

## Delaware's Water Quality Problems: Causes and Solutions

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Water quality is an issue of vital importance to all of Delaware's citizens. We rely on surface and ground waters for our drinking water supply and value our surface waters for their ecological, recreational, fishing, and commercial uses. Unfortunately, recent reports from the Delaware Department of Natural Resources and Environmental Control (*DNREC*) Watershed Assessment 305(b) program (<http://www.dnrec.state.de.us/water2000/Sections/Watershed/TMDL/305and303.htm>) clearly indicate that the quality of many of our surface waters has been impaired by point and nonpoint source pollution. For example, this report indicated that 99% of Delaware rivers and streams and 87% of our ponds and lakes do not fully support their use for swimming; 64% of Delaware's rivers and streams and 21% of the ponds and lakes do not fully support fish and wildlife uses. The major causes of Delaware's surface water quality problems are pathogenic bacteria, nutrient over-enrichment, toxic compounds, and the physical degradation of stream habitats. Delaware's ground waters have also been impacted by nutrients from fertilizers, animal manures, and septic systems, by leakage of contaminants such as petroleum from underground storage tanks, and by salt water intrusion.

The Delaware Water Resources Center (*DWRC*) asked Kevin Donnelly, Director of the *DNREC* Division of Water Resources, for an update on the state's efforts to protect and improve water quality. His responses follow.

## Promoting Delaware Water Quality: DNREC Goals and Achievements

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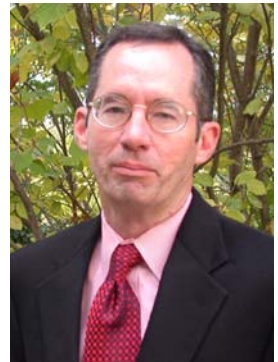
*By Kevin Donnelly, Director, Delaware Department of Natural Resources and Environmental Control (DNREC) Division of Water Resources and Member, DWRC Advisory Panel.*

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<http://www.dnrec.state.de.us/water2000/>

*Photo by Danielle Quigley*

In the water quality arena, we fall victim to our own diligence. Delaware has perhaps the most sophisticated and extensive surface water quality-monitoring network in the nation. Our advanced knowledge about the chemical and biological water quality of our watersheds, coupled with genuine water quality problems, results in our rivers, lakes and streams being rated as some of the worst in the nation. Delaware's non-attainment of Clean Water Act standards is addressed by a federal court order requiring the development of "**total maximum daily load**" (**TMDL**) regulations for nearly the entire state, according to a schedule stretching into the next decade. These TMDLs will establish the maximum amount of pollutants a water body can receive daily without violating water quality standards, thereby allowing the use of these waters for swimming, fishing, and drinking water supplies.



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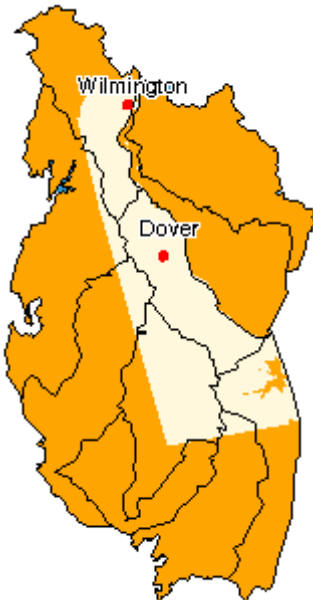
(Kevin Donnelly on **DNREC and Water Quality**, continued from page 1)

Over the past several years, *DNREC* has developed TMDLs for the Inland Bays, the Nanticoke River and Upper Christina watersheds, the Murderkill River, the Appoquinimink, and others. Funding has been provided by the state General Fund, the United States Environmental Protection Agency (*USEPA*), and *DNREC's* penalty fund for this work.

Additional programs are in place to ensure continued compliance with the court order and to achieve Delaware's water quality standards. **Pollution control strategies (PCS)** are required to address how, where and when pollutant loadings are to be curtailed to achieve TMDL levels. *DNREC* has also scheduled a number of improvements to Wilmington's **Combined Sewer Overflow (CSO) system** aimed at better control and public notification of discharges. The City's CSO system, like those found in over 950 of the nation's older Northeast, Great Lakes and Mid-Atlantic cities, permits by design the overflow discharge of raw sewage and stormwater runoff into waterways during heavy rains. A description of the system is found at <http://www.wilmingtoncso.com/>.

*DNREC's* scheduled activities to meet Delaware's water quality goals are:

- **Develop pollutant Total Maximum Daily Loads (TMDLs):**



- By December, 2003, for nutrient and dissolved oxygen levels in the Inland Bays Tributaries and Little Assawoman Bay, and for Polychlorinated Biphenyls (PCB) levels in the Delaware River. The latter TMDL will be developed in conjunction with the Delaware River Basin Commission (*DRBC*) and the states of Pennsylvania and New Jersey. Over a hundred possible dischargers and additionally hundreds more possible nonpoint PCB sources flowing into the 13,539 square mile Delaware Estuary watershed need to be addressed.
- By December, 2004, for nutrient, PCB, and bacteria levels in the Upper Christina watershed (Red and White Clay, Brandywine and Christina), and for bacteria, nutrient, PCB, and chloridane pesticide levels in the Shellpot Creek; and
- By December 2004 through December 2006, for bacteria levels in Delaware watersheds. *DNREC* is working with the University of Delaware and others to use DNA techniques to determine the sources of bacteria (human versus non-human) and then develop our regulatory and non-regulatory programs accordingly.

- **Complete the creation of Pollution Control Strategies (PCS):**

- By September, 2003, for the Inland Bays;
- By September, 2003, for the Appoquinimink River; and
- In 2004, for the Nanticoke-Broad Creek and Murderkill River.

- **Address Wilmington's Combined Sewer Overflows (CSO) concerns:**

On an ongoing basis, work with Wilmington and *USEPA* to increase water quality testing and public notices of discharges; work with the City to revise its draft CSO Long Term Control Plan to shorten the implementation period from 19 to 10 years.

- By July 2003, work with the City to obtain federal funding for and also monitor the start of construction on CSO 27(Lancaster Ave.); and
- By September 2003, monitor completion of construction of improved controls, featuring a series of below ground storage chambers that will capture and store overflow events and then slowly release them for treatment by the City's wastewater treatment plant. Actual construction at CSOs 28 and 29 in the Canby Park area started in the summer of 2002.

*(continued p. 3)*

(Kevin Donnelly on **DNREC and Water Quality**, continued from page 2)

**Other DNREC Water Quality Initiatives include:**

**Delaware's Water Quality Standards:** Updating these by February 2003 to include the latest technical information and to address issues presented by the *USEPA*. Adopting the new standards by summer 2003.

**Sediments and Stormwater:** Updating regulations to better address water quality concerns associated with site development and to enhance opportunities to include conservation design principles into stormwater plans. Draft regulations have been prepared and informational workshops are being held. Our goal is to promulgate the revised regulations by next summer.

**Non-Point Source (NPS) Pollution:** Reducing this by enhancing our coordination of the Division of Soil and Water's Conservation Cost Share Program with the *USEPA's* NPS Management 319 Program and of the National Oceanic and Atmospheric Administration's (*NOAA's*) Coastal NPS Management 6217 program with the Delaware Nutrient Management Commission's (*DNMC's*) program through Delaware's Department of Agriculture (*DDA*). This effort will direct almost 5 million dollars toward a comprehensive NPS program aimed at reducing pollutant loads, restoring streams and riparian buffers, and installing Best Management Practices such as cover crops, nutrient management plans, manure storage structures, and manure relocation efforts, within TMDL watersheds.



**Stream Restoration:** Rehabilitating stream corridors, stabilizing stream banks, decreasing erosion, improving biological water quality and providing buffers along the stream for riparian habitat. We have two projects scheduled for next year: one along the Perkins Run in northern New Castle County, and another on Pike Creek at Three Little Bakers; both are scheduled for completion by December, 2003.

**On-site septic systems:** Regulations were revised in spring 2002, and we look forward to passing legislation creating a Licensed Septic Inspector Program. This year we are using grant funds from the Division of Soil and Water to conduct a septic inspection and pump-out program in the Inland Bays watershed. Last year we used grant funds from the

General Assembly and Sussex County to inspect over 300 holding tanks in Sussex County.

**Cooperative efforts:** Almost everything we do requires the cooperative efforts of citizens, other state and federal agencies, universities, county and municipal governments, conservation districts, and non-governmental organizations (NGOs). PCS development and implementation is driven by Tributary Action Teams (TAT) comprised of interested citizens and representatives from agencies and NGOs. Currently four TATs are focused on the Inland Bays, Nanticoke, Appoquinimink and Murderkill watersheds. The Center for the Inland Bays, the University of Delaware's Cooperative Extension, the Nutrient Management Commission, New Castle, Kent and Sussex County governments, Sierra Club, the county conservation districts, *USDA*, other *DNREC* divisions and many others have also been vital contributors to PCS development.

The University's of Delaware's Water Resources Agency has been one of the lead groups working on the **Upper Christina TMDL**. This interstate TMDL partners Delaware and Pennsylvania agencies with federal affiliates from *USEPA*, the United States Geologic Survey (*USGS*), and the United States Department of Agriculture (*USDA*). Additional active participants include the Delaware River Basin Commission (*DRBC*), the City of Wilmington and groups such as the Delaware Nature Society.

The scientific complexity of the DNA technology in *DNREC's* bacteria source-tracking laboratory requires us to develop a matching laboratory at the University of Delaware for quality control and quality assurance purposes. New agreements with the University of Georgia and University of Washington allow us access to their extensive libraries of genetic samples. The need to update our water quality standard regulations is based upon the refinement and development of better science by *USEPA* and upon the needs of our surrounding states. The Division of Soil and Water Conservation's efforts to revise their stormwater regulations have included close contacts with New Castle County, the building and development community, and the conservation districts.

Developing and implementing new TMDLS has been the most difficult task because it will require greater regulatory controls, more innovative solutions to pollution problems and additional financial resources on the part of government, industry, and citizens in reducing pollution loadings. One thing is clear, all sectors will be required to contribute to the solutions – as they are all part of the problem.

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## Applying Molecular Scale Research to Water Quality Problems: Improving Our Understanding of Phosphorus Chemistry in Manured Soils

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**Stefan Hunger, *DWRC* 2000-2003 Fellow  
Dr. Donald Sparks, Advisor,  
UD Department of Plant and Soil Sciences**

Photo by Jonathan Cox

Delaware's 1999 Nutrient Management Act required the Delaware Nutrient Management Commission (*DNMC*) to develop a statewide program for managing nutrients to protect water quality. The ***DWRC*** is providing scientific support to the *DNMC*'s ongoing efforts to improve nutrient management in Delaware by funding three graduate fellowships. Our spring issue described ***DWRC*** fellow Jennifer Jennings' study of the role of land use and land cover in the delivery of nutrients to Delaware's Inland Bays. This issue highlights the research of ***DWRC*** fellow Stefan Hunger on the "*Mechanisms of Phosphorus Stabilization in the Soil Environment: A Molecular Scale Evaluation*".

One of the key features of the Delaware act was a requirement that improved phosphorus (P) management be required for "high P" soils, those that have received long-term over-applications of manure P and fertilizer P. Research world-wide has shown that areas with highly concentrated animal agriculture, such as poultry production on the Delmarva peninsula, have some of the greatest concerns with nonpoint P pollution of surface waters. A major cause of this is the fact that animal manure applications often provide more P than is removed in crop harvest, resulting in the buildup of P in soils. In recent years the effects of manure application on soil P and water quality have been studied extensively, with the goal of developing improved P management practices for manure use. One "best management practice" (BMP) that has been proposed for poultry manure is the addition of alum (aluminum sulfate) to the manure to stabilize P in a form that is less soluble and thus less likely to be lost by runoff and leaching. While this BMP has been shown to be effective in field studies, the exact chemical mechanisms involved are unknown.

Stefan Hunger's ***DWRC***-funded research has focused on improving our understanding of the basic chemistry of P in alum-amended manures and soils. His research is unique in that it applies modern chemical methods, such as nuclear magnetic resonance (NMR) and x-ray absorption near edge (XANES) spectroscopy to determine the exact forms of P present in manures and soils. "Using samples taken at different times during my experiments," Hunger explains, "I can observe changes in the exact

chemical species of P present in manures and soils." Hunger is also exploring, at the molecular level, the interactions of P with other minerals and acids over time and with changing pH conditions. He concludes: "My primary goal is to understand if and how P interacts with aluminum, calcium or organic acids and how they influence its adsorption and potential availability to plants and losses in runoff and leaching. However, the longer I research these reactions and the more I read others' findings, the more I think that the application to soils of P in fertilizers and poultry litter, even litter amended with alum, has to be closely monitored in order to supply only as much P as can be used by the crops in order to avoid an accumulation of P. It has been shown very clearly by many researchers that the more P is in soils, the higher the likelihood that P will be lost to streams and lakes, with known detrimental effects. The sensible thing would be to avoid over-application of P in the first place."



*Stefan Hunger in UD campus WorriLOW Lab*

Results of Hunger's research are expected to improve predictions regarding P stability and mobility toward the goal of protected aquatic ecosystems and water quality. Says Hunger: "I appreciate the chance Dr. Sparks gave me to integrate my own ideas into this project, making it more intriguing. I believe I can contribute to the effort towards a more sustainable agriculture. After graduating next summer, I hope to continue working with spectroscopic techniques in the field of environmental chemistry, especially to learn how contaminants are retained and degraded in natural media, and how their mobility and bioavailability is influenced by environmental factors." As for his experience with the ***DWRC*** fellowship, Hunger says, "My advisor, Dr. Sparks, suggested I apply since the efforts supported by the ***DWRC*** fit nicely with my research. I have enjoyed living in the U.S. due to the wonderful people I have met and the research possibilities that I would not have had in my native Germany."

For more information on this project, contact Stefan Hunger at [hunger@udel.edu](mailto:hunger@udel.edu), or Donald Sparks at [dlsparks@udel.edu](mailto:dlsparks@udel.edu).

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## Delaware Water Quality and The Two Faces of *Phragmites australis*

Michael T. League

**DWRC 2002 – 2003 Undergraduate Intern  
Dr. John L. Gallagher, Advisor, College of  
Marine Sciences, University of Delaware**

"*Understanding the Mechanisms of the Spread of Phragmites: For Better or For Worse*" is the project University of Delaware senior **Michael T. League** hopes will provide valuable research on improving wastewater treatment methodologies as well as wetlands protection and restoration. One of six **DWRC** undergraduate interns for 2002 – 2003, League is working with his advisor Dr. John L. Gallagher of the UD College of Marine Studies to better understand propagation and survival mechanisms of common marsh reeds.

Within the last six decades, *Phragmites australis* has spread rapidly in Delaware tidal wetlands, its dense stands deterring native plant diversity and restricting small stream flow into and across the marsh plains. With the expanded presence of this invasive species, the wetlands' accessibility by wildlife and its role as water purifier and floodwater buffer are compromised.



League is continuing his work begun with Dr. Gallagher and Dr. Denise M. Seliskar in the summer of 2001 when he was both a UD Science and Engineering Scholar and Marine Sciences Summer Intern under the Research Experience for Undergraduates program of the National Science Foundation. By further analyzing rhizome physical properties affecting *Phragmites*' growth dynamics at the UD College of Marine Studies Halophyte Biotechnology Center in Lewes, League has found: "Preliminary experiments...indicate that new shoot growth is coming from new rhizome buds, and that the deeper-growing rhizomes are more efficient at producing shoots. This suggests that past three-year control treatments such as spraying and burning root mats have not been as effective in terminating the newest or deepest rhizome buds."

*Phragmites*' robust resilience may have positive as well as negative consequences for water quality. Reed beds serve as an effective and environmentally-friendly means for drying sludge in wastewater treatment centers. League's research on *Phragmites*' growth mechanics helps clarify requirements for methods to prevent plants in centers escaping into wetlands. In addition, his further evaluation of tissue cultures for cellular responses to environmental

stresses sheds light on survivability expectations for *P. australis* drying beds. "I've now established growth and survival rates of *Phragmites* in varying salinity conditions, and am hopeful future chemical analysis will further illuminate cellular adaptive mechanisms under extreme stresses," says League.

For more information on this project, contact John Gallagher at [jackg@udel.edu](mailto:jackg@udel.edu).

League's five fellow **DWRC** 2002 – 2003 undergraduate interns are researching topics including water quality modeling and testing, pollution reduction through reforestation, wetlands regulation, and wastewater remediation. For photos and abstracts, visit the **DWRC** site at [http://ag.udel.edu/dwrc/publications.html#internship\\_program](http://ag.udel.edu/dwrc/publications.html#internship_program).

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## Water Policy Forum Held Oct. 9

"Drought.02: A Debate and Panel Discussion Concerning Water Supply Policy in Delaware" was held Oct. 9 on the UD campus and was sponsored by the UD Institute for Public Administration Water Resources Agency (*WRA*), *DNREC*, and the **DWRC**. Panelists from government, private sector, and academia discussed the pros and cons of issues concerning drinking water policy in Delaware by considering the question: "In the wake of multi-year droughts in Delaware, what should be done to ensure the delivery of clean and plentiful drinking water to Delaware residents and businesses?" The panel was moderated by Kevin Donnelly, director of *DNREC*'s Division of Water Resources.



Ninety-seven attendees were surveyed to establish the extent to which they would pay more to ensure unlimited water usage and to learn their preferred methods and governance options for managing water supplies. When the seventy-nine who were Delaware residents were asked whether they would pay more annually to ensure year-round unrestricted use of water, a slight majority (57%) said they would not mind a \$200 increase, but only 16% would be in favor of a \$400 increase. The most favored option for addressing the water needs of northern Delaware was increasing the size of Hoopes Reservoir in Wilmington. The choice of governance options for managing water supplies in New Castle County was split equally between the Water Supply Coordinating Council and a regional water district office. Finally, the option most favored by Delaware residents to lower demands during drought emergency conditions was the restricting of all lawn watering and car washing.

For information, contact *WRA* state water coordinator Gerald Kauffman (phone: 302-831-4925, fax: 302-831-4934, email: [jerryk@udel.edu](mailto:jerryk@udel.edu)) or go to *WRA*'s website at <http://www.wr.udel.edu/>.

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## Water News You Can Use

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**New Clean Water Protection Legislation** was introduced to the U.S. Senate and House in July, 2002 in response to the 2001 U.S. Supreme Court ruling overturning the federal government's authority under the 1972 Clean Water Act to protect non-navigable, intrastate, isolated waterbodies from pollution based on their use by migratory birds. The Court's action had thrown into question whether federal Clean Water Act protections apply to as much as 20 to 30 percent of the nation's wetlands that can be deemed "isolated", defined as not having a direct surface connection to rivers and streams used for navigation.

The Clean Water Authority Restoration Act of 2002, S.2780 and H.R. 5194, in subcommittee since July, may be viewed at <http://thomas.loc.gov>. The Act clarifies Congress's intent for Clean Water Act protection to extend to all of the nation's waters, defined by existing Army Corps of Engineers regulations, including the "isolated" wetlands, streams, ponds and other waterbodies that play such an integral role floodwater storage, filtration of pollutants, recharge of groundwater and critical habitat for many species of birds, fish and wildlife. The bills would also delete the word "navigable" from the Clean Water Act to clarify that the primary concern of Congress in 1972, and now, is the protection of the nation's waters from pollution, rather than to sustain the navigability of waterways.

A few states have their own regulations which limit pollution discharges, filling, ditching and draining affecting isolated waters. In Delaware, HB340 was introduced early this year by Rep. Cathcart(R), Sens. Simpson and Sokola, and sponsored by Reps. Buckworth, Carey, DiPinto, Fallon, Lavelle, Reynolds, Valihura, Wagner, Gilligan, Houghton, Keeley, Viola and Sens. Amick, Connor, and Sorenson. The bill, out of committee in June, aimed to establish State protection of waters in two classes based on ecological function and value. To track the status of this bill, visit <http://www.legis.state.de.us>.

Information on waters affected by the Supreme Court ruling by region is available at <http://www.nwf.org>. The U.S. Fish and Wildlife Service has issued a report on Geographically Isolated Wetlands, available at <http://wetlands.fws.gov>. Contact Debbie Heaton for local Delaware details at 302-378-8501.

Article source:

<http://www.delaware.sierraclub.org/WaterLeg.htm>

**UD has joined 50+ universities in the Consortium of Universities for Advancement of Hydrologic Science, Incorporated (CUAHSI)**, established in 2001 to foster advancements in the hydrologic sciences. During 2002, UD actively participated in developing CUAHSI's broad-based research and education agenda, which is derived from an ongoing dialogue between research and application professionals. A research objective is the creation of sufficient Long-Term Hydrologic Observatories on the east coast to collect meaningful long-term data across multiple media (e.g. streams, ground and surface waters, atmosphere) and spatial scales (field plots, watersheds).



The observatories' data will permit more accurate water quantity and quality predictions and additionally reveal the impacts of regional changes in land cover, climate, pollution, and water management programs such as large-scale water transfers. CUAHSI further aims to enhance the visibility, appreciation, understanding, and utility of hydrologic science through programs of education, outreach, and technology transfer. UD's Dr. Paul T. Imhoff ([imhoff@udel.edu](mailto:imhoff@udel.edu), Dept. of Civil and Environmental Engineering) and Dr. James E. Pizzuto ([pizzuto@udel.edu](mailto:pizzuto@udel.edu), Dept. of Geology) are the current faculty representative and alternate, respectively. Visit CUAHSI for details at: <http://www.cuahsi.org>.

### Water Quality Starts at Home...

Visit <http://www.delaware.sierraclub.org/water.htm> to learn about

**homeowner's responsibility for the safety of private well water.**

Private laboratories that can perform annual tests for contaminants are listed. Call Ed Hallock of the Delaware Division of Public Health Office of Drinking Water (302-739-5410) for basic information. Also discussed is a new federally-funded, DNREC-run cost-sharing **Septic System Pump Out and Inspection Program** offered to qualified Sussex County Inland Bays area property owners. The program objectives are to educate property owners on the importance of proper maintenance of their septic systems and to reduce nutrient loading to the Inland Bays.



### New Publications from USGS

Six articles on the findings from USGS's National Water Quality Assessment Program 10-year studies may be requested in print from [tmiller@usgs.gov](mailto:tmiller@usgs.gov) or online at: <http://www.awra.org/impact/index.html>.

### New Websites from USGS

The new *USGS-EPA* National Environmental Methods Index is a free, web-based database facilitating comparisons and sharing of water quality monitoring methods data, at <http://www.nemi.gov>. The **NEMI** database contains chemical, micro-biological and radiochemical method summaries and will be expanded to include biological and other methods.

Visit the new "**WaterWatch**" Website for Nation's Water Data at <http://water.usgs.gov/waterwatch/> for real-time conditions at 3,000 streamgages. **The example below** was created from the WaterWatch page by clicking "Water Resources", "Real Time", Delaware as Geographic Area, then choosing the predefined display "Delaware Precipitation Table" grouped by county (Sussex).



Real-Time Data for Delaware: Precipitation -- 3 site(s)  
Updated 2002-11-21 12:24:58 US/Eastern

Station name	Date /time	Precip. total in.
MILLSBORO POND OUTLET AT MILLSBORO, DE	11/21 11:15	.00
BEAVERDAM DITCH NEAR MILLVILLE, DE	11/21 11:15	.00
NANTICOKE RIVER NEAR BRIDGEVILLE, DE	11/21 11:15	.00

**Fall Highlights from the DWRC's Web Site**  
<http://ag.udel.edu/dwrc/>

### UD Water Resources Researchers / Courses list

compiled by UD's Water Resources Agency and the **DWRC** is at <http://ag.udel.edu/dwrc/courses.html> on the **DWRC** site. The list facilitates student selection of water resources courses across multidisciplinary college and departmental boundaries, and helps UD researchers find potential partners for collaborative water resources teaching and research efforts.

### Distribution of DWRC monthly WATER E-NEWS

is now extended beyond members of the UD Water Resources Researchers list to all interested members of the water community. Typical topics range from water resources professional organizations news, upcoming conferences, grant programs, job opportunities, and new publications / information sources. Links to internet sites are provided for additional detail. Email [aboymd@udel.edu](mailto:aboymd@udel.edu) to subscribe with the subject "Subscribe WATER E-NEWS".

### Grants / fellowships: [ag.udel.edu/dwrc/jobs.html](http://ag.udel.edu/dwrc/jobs.html)

**By Dec. 3:** National Decentralized Water Resources Capacity Development Project RFP applications.

**December:** *NIWR* 2003 National Competitive Grants RFP registration will open at <http://www.niwr.org/>.

**Upcoming conferences:** For details on these events, visit <http://ag.udel.edu/dwrc/calendar.html>

**Jan. 12-15, 2003:** *USDA* Water Quality Conference Tucson AZ.

**Jan. 28-31, 2003:** *USEPA* Technical Transfer Conference "Emerging Technologies, Tools, and Techniques to Manage Our Coasts in the 21st Century" Cocoa Beach, FL.

**Mar. 29, 2003:** Longwood Graduate Program Symposium "Responsible Water Use in the Garden" Winterthur. Call 302-831-2517.

**May 12-14, 2003:** *USGS-AWRA* "Agricultural Hydrology and Water Quality", Kansas City, MO.

**Jul. 26-30, 2003:** Soil and Water Conservation Society 2003 annual conference, Spokane, WA. Papers due **Dec. 1.**

**Jul. 30-Aug. 1, 2003:** Annual joint event of the Universities Council on Water Resources (*UCOWR*), National Institute for Water Resources (*NIWR*) and *ASCE Environmental Water Resources Institute (EWRI)*, "Water Security in the 21st Century" Washington, DC.

**Sep. 16-19, 2003:** International Conference of GIS and Remote Sensing in Hydrology, Water Resources and Environment (*ICGRHWE*), China.

**Training:** [www.rec.udel.edu/nutrient/page3.html](http://www.rec.udel.edu/nutrient/page3.html)

**Free Session I Nutrient Management certification classes.** Nov. 26 (in Sussex County), Dec. 3 (Kent) and Dec. 9 (New Castle).

### Publications / Water Resources web sites:

Visit <http://ag.udel.edu/dwrc/publications.html> and <http://ag.udel.edu/dwrc/publications/nondwrc.html>.

### **Nutrient Best Management Practices booklet available for Delaware Farmers:**

The Delaware Nutrient Management Commission is currently distributing Nutrient Best Management Practices booklets that provide a list and description of fifty-three different best management practices (BMPs). The BMPs help protect the environment and maintain profitable agriculture. Call to receive a copy:

Delaware Nutrient Management (302) 698-4500;  
New Castle Conservation District (302) 832-3100;  
Kent Conservation District (302) 730-4000;  
or Sussex Conservation District (302) 856-3990.

The booklet is also available online at:

<http://www.state.de.us/deptagri/nutrients/bmp.htm>

**"Drought and Weather" Web page** is now found at <http://www.nal.usda.gov/wqic/drought.html>; **new drought bibliography** "Water Allocation & Drought (II)" is now online at <http://www.nal.usda.gov/wqic/Bibliographies/drought2.html>.

New **Spanish water resources site** is found at: <http://www.nal.usda.gov/wqic/Spanish.html>