Nonpoint Source
News-Notes

September 2006, #79

The Condition of the Water-Related Environment
The Control of Nonpoint Sources of Water Pollution
The Ecological Management & Restoration of Watersheds

NOTES ON THE NATIONAL SCENE

Alien Invaders Affecting Our Nation's Waters

Invasive species. They sound menacing, and for many ecosystems, invasive species have been just that. These species include aquatic and terrestrial plants, animals, and microorganisms, and are found at the tops of mountains, in the oceans, and everywhere in between. Invasive species are infamous for negatively impacting natural communities—either through unchecked colonization of an ecosystem or by spreading disease. Aquatic invasive species can drastically alter a water ecosystem and can interfere with recreational use. Even when not directly colonized by invasive species, water resources can suffer indirect consequences from terrestrial invasive species. For example, altering a watershed's upland ecosystem can lead to changes in water tables, runoff dynamics, and other attributes that influence the watershed drainage system. As the widespread negative impacts of invasive species have become apparent, agencies and organizations across the U.S. and the world have launched programs to monitor invasive species populations and to try to prevent or prepare for further spread.

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Inside this Issue

Native, Exotic, or Invasive?

The media often use terms such as native, exotic, and invasive to describe different plants and animals. What is the difference? A native or indigenous species is one that evolved in a particular place. Climate, geology, soils, hydrology, biological interactions, and natural dispersal govern that species' evolution and its development within a balanced ecosystem. Species native to North America are generally recognized as those occurring on the continent prior to European settlement.

An organism is considered non-native, or exotic, when it has been introduced by humans to a location outside its natural range. Many non-native species co-exist with native plants and cause no apparent ecosystem disruption. In fact, our nation's agricultural industry is largely based on non-native species, including oats, rice, soy, wheat, cattle, and poultry. However, sometimes the exotic species find a niche where they have no predators or other natural controls, and are able to aggressively colonize a region. Once the spread of an exotic species causes harm to human health, the environment, or the economy, the National Invasive Species Council then considers it an "invasive species."

Invasive species typically enjoy robust growth, high reproductive rates, and longevity. While some native species display invasive tendencies under certain ecosystem conditions, eventually the ecosystem's natural checks and balances will bring the native population back under control. By contrast, invasive species often lack natural controls and can overwhelm and severely disrupt an ecosystem, thereby altering watershed characteristics in the process.

Recent Study Offers Grim News

A recent Cornell University study (Pimentel et al., 2005) reports that invasive species in the United States cause major environmental damages and losses adding up to almost $120 billion per year. The study estimates that the U.S. is home to 50,000 invasive species—and the number continues to increase. Moreover, approximately 42 percent of native species on the threatened or endangered species lists are thought to be at risk primarily because of competition with, or predation by, invasive species. The study was described in an article printed in the February 2005 issue of *Ecological Economics* (52:273-288). An "in-press" version of this article is available online at http://ipm.ifas.ufl.edu/applying/invasive-species/EconomicCosts_invasives.pdf. An earlier version of the article, released by Cornell University, is available at www.news.cornell.edu/releases/Jan99/species_costs.html.

How Do Invasive Species Impact Water Resources?

The effects of invasive species on water resources can be direct, as in the case of many aquatic invasive plant and animal species, or indirect, as in terrestrial species that change water table levels, watershed cover, speed and frequency of runoff, fire frequency, and other watershed attributes that in turn can alter the condition of water resources. Moreover, people can poison water resources when they misapply pesticides and herbicides to control invasive species. The chemicals can find their way into waterbodies by accidental direct application, wind drift, and nonpoint source runoff.

Aliens on Our Shores

The problem of invasive species has likely been around as long as human trading routes have existed—long before Hannibal and Marco Polo. However, in modern times, the increase of global trade and transport has significantly increased the pace of invasive plant, animal, and microorganism species introduction around the globe. Invasive species are constantly on the move; sometimes they escape from aquariums or the live food industry and sometimes they are intentionally released. Often, they hitch a ride in ballast water (water added to the empty cargo holds of ships to provide stability), on boat hulls, on diving gear, on vehicles, on boots, in transported firewood, in packing material, in nursery plants, or in countless other instances involving transport. For more on the pathways of invasive species introduction, see www.epa.gov/owow/invasive_species/pathways.html.

America's Least Wanted

Some examples of the invasive species and their widespread water quality impacts include:

* Cheatgrass (*Bromus tectorum*) is a winter annual grass that originated in Europe and Asia and came to the Inter-mountain West in contaminated seed in the 1890s. By 1920, cheatgrass had invaded native semi-arid grasslands and open pinyon-juniper woodlands of the Colorado Plateau. Despite its early growth and rich color, cheatgrass is unpalatable to sheep and other livestock, which tend to overgraze native plants when cheatgrass begins to prevail. Cheatgrass now covers millions of acres, where it increases the frequency and intensity of wildfires. This increases the number of heavily-burned watersheds and increases fire-related impacts on water resources. Cheatgrass is also a heavy user of early season moisture, which reduces much-needed spring runoff in western watersheds.

* The hemlock woolly adelgid (*Adelges tsugae*), a small, aphid-like insect, was imported from Asia and first appeared in 1951 near Richmond, Virginia. By 2005, it was established in portions of 16 States from Maine to Georgia, where infestations covered about half

of the range of eastern and Carolina hemlock in the eastern United States. In the Appalachians, hemlock woolly adelgid infestations have been 100 percent fatal for Eastern Hemlock trees, a key native species providing riparian forest cover and bank stability for headwaters streams. Deforested streams are at risk for developing temperature and sediment problems and losing their coldwater aquatic communities.

A nutria hunts for food.

Purple loosestrife grows along the shore of Lake Huron.

Water hyacinth grows along the edge of a lake.

* Nutria (*Myocastor coypus*) are large rodents imported from South America in 1899 for fur production. Some nutria escaped, while others were released into southern coastal marshes in the 1940s after the nutria fur market collapsed. Nutria destroy marsh vegetation by digging underneath and overturning the plants to feed on the root mat. The destruction of these wetlands increases the vulnerability of adjacent upland sites to erosion and flooding during storms. Nutria are found in coastal areas from Texas to Delaware.

* Purple loosestrife (*Lythrum salicaria*), a plant with purple flowers, was introduced from Eurasia to the northeastern United States and Canada in the 1800s for ornamental and medicinal uses. According to the U.S. Fish and Wildlife Service, purple loosestrife now occurs in every state except Florida. Purple loosestrife is capable of invading many wetlands, including wet freshwater meadows, tidal and non-tidal marshes, river and stream banks, pond edges, reservoirs, and ditches. Under favorable conditions, loosestrife is able to rapidly establish and replace native vegetation with a dense, homogeneous stand that changes the biogeochemistry of the wetland, reduces local biodiversity, endangers rare species, and provides little value to wildlife. Some areas experience economic losses resulting from reductions in waterfowl viewing and hunting opportunities.

* Saltcedar (*Tamarix ramosissima*), a deciduous shrub/small tree native to Eurasia and Africa, was released in 1837 as an ornamental shrub and to help control wind and water erosion. Saltcedar is extremely invasive in the western U.S.—infesting more than one million acres. It spreads rapidly along streams, out-competing beneficial native vegetation such as willows and cottonwoods and displacing animals and insects. Saltcedar has a very high evapotranspiration rate, and depletes ground water and surface water that would otherwise be used by native vegetation or by farmers to irrigate fields. Reduced water levels change stream morphology and increase the risk of wildfire. The U.S. Department of Agriculture reports that saltcedar alone causes economic losses in the millions of dollars per year.

* Water hyacinth (*Eichhornia crassipes*), a floating flowering aquatic plant native to South America, was released into Florida's St. John's River in the 1880s. It spread rapidly, and is now abundant in the southeast U.S, the U.S. gulf coast, California, and Hawaii, as well as other sub-tropical areas worldwide. Water hyacinth can form dense, impenetrable mats of floating vegetation that interfere with navigation, recreation, irrigation, and power generation. Water hyacinths reproduce extremely rapidly by seed and rhizomes and quickly out-compete native submersed and floating-leaved plants. The water hyacinths cover the water's surface, which prevents photosynthesis from occurring in the water column and leads to low oxygen conditions. Decaying plant mats further reduce oxygen levels. Water hyacinth quickly spreads to new water bodies when plant fragments or seeds hitch a ride on boats, trailers, or other recreational equipment.

* The zebra mussel (*Dressenia polymorpha*) is a mollusk that is native to the Caspian Sea and was accidentally introduced to the Great Lakes in the ballast water of ships. It was first found in Lake

St. Clair in 1988 and has spread to each of the Great Lakes. Zebra mussels are estimated to have caused more than $3.1 billion in economic damages during the past 10 years alone. Zebra mussels clog engines, municipal water intakes, and cooling systems. Each mussel filters up to a quart of water each day, reducing available phytoplankton and altering food chains, which reduces fish populations. Zebra mussels damage spawning areas, smother native mussel beds, and cause taste and odor problems in water.

Collection of zebra mussels.

What is Being Done?

In 1999, President Clinton signed Executive Order 13112, which outlined the federal government's invasive species-related duties and established the National Invasive Species Council (Council). The Council is an inter-departmental body that helps to coordinate and ensure complementary, cost-effective federal activities regarding invasive species. Together with other stakeholders, concerned members of the public, and member departments, the Council formulated a national action plan—the National Invasive Species Management Plan. Completed in early 2001, the Plan provides an overall blueprint for federal action. The Plan recommends specific action items to improve coordination, prevention, control, and management of invasive species by the federal agency members of the Council. Bi-annual reports chart the Council's progress as it implements the Plan. These reports, along with the original Plan, are available for download at www.invasivespeciesinfo.gov/council/nmp.shtml.

One of the Council's most important tools to assist and enhance the quality and accessibility of information about invasive species is the Council's Web site, www.invasivespeciesinfo.gov. Launched and maintained by the National Agricultural Library's National Invasive Species Information Center, the site provides a convenient Web gateway to more than 13,000 science-backed information resources from both the private and public sectors. Users can browse for information by invasive species type, such as aquatic species, plants, animals and microbes, or by other topics, such as economic impacts, laws and regulations, management, or news, and events. The site provides profiles for nearly a hundred species, and offers links to images, fact sheets, management plans, and an extensive list of state, federal, and local government agencies and other private and public organizations with interest in preventing, controlling, or eradicating invasive species.

The Web site offers links to documents and guidebooks prepared by organizations specializing in different areas of invasive species control. For example, the Web site lists a new aquatic invasive species management document developed by The U.S. Environmental Protection Agency (EPA) Office of Water, in response to Executive Order 13112, which required "each Federal agency whose actions may affect the status of invasive species … to identify such actions [and] use relevant programs and authorities to detect and respond rapidly to and control populations in a cost-effective and environmentally sound manner."

EPA's new document, *Overview of EPA Authorities for Natural Resource Managers Developing Aquatic Invasive Species Rapid Response and Management Plans* (Dec 2005), was created to help states and localities respond quickly and appropriately to invasions of aquatic invasive species. The document, available at www.epa.gov/owow/invasive_species, provides an overview of EPA authorities that might apply to state or local aquatic invasive species rapid response and control actions, such as the Clean Water Act (CWA) and the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). The document also describes case studies in which state and local natural resource managers successfully obtained FIFRA emergency exemptions and special local need registrations for aquatic invasive species eradication or control actions. Like other federal organizations, EPA also maintains its own Web site about invasive species at www.epa.gov/owow/invasive_species. EPA's Watershed Academy Web, an online training resource, offers an invasive species training module at www.epa.gov/watertrain/invasive.html.

Is Victory Possible?

While agencies and organizations around the globe are placing more emphasis on preventing the introduction of invasive species, today's mobile and global economy will ensure that new infestations will be a constant threat. In those places already colonized by invasive species, scientists are constantly seeking new methods, or combination of methods, to best control these invaders. Typical methods include:

(1) Physical or mechanical control—removing or killing invasive species using mechanical means such as cutting or pulling.

(2) Biological control—identifying other species, often derived from the invasive species' homeland, that can be safely used to control the invasive; also, genetically altering and releasing sterile invasive species individuals to reduce that species' successful reproductive capabilities.

(3) Cultural change—educating people to alter habits to reduce the spread of invasive species, such as cleaning boats and recreational equipment before entering a new waterbody.

(4) Chemical techniques—using chemicals to kill or prevent spread of invasive species.

The magnitude of the invasive species problem is daunting; however, some victories have been reported using one or more of the methods above. Just a few of the many examples include:

- In 2004, authorities from Maryland's Blackwater National Wildlife Refuge announced that they had successfully eradicated nutria from 35,000 acres in and around the Refuge. The effort required two years, $2 million, and 15 full-time trappers. After more than 8,300 nutria were killed, a survey finally showed no further evidence of nutria damage in the Refuge. Because nutria populations still exist in other U.S. coastal areas, the Refuge will need to work to prevent reinfestation.

- In the 1990s, several states began rearing and releasing *Galerucella* beetles to help control purple loosestrife. Previous studies had shown that these European beetles—themselves nonnative—are natural, host-specific predators of purple loosestrife that do not pose a threat to other plants. Scientists are also working to establish populations of two other beetles that prey primarily on purple loosestrife. Scientists expect that once stable populations of these insects are established, populations of this invasive plant will be reduced by 90 percent.

- In Pennsylvania's Edinboro Lake, authorities have successfully reduced zebra mussel populations by drawing down the lake levels in the winter months, thereby exposing the mussels to cold temperatures. This technique reduced the zebra mussel population from 160 million in 2001 to just more than two million in 2002.

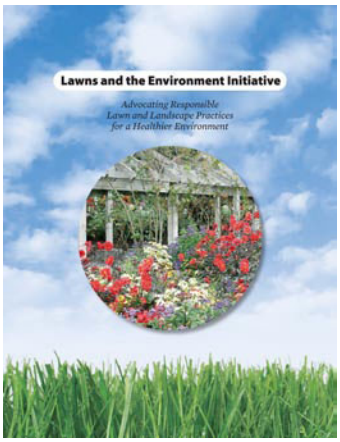
- In June 2000, the first known infestation in the Western Hemisphere of the invasive strain of the tropical alga, *Caulerpa taxifolia*, was discovered in two lagoons in Carlsbad, California. *C. taxifolia* grows as a dense smothering blanket, seriously disrupting the aquatic ecosystem. Home aquariums were believed to be the source of the infestations. California's Nonpoint Source Program managers used $1.1 million of CWA Section 319 funds to address the problem through surveillance, treatment, outreach, and education. The primary eradication treatment consisted of placing tarps over infested areas and applying liquid or solid formulations of chlorine directly to infested waters. The effort appears to have been successful—current data indicate that *C. taxifolia* has not been detected since the fall 2002.

The fight against invasive species will continue for the foreseeable future. As governments' awareness of the problem continues to grow, response and management will become better coordinated and more successful on a larger scale. Efforts to educate and energize the public will also help. We might not win the war against invasive species anytime soon, but we certainly can win battles in our own backyards.

Alien Invaders Affecting Our Nation's Waters (continued)

[For more information, visit www.invasivespeciesinfo.gov or contact a National Invasive Species Council technical representative listed at www.invasivespeciesinfo.gov/council. For more information about the U.S. EPA's efforts to control invasive species, contact Marilyn Katz at U.S. EPA, Ariel Rios Building, 1200 Pennsylvania Avenue, N. W., Mail Code: 4504T, Washington, DC 20460. Phone: 202-566-1246; E-mail: katz.marilyn@epa.gov.]

Lawns and the Environment Initiative Reaches Out to Homeowners



Summer is winding down! For many Americans, that means that it will soon be time to wrap up this year's yard work—planting, weeding, mowing, fertilizing, and controlling pests. Unfortunately, some people are unaware that some of their yard management practices have a negative impact on local and regional water resources, local wildlife (including songbirds), pets, and even nearby yards. To help people become more aware of the links between their yards and the environment, a diverse voluntary coalition—made up of government agencies, the lawn care and landscaping industry, and environmental groups—is promoting responsible lawn and landscaping practices through a new partnership called the "Lawns and the Environment Initiative." The coalition has developed a set of guidelines—the *Environmental Guidelines for Responsible Lawn Care and Landscaping*—to help residential landowners make decisions about yard maintenance activities and landscape design. The guidelines provide information about plant selection, the use of water, application of pesticides and fertilizers, and potential effects on wildlife and neighbors.

The Center for Resource Management (CRM), a non-profit organization that promotes collaboration to improve environmental stewardship efforts, launched the initiative in 2002 with a steering committee that consisted of the U.S. Environmental Protection Agency; U.S. Department of Agriculture (USDA); The Scotts Company; National Gardening Association; San Antonio Water System; Audubon International; and many others. As part of the initiative, the National Gardening Association released a study which showed that fewer than 50 percent of people working in their yard employ practices consistent with ten important environmental principles, such as building healthy soil, preventing landscape pollution, reducing stormwater runoff, and managing pest problems responsibly, among others.

Guidelines Content

The authors expect the guidelines to better inform landowners so more will use environmentally friendly practices. The guidelines include information on a variety of topics, including:

- Designing and implementing a landscape—discussing topics such as wildlife-friendly yards, planning for water conservation, and drainage;
- Landscape maintenance—covering irrigation, pest control, mowing, and yard waste, as well as tips on equipment usage and hiring a landscaping firm; and
- Community issues—addressing topics such as shared drainage and drift of materials offsite.

The guidelines include a 13-question environmental scorecard that helps highlight key points. An interactive survey—based on the scorecard—will be made available on stakeholder Web sites. The guidelines also highlight a variety of demonstration projects in different parts of the country that "show rather than tell" some of the key topics discussed in the guidelines. The coalition hopes that these projects, supported by the information provided in the guidelines document, will help encourage the public to become better stewards of their local environment.

The steering committee sees the guidelines as a way not only to promote greater public awareness and stewardship on the appropriate use of chemicals, water, and plant species, but also to create a set of practices that will allow homeowners to develop healthy landscapes that everyone can appreciate.

Disseminating the Information

The mission of the initiative is to both develop the guidelines and encourage the public to adopt them. The USDA Extension Service-funded Integrated Pest Management Centers will include

Lawns and the Environment Initiative Reaches Out to Homeowners (continued)

information from the guidelines in their Web-based "training the trainer" program, which reaches out to Master Gardeners, a nationwide network. CRM is helping its steering committee members and gardening-related organizations plan ways to distribute the guidelines to the public. The National Gardening Association currently has a Web site devoted to the *Environmental Guidelines for Responsible Lawn Care and Landscaping*, and has the current version of the guidelines posted for free download (www.nationalgardenmonth.org/index.php?page=LandE).

[For more information contact Paul Parker at the Center for Resource Management, 1104 East Ashton Avenue, Suite 210, Salt Lake City, UT 84106. Phone: 801-466-3600; E-mail: pparkercrm@comcast.com; Web: www.crm.org.]

NEWS FROM THE STATES, TRIBES, AND LOCALITIES

Virginia is for Loggers: New Cost-share Program Aids Pollution Prevention

Loggers in Virginia are finding it a bit less costly these days to comply with voluntary best management practices (BMPs) during timber harvesting operations. The Virginia Department of Forestry (VDOF) recently launched a new BMP cost-share program, thought to be one of the first in the nation to target logging contractors, rather than landowners. The program allows contractors working in most Virginia watersheds to use cost-share funds when installing approved stream crossings such as bridges and culverts. VDOF hopes that the program will not only better protect streams from sedimentation, but will also provide incentives for loggers to plan ahead and take advantage of free training opportunities offered by the state.

Program Encourages Virginia Loggers to Be SHARP

Virginia developed its Sustainable Harvesting and Resource Professionals (SHARP) logger program 10 years ago to train those people actually harvesting trees. The SHARP program teaches about practices that protect environmental quality, promote forest regeneration, and enhance the safety of loggers and the public. By requiring SHARP logger certification as an eligibility condition for the cost-share program, VDOF hopes to continue to encourage more loggers to join this free certification program. Since 1996, more than 2,800 loggers, foresters, and others from across Virginia have completed the SHARP Logger training program. For more information, see www.virginiasfi.org.

Matt Poirot, VDOF's Water Quality Program manager, sees the program as "an opportunity to help loggers do the right thing." Since implementation of forestry BMPs is voluntary in Virginia, VDOF has historically relied heavily on site inspections and tight enforcement of water quality regulations to encourage loggers to implement necessary BMPs. At least once a year, VDOF or its cooperators inspect every active logging site greater than five acres in size to ensure that water quality is protected.

Since 1993, VDOF has randomly selected 30 of these sites for semi-annual BMP field audits. The audits are designed to assess and document BMP effort (a measure of a logger's attempt to voluntarily implement BMPs), BMP implementation (a measure of a logger's success in implementing BMPs to VDOF's technical standards), and BMP effectiveness (whether the BMPs work if implemented correctly). Audit results have shown that although the BMP effort level is consistently high (90 percent or greater), BMP implementation to VDOF's technical standards usually falls short (typically less than 30 percent of the BMPs meet standards). The audits also confirm that BMP effectiveness remains high when the BMP is implemented to VDOF standards. Because the new cost-share program requires that BMPs meet VDOF's technical standards, Poirot anticipates that the audits' "BMP implementation" success rate will soon increase.

How Does it Work?

Loggers are eligible if they: (1) are certified under Virginia's SHARP Logger program (see box); (2) have no current debt for either civil penalties or past-due bills owed to VDOF, and (3) do not have active water quality impairments open on any tracts on which they are operating. "We aren't going to provide funds to help loggers fix problems that they created by not planning ahead," explained Poirot. "Our program is geared toward preventing problems and encouraging the use of good practices."

The cost-share program provides up to 50 percent of the actual cost (not to exceed $2,000 annually) of an approved stream crossing in watershed areas designated as "impaired" or those of "special interest" as defined by the VA Department of Environmental Quality. Stream crossings include

Virginia is for Loggers: New Cost-share Program Aids Pollution Prevention (continued)

temporary and portable bridges, culverts, and fords. If the approved stream crossing includes the purchase of a portable bridge, the 50 percent funding level increases to a maximum of up to $4,000 of the actual cost.

VDOF favors portable bridges wherever possible because they require little or no instream work during installation and have a limited impact on fisheries. Portable bridges typically require less time to install and can be used many times—making them more cost-effective than culverts. Typically, a 30-foot long portable steel bridge will cost approximately $9,000 and last between six and ten years. In comparison, a portable wooden bridge costs about a third as much (approximately $2,500), but has a service life only half as long. Furthermore, wooden bridges hold less weight and span shorter distances than steel bridges. The cost for culverts, which can be installed and used in only one location, varies widely, but will often cost more than $2,000.

Heavy machinery drags logs across a portable wooden bridge spanning a small stream.

To date, most of the applications submitted to VDOF have been for portable bridges. Poirot explains, "Cost-sharing a portable bridge yields the most bang for our buck because the logger will remove the bridge and reuse it at the next harvest site." The purchase of portable bridges pays off for loggers, as well. Typically, a logger's BMP costs range in the thousands of dollars for each tract harvested. Since most Virginia loggers harvest more than six tracts per year, an up-front investment in a half-price portable bridge usually yields significant savings over time.

This culvert protects a small stream from logging traffic above.

Funds are distributed on a reimbursement basis, once the BMP is implemented, used, and the BMP site is closed. For example, cost-share funding for a portable bridge would be provided only after the bridge has been properly installed the first time, used, removed, and the area restored.

How is it Funded?

Funding for the program comes from the Virginia Water Quality Improvement Fund, a state grant program designed to support point and nonpoint source pollution prevention, reduction, and control programs. VDOF has a total of $250,000 to distribute through July 2007, although Poirot expects to allocate all of the available funds by this fall. As of June 1, more than $50,000 had already been allocated, with several applications pending. VDOF plans to apply for additional funding to continue the program next year and expand it to include other forestry BMPs. More information is available at www.dof.virginia.gov/press/nr-2006-03-07-logger.shtml.

[For more information, contact Matt Poirot, Virginia Department of Forestry, 900 Natural Resources Drive, Charlottesville, VA 22903. Phone: 434-977-6555; E-mail: matt.poirot@dof.virginia.gov.]

Virginia Reference Streams Highlight Natural Nonpoint Source Pollution

"You say the stream's turbidity levels are too high. Compared to what?" This and other similar questions posed by logging companies convinced the Virginia Department of Forestry (VDOF) to launch a unique data gathering effort on forest reference streams beginning in 1998. Eight years later, VDOF has amassed an incredible amount of data on what the true natural conditions of a stream should be. The data are organized according to the Rosgen Stream Classification System and are, therefore, easily transferable to other streams of the same classification throughout the mid-Atlantic region. By having reference data readily available, VDOF and others are better equipped to evaluate nonpoint source pollution levels and defend current water quality standards.

Virginia Reference Streams Highlight Natural Nonpoint Source Pollution (continued)

Network of Monitored Streams

VDOF has developed a network of continuously monitored forest reference streams that flow through protected, forest-dominated watersheds. The streams represent natural, or nearly natural, conditions exhibiting few of the effects caused by human activities, such as road building, timbering, or development. Most of these sites have been left virtually untouched for 70 to 80 years, and thus can serve as effective benchmarks or "reference points" for describing stream conditions within their normal range of natural values. VDOF's network provides a continuously monitored characterization of natural stream attributes, including water quality, sediment movement, and channel processes collected over the full range of water flows.

One of VDOF's monitoring stations placed in a stream classified as a C4, typically associated with mountain meadows and alluvial valleys.

Over the course of the project, an extensive and robust data set has emerged, containing thousands of data points which describe the natural range of water turbidities, dissolved oxygen, pH, conductivity, temperature, and stream bed particle sizes within a variety of natural channel types. These data, along with newly derived management tools, allow in-depth understanding and description of stream parameters that can yield improved watershed management decisions.

VDOF is analyzing the data and cataloging meaningful reference conditions for different classes of streams. The data are organized by Rosgen stream type, one of the features that makes VDOF's data set unique, explains Sam Austin, VDOF Forest Hydrologist. The data are indexed to bankfull flow—this allows channels large and small, of the same Rosgen stream type, to be meaningfully compared with one another. VDOF's data will complement data sets gathered by other organizations and "give a richer characterization of what is happening in streams," explains Austin.

VDOF is posting the reference conditions data online as soon as they become available (see www.dof.virginia.gov/wq/monitoring.shtml). For example, the Web link to the "Rosgen Class C4 Forest Reference Stream Monitoring Data" includes a description, photo, and even a video clip of a C4 stream, and charts and graphs that describe C4 stream geomorphology, hydraulic geometry, and turbidity (see Figure 1). "This is only the beginning," adds Austin. VDOF plans to develop reference conditions for other water quality parameters, such as dissolved oxygen and temperature.

Applying the Data

Perhaps the most important of these parameters from a forestry perspective is sediment. The VDOF reference stream monitoring network provides an array of information specific to sediment loads in Virginia streams. This includes information that describes the normal range of bed load sediments, the critical shear stresses needed to initiate sediment motion, and the normal range of suspended sediments expressed over the full range of water discharge rates.

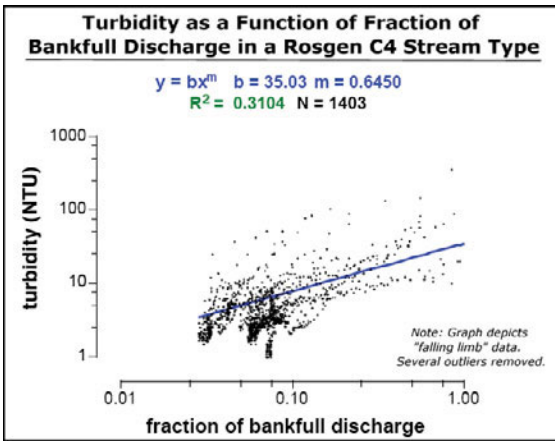


Figure 1. Example of VDOF reference stream data.

VDOF has already been incorporating the new data into its everyday operations, explains Austin. "We are beginning to use the data in the field to gauge deviations from reference streams." The reference stream data have been especially helpful when conducting audits to assess how successful forestry BMPs are in action (see previous article, *Virginia is for Loggers*, for more information on VDOF's BMP audits.) "We are using the data as a tool to help identify when particular thresholds are exceeded."

Austin also anticipates that the data will prove invaluable for VDOF and others for development of upcoming sediment Total Maximum Daily Loads (TMDLs). "This affords us an opportunity to lead our TMDL development with top quality, Virginia-specific, water resource information and insight—at the very time such insight is most needed." Austin has already been contacted by several organizations, including county

Virginia Reference Streams Highlight Natural Nonpoint Source Pollution (continued)

conservation districts, for help in using the data for their TMDL development and watershed planning. Austin expects interest to continue to grow throughout Virginia and beyond as word of the newly available data set spreads.

[For more information, contact Sam Austin, Forest Hydrologist, Virginia Department of Forestry, 900 Natural Resources Drive, Charlottesville, VA 22903. Phone: 434-977-6555; E-mail: sam.austin@dof.virginia.gov.]

Invasive Garlic Mustard—a Culinary Delight?

"Rain or shine, we pull and dine"—that is the motto for the Patapsco Valley's annual Garlic Mustard Challenge. For the past seven years, Maryland's Friends of the Patapsco Valley & Heritage Greenway has partnered with Patapsco Valley State Park to co-sponsor a festival promoting the pulling and eating of garlic mustard, an invasive plant. This annual May event is not only fun, it is also significantly reducing the numbers of the unwanted garlic mustard plants in the park. Betsy McMillion, Stream Watch Coordinator for the Friends of the Patapsco Valley & Heritage Greenway, is pleased to report that garlic mustard is not as prevalent as it once was in certain parts of the park "where it was once taking over." By removing garlic mustard and its seeds, the project helps protect the park's upland forests and sensitive riparian areas from infestation. The garlic mustard festival serves as a great example of how a community's creativity can win a local battle against an invasive species.

Why create a festival centered around one plant? Garlic mustard (*Alliaria petiolata*) is listed as a "Maryland Invasive Species of Concern," because of its tendency to rapidly colonize the forest floor and crowd out spring wildflowers and other native plants. A native of Europe, garlic mustard was first recorded in the United States in about 1868 in Long Island, New York, and now ranges from eastern Canada south to Virginia and as far west as Nebraska. Settlers likely introduced it for culinary and medicinal purposes. After spending the first half if its two-year life cycle as a rosette of leaves close to the ground, garlic mustard plants develop rapidly the following spring into mature plants that flower, produce seeds, and die by late June. A single plant can produce thousands of seeds, which scatter as much as several meters from the parent plant. The seeds can remain viable for five years or more, making eradication a long-term project. Seeds will mature even if the parent plant is pulled out of the ground, so all garlic mustard must be placed into trash bags and removed from the infested area.

Can You Rise to the Challenge?

Two event participants show off their bag of garlic mustard.

This family-oriented event opens with the first of three challenges—a two-hour "garlic mustard pull" for all ages. Participants are directed to areas of the park where infestations are the greatest. Winners are selected based on both the total weight of garlic mustard pulled per group, as well as pounds pulled per person. All participants receive a prize. Prizes are donated from local businesses and other organizations, with "first pick" going to the winners. Since the festival's inception in 2000, families, scout groups, church groups, community and civic organizations, businesses, school groups, groups of friends, and individuals have pulled out 6,730 pounds of garlic mustard from Patapsco State Park, which extends along 32 miles of the Patapsco River. "Participation continues to grow over the years as the event becomes more well known," explains McMillion. In 2006, 82 people helped remove more than 1,877 pounds of garlic mustard. An additional 37 people participated in other aspects of the day's events.

After the weed-pulling event, participants enjoy live music and storytelling, play games, ask local historians about Patapsco Valley history, and visit environmental exhibits. In May 2006, exhibits included a rain barrel demonstration, an invasive plant display from the University of Maryland's Cooperative Extension Service, a composting display from a local garden center, an exhibition of state park artifacts, an environmental model showing how stormwater runoff affects land, information

about a blue bird box and a frog watch program from the local county recreation and parks department, a scavenger hunt, and old-fashioned games such as pillowcase races and an egg toss.

The second challenge of the event is intended for the children 12 years of age and younger—a "Villain of the Valley" poster contest designed to highlight how garlic mustard hurts the Patapsco Valley region. Children bring their prepared posters to the event, where a team judges the posters for their originality and graphic expression. "The poster contest is a creative way to teach others, through children, about the garlic mustard plant," explains McMillion. While prizes are awarded to all participants, event winners' artwork is displayed throughout the Patapsco Valley.

While participants are enjoying the many activities, adult and child amateur chefs are preparing for the third challenge of the festival—the cooking contest. Chefs of all ages compete to prepare the tastiest dishes using garlic mustard. After the judging, festival attendees are welcome to enjoy samples of all the dishes. Judges rate each dish for taste, appearance, and originality. Each of the winning chefs receives a complimentary lunch gift certificate for a restaurant in the Patapsco Valley area. Previous award-winning recipes include "spring asparagus with garlic mustard," "stuffed garlic mustard leaves," and "garlic mustard meatloaf." Many recipes are available at www.patapscoheritagegreenway.org/garlic07.

Since the event organizers are already seeing a significant reduction in overall garlic mustard infestation, they expect that they will need to change the focus of the event in the next few years. McMillion suggests they might change the name of the event to the "Villain of the Valley Challenge," and broaden it to include removal of other invasive plants such as Japanese honeysuckle, autumn olive, and multiflora rose. Unlike garlic mustard, which can be easily removed by pulling the plant out of the ground, these other invasive plants pose the additional challenge of having persistent underground root systems and/or painful thorns. No matter how the event evolves over time, it will continue to make a positive difference—and serve as a beacon of hope for others faced with the seemingly insurmountable problem of invasive species infestation.

[For more information, contact Betsy McMillion, Coordinator, 2006 Garlic Mustard Challenge, Friends of the Patapsco Valley & Heritage Greenway, 6759 Athol Avenue, Elkridge, MD 21075. Phone: 410-480-0824; E-mail: patapscofriend@comcast.net.]

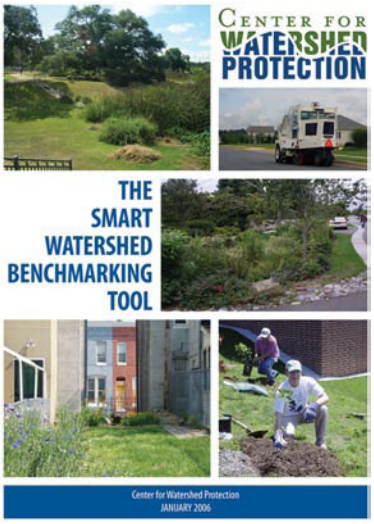
If You Can't Beat Them, Eat Them

The Plant Conservation Alliance maintains a Web site titled "Eat Your Weedies," located at www.nps.gov/plants/alien/recipes. The site offers links to a variety of recipes that use invasive species as an ingredient, including garlic mustard, barberry, autumn olive, and others.

NOTES ON WATERSHED MANAGEMENT

Urban Watershed Programs Look to New Benchmarking Tool

The Center for Watershed Protection (CWP) recently released its *Smart Watershed Benchmarking Tool*, a new self-assessment document designed to help local communities integrate and align their urban watershed programs. CWP developed the tool to help communities meet their water resource goals, help local program managers make better decisions on watershed restoration priorities, and help local watershed groups work with their local governments.



CWP's Smart Watershed Benchmarking Tool document is available for free online.

Origin

The *Smart Watershed Benchmarking Tool* evolved from a series of meetings in 2001 at which experts focused on the challenges of managing growth in highly urban watersheds. At the meetings' conclusion, the group agreed that a unified framework was urgently needed to organize municipal programs into a coherent strategy for restoring urban watersheds. CWP responded to this need by surveying more than 50 communities across the country about their municipal watershed restoration activities.

Urban Watershed Programs Look to New Benchmarking Tool (continued)

Based on the survey's findings, CWP produced a report in 2003 that outlined a unified framework for integrating 14 municipal programs to restore urban watersheds. Next, CWP developed the new assessment guidebook—the *Smart Watershed Benchmarking Tool*—to help communities quantitatively assess their own restoration program performance.

For the purpose of this new tool, CWP uses the term Smart Watershed to refer to the integration and alignment of 14 municipal programs (see box) that treat stormwater runoff, restore stream corridors, and reduce pollution discharges in urban watersheds. Taken together, the programs create a unified framework to integrate diverse programs and regulatory drivers into a strategy for restoring urban watersheds and measurably improving water quality. The framework can help communities make better decisions on watershed restoration priorities and make the most out of limited funding and staffing resources.

Guidebook Structure

The guidebook is organized into three chapters. The first chapter presents an overview of the 14 Smart Watershed programs, outlines why they were developed, and reviews some of the benefits and applications of the benchmarking tool for local communities. Chapter 2 presents a series of detailed profile sheets that describe each of the 14 Smart Watershed programs. Each profile sheet contains the following elements:

- Program description and goal,
- Benchmarks for the program,
- National average of program activity,
- A case study illustrating an outstanding municipal program,
- Tips on program implementation, and
- Resources on the program area, including links to additional examples and technical resources.

Chapter 3 presents the Smart Watershed benchmarking tool. The beginning of the chapter provides step-by-step guidance on how to use the tool and interpret community scores. The remainder of Chapter 3 presents the 56 individual benchmark questions that comprise the Smart Watershed benchmarking tool. The guidebook also contains four appendices that provide further details on restoration budgeting and adapting the benchmarking tool for special community conditions. Staff members from communities that have used the tool indicate that it takes about 40 hours to complete the questions and provide supporting documentation.

Applying the Tool

CWP anticipates that communities will use the benchmarking tool to build or strengthen their watershed programs in several ways:

- *Assessment of Specific Watershed Restoration Plans.* A community or watershed group may use the tool to evaluate an existing watershed restoration plan to determine how well local programs and resources are focused. The scoring can identify gaps in implementation, suggest

Smart Watershed Programs

1. Subwatershed Restoration Planning
2. Stream and Subwatershed Field Assessment
3. Subwatershed Monitoring and Reporting
4. Watershed Restoration Financing
5. Management of Natural Area Remnant
6. Stormwater Retrofitting
7. Urban Stream Repair/Restoration
8. Illicit Discharge Detection and Elimination
9. Maintenance, Inspection, and Enforcement
10. Smart Site Practices During Redevelopment
11. Watershed Education and Personal Stewardship
12. Public Involvement and Neighborhood Consultation
13. Pollution Prevention at Stormwater Hotspots
14. Pollution Prevention at Municipal Operations

new local partners to involve in the plan, and identify opportunities for coordinating existing local programs and improving restoration efforts.

- *Self-Assessment of Community Restoration Programs.* A local stormwater or watershed program manager may choose to use the tool to evaluate the integration and alignment of current local programs. Scores from the self-assessment can identify program strengths and weaknesses, thereby providing a basis to streamline watershed services, justify budget requests, validate ongoing efforts, and promote greater interagency coordination. The tool is a useful checkup for managers of existing programs that also helps them build new programs to leverage their efforts.
- *Overall Assessment of Municipal Separate Storm Sewer System (MS4) National Pollutant Discharge Elimination System (NPDES) Stormwater Permit Compliance.* In this application, the tool is used as a streamlined way to review overall compliance with existing MS4 NPDES stormwater permits.

Prior to releasing the guidebook, CWP staff applied the tool to various municipalities around the country to evaluate the adaptability and applicability of the benchmarks and to refine them accordingly. For example, in highly urban Santa Monica, CA, the tool revealed the success of the City's Urban Runoff Program. The tool showed that the City has promoted project work in many of the 14 smart watershed programs, including pollution prevention and illicit discharge control. The tool also highlighted some program areas where additional effort could be expended, such as stormwater retrofitting or conducting pollution source assessments.

"Overall, Santa Monica scored extremely high for a city its size, which clearly illustrates its commitment to protecting both public health and Santa Monica Bay," said CWP Watershed Planner Chris Swann. "The City has implemented several progressive programs that can provide a blueprint for other communities in their efforts to reduce runoff, improve water quality, and promote water conservation."

The Smart Watershed benchmarking tool, which was developed with funding from the U.S. Environmental Protection Agency's Office of Water, is available for free download at www.cwp.org.

[For more information, contact Lauren Lasher, The Center for Watershed Protection, 8390 Main Street, 2nd Floor, Ellicott City, MD 21043. Phone: 410-461-8323; E-mail: lsl@cwp.org.]

NHD: Serving up Surface Water

Few if any News-Notes readers would say they have never used an Internet mapping application such as MapQuest, Google Earth, or Yahoo Maps to figure out directions or plot a location. And most users of these geographic information system (GIS)-based applications would agree that they are indeed GIS users. The applications are transparently used, and the learning curve takes minutes.

Yet these same users often hold the perception that a more advanced set of technology skills is necessary when using GIS to analyze data on waterbodies, watersheds, and water-pollutant flow and concentrations. There is plenty of good news to counteract this view. With the public release of the 1:100,000 scale National Hydrography Dataset (NHD) in 2000 and the 1:24,000 scale NHD nearing completion, advancements in the GIS of surface water hydrology, and tools and applications built on this dataset, are making it nearly as easy to analyze the nation's waterbodies as it is to navigate the nation's roads.

The NHD is the digital—and hence desktop display- and print-ready—version of the surface water features found on the U.S. Geological Survey's (USGS) topographic quadrangle maps that cover the nation. Since the NHD is publicly available over the Web, it can be displayed, printed, and otherwise used by most anyone through the Web-based NHD Viewer (http://nhdgeo.usgs.gov/viewer.htm). For the first time, the country now has an electronic dataset that provides a consistent, seamless, national coverage of surface water features—ponds, streams, playas, beaches, reservoirs, intermittent streams, estuaries, pipes, ditches, and so on. Users can zoom into higher resolution

data using NHD Viewer, and see more features than would be seen at a more panoramic scale, mirroring the difference in detail between a 1:24,000 scale and 1:100,000 scale map.

Multiple government agencies, under the primary leadership of the U.S. Environmental Protection Agency (EPA), USGS, and the U.S. Forest Service, provided support to develop the NHD. The data model itself, and architecture of the system, allow huge volumes of data to be served up at high speed over the Internet. NHD data are available free, and can be downloaded from the Web at http://nhd.usgs.gov. Viewing tools, such as the NHD ArcView Toolkit, can be downloaded to facilitate use of NHD data when not connected to the Internet (see http://nhd.usgs.gov/tools.html).

Numerous private organizations, utilities, local and regional governments, and federal government agencies are now using this "base map" of surface water for various purposes, including water resource management, water quality protection, water supply analyses, risk assessments, and so forth. This community of water science and engineering users and practitioners are involved in further developing the dataset and refining its uses. Tools and mapping applications developed by states, the EPA, and other groups to harness the NHD data sets are increasingly available to help visualize, display, and analyze water features and watershed information.

WATERS: EPA Uses NHD to Link Water Programs

A key characteristic of the NHD is its addressing system for waterbodies. Just as you can pinpoint street address locations with unique combinations of address block information, the NHD allows you to pinpoint waterbody locations with unique "reach addresses." This unique waterbody identifier is based on the eight-digit watershed code, also known as a Hydrologic cataloging Unit Code, or HUC. Within each cataloging unit, parts of streams are assigned unique six-digit identifiers, which combine with the eight-digit water code for the encompassing watershed to form a 14-digit reach code that is used to uniquely identify waterbodies across the country. Locations along reaches are identified by specifying an offset, ranging from zero to 100. The reach code and offset that make up a reach address are analogous to the street name and number that make up a street address. This addressing system provides an underlying framework whereby different EPA water program data can be linked and then integrated. For a given waterbody, various kinds of data can now be related and cross-analyzed because all the data can reference the unique locational identifier provided in the NHD; this is known as data geo-referencing.

Prior to the advent of NHD, EPA's water programs independently monitored and tracked their own data for their own specific purposes in databases such as:

(1) Water Quality Standards: information on the designated uses for waterbodies and criteria to support those designated uses

(2) STORET: water quality monitoring parameters, and measurement values

(3) Assessment: whether waterbodies are meeting the water quality standards

(4) TMDL: information on impaired waterbodies and pollution budget analyses

(5) GRTS: grant funding to implement nonpoint source pollution control programs

The NHD-RAD (Reach Address Database) contains waterbody address information for each of these programs, which allows the data for the programs to be linked together based upon waterbody location. EPA has developed a data architecture to link these water program databases, which it has named WATERS, the acronym for Watershed Assessment, Tracking, and Environmental ResultS (see www.epa.gov/waters for more information).

WATERS offers multiple reporting and mapping tools that, based on NHD and EPA's geo-referenced program data, can perform cross-program queries either on watersheds or particular waterbodies (see Figure 2). For example, using the WATERS mapping application "EnviroMapper for Water," one of a few of EPA's EnviroMapper tools, you can zoom into an area of interest and search for particular information on a waterbody. A query can reveal information such as permit records

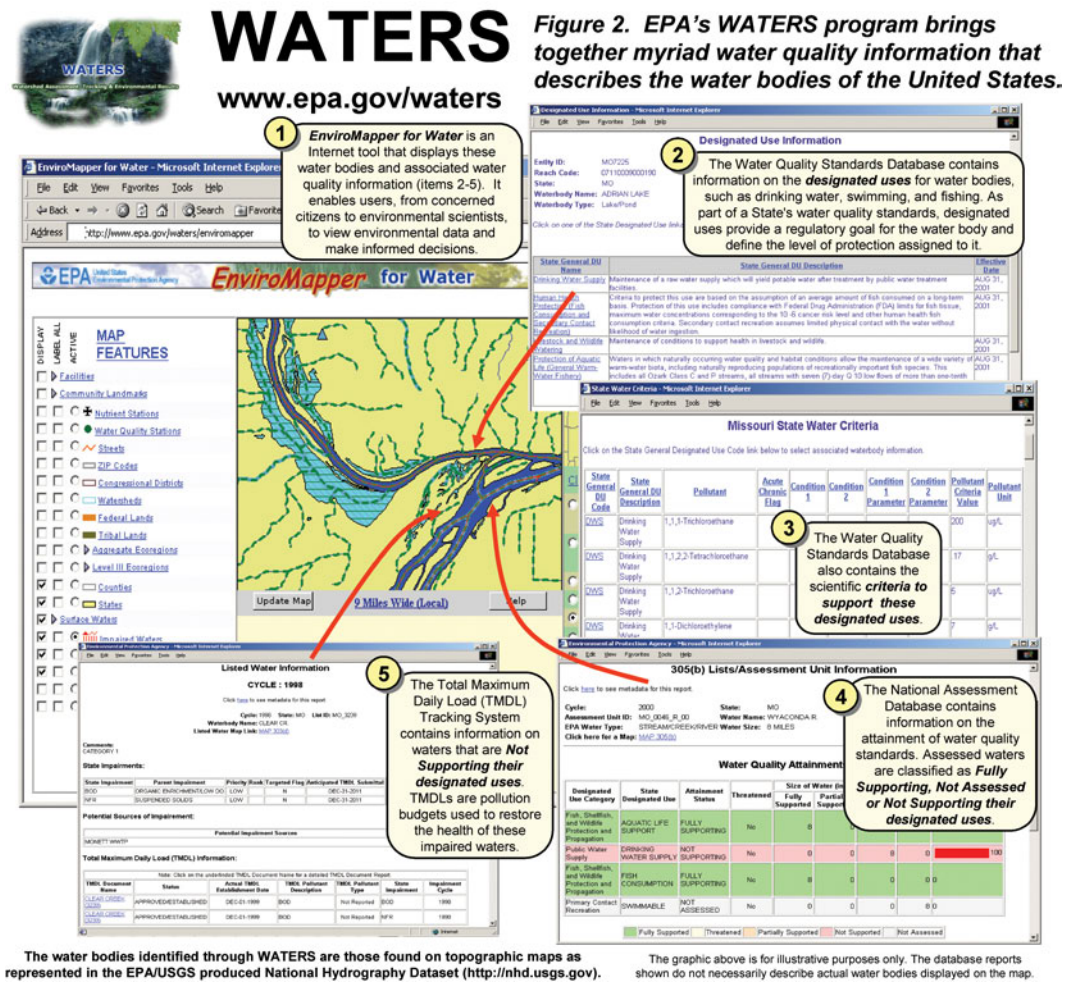


Figure 2. EPA's WATERS program brings together myriad water quality information that describes the water bodies of the United States.

The water bodies identified through WATERS are those found on topographic maps as represented in the EPA/USGS produced National Hydrography Dataset (http://nhd.usgs.gov).

The graphic above is for illustrative purposes only. The database reports shown do not necessarily describe actual water bodies displayed on the map.

and discharge monitoring records from a point source facility on the waterbody, or water quality monitoring information from a sampling station on the waterbody.

NHDPlus

This year, EPA and USGS unveiled an additional suite of NHD products called NHDPlus, which offers more geospatial technologies by integrating NHD with the National Elevation Dataset (30-meter), the National Land Cover Dataset, and the Watershed Boundary Dataset. The new products allow more advanced queries and analyses such as stream network modeling, flow direction, and pollutant dilution modeling. As these data are completed, they will become available for download at www.epa.gov/waters.

Other Uses of NHD

State governments, regional agencies, engineering firms, utilities, and watershed groups are building their own datasets linked to the NHD. They are also creating applications that capitalize on the features of NHD, to help with data visualization, modeling of streamflow and pollutants, fisheries management, risk assessment for water-borne contaminants, decision-making on water supply systems, and other purposes. Some representative examples of these are listed at http://nhd.usgs.gov/applications.html and are available to serve as models for others wanting to apply NHD.

[For general information on NHD, visit http://nhd.usgs.gov. For more information on EPA's use of NHD, contact Thomas Dewald, U.S. EPA, Ariel Rios Building, 1200 Pennsylvania Avenue, N.W., Mail Code: 4503T, Washington, DC 20460. Phone: 202-566-1178; E-mail: dewald.tommy@epa.gov.]

NOTES ON EDUCATION

Student's Award-Winning Nonpoint Source Pollution Project Educates Many

Shannon Babb never expected that Utah's Spanish Fork River would lead her to Sweden. Babb began monitoring the water quality of her nearby Spanish Fork River system in 2001, when she was still in middle school. Five years later, her continuing investigation into that river's water quality has provided insight into the nonpoint source pollution challenges faced by the river, allowed her to craft a plan to solve some of the problems, and has earned her numerous local, state, and national awards. In May, Babb was named America's top high school scientist of 2006 by the Intel Science Talent Search, and received a $100,000 scholarship. Shortly thereafter, she was awarded the opportunity to travel to Sweden for an international youth science seminar. Babb's success has also earned her another, less obvious award—the chance to inform and educate people from all backgrounds about water quality and nonpoint source pollution.

A Self-Starter at a Young Age

Babb first began monitoring the Spanish Fork River and its tributaries in 2001 to assess water quality. Then a middle school student, she discovered that, although the stream looked healthy, the water quality data indicated that pollution problems existed. Little other data was available on the watershed. During the next few years, Babb performed additional research and interviewed local scientists—but found she still had many unanswered questions. Once she reached high school, she decided to develop an intensive six-month project to better determine the water quality problems, dominant factors, and potential solutions.

Babb's award-winning project, titled "*Troubled Waters: A Six-month Longitudinal Study of the Spanish Fork River System*," investigated the water quality at seven sites in the Spanish Fork watershed over a six-month period from May through October 2004. Once a month, Babb spent an entire day visiting her sites and gathering data. She collected water samples and analyzed them for dissolved oxygen, phosphorus, nitrate, and pH. She tested for E. Coli, performed macroinvertebrate surveys, and collected physical data, including temperature, turbidity, stream width/depth, and stream velocity. She also took pictures and observed the condition of the stream and its riparian zone (i.e., evidence of cattle, condition of sedimentation in stream bed).

Project Reaches Many

Babb's data indicated that all the stream sites, at some point during the study, failed to meet the nitrate, phosphorus, pH, and/or temperature water quality standards for cold-water fisheries. She also found turbidity to be a problem at three of her sites. Babb concluded that human activity from urban and agricultural areas was the primary cause of water quality degradation. She suggested some solutions, including reducing runoff from golf courses and agricultural land, establishing or expanding riparian area plantings to filter pollutants from runoff, and excluding livestock from riparian areas. Babb believed that educating homeowners was critical because picking up pet waste, washing cars on permeable surfaces, reducing fertilizer use, and properly maintaining septic systems are practices that can help reduce nonpoint source pollution.

Babb has used her project to educate people throughout her local community and beyond. She has spoken to almost 1,000 people in a variety of venues; including Utah state government representatives, community groups, and students. She has received numerous awards, which has greatly

Award Places National Spotlight on Nonpoint Source Pollution Project

Shannon Babb's project "*Troubled Waters: A Six-month Longitudinal Study of the Spanish Fork River System*," earned the top award—a $100,000 scholarship—in the nationwide 2006 Intel Science Talent Search (STS). Often considered the most prestigious high school student science competition, the 2006 Intel STS included projects covering all scientific disciplines, including biochemistry, chemistry, environmental science, physics, mathematics, engineering, behavioral science, and medicine and health. The competition was fierce: from 1,558 high school students' entries, a judges' panel selected 300 semifinalists. Then, more than 100 top scientists from a variety of disciplines reviewed all entries to narrow the field to 40 finalists. They examined each individual's research ability, scientific originality, and creative thinking. The 40 finalists completed the final phase of the competition, which included extensive interviews. By winning, Babb takes her place among esteemed former Intel STS winners that include six Nobel Laureates, three National Medal of Science winners, 10 MacArthur Foundation Fellows, and two Fields Medalists. Through her project and subsequent media attention, Babb has truly helped to further awareness of nonpoint source pollution and it impacts. For more information, see www.intel.com/pressroom/kits/education/sts.

expanded the audience that hears her water quality message. She received Utah's Governor's Water Award, as well as many national awards, including the Gloria Barron Prize for Young Heroes, the American Museum of Natural History's 2005 Young Naturalist Award, an award from the U.S. Bureau of Reclamation, and the top prize from the 2006 Intel Science Talent Search. Babb recently expanded her project to investigate a newly erupted sulfur spring in her watershed, for which the 2006 Intel International Science and Engineering Fair awarded her a trip to the Stockholm Youth International Science Seminar and Nobel Prize Ceremonies in December 2006.

When asked about her success, Babb sees the larger picture. "I hope it will touch someone else's life, and motivate them to take a risk and explore a field that they are interested in, even if they are the first to do so." Babb plans to attend Utah State University in the fall of 2006 and pursue an environmental degree. For more information about Babb's project, see www.amnh.org/nationalcenter/youngnaturalistawards/2005/Shannon.html.

Shannon Babb explains the data she gathered for her water quality project.

Ohio Students' Commitment Influences Community

What started as a small summer project for three Ohio middle school students has changed their lives. The students initially embarked on a project to help protect the endangered native brook trout in a local stream near Cleveland. As they learned about water pollution and water quality monitoring, they expanded the project to include their entire local watershed. The students soon found themselves influencing zoning regulations, participating in restoration projects, and educating elementary school students, municipal leaders, and the general public about water quality and their native trout population. Along the way, they found themselves winners of a string of state and national awards that propelled them into the media spotlight and helped them to secure grant awards to further their efforts.

In 2003, Amanda Weatherhead, Angela Primbas, and Evin McMullen joined forces to work on a summer project. They became interested in the native brook trout living in Woodiebrook, a local stream. They learned that these trout—descendants of trout left after glaciers receded 12,000 years ago—were one of only three populations of reproducing native brook trout left in Ohio, and were therefore endangered. Moreover, they learned that brook trout are coldwater fish that thrive in water below 60 degrees Fahrenheit and need clean stream bottoms to deposit their eggs.

Although the Woodiebrook trout population was still healthy, the girls realized that it was threatened by development and associated erosion, sedimentation, and thermal impacts. They became concerned about the lack of protection for the stream. Moreover, they realized that few local citizens were even aware of the trout. As the girls learned about the impacts of polluted runoff from everyday actions such as fertilizer and pesticide use on local lawns, they became convinced that they should launch a public education campaign to help protect the trout.

Project Targets Education

The trio named their project "Save Our Stream." With help from a local high school biology teacher, they learned how to perform stream testing. They also conducted public surveys at local stores to find out what people understood about water pollution. Of the 180 people who participated in their survey, only 20 percent knew that runoff polluted surface water. The students realized the great need for education and broadened the focus of their project to include the entire watershed.

The team initiated a series of small projects to raise awareness. Since the girls knew that neighborhood storm drains led directly to the streams, they designed weatherproof stickers that read, "No Dumping, Drains to Stream," and placed the stickers at roadside drain sites. They designed informational leaflets and distributed them door-to-door and at public meetings. They also created awareness-raising messages about nonpoint source pollution and placed them on signs along a hiking trail in Geauga County Park.

The girls also gave presentations to a variety of groups, including elementary school children. Many children had never been out in the woods or along a stream, so the team brought trout into classrooms along with eggs, fry, and a microscope so the children could get a good look. Since brook trout are endangered, the girls substituted brown trout for their classroom presentations.

Evin McMullen places a "No Dumping, Drains to Stream" sticker on a storm drain while Angela Primbas (left) and Amanda Weatherhead look on.

The girls also spoke with municipality officials and builders, and presented at public meetings to explain how development projects can threaten the water quality of nearby streams. Occasionally, they were subjected to heckling. Evin McMullen recalled being told at one point, "Sit down kid, you don't know what you're talking about." Although the rudeness surprised her, McMullen says she strived to maintain her composure by politely asking the heckler to listen to what she had to say first and then she would listen to what that person wanted to say. She regards those situations as opportunities for education.

National Recognition, Successes, and Disappointments

The girls' persistence and passion for the project began to pay off in ways they never imagined. In June 2004, they received the gold medal for the prestigious National Science Foundation's Christopher Columbus Award. Out of 1,200 entries, their project was selected to receive $25,000 to continue their work. The girls also won the Fuji Film Busch Gardens competition, and received grants from State Farm Insurance and the PraxAir Foundation, Ohio EPA, and several others. In spring of 2005, the trio met President Bush in the East Room of the White House where he awarded them the President's Environmental Youth Award. Evin received one of the latest awards when she was named one of Ohio's two top youth volunteers for the 2006 Prudential Spirit of Community Awards, a nationwide program honoring young people for outstanding acts of volunteerism.

Evin McMullen, Angela Primbas, and Amanda Weatherhead (left to right) present watershed information to students at a day camp in July 2006.

The girls even found themselves influencing passage of new regulations. Thanks in part to the girls' efforts, in early 2005, Ohio's Munson Township passed zoning regulations that require riparian setbacks or buffers at construction sites. Unfortunately, however, the change was ultimately overturned through a ballot referendum. Kyle Dreyfus-Wells, of the Chagrin River Watershed Partners, helped the girls map the water system. She said that the girls had definitely raised awareness in the community, and that the support of the local government had added credibility to the girls' project.

The girls are using award money to further their watershed protection efforts. The team at one time had helped plant trees in the riparian buffer of a restored local creek. Later, they returned to the same creek and hosted a planting event. They used some of their prize money to buy shovels and 1,000 trees, and invited families to plant trees at three "Tree Day" events. The girls also recently funded and planned a free symposium with invited speakers to educate the public about water quality issues and land conservation.

The Future

Now in high school, the girls are looking toward the future. Evin is interested in journalism, science, and nature. She recently wrote a book for 4th grade children titled "Where Did They Go?" to teach children about native Ohio brook trout. When asked what she learned from the project, Evin

Ohio Students' Commitment Influences Community (continued)

replied, "I learned that an individual can make a difference." Similarly, Angela expects to choose a conservation-related career. She feels the project benefited her because she has learned that she "can communicate with all age groups and have a positive impact on them to change their lives." Amanda said that she also had connected with the environment, and is considering studying law. No matter where their life takes them, the girls will certainly continue to strive to make the world around them a better place.

[For more information, please contact Evin McMullen, Save Our Stream, P.O. Box 183, Chesterland, OH 44026. Phone: 440-729-0457; E-mail: saveourstream@adelphia.net; Web: www.saveourstream.org.]

The World is their Classroom

At Sparks Elementary School in Baltimore County, MD, Pokey Fair was teaching math, science, reading, writing, research skills, and environmental stewardship to a small team of fifth-grade students—all at the same time. The students clustered around their teacher as she spoke. "You're writing to ask for grant money, but you'll each be working on different things," Fair told her students. "You need to do some research first."

She nodded toward one listener. "Your job is to cover the tree planting. To start, we'll need to figure out how many trees we'll need, and what kinds." To another, "Your job is to figure out how many buses we'll need for the grass planting trip and what they cost. You'll have to go to the office and ask some questions. We also need to decide how long to stay, so we can figure out the costs for a substitute teacher. Should we stay for a half day and do the planting, or stay for the whole day so that we can hike around and do more studies?" Fair asked. The answer to that one was easy.

Fair and her students were working on grant applications to fund three hands-on projects that help students protect and restore the Chesapeake Bay. One project would create a forest buffer to protect water quality in a local stream. Another would help the "EcoSharks" club plant a rain garden to reduce stormwater runoff. Yet another would help trays of underwater grasses—nurtured for weeks in the classroom—find a permanent home in Bay waters as critical habitat for fish, young crabs, and shellfish.

These projects are three of many activities that have won Sparks Elementary recognition as one of the 112 Maryland Green Schools. The honor is reserved for schools that have moved environmental education beyond the bounds of individual classrooms to involve the entire student body, the school building, its grounds, and the community at large.

The Maryland Green Schools program is sponsored by the Maryland Association for Environmental and Outdoor Education (MAEOE). The Virginia Department of Game and Inland Fisheries coordinates a similar program known as Virginia Naturally Schools. Both aim to produce better students, better citizens, and a healthier Chesapeake Bay.

Schools Incorporate the Environment

"Green Schools is far more than one fired-up teacher," said Jeanne Armacost, co-chair of the MAEOE Green Schools committee. "It's cross-disciplinary. The theme of the environment is used as a context behind learning, drawing on connections that kids have to their personal, real world."

While many schools work effectively on single issues or projects, such as recycling or schoolyard habitat, programs such as Maryland's Green Schools raise the bar with a wider set of criteria designed to involve the entire school community. The specifics differ by program, but focus on common themes: curriculum connections and field experiences for students, professional development for teachers, good stewardship practices for the school building and its grounds, and developing community partnerships.

Interested Students Learn More

"So often, kids learn things just because the teachers tell them to," said Suzie Gilley, chair of the Virginia Naturally Schools program. "But when you use the environment as a context, they get

excited. They take a vested interest in their learning. It's local, it's something they can touch, and they want to learn more."

Research increasingly affirms this. A 1998 study by the State Education and Environmental Roundtable found that using the environment for cross-disciplinary studies led to higher scores on standardized tests in reading, writing, math, science, and social studies. Schools enjoyed more student enthusiasm and fewer discipline problems. Other studies showed an increase in teachers' job satisfaction.

A series of follow-up studies, including one focused on Maryland Green Schools, reinforced some of these findings. The 2004 MAEOE study compared math and reading scores from fifth and eighth grade students in Green Schools to those from non-Green Schools. After controlling for variables such as social and economic factors, researchers found that students at Green Schools performed at a higher level on standardized tests than students at non-Green Schools.

Green Schools in Action

At Sparks Elementary, principal Barbara Bisset sees the positive effects of the Green Schools program firsthand. "Green Schools doesn't replace the required curriculum. It just extends it," Bisset said. "Kids still use their reading, writing, and math skills, but it's in a real-world application."

Green Schools activities at Sparks Elementary are guided by a teaching team that includes two fifth grade teachers, the physical education teacher, the music teacher, and the school nurse. Projects involve the whole school and draw many parent volunteers.

Last year, they tackled erosion problems on the school grounds. "We did a buffer planting along the stream. Before the planting, the science team worked with fifth graders to research what buffers do and what kind of trees to use. Then the fifth graders taught the other kids about why they were doing this and how it will make things better down the road," Bisset said.

Other projects include a butterfly garden and a one-mile nature trail with bluebird boxes. Students monitor the wildlife while practicing math and graphing skills. A recycling program reduces cafeteria waste, but also raises money for the school by working with companies that pay cash for used paper and ink cartridges.

Sparks Elementary is fortunate to have extensive grounds and an active corps of parents, but Armacost said that every school, public or private, should operate as a green school. In urban settings, the ecosystem is still at work even if it looks less green. "It's about looking at your school and finding opportunities where you are. The Ascension Catholic School just southwest of Baltimore is on a concrete pad, but it was one of the first Maryland Green Schools," Armacost said. The school made up for its lack of on-site restoration opportunities by growing aquatic grasses in the classroom and then planting them in a Bay tributary.

Resources are Easy to Find

And while teachers and students put plenty of energy into these projects, they often cost the school little or nothing. Donations of materials and expertise come from many partners, including community businesses, state agencies, and watershed groups. Teachers in Virginia Naturally Schools receive a free, full day of training from state resource education specialists at their own schools on a topic of their choice.

Nature centers offer lots of resources, too. The MAEOE has launched a Maryland Green Centers program to identify environmental education centers that are especially active with Green Schools, providing models, teacher training, and classroom support. Virginia is beginning a master naturalist program that will train volunteers to share their knowledge with schools.

Small grants help to fund restoration projects, field expenses, and even some teacher training. Virginia Naturally Schools have benefited from grantmakers such as the National Oceanic and Atmospheric Administration's Chesapeake Bay Office and the Virginia Environmental Endowment.

The World is their Classroom (continued)

In Maryland, schools often find support through the Chesapeake Bay Trust and the Aquatic Resource Education program at the Maryland Department of Natural Resources.

The network of partners supports beginning schools, as it did for Sparks Elementary. "At the beginning, I went to one workshop on schoolyard habitat and met all these people I could work with—friendly, easy, accessible partners who are realistic about all of the demands on teachers," Fair said. "Whenever I'm involved with one thing, I learn about five more."

Virginia Naturally Schools offers tiered recognition so that schools can be rewarded for smaller, early efforts, while the more comprehensive program takes shape. "Every school can get there," Gilley said, "and they can do it in baby steps."

[This article was excerpted from the April 2006 issue of the Bay Journal, the monthly newsletter of the Alliance for the Chesapeake Bay. For the full original article, see www.bayjournal.com/article.cfm?article=2777. For more information about Maryland Green Schools or Virginia Naturally, visit www.maeoe.org or www.vanaturally.com, respectively.]

REVIEWS AND ANNOUNCEMENTS

Community Spaces, Natural Places

The Delaware Department of Natural Resources and Environmental Control's Coastal Program has produced a free manual entitled *Community Spaces, Natural Places: a guide to restoration, management and maintenance of community open space*. This document provides guidance on how to design an open space management plan and how to mobilize a community to implement habitat improvement projects. This document is available for free download at www.dnrec.state.de.us/dnrec2000/Divisions/Soil/dcmp (look under "Publications of Interest"). For more information, contact Marcia Fox at 302-739-9283 or by e-mail at marcia.fox@state.de.us.

Conservation Almanac Serves as Resource

The Trust for Public Lands recently released *The Conservation Almanac of Federal and State Lands in the West*, which serves as a comprehensive source of information on the status of land conservation in the thirteen western states of Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. The Almanac covers land conservation activity from 1998-2003. The project grew out of the many requests that the Trust received for data to understand the context for land conservation and the growing conservation finance movement. County leaders, governors' offices, journalists, foundations and others asked questions such as: How much land has been protected in my state? Which state and federal agencies have protected lands in the state? With all the new money being created for land conservation, what kind of impact are we getting? What policies and programs might help us make progress in reaching our conservation objectives? The new Almanac, available at www.conservationalmanac.org (registration required) attempts to answer these and other questions.

EPA Publishes Updated Watershed Training Opportunities Booklet

EPA recently published an updated version of the *EPA Watershed Training Opportunities* booklet. This 27-page booklet highlights watershed training opportunities sponsored by EPA's Office of Water and its Watershed Academy. The booklet briefly describes all EPA-sponsored live training courses, Web-based training opportunities including webcasts, training materials such as documents and videos, and watershed-related Web sites that are available to EPA staff and others. Hard copies of the booklet are available at no charge from the National Service Center for Environmental Publications (NSCEP) at 800-490-9198 or 513-489-8190. Request document number EPA 841-B-06-001. The booklet is also available on the Watershed Academy Web site at www.epa.gov/owow/watershed/wacademy/wtopps.html.

EPA Unveils First-Ever Assessment of U.S. Wadeable Streams

EPA recently released its draft Wadeable Streams Assessment (WSA) report for public review. The WSA is a first-ever, statistically-valid survey of the biological condition of streams throughout the nation. Wadeable streams—streams and rivers that are shallow enough to sample without boats—were chosen for study because they are a critical natural resource, because we have a well-established set of methods for monitoring them, and because they are frequently under-sampled in traditional monitoring programs. The WSA is the first consistent evaluation of the streams that feed rivers, lakes, and coastal waters.

The survey found that stream conditions vary widely across the diverse ecological regions of the country, and that streams in the West were in the best condition. Humans, the researchers found, have a significant impact on wadeable streams. A majority of streams showed evidence of human influence. The most widespread stressors observed are nitrogen, phosphorus, and streambed sediments. The WSA is part of a series of surveys to evaluate all of the nation's waters. Coastal conditions have already been evaluated (see www.epa.gov/owow/oceans/nccr). During the next five years, EPA will sample the condition of lakes, large rivers, and wetlands. Then the process will be repeated to provide ongoing comparisons of the state of the waters and point to possible future action. For further information on the WSA, or to download a copy of the report, go to www.epa.gov/owow/streamsurvey.

Fact Sheets Explore How to Build Sustainable Communities

The Northeast Illinois Planning Commission and the Campaign for Sensible Growth have developed a series of four-page fact sheets detailing a broad range of community sustainability issues. The series—*Building Sustainable Communities*—presents thirteen sustainable development techniques, explains why they are important, how they can be and have been applied in communities throughout the state of Illinois, and where to go for further information. The fact sheets are intended primarily to help local government officials make sustainable community decisions and secondarily as a guide for those working with local governments such as developers, civic organizations, and the private sector. Although written for Illinois, the concepts presented by the fact sheets are applicable to most locations nationwide. To view the fact sheets, see www.nipc.org/environment/sustainable/development/communities.

Great North American Secchi Dip-In Held

The 13th Annual Great North American Secchi Dip-In took place across the United States and Canada from June 24 to July 16, 2006. This year's Dip-In focused on the Mississippi River and its associated reservoirs, lakes, and streams. The goal of the annual Dip-In is to encourage volunteers to participate in monitoring by taking a transparency measurement at some point within the designated time period. Volunteers may monitor any type of waterbody, including lakes, reservoirs, estuaries, rivers, or streams. There are now five or more years of data on more than 6,000 waterbodies in the U.S. and Canada. For more information about participating in this event and for access to past years' data, visit the Secchi Dip-In Web site at http://dipin.kent.edu/volform.htm or e-mail dipin@kent.edu.

Natural Heroes on TV

This summer the Public Broadcasting Service debuted the second season of an award-winning series called "Natural Heroes." The series was created in 2004 to showcase independently-produced films that share a common theme: real people making a difference for the environment and enhancing the world around them by getting involved. The second season addresses a broad range of issues from across the country and other parts of the world, and features stories of people working to protect endangered species and fragile ecosystems, preserving water resources, improving local communities, fighting for justice, planning for the future after environmental disasters, and more. For more information, see www.greentreks.org/naturalheroes.

New Report on Bioretention Practices Available

North Carolina State University recently released a new document detailing the results of a research project examining the performance of bioretention cells installed in four North Carolina cities. Authors of *Bioretention Performance, Design, Construction, and Maintenance* report that bioretention cells will efficiently remove nutrients and other pollutants from stormwater. The document summarizes the research findings, discusses design considerations, and explores how filter media can be changed to address various nutrients. The document is available online at www.bae.ncsu.edu/stormwater/PublicationFiles/Bioretention2006.pdf.

River Network's River Rally 2006 Has Record Attendance

More than 500 participants from 44 states and 16 tribal groups attended the River Network's 2006 River Rally in Bretton Woods, New Hampshire. The River Rally is an annual conference providing training, professional development, networking, strategy development, coalition building, campaign planning, celebration, and personal renewal for watershed protection community leaders. For more information about the 2006 Rally, and to download presentations, visit www.rivernetwork.org/rally. Next year's Rally is planned for May 18-22 in Stevenson, Washington.

Texas' KTVT launches Envirocast

The Dallas/Fort Worth area now has access to Envirocast, thanks to a partnership between the Texas State Soil and Water Conservation Board, North Central Texas Council of Governments, KTVT, and StormCenter Communications. The partners used funding from the EPA's Clean Water Act Section 319 grant program to develop a Web site dedicated to weather and watershed information, including a "find your watershed" feature, current environmental news stories, and a learning center with several interactive graphics. A special feature is dedicated to the 2005 hurricane season. Check out this new outreach effort at http://ktvt.iewatershed.com.

"Turning the Tide" Documentary Available Online

NJN Public Television and Radio's latest documentary, "Turning the Tide," takes the viewer on a visual journey down the rivers and streams that wind through New Jersey's open spaces, under bridges and roadways, past towns and historic sites, and near habitat that is home to numerous bird species. Once considered wastelands, wetlands are now recognized as a critical natural resource. This change in attitude has inspired individual action as well as major policy changes to help protect, preserve, and revitalize these special places. The documentary showcases the hidden beauty of the tidal areas in and around the Hackensack Meadowlands of northern New Jersey and the Hamilton-Trenton Marsh just south of Trenton, NJ. The program follows scientists, senior citizens, and young children as they visit urban wetlands and discover wilderness areas that are home to a rich variety of wildlife. The 30-minute program originally aired in the spring of 2006, and is now available as streaming video at www.njn.net/community/specialinterest/turningthetide.

USGS Pesticide Study Raises Concern

A recent U.S. Geological Survey (USGS) study found that lawn pesticides entering streams via stormwater runoff are not only increasing, but are also changing chemical composition and forming combinations that have never been assessed for human health effects. *Circular 1291—Pesticides in the Nation's Streams and Ground Water, 1992-2001*—is available at http://pubs.usgs.gov/circ/2005/1291/, or by calling 1-888-ASK-USGS. In-depth information about the pesticide assessment may be found at: http://water.usgs.gov/nawqa (look under "What's New").

Webcasts Explore Alternative Practices for Highway Stormwater Management

The Izaak Walton League has launched its latest educational webcast series, titled *Alternative Practices for Highway Stormwater Management*. This four-part webcast series outlines the latest techniques available to help transportation agencies save money, comply with water quality and water supply regulations, and improve water quality with context-sensitive stormwater management practices, including low impact development techniques. These techniques also can help highway department personnel manage stormwater quantity and quality while using existing rights-of-way and providing easy access for maintenance crews. Each session includes valuable background information and specific guidance on how to apply these principles for highway projects. The series addresses barriers to using innovative stormwater management techniques and how to overcome them.

The first two webcasts in this series, "Introduction to Alternative Practices to Manage Highway Runoff" and "Planning Highway Projects Using Alternative Practices for Stormwater Management," were aired earlier this summer, and are available online at www.iwla.org/index.php?id=223. The remaining two webcasts, "Alternative Practices for Highway Stormwater Management: Design, Construction and Maintenance–Parts One and Two" are scheduled for September 21 and October 26, respectively. For more information, see www.iwla.org.

Wetlands and Watershed Article Series Grows

The Center for Watershed Protection (CWP) recently released *Article 2: Using Local Watershed Plans to Protect Wetlands*, the second of CWP's six-part Wetlands & Watersheds article series (available for download at www.cwp.org/wetlands/articles.htm). This article briefly describes a proposed framework for integrating wetland management in the context of local watershed planning efforts. It outlines the rationale for managing wetlands at the watershed scale, provides the basics of the watershed planning process, and recommends 11 watershed-planning elements that relate to wetlands. Also available is *Article 3: Adapting Watershed Tools to Protect Wetlands*, which describes 37 techniques for protecting wetlands through local programs and ordinances. CWP expects to complete the four remaining articles of the series by the end of 2006.

RECENT AND RELEVANT PERIODICAL ARTICLES

From Icy Roads to Salty Streams

By Robert Jackson and Esteban Jobbagy (www.biology.duke.edu/jackson/pnas05.pdf). This article, printed in the October 11, 2005 edition of the *Proceedings of the National Academy of Sciences*, describes how the application of rock salt on U.S. roads has greatly increased during the past 65 years, leading to increases in chloride concentrations in waters of the northeast. The article explores the fate of chloride, providing evidence of its link to road salt and build-up in streams.

Greener Links

By Peg Herring (http://eesc.oregonstate.edu/oap). This article, printed in the spring 2006 issue of Oregon State *University's Oregon's Agricultural Progress*, explores the long-term environmental success of that school's turf management program. The article recounts the efforts of program director Tom Cook, who has been pivotal in producing graduates who became early adopters of environmental stewardship in golf course management.

Parking Lot Sealants: On the Trail of Urban PAHs.

By David Richardson (www.forester.net/sw_0605_parking.html). This article, printed in the May 2006 issue of *Stormwater*, describes how the discovery of high PAH levels during water quality tests on creeks in Austin, Texas, sparked a wider investigation by the USGS, and ultimately led to a ban on the use of coal-tar asphalt sealants in the city.

The Perils of Parking Lots

By Leo Pierre Roy (www.landdevelopmenttoday.com/Article632.htm). This article, printed in the April 10, 2006 online edition of *Land Development Today*, explores the use of porous pavement as a tool for sustainable site design.

Permeable Pavement Research: Water Quality, Water Quantity, and Clogging

By Eban Bean and William Hunt (www.bae.ncsu.edu/programs/extension/wqg/issues/notes119.pdf). This article, printed in the November 2005 issue of the NC State University Water Quality Group's newsletter *NWQEP Notes*, features results of the University's recent research on permeable pavement. Researchers evaluated three of the most common types of permeable pavement for their ability to reduce stormwater runoff volumes and pollutants, and investigated the effect of clogging on surface infiltration rates. Findings indicated that, when compared with traditional impervious pavements, the permeable pavements successfully reduced stormwater runoff and pollutant loadings.

RAN: Working With Neighborhoods to Manage Stormwater—An innovative project works with suburban homeowners to design stormwater controls

By A. McIntosh, B. Bowden, E. Fitzgerald, A. Hackman, B. Kirk, J. Todd, H. Vladich, A. Voinov, and J. Bartlett (www.stormh2o.com/sw_0605_ran.html). This article, featured in the May/June 2006 issue of *Stormwater*, describes the efforts of a team of researchers at the University of Vermont and city officials from South Burlington, VT, as they assist suburban neighborhoods that are struggling to comply with current stormwater regulations. The article describes the USEPA-funded Redesigning the American Neighborhood (RAN) program, which helps homeowners to evaluate environmental, economic, and social factors while designing the best approach for managing stormwater in their neighborhoods.

The Social Side of Watershed Restoration

By Mary Carr, Susan Holtzman, Janice Staats, and Laura Van Riper (www.fs.fed.us/wildlandwaters). This article, printed in the spring 2006 issue of the U.S. Forest Service's newsletter *Wildland Waters*, explores the social and human aspects of watershed work. The article discusses the social aspects of watershed management—why restoration is more than a technical task and why collaboration and community involvement take time and skill to do well, but are worth the effort. The article outlines a few approaches to collaborative community-based watershed restoration, followed by a sampler of ways to apply basic principles of collaboration. The article also provides key resources to help guide public/private collaborative work and lists some policy and research needs whose solutions could help create and maintain effective collaborative processes.

WEB SITES WORTH A BOOKMARK

10,000 Rain Gardens (www.rainkc.com)

10,000 Rain Gardens is an initiative launched by citizens, corporations, educators, non-profit organizations, and the local government in Kansas City, MO to voluntarily reduce the amount of runoff that pollutes waterways. Although developed for the Kansas City area, this Web site offers useful information for anyone interested in rain gardens.

Beach Kids (www.epa.gov/beaches/kids)

As part of its effort to increase the public's awareness about beaches, EPA has created an interactive Web site especially for kids. Young Web users can play games while learning about beach protection and safety.

Educating Young People about Water (www.uwex.edu/erc/eypaw/)

The Environmental Resources Center at the University of Wisconsin-Extension maintains the "Educating Young People about Water (EYPAW)" Web site, which offers educational guides and a water curricula database to help educators develop community-based, youth water education programs. EYPAW Web-based resources include ideas, checklists, references, partner lists, and community action education materials.

EE-Link: Environmental Education on the Internet (http://eelink.net)

The North American Association for Environmental Education maintains this Web site, designed to support students, teachers, and professionals involved in K-12 environmental education. EE-Link offers access to environmental education resources and information from around the globe.

River of Words (www.riverofwords.org)

River of Words is a California-based nonprofit organization that helps people incorporate observation-based nature exploration and the arts into their work with students. Each year, in affiliation with The Library of Congress Center for the Book, River of Words conducts a free international poetry and art contest for youth on the theme of watersheds. The contest is designed to help youth explore the natural and cultural history of the place they live, and to express, through poetry and art, what they discover. The River of Words' Web site features many examples of student entries and offers a variety of student art and poetry compilation books.

CALENDAR

September 2006

18-20	*2006 AWRA Wetlands Restoration Dialogue*, Fort Lauderdale, FL. For more information, see www.awra.org/meetings/Wetlands2006.
18-20	*9th International Conference on Remote Sensing for Marine and Coastal Environments*, New Orleans, LA. For more information, see www.marineconference.org.
18-21	*North American Weed Management Association 2006 Conference*, Calgary, Alberta Canada. For more information, see www.nawma.org.
18-22	*NPDES Permit Writers' Training Course*, Albany, NY. For more information, see www.epa.gov/npdes/outreach_files/albany_announcement.pdf.
19-20	*Meeting the Challenge: Invasive Plants in the Pacific Northwest*. For more information, see http://depts.washington.edu/urbhort/html/invasives/homepage.htm.
20-21	*Getting in Step with Phase II: A Workshop for Stormwater Program Managers*, Lexington, KY. For more information, see www.epa.gov/npdes/outreach_files/lexington_workshop_brochure.pdf.
20-21	*New York City Watershed Science and Technical Conference*, Fishkill, NY. For more information, visit www.nywea.org.
21	Webcast: *Alternative Practices for Highway Stormwater Management: Design, Construction and Maintenance – Part One*. For more information, see www.iwla.org.
21-25	*WEFTEC 06: Water Environment Federation Technical Exhibition and Conference*, Dallas, TX. For more information, see www.weftec.org.
24-28	*14th National Nonpoint Source Monitoring Workshop*, Minneapolis, MN. For more information, see www.ctic.purdue.edu/.
25-27	*STORM: Stormwater, Treatment, Operations, Research, Management*, Sacramento, CA. For more information, see http://stormwaterconference.com.
27-30	*Forestry in the Headwaters: Protecting Water Through Excellent Forestry*, Boulder Junction, WI. For more information, see www.forestguild.org/FGAM06.html.
28-29	*Regional Planning Comes of Age*, New Brunswick, NJ. For more information, see www.regionalplanningcomesofage.org.

October 2006

2-5	*2006 Stream Restoration in the Southeast: Accomplishments and Opportunities*, Charlotte, NC. For more information, see www.bae.ncsu.edu/programs/extension/wqg/sri/2006conference.
3-4	*2006 Tamarisk Research Conference: Current Status and Future Directions*, Fort Collins, CO. For more information, see www.tamarisk.colostate.edu.
10-14	*Gathering at the Headwaters: Building Environmental Education in Society*, St. Paul, MN. For more information, see www.naaee.org.
11-13	*Managing Agricultural Landscapes for Environmental Quality: Strengthening the Science Base*, Kansas City, MO. For more information, see www.swcs.org.
11-13	*National Beaches Conference*, Niagara Falls, NY. For more information, see www.epa.gov/OST/beaches.
12-15	*National Land Conservation Conference: Rally 2006*, Nashville, TN. For more information, see www.lta.org/training/rally.htm.
16-19	*Annual Conference on Soils, Sediments and Water*, Amherst, MA. For more information, see www.umasssoils.com.
17	*Satellite Conference—Stormwater Management from a Watershed Perspective: Extreme Western Climates*. For more information, see www.pnwwaterweb.com/initiatives/pnw_084.htm.
23-26	*2006 Watershed Institute*, Columbus, OH. For more information, see www.cwp.org/WI06/wi06info.html.
23-26	*9th Annual Wetlands and Watersheds Workgroup*, Atlantic City, NJ. For more information, see www.wetlandsworkgroup.org.
23-27	*NPDES Permit Writers' Training Course*, Woodbridge, VA. For more information, see www.epa.gov/npdes/outreach_files/woodbridge_announcement_oct2006.pdf.
26	Webcast: *Alternative Practices for Highway Stormwater Management: Design, Construction and Maintenance – Part Two*. For more information, see www.iwla.org.

November 2006

2-3	*Ecosystems Restoration and Creation*, Plant City, FL. For more information, see www.hccfl.edu/depts/detp/ecoconf.html.
6-9	*2006 American Water Resources Association Conference*, Baltimore, MD. For more information, see www.awra.org/meetings/Baltimore2006.
7-9	*Science Symposium: Sources, Transport, and Fate of Nutrients in the Mississippi and Atchafalaya River Basins,* Minneapolis, MN. For more information, see www.epa.gov/msbasin/news.
9	*Vulnerable Wetlands Forum: A Research and Policy Update Examining Federal Jurisdiction Over Vernal Pools and Headwater Wetlands Post-SWANCC*, Westford, MA. For more information, see www.neiwpcc.org/vulnerablewetlandsforum.
13-15	*Farming on the Edge: The Next Generation*, Newark, DE. For more information, see www.farmland.org/conference2006.
15-16	*State of River Restoration Practice: a River Ecosystem Restoration Forum*, Powell, OH. For more information, see http://riverinstitute.org/home.html.
28-30	*Innovations in Reducing Nonpoint Source Pollution*, Indianapolis, IN. For more information, see www.riversinstitute.org.
28-30	*The Partners in Environmental Technical Symposium & Workshop - Meeting DoD's Environmental Challenges*, Washington, DC. For more information, see www.estcp.org/calendar.

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Do you have an article or idea to share? Want to ask a question or need more information? Please contact NPS News-Notes, c/o Carol Forshee, by mail at U.S. EPA, Mail Code 4503-T, 1200 Pennsylvania Ave., NW, Washington, DC 20460, by phone at 202-566-1208, or by e-mail at forshee.carol@epa.gov.

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