

**Land Use Planning and Water Quality:
State and County Experts Discuss Issues
at the 2003 Delaware Water Policy Forum**

What is being done in Delaware on the state and county level to protect water quality through land use planning? Expert speakers addressed this topic at the Delaware Water Forum "Land Use Change And Water Quality: Assessing the Impacts and Planning for the Future", attended by nearly 150 visitors from government, academia, and the commercial and private sectors on October 2, 2003 at the University of Delaware's (UD) Clayton Hall. Co-sponsors of the event included the Delaware Water Resources Center (DWRC), UD Institute for Public Administration (IPA) Water Resources Agency (WRA), Delaware Geological Survey (DGS), Center for the Inland Bays (CIB), and the Delaware Department of Natural Resources and Environmental Control (DNREC).

Please note: For more detailed Forum presenter biographies, talk abstracts, and slide presentations, visit <http://ag.udel.edu/dwrc/news.html>. To request Forum proceedings, contact WRA director Gerald Kauffman (phone: 302-831-4925, fax: 302-831-4934, email: jerryk@udel.edu), or visit WRA's website at <http://www.wr.udel.edu/>.

Convening the session was IPA Director **Dr. Jerome Lewis**, who stressed the relatively small cost of planning that prevents more expensive solutions to address impaired water quality. He also pointed out that IPA's strong land use planning and water resources groups provide technical leadership and serve in partnership with other water agencies and state and municipal governments. DWRC Director **Dr. Tom Sims** welcomed attendees and explained

DWRC's research and training program, which leverages federal and local co-sponsor funds to find solutions to Delaware's priority water problems. He expressed appreciation for the guidance of the 16-member DWRC Advisory Panel, comprised of water resources advocates throughout the state, and directed listeners to the DWRC's website and publications for statewide water news.

A fascinating survey of Delaware's land use trends, both past and projected, was presented by **Ed Ratledge**, Director of the UD Center for Applied Demography and Survey Research, setting the stage for the state and county policymakers' presentations. Among his observations, which are now posted online at <http://www.cadsr.udel.edu/DOWNLOADABLE/DOCUMENTS/waterforum.pdf>, with regard to population and housing growth:

- **Population growth:** Delaware's population growth rate was greatest during the 1960's, when 130,000 were added to the total. In the last three years, Delaware's population has grown 35,000 to the present total of 818,000, and 15,000 new housing units were added. The population growth rate is therefore about 12,000 people per year, in the 0-2% range. Delaware's population is projected to reach about one million around 2030.
- **Households growth:** The rate of creation of new households is growing faster than the population itself in Delaware. Today's population per household of 2.6 will decrease to 2.2 by 2030. Most households during the last decade were built in southern New Castle County and parts of Kent and Sussex Counties. During the current decade, there will be a net increase of 50,000 new Delaware households; the majority of these will be single family residences. *(continued, page 2)*

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(Ratlidge on Delaware growth, continued)

* **Related land use trends:** Every household takes about 1½ acres of land to sustain it, in terms of space for roads and other forms of transportation, parking, and buildings for homes, work, and supporting businesses. Of today's 580,000 acres of farmland, only 380,000 are projected to remain in Delaware by 2027.

***Future growth forecasts:** Ratlidge predicts that during the next thirty years Sussex will be the fastest growing county in Delaware, adding 50,000 more housing units and 30,000 vacation units, mainly concentrated around the Inland Bays. Water demand in Sussex will grow rapidly with increased population; residents will experience increased runoff rates and flooding associated with increased impervious land cover. Kent County's growth rate will remain fairly steady. Economic growth in New Castle County has been flat since 2000, and a corresponding slowdown in population growth is expected there.

Constance Holland, Director of the **Delaware Office of State Planning and Coordination (OSPC)**, next spoke on current and planned efforts statewide to create a comprehensive land use plan protecting and improving water quality. Her mission is implementing Governor Minner's Executive Order 14, the "*Livable Delaware Initiative*", which places priority on ensuring improved quality of life, including water quality, for Delaware citizens. Initiative subcommittees will be using "livability indicators" to create new standards for water quality measurement in redrafting regulations for the use of public water and sewer systems in new development. Holland stated that the state's three-prong overall water quality protection strategy is: (i) support investment in existing infrastructure, such as the water and wastewater systems; (ii) coordinate inter-governmental efforts at the grass roots, implementing new legislation and approaches to design land use at this level; and (iii) provide state agencies with environmental impact information earlier in the development review process.

An example of water protection at the grass roots level is *HB 255*, passed in 2001, which requires the 57 local Delaware municipalities to create certified land use plans outlining water and wastewater efforts to protect wellheads and groundwater recharge areas before any land annexation may be passed. To date, 90% of municipalities have created or are developing certified plans. Another example is the cooperative

effort of the multi-agency Delaware River Basin Commission to develop a workable, long term PCB pollution control strategy. Citizens and state agencies have provided input to create "*Community Design Guidelines*" for private and public landscaping, to be published next year to inform the public and encourage developers to protect water resources through development design practices.

Early assessment of development projects is coordinated between the Delaware Department of Transportation (**DeIDOT**), **DNREC**, and **OSPC** and is mandated by the *Preliminary Land Use Service (PLUS)* bill passed by the General Assembly in 2003. State agencies now have comprehensive information at the parcel level, such as groundwater recharge data available from the Delaware Geological Survey and land use data from **UD**, to make effective decisions related to water quality protection in advance of development.

On the county level, representatives from New Castle, Kent, and Sussex counties presented county initiatives in land use planning for water quality protection. **Charles Baker**, General Manager of the **New Castle County Department of Planning**, explained that, beyond federally- and state-protected areas governing the coastal zone and wetlands, all other water protection is left to the local governments. He cited the success of the county's 1988 *Comprehensive Plan*, later updated in 1996, 1997, and 2002, which directly linked water quality protection to the County's land use regulations. Through major legislative efforts into the early 1990's, the County adopted floodplain and water resource protection overlay zones, steep slope districts, critical natural area designations, comprehensive revisions to its existing wetland regulations, and cluster development regulations to help limit sprawling development patterns. The 1996 *Comprehensive Development Plan* and 1997 *Unified Development Code* enhanced existing regulations through inclusion of all land use applications and added additional water quality measures, such as 100% protection of floodplain/floodways, wetlands, riparian buffers, steep slopes, and certain water resource protection area wellheads and forests. The 2002 *Comprehensive Development Plan Update* not only further assures the protection of the quality of water resources in New Castle County through environmental protection regulations, but also includes and combines the principles of conservation design and low impact development. This legislative initiative, known as "Environment First", requires land



development to consider environmental impacts as an initial step in the design process. Conservation designs now must meet a series of holistic design goals that maximize protection of key land and environmental resources, preserve significant concentrations of open space and greenways, evaluate and maintain site hydrology, and ensure flexibility in meeting community needs for complementary, aesthetically pleasing development.

Kent County was the first county in the state to complete a comprehensive land use plan and was the first county to delineate a Growth Overlay Zone where development was most supportable based on sewer availability. **Kent County Department of Public Works** Director **Hans Medlarz** cited well-regulated, well-run sewer transmission and treatment systems as the best tools to protect water resources. With the 1996 amendment to *Chapter 205* of the Kent County Code (Zoning), changes in zoning regulations encouraged voluntary movement toward central sewer service, reversing the former trend of groundwater nutrient contamination caused by onsite wastewater treatment and disposal in large lot development. *Chapter 180* of the Kent County Code (Sanitary Sewers) was completely revised in March 2003 and introduced public/private partnerships permitting County creation of centralized sewer utilities for an entire sewer drainage basin to serve and share economic burdens between present and future developers. It further deals with extension of central sewer service outside of the growth zone, prohibiting new development from increasing the underlying zone density, and requiring environmental measures such as conservation storm water design, ground water recharge, and 90% woodland preservation. The revised *Chapter 187* of the Kent County Code (Subdivision of Land) adopted by Levy Court in June 2003 requires central sewer service or onsite advanced treatment and disposal systems throughout the Growth Overlay Zone for all future major residential and commercial subdivisions. The revision effectively eliminates future groundwater contamination from septic systems. Outside this zone, community wastewater systems will be required in developments above 25 units. Other components of the revision linking land use to surface water quality are strengthening of the riparian buffer and woodland protection requirements and prohibition of all development within floodplains. Mr. Medlarz concluded that Kent County places a high priority on water resource protection and is currently investing \$14 million to expand sewer transmission service with the goal to maintain residents' quality of life.

Dr. Bruce Richards, Director of **Sussex County's Center for the Inland Bays**, described the county as one of extreme diversity in land use and population distribution between coastal and inland areas. Rapid population growth in Sussex has caused a significant loss of open space and habitat. Property values in the coastal area have increased dramatically over the past few years, and some property rights issues have arisen from land use conflicts between coastal and rural residents. Developers experience pressure to create innovative designs but find moving unique designs through the approval process difficult. In December 2002, Sussex County adopted a five year *Land Use Plan* creating an "environmentally sensitive zone" around the Inland Bays and dictating specific planning and approval requirements for development in sensitive areas. Major issues of concern today include the need to: prevent and reduce water pollution by nutrients and also by the septic systems installed for wastewater management in nearly 45% of existing development; protect threatened and endangered species; understand the impact of traffic on environmental quality; preserve open space, protect sensitive areas, and regulate impervious surface ratios; and establish protective land and riparian buffers for water quality protection. Priorities for Sussex County with regard to land use for water quality protection are: to increase total equivalent dwelling units connected to county-operated sewers [the current total is 42,000]; to purchase more open space; to revive discussion of the creation of habitat protection areas; and to decrease nutrient pollution throughout the county.

All three county spokesmen expressed the need for the eventual creation of an efficient, single agency to regulate water policy and management, replacing the current structure of separate agencies.

We Welcome Dr. Maria Labreveau



Dr. Maria Labreveau, Assistant Professor of Plant Science in Delaware State University's Department of Agriculture and Natural Resources, has joined DWRC's 16-member Advisory Panel. Dr. Labreveau (email mlabreveau@desu.edu, phone 302-857-6414) teaches fundamentals of crop production, biological statistics, and sustainable agriculture. She tells the DWRC, "I am honored to have been given the opportunity to serve on the Advisory Panel and hope to increase Delaware State student awareness and participation in DWRC activities."

More from the Water Forum

In addition to the Oct. 2 Delaware Water Forum talks on historical perspectives and state/county policies linking land use with water quality, talks by seven state water experts explored planning priorities, challenges, strategies, new information tools, and gave an update on causes and historical relevance of land use to the flooding experienced in New Castle County September 15 during Tropical Storm Henri.

Kevin Donnelly, Director of **DNREC's Division of Water Resources**, listed action priorities addressing the state's most serious water quality problems. Trends in land development and water quality challenges in agriculture and forested lands were described by **Dr. John Mackenzie** of the **UD Department of Food and Resource Economics**. Stormwater management and land use planning strategies used by the Delaware Department of Transportation (**DelDOT**) to promote better water quality were given by **Dave Athey**, Project Manager of **URS Corp.** **Scott Andres**, **Delaware Geological Survey** Senior Scientist, clarified how groundwater recharge mapping helps to understand land use – water quality relationships. **Keynote speaker Lee Ann Walling**, Deputy Director, **Delaware Economic Development Office** and Special Advisor to Governor Minner, gave concluding remarks outlining strategies "*Resolving Water Issues through Livable Delaware*", which included:

- * Allocating more resources to identify and protect open space and critical aquatic areas
- * Practicing sound growth management, by passing more comprehensive legislation that includes incentives for smart growth and designated growth areas; investing in existing communities by rehabilitating infrastructure
- * Encouraging more efficient, compact development on less land, mixing retail, commercial and residential uses.

Prior to adjourning the Forum for lunch, **Gerald Kauffman**, **WRA** Director, and **John Talley**, **DGS** Director, using data analysis by **DGS** analyst **Stefanie Baxter**, gave a special update explaining the effects of urbanization on flooding in the Red Clay Creek watershed in the aftermath of Tropical Storm Henri.

Visit <http://ag.udel.edu/dwrc/news.html> for copies of the presentations of Walling, Kauffman, and Talley.

Henri Visits Delaware: September 15, 2003 Tropical Storm Floods Red Clay Creek Watershed

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Damage to Faulkland Road and Bridge. Photo by John Talley

On Monday, September 15, 2003, the remnants of Tropical Storm Henri caused historic flooding in the Red Clay Creek watershed in Pennsylvania and Delaware. After reviewing precipitation and stream gage data, floodplain and watershed mapping, we can conclude that the damage along the Red Clay Creek during that event resulted from a combination of four factors: (1) a storm with high-intensity, short duration rainfall, (2) saturated soil conditions from previous storms, (3) a hilly, rocky watershed, and (4) urbanization within the floodplain and surrounding subwatershed. While the first three factors are naturally occurring, the last is a result of human activity.

Our complete Water Forum presentation on the flooding, including Red Clay Creek watershed and floodplain maps, graphs updated as of Nov. 11, 2003 indicating creek cumulative rate of rise, cumulative precipitation, peak discharges, and peak gage heights of record associated with several New Castle County creeks, and 13 annotated storm photos, is now online at <http://ag.udel.edu/dwrc/news.html>. In summary, more than 10 inches of **rain** fell in a 5-hour period in the upper Red Clay drainage basin according to Doppler radar interpretation by the Office of the Delaware State Climatologist, exceeding the 24-hour 100-year return period value of 8 inches

for the area. The 3-hour 100-year period value of 4 inches of rain was also greatly exceeded. This was a localized event that would not be expected to occur more than once in a 100-year period. The recorded peak discharge flood flow at the USGS Red Clay at Wooddale Gage, generated in a relatively small drainage area of 47 square miles, exceeded 32,000 cubic feet per second (cfs), the highest peak discharge on record dating back to 1943. The next highest peak flow of 7650 cfs occurred during Hurricane Floyd on September 16, 1999. The 500-year flow discharge at this location, according to the Federal Emergency Management Agency (FEMA) Flood Insurance most recent 1993 study for New Castle County, is 14,300 cfs. The watershed's **soils** have low to moderate infiltration rates causing naturally high runoff ratios, and its **steeply sloped, funnel-shaped topography** has a natural propensity for flash floods.



*Executive Hall, Stanton:
Courtesy of the
News Journal*

New Castle County's *Unified Development Code* of 1997 barred development within

the 100-year floodplain along the Red Clay Creek, but urbanization had occurred there decades before, particularly between Stanton and Yorklyn, altering the area's ability to store floods. Over 200 properties situated within the Red Clay Creek floodplain were damaged during Henri's aftermath. The overall level of **urbanization** [defined as the ratio of built-upon or paved-over land surfaces to forested, agricultural, or otherwise "open" landscapes] in the upstream portion of the Red Clay Creek watershed in Delaware and Pennsylvania is quite low. However, urbanization in the creek's downstream subwatershed, near Marshallton and Stanton, is quite high. Latest statistics show that the impervious cover ratio of the overall watershed is around 15%; the runoff ratio in a watershed increases markedly when the impervious cover exceeds 20%. The impervious cover of the subwatershed below Wooddale, near the greatest flooding at Glenville and Stanton, exceeds 30%, thus delivering higher stormwater runoff to the floodplain.

In response to the destruction caused by Tropical Storm Henri, federal, state, and local governments are considering alternatives such as acquisition of properties in the Glenville area and restoration of the area as a wetland. The best way to mitigate flood damage is to preserve the floodplain and allow it to perform its intended function, storing floods.

Groundwater Recharge Potential Maps For Water Quality Protection Now Complete

*Submitted by Scott Andres, Delaware Geological Survey (DGS) <http://www.udel.edu/dgs>
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Groundwater recharge potential maps categorize land areas as "excellent," "good," "fair," or "poor" in their ability to transmit water (recharge underlying aquifers). Recharge areas designated as "excellent" and "good" transmit the greatest volume of water, and also potentially the greatest amount of contaminants, to groundwater aquifers at the greatest speed. Therefore, they need the highest level of protection to preserve water quality.

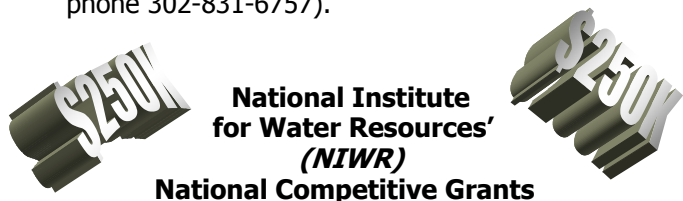
Groundwater recharge maps have been used for nearly two decades to guide land-use decisions in New Castle County, where plans for development in Water Resource Protection Areas (WRPA) must meet design criteria and go through a review process to ensure that impacts to ground water are minimized. More recently, areas mapped as having excellent recharge potential in Kent and Sussex counties were also identified in Delaware code as critical resource areas. The state code also directs counties and municipalities with 2000 or more residents to include provisions in comprehensive land use plan updates protecting these areas.

DGS has now completed its project mapping the recharge potential in Kent and Sussex Counties. In Kent County, 14% of land areas mapped are rated "excellent" and 42% "good"; in Sussex County, 8% of land areas are categorized as "excellent" with 41% considered as "good".

A limited number of lightweight printed maps of **Kent and Sussex Counties'** recharge potential are available via U. S. Mail; contact Delaware Geological Survey, DGS Building, Academy Street, Newark, DE 19716-7501, phone (302) 831-2833, or email dgs@udel.edu. A larger number of heavier printed maps are available for pickup directly from the DGS office or from the DNREC Department of Water Resources offices in Georgetown (302-856-4561) or Dover (302-739-4771, 89 Kings Highway). **New Castle County's** groundwater recharge potential maps are available to the public from the UD Water Resources Agency (302-831-4925, DGS Annex, Academy Street, Newark, DE 19716), and from the New Castle County Department of Land Use (302-395-5400, 87 Reads Way, New Castle DE 19720).

EPA NNEMS Fellowships and NIWR National Competitive Grants for 2004

Applications are due **January 26, 2004** for 40 to 50 **EPA National Network for Environmental Management Studies (NNEMS) Undergraduate and Graduate Fellowships** to work this coming summer or fall for the **EPA**. The **NNEMS** fellowship program is designed to provide undergraduate and graduate students with practical research or training experiences in contemporary environmental issues linked directly to their field of study. For more details, visit <http://www.epa.gov/enviroed/students.html> or call 1-800-358-8769. The program catalog is online: <http://www.epa.gov/enviroed/NNEMS/pdf/catalog2004.pdf>. A reference copy is also available for perusal from **UD** College of Agriculture and Natural Resources secretary Cathy Kinney, 302-831-6757. For details on qualification criteria and specific opportunities, visit these websites or contact Dr. Tom Sims (email jtsims@udel.edu, UD 113 Townsend Hall, phone 302-831-6757).



The NIWR RFP for 2004 has been released to support water research on the following topics: water supply and water availability; water quality trends in raw water supplies; the role of economics in water supply and demand; and institutional arrangements for tracking and reporting water supply and availability. Any investigator at an institution of higher learning in the United States is eligible to request up to **\$250,000** in federal funds for projects of 1 to 3 years in duration. Successful applicants must match each dollar of the federal grant with one dollar from non-federal sources. View the RFP online at https://niwr.org/2004_104G_RFP and proposal topic details at <http://water.usgs.gov/pubs/circ/circ1223/>. The NIWR's site at <https://niwr.org/NIWR/> **opens for RFP applications on December 1, 2003** with instructions for proposal preparation and submission. Visit <http://water.usgs.gov/wrri/projects.html> for a list of **1996-2003 successfully funded projects**. The closing date for proposals to be filed on the NIWR web site by principal investigators is 5 PM EST, **March 1, 2004**. The local Institute Director, whose proposal approval deadline is 5 PM EST, March 12, 2004, is Dr. Tom Sims, Director, Delaware Water Resources Center, 113 Townsend Hall, University of Delaware, Newark, DE 19716-2103 (302-831-6757; FAX 302-831-6758; jtsims@udel.edu).

DWRC Awards Two New Graduate Fellowships

Photo by Amy Boyd



Jen Seiter in UD lab, studying arsenic fate in water supply

The **DWRC** has awarded two graduate fellowships to support the ongoing efforts of the state of Delaware to protect and improve water quality. Annual stipends of \$19,000 are provided by the **DWRC** for each of these fellowships. Each fellowship may be renewed a maximum of three years and requires 2:1 matching funds from other sources. Based on the **DWRC** Advisory Panel's reviews of the proposals submitted, the following outstanding research projects were selected for funding:

- **"Removal and Inactivation of Water-borne Viruses Using Permeable Iron Barriers"**. Faculty advisors will be Dr. Yan Jin, Department of Plant and Soil Sciences, and Dr. Pei Chu, Department of Civil and Environmental Engineering, University of Delaware; and
- **"Fate and Transport of Arsenic in Delaware Soils: Impacts on Water Quality"**. Graduate fellow is Jen Seiter; faculty advisor is Dr. D. L. Sparks, Department of Plant and Soil Sciences, University of Delaware

Thank you, Dr. Edward R. Jones

Ed Jones, representative for Delaware State University to the **DWRC** Advisory Panel since 1999, has retired from the Panel. We thank him for his many efforts to support **DWRC** activities in research, education, and the training of future water professionals.

DWRC Interns Study Stream Restoration and Storm Ponds for Pollutant Removal

Photos by Danielle Quigley

Three **UD** undergraduate senior Delaware Water Resources Center interns from the University of Delaware are researching stream restoration strategies and storm pond pollution removal efficiency in the **UD** Experimental Watershed, north of the Newark campus. Judith Walker, Kristen Sentoff, and Kathleen Cormier are working on the third phase of a project begun more than two years ago by two other DWRC undergraduate interns under the advisement of Gerald Kauffman, of the **UD** Institute for Public Administration Water Resources Agency (**WRA**). The previous interns created "report cards" of the watershed's overall health based on field data and land use and land cover map data, which included information on potential contaminant sources, zoning, geology, soil types, topography, wetlands, and floodplains in the watershed. The current internship team is now evaluating stream restoration strategies and pollution removal best management practices (BMPs), such as wetlands and stormponds. New information on stream habitats, bank vegetation, and nutrient and road salt loadings helps them to link local land uses to water quality and identify the most appropriate BMPs.

New 2003 intern Judith Walker is first completing an extensive riparian buffer study as one of 41 Earth Semester students in Columbia University's 16-week Biosphere-2 research program in Arizona. Her **DWRC**



and WRA co-sponsored project is "Blue Hen Creek: An Evaluation of Stream Habitat Restoration at the UD Experimental Watershed". Kristen Sentoff is investigating a nearby tributary in her **DWRC**-sponsored internship entitled "Fairfield Run: An Evaluation of Stream Habitat Restoration at the UD Experimental Watershed."

Both will be advised by Kauffman of the **WRA** and will recommend habitat restoration techniques for areas along Blue Hen Creek and Fairfield Run, two tributaries of the White Clay Creek classified as impaired by bank erosion due to watershed urbanization. Sentoff has evaluated a nearby, higher-quality reference creek and identified potential restoration techniques to decrease runoff and erosion, such as the use of live willow stakes, root wads, brush cribs, and rock pools. Says Sentoff of her internship experience, "Many students do not

realize what wonderful natural resources we have right here in Newark. I am excited to have the opportunity not only to learn about water resources management in the UD Experimental Watershed, but also to help improve the watershed for future education and enjoyment."



Ms. Cormier and Ms. Sentoff measure turbidity in White Clay Creek

Kathleen Cormier is conducting "Field Measurements of Non Point Source Pollutant Removal Efficiencies of Stormwater BMPs at the UD Experimental Watershed" for her **DWRC/DNREC** cosponsored internship. Under the advisement of Mr. Martin Wollaston of the **WRA**, she is monitoring the quality of stormwater inflow to and outflow from several stormwater ponds and wetlands on the campus. "I'm very interested to see just how efficiently these Best Management Practices can remove pollutants, as compared to my estimates. There are very little field data currently available on the use of stormwater ponds and installed wetlands to improve water quality; this research should help us to better apply these strategies in future projects", Cormier says.

Christina Watershed group receives \$1 million EPA grant

Contributed by Lori Spagnolo, Associate Director, Natural Resources Conservation, Delaware Nature Society
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The **U.S. Environmental Protection Agency** has awarded a three-year, \$1 million grant to the Christina Basin Partnership to support efforts to preserve and protect the Christina watershed in Delaware, Pennsylvania and Maryland. The Christina Basin includes the Brandywine Creek, Red Clay Creek, White Clay Creek, and Christina River subwatersheds. The Christina watershed group plans to use the funding to implement agricultural and stormwater control best-management efforts in targeted areas, and to study stream bank restoration and residential landscape and runoff control. They plan to involve the public in BMP-related activities such as water testing and establishing "smart yards" backyard habitats.

**The Delaware Water
Resources Center**

The Delaware Water Resources Center (DWRC), established in 1965, is part of a network of 54 Water Resources Research institutes throughout the nation. The DWRC receives funding through Section 104 of the Water Resources Research Act of 1984. The U.S. Geological Survey administers the provisions of the Act and provides oversight of the nation's Water Resources Centers. The primary goals of the DWRC are: to support research that will provide solutions to Delaware's priority water problems, to promote the training and education of future water scientists, engineers, and policymakers, and to disseminate research results to water managers and the public. For further information, visit our website:

<http://ag.udel.edu/dwrc/>

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