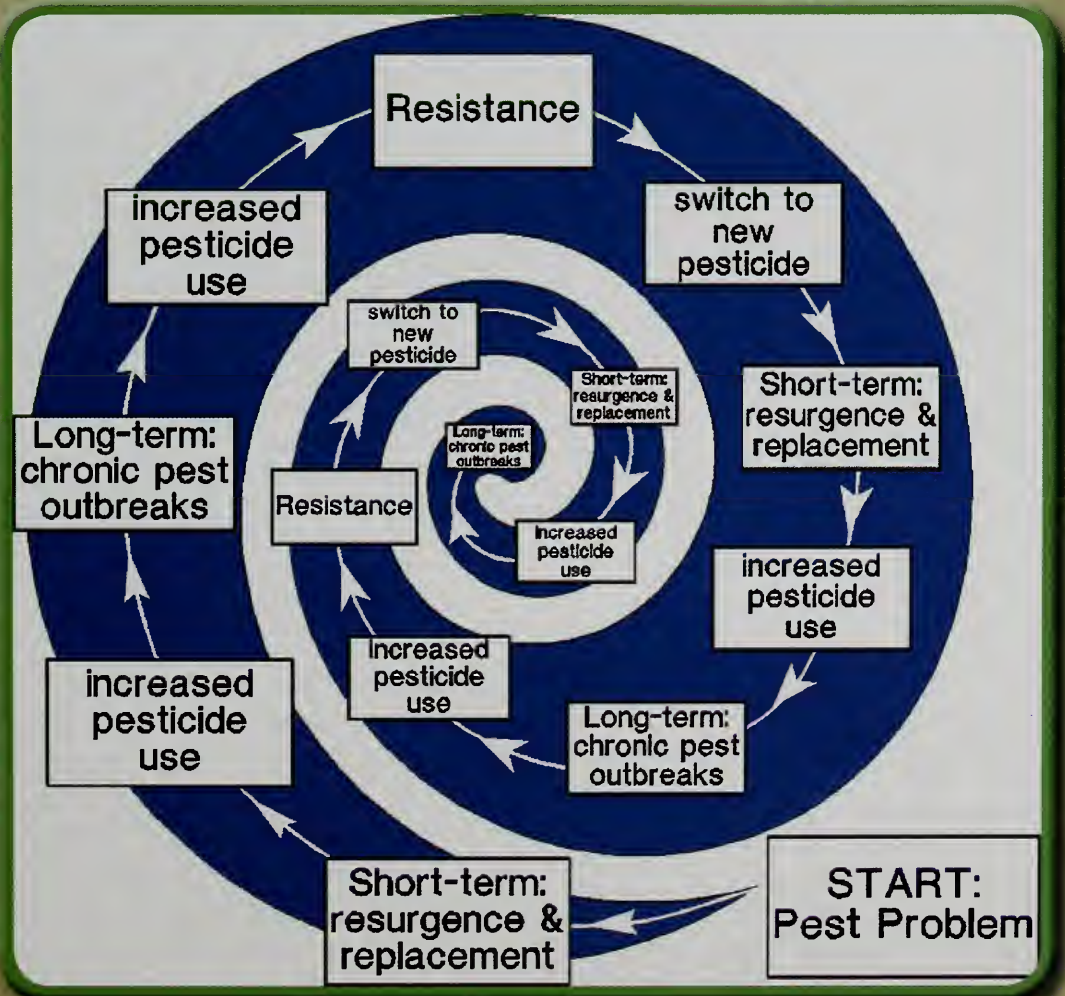
universities. In addition, the regional pest management specialists publish annual crop protection guides to assist agricultural professionals and homeowners with proper pesticide choices and pesticide safety information. Finally, pesticide safety educational curricula in the form of PowerPoint presentations and Extension bulletins have been developed to provide current pesticide certification education to potential pesticide applicators.

Outcomes

- Producers are able to access NRCS cost-share funding for IPM practices that enhance water quality.
- Producers and home gardeners are more aware of dangers from improper management of pesticides.
- Improved water quality in return irrigation flows to rivers.
- Groundwater is protected from contamination.
- Landowners and agricultural producers better manage chemicals used to enhance landscapes and to grow crops.



Growers exchanging information about succesful IPM practices that protect both surface and groundwater quality.



Growers that fail to implement IPM practices often end up on the never-ending pesticide treadmill.

10 Years of Regional Progress: Stormwater Management Education and Outreach

J. Seago (University of Idaho/WSU), R. L. Mahler, B. Simmons, P. Pearson, F. Sorensen and M. Gamroth

Impervious surfaces caused by urbanization and land changes from forests to strip malls and farms to housing developments are causing an increase in stormwater runoff. These surfaces prevent stormwater from soaking into the ground; instead the water runs off and adds to water pollution from heavy metals, trash, pet wastes, and other sources that increased population density produces. Since the census of 2000, the population of Idaho has grown by 19.5 percent, Washington State by 13.1 percent; Oregon by 11.8 percent; and Alaska by 11.4 percent.

The Pacific Northwest Regional Water Program recognized the effects this growth is having in the suburban areas of the states and established a plan of public education and outreach on the issue. In 2001, a traveling one-day workshop for the Interstate 5 corridor through Oregon and Washington was developed. The Suburban Salmon Workshop focused on home and business owners whose properties bordered on woodland streams, and introduced strategies that would create buffers between fertilized and manicured lawns and the habitat of endangered salmon and trout. As the workshop moved through the states, local experts spoke of the need to slow down and infiltrate more of the annual runoff to prevent habitat damage and flash flooding that cut away creek banks. The afternoon

sessions of the workshop featured a field trip led by local watershed groups or Conservation District personnel. It was a small beginning of a large effort.

By 2005, the U.S. Environmental Protection Agency focused on population densities of less than 100,000 with Phase II stormwater management requirements. One of EPA's Six Minimum Measures was public outreach and education. The PNW Water Team used strategies developed over the prior five years of the grant to offer educational materials on stormwater management. Since 2002 the team had been producing satellite and Internet-based video workshops on watershed management issues to help build capacity for watershed groups. Using the format of video case studies and a panel of experts to answer the questions, three workshops were released. On a national scale, "Stormwater Management



Runoff water from a Seattle parking lot that is headed for storm sewers.

from a Watershed Perspective" investigated how different jurisdictions planned to manage stormwater. Northwestern North Carolina counties were doing first-line stream restoration to prevent bank cutting and siltation during large storms. East of Cleveland, OH, townships and villages were restructuring building and code ordinances for new construction that preserved green spaces and infiltration zones. Portland, OR, had

been working with the stormwater permitting regulations many years. The city responded to neighborhood concerns by offering partnerships, technical support, and grants that helped to manage runoff on-site rather than through the combined sewer system. A national audience tuned into the program in 192 registered sites with more than 4,000 attendees. With this successful program posted to a Web site (<http://eces.wsu.edu/video/StormwaterMgmt.html>) and available on DVD, the team pushed on to address Western specific issues.



Local citizens on a tour of rain garden options that can be used to manage stormwater.

10 Years of Regional Progress: Water Conservation and Management

*M. Barber (Washington State University), R. L. Mahler, Troy Peters,
B. Simmons, P. Pearson, M. Gamroth and Fred Sorensen*

Pacific Northwest surface and groundwater resources provide water for industrial, agricultural, residential, hydroelectric, and recreational uses, and support ecosystem diversity. Increased demands from population and economic growth, additional agricultural production, and ecosystem management have resulted in temporary local shortages of available water. Agriculture is the largest water user in the region, so conservation efforts can have significant impacts. Inefficient irrigation methods are being replaced by modern science-based water saving techniques, and crops requiring less water are being planted. Land grant universities in the Pacific Northwest are researching water conservation and providing educational outreach for agricultural operations. This update highlights some of the documented outcomes in water conservation and management over the last 10 years.

Regional Irrigation Management Website

The land grant institutions in Washington, Idaho, and Oregon, under the leadership of Dr. Troy Peters, an Extension irrigation specialist at Washington State University, jointly developed a regional "Irrigation in the Pacific Northwest" website. Irrigation specialists Dr. Howard Neibling from the University of Idaho and Dr. Marshall English from Oregon State University were on the website development team. This website (<http://irrigation.wsu.edu>) is dedicated to improving the understanding of irrigation planning and management, with a significant emphasis on water use efficiency.

The site has received more than 150,000 hits from 16,000 unique users since its inception. Based on observations and collected data, the site's clientele is primarily agricultural producers and irrigators. An estimated one-third or more of potential agricultural irrigators in the Inland Pacific Northwest have visited this regional website.

Residential Water Use

A regional survey conducted by the PNW Water

Resources Team in 2007 assessed how Pacific Northwest residents use water in their yards, and found most people water some part of their lawn. However, many residents also practice landscape water conservation. Because residential landscapes soak up a large portion of municipal water, understanding how people use and conserve water—and their reasons for and difficulties with water conservation—is essential. The findings indicate that climate matters—water conservation is more widely practiced in the drier parts of the Pacific Northwest such as Idaho, eastern Washington state, and eastern Oregon. People already use the most convenient and low-cost water conservation practices. Barriers to water conservation do not exist for most people.

Farmers Make Water Quality a High Priority

In conjunction with the U.S. Department of Agriculture-funded CEAP (Conservation Effectiveness Assessment Program), 95 percent of growers in the 15- to 25-inch annual precipitation zone of eastern Washington and northern Idaho were found to believe soil erosion rates on their farms have decreased. From a watershed standpoint, more than 90 percent believe that the reduced soil erosion has improved water quality in their watershed.

The acknowledged reduction in soil erosion rates and improvement in water quality have economic and time commitment prices. More than 60 percent of growers in the region agree that conservation structures require effort, and 86 percent agree that farmers are often burdened with on-site costs associated with conservation efforts. Nevertheless, 90 percent of the growers surveyed said they promote conservation activities. Consequently, more than 65 percent of growers prefer not to wait for government incentives to initiate conservation practices.

Factors affecting Conservation Decisions

Also in conjunction with the USDA-funded CEAP program, team members evaluated the importance of various factors contributing to on-farm conservation decisions

and found 85 percent of the growers responding to this survey felt the costs of conservation practices were very important (37 percent) or important (48 percent) in their decision-making process for implementation. After the costs of initiating practices to protect soil and water, the costs of maintaining the conservation practices were considered very important (34 percent) or important (47 percent) by the majority of respondents. Growers listed both soil quality and water quality stewardship as important factors that led to the use of conservation practices. Ninety-six percent of survey respondents consider the potential loss of soil quality very important (65 percent) or important (31 percent) in the implementation of conservation practices. Apparently growers in dry land areas of the Inland Pacific Northwest consider conservation practices key to maintaining soil quality.



Over 7,000,000 acres of farmland are routinely irrigated in the Pacific Northwest.

Irrigation in the Pacific Northwest

Washington State University Extension Oregon State University Extension University of Idaho Extension



Over one-third of farmers that irrigate their land in the Pacific Northwest have used our regional Irrigation Management web site.

Outcomes

- Water is a limited resource in the Pacific Northwest.
- A regional irrigation website developed for growers in Idaho, Oregon, and Washington is widely used.
- Farmers in the rain-fed agricultural areas of the Pacific Northwest have made soil erosion control and water quality high priorities.
- Factors including the costs of installing and maintaining conservation practices, and soil and water quality are important to farmers when making conservation decisions.
- Homeowners are already using the most convenient and low-cost water conservation practices. Barriers to water conservation do not exist for most homeowners.

10 Years of Regional Progress: Watershed Management/Education

*Robert Simmons (Washington State University),
Pat Pearson, Robert Mahler, Mike Gamroth and Fred Sorensen*

Community-based watershed management is an approach to water resource protection that allows individuals, groups, and institutions to collaborate on identifying and addressing local issues that affect their watershed. The Pacific Northwest Region's land grant universities are active in research and assistance to these communities through partnerships with federal and state agencies, planning councils, and educational materials. Research and science-based educational materials and programs cover land-use management, conservation techniques, and water management model programs.

The PNW Water Program has made water quality and quantity at the watershed scale a priority. Over the past decade the program has reached thousands of people in the Pacific Northwest and beyond. The program has trained hundreds of other professionals on water issues, developed Internet-accessible video programs, produced publications targeting specific water issues, sponsored conferences reaching more than 1,000 water resource professionals, and presented other activities to lead to changes on the ground.

One key strategy has been to train other professionals who provide outreach and education so they can incorporate water issues into their programs. These training opportunities have included two three-day water quality monitoring programs, a two-day training on the use of GIS (geographic information system) mapping strategies to identify and educate about water issues, a series of three day-long workshops on salmon habitat protection and restoration techniques, use of Integrated Pest Management to protect water quality, and a two-day program on public outreach techniques that led to adoption of practices that protect water resources.

To help people understand the critical role that riparian areas play in protecting water quality and providing habitat, a series of short fact sheets was developed, each one targeting a specific land use. These were used across the region at public events, festivals, and workshops. One of the goals was to make "riparian" a household word.

In an effort to reach a broader audience using Web-based technologies, team members provided watershed educational materials in a "Welcome to Your Watershed" framework that will soon be downloadable from the PNW website.

A recent program success was the development and facilitation of a "Water Circle Study Course: Our Watershed" to teach residents how individual behavior and actions affect the health of regional watersheds. A study circle is a group of up to 15 people who meet informally for a series of sessions on complex issues. They use expert opinion and selected published articles to inform their ideas and choices. Seven session topics and related articles provide the basis for these discussions. The study circle framework bonds participants, and a many continue to work together on watershed-related issues after completion of the course.

The program also sponsors bi-annual conferences on water resource issues where leading-edge research, knowledge, and outreach techniques are shared among those attending. The goal is to connect current research with practitioners in the region. Conference titles include:

Research and Extension Regional Water Quality Conference 2002

Getting It Done: The Role of TMDL Implementation in Watershed Restoration

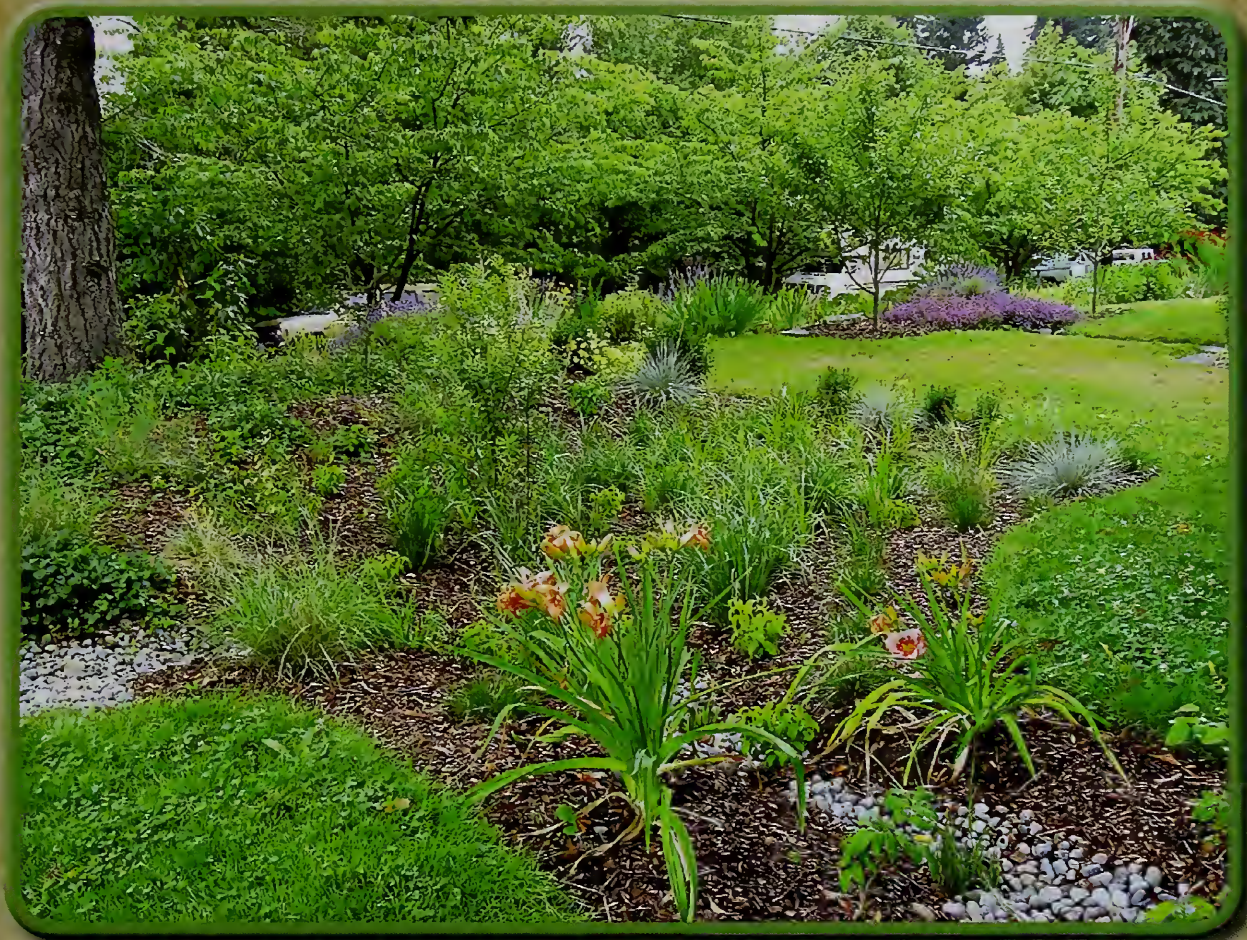
Groundwater Under the Pacific Northwest: Integrating Research, Policy & Education

Water in the Pacific Northwest: Moving Science into Policy and Action

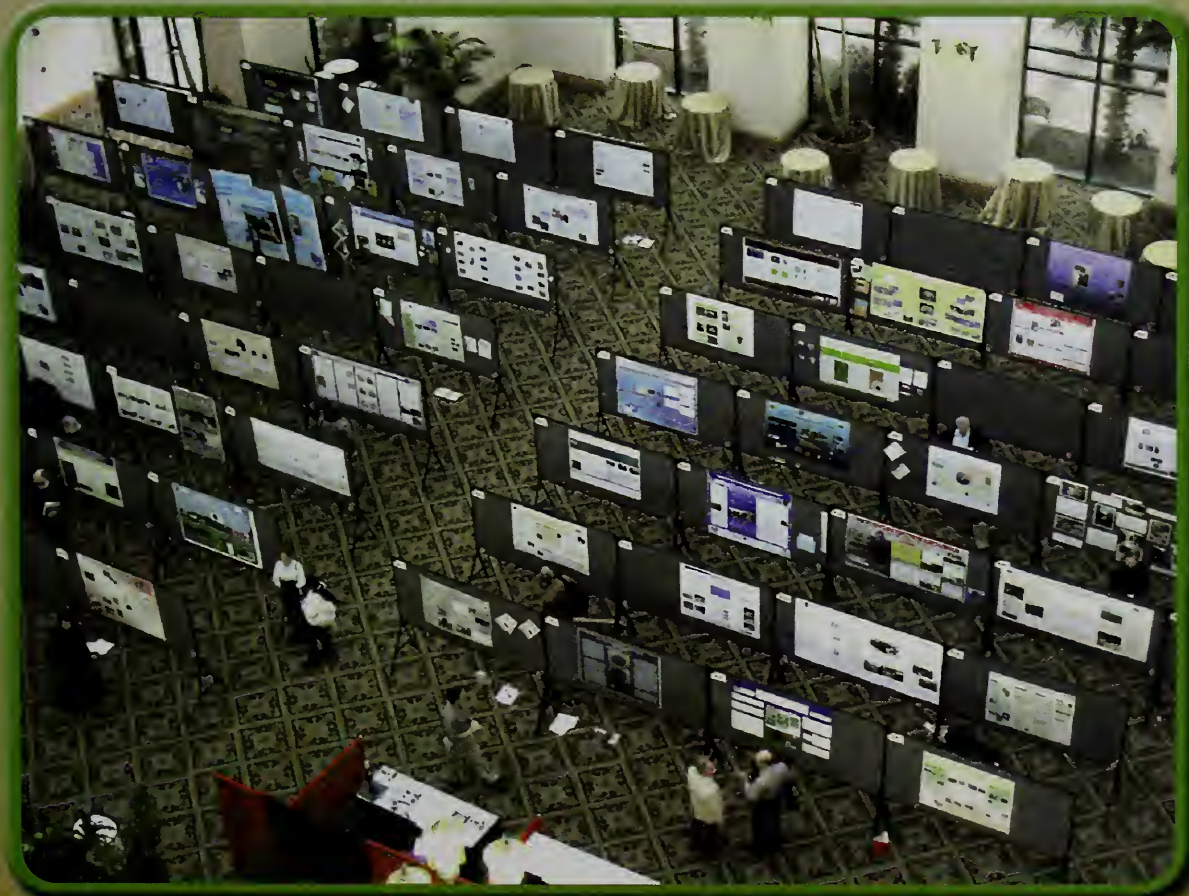
Water and Land Use in the Pacific Northwest: Integrating Communities and Watersheds

In the Pacific Northwest are many organizations providing environmental education to meet specific objectives. To prevent duplication of efforts and to more effectively educate the region's residents, the PNW Water Resources program has established environmental

education networks. Participants in these networks have included non-profit organizations, government agencies, school teachers, and businesses. Through regular meetings the networks have provided collaboration, coordination, and synergy among the groups that are providing outreach to their communities.



Raingarden landscape feature designed to capture and soak in rainfall before it becomes runoff that carries pollutants to streams and bays. (photo: Erica Guttman)



10 Years of Regional Progress: Public Attitudes and Actions Toward Water Issues

Robert Mahler (University of Idaho), Michael E. Barber, Michael Gamroth, Fred Sorensen, Bob Simmons and Pat Pearson

The Pacific Northwest Regional Water Resources Program has used a series of public surveys to measure public literacy, needs, attitudes, and actions on water issues over the last 10 years. Surveys have identified water issues both among the general public and in agricultural settings. All surveys have been designed to: (1) be representative of the region's population, and (2) address change over time.

These surveys provided a wealth of information about public attitudes toward water issues in the Pacific Northwest. Even though some differences existed among states on some issues, the four Pacific Northwest states have much in common on water literacy, needs, attitudes, and actions. This has made regional water educational programming logical and efficient for Alaska, Idaho, Oregon, and Washington.

administered in five-year intervals so long-term change can be measured. In 2002 the major issues associated with water resources were closely related to water quality; however, by the time the survey was conducted in 2007, water quantity issues had become equally important.

As part of the 2002 and 2007 surveys, residents were asked about 10 specific regional water issues: (1) clean drinking water, (2) clean rivers, (3) clean groundwater, (4) water for agriculture, (5) prevention of salmon extinction, (6) loss of wetlands, (7) watershed restoration, (8) water for power generation, (9) water for economic development, and (10) water for recreation. A majority of respondents in 2007 considered nine of the 10 issues as having high priority; the 10th was water for recreation. More than 90 percent of the survey respondents considered clean drinking water, clean rivers, and clean



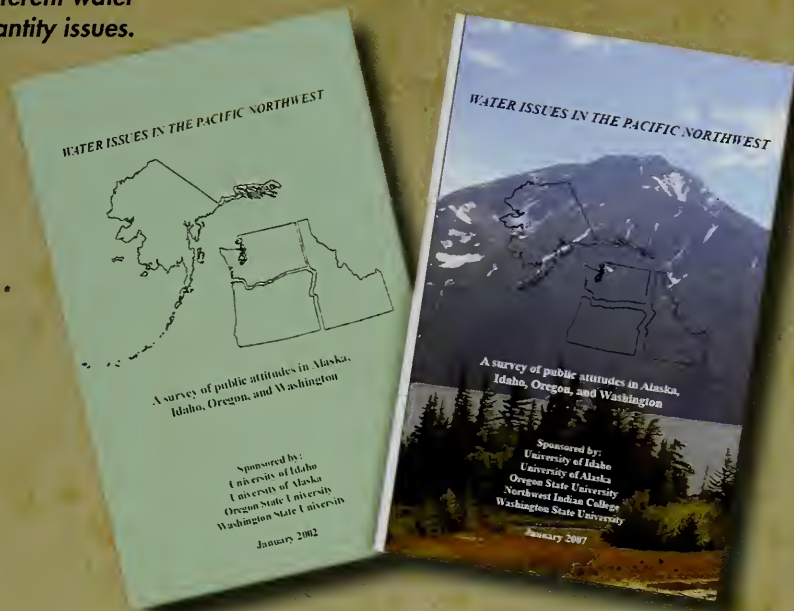
Needs assessment surveys were used to measure public priorities, attitudes and actions taken to address water issues in the region.

Attitudes about Water Issues

A regional 50-question water needs assessment survey was developed in 2002. This survey was administered to more than 2,000 randomly selected residents in 2002 and again in 2007. The same survey will be

groundwater as high priority. Seventy-seven percent of the 2007 respondents said that having enough water for agriculture was high priority, despite the fact more than 85 percent of Pacific Northwest residents live in urban areas. When the 2007 and 2002 survey responses are

Needs assessment surveys in the Pacific Northwest addressed over 20 different water quality and water quantity issues.



compared, water priorities in the region seem to have changed very little over the past 10 years.

Actions Taken to Address Water Quality:

Most of Pacific Northwest residents have addressed water quality issues since 2002 by taking individual actions. More than 46 percent of survey participants said they have changed how they dispose of household wastes. This includes disposing of yard wastes at a composting facility or through special trash pick-ups, and disposing of hazardous wastes at special collection events instead of dumping these chemicals down the drain or in the regular trash. Another 31 percent of participants have changed the amounts or application methods of fertilizer and pesticides they use in their yards. More than 29 percent of survey respondents are now disposing of used motor oil in a more water quality-friendly manner than they were in 2002. Only about a quarter of survey respondents said that they have not taken individual action to address water quality in the last five years.

Actions Taken to Address Water Quantity

More than 80 percent of the region's adults have made lifestyle changes in the last five years to address water quantity issues. A majority of survey participants (59 percent) have installed or used a water saving appliance in their residences since 2002. Another 46 percent reported that they have changed how they use water in their yards. Almost 43 percent of those surveyed reported changes in household water use in this five-year period. Almost one-third of survey participants have reduced the amount of water used when washing their vehicles. Conversely, only 17.5 percent of people surveyed have not taken any actions to reduce water use since 2002.

Outcomes

- Pacific Northwest (PNW) residents consider water to be region's most important natural resource.
- More than 90 percent of PNW residents consider clean drinking water, clean rivers, and clean groundwater as the high priority water issues.
- A majority of PNW residents consider water for agriculture, prevention of salmon extinction, wetlands, watershed restoration, water for power generation, and water for economic development as high priority water issues.
- More than 70 percent of PNW residents have individually taken action(s) to address water QUALITY issues in the last 10 years. Common actions included: (1) changes in household waste disposal, (2) changes in used motor oil disposal, and (3) changes in the use of pesticides and/or fertilizers in their yards.
- More than 80 percent of PNW residents have individually taken action(s) to address water QUANTITY issues in the last 10 years. Common actions included: (1) installing a water saving appliance in the home, (2) conserving water in yards, and (3) using of xeriscaping in the urban landscape.

Contact the **NIFA** National Water Program

National Program Leader

Dr. Michael P. O'Neill

USDA-NIFA, Mail Stop 2210
1400 Independence Avenue, SW
Washington, D.C. 20250-2210
202-205-5952 Phone
202-401-1706 Fax
moneill@nifa.usda.gov

Committee for Shared Leadership Members

The Committee for Shared Leadership for Water Quality is an internal working group created to foster development of the National Water Quality Program. Members include the 10 Regional Coordinators from Regional Projects funded through the Section 406 Integrated Water Quality Grants Program, an 1890 and a 1994 Representative, and the NIFA National Program Leader for Water Quality.

Region 1

Dr. Art Gold

University of Rhode Island
Natural Resources Science Dept.
1 Greenhouse Road
Kingston, RI 02881
401-874-2903 Phone
401-874-4561 Fax
agold@uri.edu

Region 2

Dr. Chris Obropta

Rutgers University
Dept. of Environmental Science
14 College Farm Rd., Rm. 232
New Brunswick, NJ 08901-8551
732-932-9800 ext. 6209 Phone
732-932-8644 Fax
obropta@envsci.rutgers.edu

Region 3

Dr. Doug Parker

University of Maryland
Dept. of Agricultural & Resource
Economics
2200 Symons Hall
College Park, MD 20742
301-405-8042 Phone
301-314-9091 Fax
dparker@arec.umd.edu

Region 4

Dr. Greg Jennings

North Carolina State University
Biological and Ag Engineering
Box 7625
Raleigh, NC 27695-7625
919-515-6791 Phone
919-515-6772 Fax
jennings@ncsu.edu

Region 5

Dr. Thomas Blewett

University of Wisconsin - Madison
432 N. Lake Street
Madison, WI 53706
608-262-1748 Phone
608-262-9166 Fax
thomas.blewett@ces.uwex.edu

Region 6

Dr. Mark L. McFarland

Texas A&M University
Texas AgriLife Extension Service
Soil & Crop Sciences Department
348 Heep Center
College Station, TX 77843-2474
979-845-5366 Phone
979-845-0604 Fax
MMcFarla@ag.tamu.edu

Region 7

Lois Wright Morton

Leopold Center for Sustainable
Agriculture
Department of Sociology
303E East Hall / 209 Curtiss Hall
Ames, IA 50011
(515) 294-2843 Phone
(515) 294-7836 Fax
lwmorton@iastate.edu

Region 8

Dr. Reagan Waskom

Colorado State University
CSU Water Institute
1033 Campus Delivery
Fort Collins, CO 80523-1033
970-491-6308 Phone
970-491-1636 Fax
reagan.waskom@colostate.edu

Region 9

Dr. Kitt Farrell-Poe

University of Arizona
Yuma Agricultural & Biosystems
Engineering
Shantz Bldg. #38, Room 5047
1177 E. Fourth St.
Tucson, AZ 85721-0038
520-621-7221 Phone
520-621-3963 Fax
kittfp@ag.arizona.edu

Region 10

Dr. Bob Mahler

University of Idaho
Soil & Environmental Sciences
P.O. Box 442339
Moscow, ID 83844-2339
208-885-7025 Phone
208-885-7760 Fax
bmahler@uidaho.edu

1890 Representative

Dr. Cassel (Cass) Gardner

Florida A&M University
Cooperative Extension
202-J Perry-Paige Bldg., S.
Tallahassee, FL 32307
850-599-3546 Phone
850-561-2151 Fax
cassel.gardner@famuc.edu

1994 Representative

Mr. Virgil Dupuis

Salish Kootenai College
Salish Kootenai College Extension
PO Box 70 (shipping 52000 Hwy 93)
Pablo, MT 59855
406-275-4899 Phone
406-275-4809 Fax
virgil_dupuis@skc.edu

A regional map is shown on page 1.



Land Grant and Sea Grant National Water Conference

The NIFA National Water Program's annual conference held in February 2010 in Hilton Head, SC, enabled water resource professionals engaged in research, Extension, and education to share knowledge and resources, identify emerging issues, and strengthen the network of the NIFA National Water Program.

More than 180 technical presentations and 140 posters addressing key water resource issues were presented to about 520 participants attending the conference.

Participants at the National Water Conferences include state Extension water quality coordinators; university scientists, instructors, and Extension educators who focus their efforts on water resource issues; USDA-NIFA staff members who work directly or indirectly with state water quality specialists; EPA staff members involved with water resource issues; and others who work with or for public or private institutions involved with water resource management.

Proceedings for the 2003-2010 conferences are posted to
<http://www.usawaterquality.org/conferences>

The next conferences are scheduled for January 31-February 1, 2011, in Washington, DC and May 20-24, 2012, in Portland, OR. Mark your calendars!

For more information, contact:

Dr. Greg Jennings
North Carolina State University
Box 7625
Raleigh, NC 27695-7625
Phone: 919-515-6791
jennings@ncsu.edu



USDA
United States
Department of
Agriculture
National Institute
of Food and
Agriculture

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