

## DELAWARE WATER RESOURCES CENTER LAUNCHES NEW WEB SITE

Visit us at our new address: <http://ag.udel.edu/dwrc>

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*You'll find a wealth of Delaware water-related information at our comprehensive new Web Site:*

- **Delaware Water Resources Center (DWRC) and Director's News:** Latest updates on DWRC activities and information on the DWRC's mission, history, and role in the National Institute of Water Resources (NIWR).
- **Delaware Water Concerns:** Summary of the major areas of concern related to Delaware's ground and surface waters, with links to key organizations and agencies responsible for water quality and quantity.
- **Projects and Publications:** Descriptions of DWRC's undergraduate internship and graduate fellows programs, annual conference proceedings, and project publications dating back to 1993.
- **Advisory Panel:** Purpose, contact information and e-mail links for the DWRC's Advisory Panel.
- **Request for Proposals and Application Forms:** For undergraduate interns, graduate fellowships and other funding opportunities available through the DWRC.
- **Internships and Job Opportunities:** Information on undergraduate and graduate internships from a wide variety of local, regional, and national sources along with current job opportunities in water resource areas.
- **University of Delaware (UD) Water Courses and Faculty:** Current listing of UD water resource courses and researchers with an interest in water resources research; also, science and natural resource curricula links.
- **Water Resources Contacts:** Links to local, regional, and national water resource agencies and organizations categorized as government, academia, non-profit, and US Water Resource Centers.
- **Calendar:** Upcoming local, regional, and national water resources events sponsored by the DWRC and other agencies, such as conferences, seminars, meetings, and training opportunities.
- **Newsletters:** Access to DWRC newsletters dating to 1993.
- **Annual and 5-year Reports:** DWRC annual and 5-year reports, dating to 1993.
- **KIDS' Zone:** Water Resources Activities and Information for Kids and Teachers

### **DWRC 2001 Student Research Conference Highlights**

The 2001 DWRC Student Research Conference was held at the University of Delaware on February 9, 2001 and featured presentations by two graduate fellows and nine undergraduate student interns whose research was supported by the Delaware Water Resources Center (DWRC). The 70 conference participants, including representatives from academia, non-profit organizations, the agricultural community, environmental management and water resource agencies, and other students attended the oral talks and poster sessions.

A welcome and overview of their respective agencies by Dr. Tom Sims, Director of the DWRC, Gerald Kauffman of the Delaware Water Resources

Agency, and Dr. Joan Bennett, Coordinator of the UD Undergraduate Research Program, preceded presentations by graduate fellows Jennifer Jennings of the College of Marine Studies (*Land Use/Land Cover and Nutrient Discharges to Delaware's Inland Bays*) and Lynette Ward of the Center for Energy and Environmental Policy (*A Baseline Nutrient Budget for Sussex County, Delaware for Environmental Planning*). Interns Gregory Buckmaster, Jennifer Campagnini, Maeve Desmond, Robert Ehemann, Emily Gonce, Jason Hetrick, Leigh Johnson, Anna Palermo and Melissa Weitz, were introduced by DWRC coordinator Cynthia Greene and presented posters summarizing the results of their research on a broad range of water-related topics.

For more details on these projects and to request copies of any reports, visit our website at: <http://ag.udel.edu/dwrc/publications.html>

## **Drinking Water Policy Forum Held Oct. 11, 2001**

A forum on "Drinking Water 2001: Issues Concerning Delaware's Most Precious Natural Resource" was held October 11, 2001 on the University of Delaware campus. The UD Institute for Public Administration (IPA) Water Resources Agency (WRA), in cooperation with the Delaware Department of Natural Resources and Environmental Control (DNREC), sponsored the event.

Recent events such as droughts and groundwater contamination have emphasized the fragile nature of the water resource. The policy forum discussed the technical, governance, economic, and policy issues concerning drinking water in Delaware.

Keynote speakers were Dr. McKay Jenkins, who spoke about the importance of watersheds and borders and the need to re-think concepts of political boundaries when it comes to the flow and distribution of water, saying: "What does a county line mean to an aquifer, or a state line to a raincloud, or a national border to a river?"; and Lee Ann Walling, Senior Advisor to Gov. Ruth Ann Minner, who spoke on the Governor's "Livable Delaware Initiative", which, by promoting wise land use, seeks to address many of Delaware's water supply and water quality problems today and in the future.

The IPA will publish a special report in December summarizing the presentations at the conference. This report is intended to help shape drinking water policy in Delaware. For more information, contact WRA state water coordinator Gerald Kauffman (phone: 302-831-4925, fax: 302-831-4934, email: jerryk@udel.edu) or go to WRA's website at <http://www.wr.udel.edu/>.

## **WATER NEWS Editor Change**

Cynthia Greene, coordinator of DWRC programs and *Water News* editor since 1998, is no longer with the DWRC. Greene established *WATER NEWS* and the DWRC enhanced web site, and coordinated the DWRC's internship program in its infancy. Her writing skill and perspective from her years working for the EPA, New Castle Soil Conservation District, and Chester County PA Health Department, have been greatly appreciated.

New on staff is Amy Gier Boyd, whose background is in civil and systems engineering as well as computing and nature education. She has also worked in public relations and administration for the arts. Contact her with your water news or letters to the editor at [aboyd@udel.edu](mailto:aboyd@udel.edu) or 302-831-1392.

## **New DWRC Research and Education Initiatives for 2002 - 2003**



The Delaware Water Resources Center (DWRC) has as a primary goal the training and education of future leaders in water science, policy and management. In support of this objective, the DWRC has provided funding since spring 2000 to support undergraduate internships and graduate fellowships. Dr. Tom Sims, Director of the DWRC, notes that the 15 undergraduate interns and 3 graduate fellows in the program to date "are conducting research that is of direct value to those concerned about water quantity and quality today. The DWRC is proud of their efforts and committed to provide opportunities such as these for other students in the future."

Requests for proposals for the 2002 DWRC undergraduate internship program will soon be distributed and advertised to undergraduates at UD and Delaware State University. The following eight priority research areas have been identified by the DWRC's Advisory Panel:

- Nutrient management and water quality for agricultural and non-agricultural systems;
- Sources, fate, and transport of water pollutants;
- Quantifying the response of aquatic systems to pollutant inputs;
- Water supply, demand, and conservation;
- Management and control of stormwater runoff;
- Identification and protection of groundwater resources;
- Treatment and disposal of on-site sewage and wastewaters;
- Protection and restoration of wetlands.

Student research projects are not restricted to these areas, but relevance to the priority research areas is considered as a guide in the final selection process. Each undergraduate internship is supported by a \$3000 award from the DWRC. Specific details regarding eligibility, funding, faculty advisor contacts, the application process and deadlines, and program requirements, may be found at the DWRC Web Site <http://ag.udel.edu/dwrc>.

## Meet the 2001-2002 DWRC Undergraduate Interns

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Six University of Delaware undergraduate students were selected by the Delaware Water Resources Center (DWRC) Advisory Panel to participate in the 2001 DWRC undergraduate internship program. Through DWRC's unique program, students and faculty work together in research and education programs addressing water resource related issues of critical importance to Delaware and the Mid-Atlantic region. Take a look at this year's interns and a summary of their project objectives.

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### Analysis of the Laws Governing Identification, Extraction, and Allocation of Water in Delaware

Katie Lemon and Dr. Joshua Duke  
Department of Food and Resource Economics

While a participant in Columbia University's Biosphere 2 program in Arizona during the spring of 2001, Katie Lemon became more aware of the importance of proper management of groundwater resources. She had seen first-hand the contamination and limited availability of clean water in nearby Mexico and resolved to learn more about regulations governing that resource. "It was an eye-opening experience causing me to value my own water resources here in Delaware, as well as to desire a better understanding of how they are managed."

Lemon and her project advisor, Dr. Joshua Duke, Assistant Professor of Food and Resource Economics, will be conducting research to survey existing Delaware laws that govern access to groundwater. They will then analyze the effectiveness of these statutes with the goal of identifying sources of water use conflicts, both environmental and distributive. Conclusions will be drawn to suggest effective groundwater allocation strategies to alleviate current conflicts and prevent potential future conflicts as the demand for groundwater increases.



A senior Natural Resource Management major, Lemon is grateful for the opportunity afforded her by this internship to learn valuable legal research skills. She will incorporate the internship experiences into her senior thesis.

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### Functional Assessment of Wetlands for Mitigation Purposes

Kirsten Lloyd and Dr. Bruce Vasilas  
Department of Plant and Soil Sciences

Wetlands are protected by Section 404 of the Clean Water Act, as they play a critical role in preserving water quality. Their functions can include trapping potential pollutants, removing sediment from runoff waters, and reducing soil erosion through the storage of floodwaters following storm events. To receive federal protection, a wetland must be identified and delineated according to U.S. Army Corps of Engineers' guidelines requiring three characteristic indicators: a hydrophytic plant community, hydric soil, and wetland hydrology. Unfortunately, the majority of fresh water wetlands on the DelMarVa Peninsula display evidence of wetland hydrology only during annual periods of an inundation. Therefore, many wetlands have been incorrectly delineated and then destroyed, their loss a result of a variety of causes from road and housing development to agricultural drainage.

Kirsten Lloyd, who grew up in Newark, Delaware and serves as an Ag Ambassador at UD, became interested in local wetland delineation issues while enrolled in a wetlands course taught by her advisor, Dr. Bruce Vasilas, Professor of Plant and Soil Sciences. In particular, she is interested in how better assessing wetland functions can promote wetland mitigation, the process of creating or restoring wetlands to compensate for wetland losses. Since mitigation is most successful when the lost wetland is replaced by a wetland with similar functions and values, it is critical to have a wetland classification system that accurately characterizes the functions of specific types of wetlands.

Lloyd is using the Hydrogeomorphic (HGM) Method for wetland functional analyses, which relies on using collected data in a model that predicts how well the wetland will function. The predictions are then compared to reference standards based on data collected from wetlands in the same HGM sub-class.

Lloyd will be working with her advisor and soil scientist Lenore Vasilas of the USDA Natural Resources Conservation Service to collect, organize and analyze data from reference wetlands in Delaware and Maryland toward the ultimate goal of creating an HGM model for mitigation purposes in the region. She will receive training in plant identification, plant community assessment, soil morphology descriptions, and the interpretation of hydrologic conditions based on soil morphology. Lloyd hopes her research exploring wetland criterion and modeling wetland functional assessment will improve our accuracy in wetland identification and delineation, thereby ensuring greater success of "in-kind" wetland mitigation efforts.



In her senior year now as an Environmental Soil Science major, Lloyd has prior research experience through an internship with Delaware's Department of Natural Resources and Environmental Control (DNREC)'s Site Investigation and Restoration branch, for which she performed environmental assessments of sites suspected of contamination by hazardous substances. She is enthused about her DWRC internship as an opportunity to gain broader knowledge of wetland soils, plant communities, and hydrology.

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**Ectomycorrhizae as a Hydrologic Indicator in Wetland Identification**

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**Kristin Staats and Dr. Bruce Vasilas**  
 Department of Plant and Soil Sciences

Typical indicators of wetland hydrology such as drift lines and blackened leaves are evident only under conditions of inundation, yet for the majority of seasonally-saturated fresh water wetlands on the DelMarVa peninsula, these indicators are observed for only a portion of the growing season. A more useful potential indicator of wetland hydrology

permitting accurate wetland identification is the presence of ectomycorrhizae, fungi which are symbionts of plant roots. The fungal hyphae form root "mantles" during most of the growing season when the water table is close to the surface. The vertical soil distribution of these "mantles", easily discerned by the naked eye, can be interpreted to disclose hydrology and water table height profiles of a suspected wetland area.

Kristin Staats, a senior Environmental Soil Science major in the Department of Plant and Soil Sciences, is participating in a team research project under the leadership of Dr. Bruce Vasilas, with Jeff Thompson from the Maryland Department of the Environment and Lenore Vasilas from the USDA Natural Resources Conservation Service. The project goal is to evaluate the potential of ectomycorrhizae as a viable hydrology indicator, thereby facilitating wetland protection through more accurate wetland identification and delineation. Staats' training will include plant identification, plant community assessment, soil morphology descriptions, and the interpretation of hydrologic conditions based on soil morphology.

Staats grew up in Felton, Delaware and attended Lake Forest High School. At UD she has worked as a lab assistant, and also conducted research as a Science and Engineering Scholar studying the effect of alum-amended poultry litter on stabilization of phosphorus in Delaware soils. Staats has updated the Sussex County Delaware Soil Survey while working as a soil scientist trainee for the USDA Natural Resources Conservation Service, and most recently was an environmental scientist intern for Tetra Tech, Inc. mapping a landfill and calculating emissions to assess potential remediation strategies.



A winner of the Milton Draper and Burrell Marshall Scholarships, Staats has been chosen to participate in the UD Honors Program, Ag and Spirit Ambassadors, and the Alpha Zeta agriculture fraternity.

This DWRC internship project advances Staats' experience with hydric soils and field sampling techniques. She looks forward to completing her analysis of ecosystem characterization, including ectomycorrhizae distribution, for six Delaware sites.

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## **Links Between Land Use and Stream Health in the University of Delaware Experimental Watershed**

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Tara Harrell and Gerald Kauffman  
Water Resources Agency  
UD Institute for Public Administration

What effects do winter road salting, paving, commercial and suburban development, and subdivision land use all have on stream quality?

Tara Harrell, a senior in the College of Agriculture, is looking to the newly developed University of Delaware Experimental Watershed for answers. Harrell had spoken with Jennifer Campagnini, a Delaware Water Resources Center 2000-2001 intern who had done the foundation work establishing the Watershed as an on-campus education and research site. A talk given by Campagnini's advisor, Gerald Kauffman of the Delaware Water Resources Agency, during a visit to Harrell's special project class analyzing White Clay Creek State Park issues, piqued her interest further. She is now building on Campagnini's research characterizing and delineating the Experimental Watershed, gathering a second round of assessments relating water quality to local land use. Ultimately, she hopes the Watershed, which serves as a valuable living laboratory for the University research and education community, will expand to include the Lewes campus.



The Experimental Watershed, which presently encompasses several small tributaries to the White Clay Creek in the piedmont North Campus area and continues south to the coastal plain sections of main campus and University farm, was mapped and delineated during 2000 using Geographic Information Systems (GIS) technology. Initial data on stream water quality, land use and habitats was compiled in a 2000 "report card" of the watershed's overall health. The groundwork was laid for future monitoring of trends and changes relating land use to stream health over time.

The project this year will include updated watershed mapping using ARCVIEW GIS and Global Positioning System (GPS) techniques, depicting coverages of impervious cover (such as pavement) as well as stream water quality, habitats, and riparian buffer conditions. Characterizing these aspects by

letter grade or numerical index, Harrell will create the Watershed's 2001 report card, allowing the first comparison of stream health.

Harrell eagerly anticipates completion of her extended field inventories of stream water quality to assess links with land use, especially the nutrient field survey, which will serve as a "first-generation" attempt to quantify nitrogen and phosphorus loading from typical New Castle County urban/suburban land use. She will collect chloride samples before and after snow melt to quantify effects of road salt on local streams.

While a national high school Envirothon contestant, Harrell met fellow students embarking on a wide variety of environmental collegiate study programs. Their enthusiasm inspired her to choose her major in Natural Resource Management at the University of Delaware, with minors in Resource Economics and Music. A past participant of the Delaware Agriculture 2020 project sponsored by the Department of Food and Resource Economics, Harrell has also worked compiling groundwater data in her home state for the Maryland Department of the Environment, and studying plant pathology and mycology with a Maryland USDA Agriculture Research Service Foreign Disease and Research Unit.

Harrell is active in University student life, playing in the marching band, serving as campus tour guide and recruiter, and participating in Alpha Zeta, a professional Agriculture honors fraternity, the Golden Key National Honor Society, and Omicron Delta Kappa, a national leadership honors society. She is a 2001 recipient of the Harry Hayward Agricultural Scholarship, Honors Program special scholarship, and Maryland Soil Conservation Districts Scholarships.

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## **Fate of Microbial Phytase in the Gastrointestinal Tract of Chicks, and Effects on Phosphorus Solubility**

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Christina Eckstrand and Dr. William Saylor  
Department of Animal and Food Sciences

The annual production of 260 million chickens generating revenues of over a billion dollars for the state of Delaware makes the broiler industry a vital agricultural enterprise. Delaware's poultry industry also faces a number of environmental challenges, such as the need to develop improved nutrient management practices for phosphorus (P). Long-term application of poultry manures, fertilizers, and other P sources has resulted in the buildup of P in many Delaware soils to values well above those needed for optimum crop yields. Runoff and leaching

from these high P soils contributes to nonpoint source pollution of Delaware surface waters. One approach to reduce this P loss that is receiving great interest today is the development of improved dietary strategies that can enhance nutrient utilization by broiler chickens. Better nutrient utilization in turn reduces the excretion of P into manures and thus the amount of P applied to cropland.

University of Delaware student Christina Eckstrand learned of Dr. William Saylor's work with new technologies for better P utilization in broilers and was intrigued with its implications for improving surface and groundwater quality. Saylor, Associate Professor in Animal and Food Sciences at the University, recommended Eckstrand for a DWRC internship investigating the feeding of microbially-derived phytase enzymes and low-phytate grains to broilers, a process reducing total P fed while still meeting the animal's P nutritional requirements.



While the use of phytase in broiler diets has shown significant promise for improving P utilization in chickens, this project studies the fate of the phytase enzymes in chicken gastrointestinal (GI) tracts to determine if meaningful quantities are excreted and are present in manures. If so, the phytase might

continue to hydrolyze organic P, increasing the concentration of soluble P which could transfer more readily from soil to surface and ground waters. Eckstrand, a senior majoring in Animal Science and minoring in Biology with a pre-vet concentration, will analyze weekly samples of chick GI tract contents and excreta, comparing phytase activity, total, soluble and phytate P, with the related concentrations in the diet fed the chicks. Should results of her research show that significant phytase activity persists in the chick GI tracts, large-scale studies of litter and gut samples from phytase-fed broilers are planned as part of a grant funded by the USDA Initiative for Future Agriculture and Food Systems (IFAFS).

Eckstrand's love of working with animals dates to her days in high school maintaining barn animals at Bellevue State Park. She continues weekly riding lessons begun back in grade school, and also now volunteers milking cows at the UD Dairy, jobshadows practicing vets, and works part time at the University of Pennsylvania's New Bolton Center Large Animal Hospital as a Nursing Assistant. Originally a music instrumental education major, Eckstrand found greater fulfillment in the hands-on

experiences and research opportunities afforded by the College of Agriculture. Eckstrand believes her DWRC internship in particular will expand her horizons by enhancing her lab research techniques, planning and time management, and current awareness of agricultural issues.

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### **A Nutrient Management Education Program for Delaware Youth**

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**John Place and Susan Truehart Garey**  
University of Delaware Cooperative Extension Office

In the past three years legislation has been passed in Delaware, Maryland, Virginia, and other eastern states to regulate nutrient management practices for agriculture and other commercial nutrient users (e.g. golf courses, landscapers). The complexities of this environmental issue and its interrelationship with water and soil quality and the human population have created a need for increased public education. Starting with specialized youth education, University of Delaware Cooperative Extension agents aim to build a knowledge base and foster long-term positive attitudes and behaviors in the next generation of citizens toward responsible nutrient management that can protect and improve water quality.

A new Nutrient Management curriculum has been designed for this purpose in part through a \$5,000 grant from the U.S. Environmental Protection Agency Environmental Education Program. The developers are Susan Truehart Garey, Extension Agent in Animal Science, and project coordinator Becky Marasco, with guidance from Dr. Dave Hansen, Assistant Professor of Soil and Water Quality and Extension Nutrient Management Specialist, all of the University of Delaware Cooperative Extension. All the activities were designed to be interactive and "hands-on" to follow the experiential learning model that is also found in 4-H curriculums. Positive outcomes of the education could include knowledge transfer to youth's families and communities and also the promotion of water science as a future career.

John Place, Jr., a senior General Agriculture major minoring in Animal Science at the University of Delaware has received a DWRC internship to teach the pilot nutrient management curriculum to school age children statewide in day camps, summer programs such as those at Dover Air Force Base and the Boys and Girls Clubs, and 4-H groups. As Place is gaining new experiences in education, youth development, nutrient management and water science issues, responsibility and self-motivation, he in turn is providing valuable feedback evaluating the

impact of the new curriculum on youth comprehension and behaviors.



Place's interest in a career in sustainable and organic farming led him to inquire about research opportunities in soil and water resources and nutrient management. In addition to working with crops, he has extensive experience in animal training and management on several farms, including as farm assistant on the UD

Farm for the past three years and as a summer camp horse wrangler. A member of the Professional Horsemanship and Rodeo Cowboys Associations, Block and Bridle Club, and collegiate Future Farmers of America, Place has an enormous love of the great outdoors, listing his pursuits as rodeo, farming, hockey, hunting, fishing, camping, horses, mountain biking, and hiking.

His personal interests and teaching experiences have prepared him well for this internship in environmental education. Place also learned subtleties of public service while parking cars and had his first forays into teaching while supervising summer campers in horsemanship, swimming, canoeing, hiking, archery and riflery. More recently he has been teaching educational programs through the UD Animal Science Club for Girls Inc., Girl Scouts, and at Ag Day, and setting up research projects and labs for UD Farm faculty and students.



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**Nutrient Management News**  
A regular update on Delaware's  
Nutrient Management Program

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The DWRC is supporting three 2000-2003 graduate fellowships that provide scientific support to the Delaware Nutrient Management Commission (DNMC)'s Nutrient Management Program. This program is designed to improve water quality in Delaware through cost-sharing programs, the approval of alternative-use projects, the education of nutrient generators and handlers, and many other measures. The DNMC developed Delaware Nutrient Management Program regulations last year which went into effect Jan. 10, 2001, outlining nutrient management certification requirements, compliance and enforcement of standards, and complaint handling. The DNMC and DNREC have identified priority action areas encompassing inland bays and

the Nanticoke and Pocomoke watersheds of Sussex County Delaware, based on impaired water and livestock production levels.

The Nutrient Relocation Program has already provided cost assistance in relocating more than 15,000 tons of excess poultry manure. Half of this was exported off the Delmarva Peninsula, with the balance used in areas in need of nutrients or alternative use projects processing raw manure into economically and environmentally sound products. The Nutrient Management Program is offering \$5/acre cost-sharing support to help stakeholders develop nutrient management plans. To date this program has defrayed cost of planning for more than 88,000 acres well before the 2003 deadline for submitting plans.

The DNMC is now working with DNREC to develop an approach to permit large livestock operations or CAFOs (Concentrated Animal Feeding Operations). For CAFO guidelines, you may visit <http://www.epa.gov/ost/guide/cafo/index.html>, or call the CAFO hotline (202) 564-0766, or email [CAFO.comments@epa.gov](mailto:CAFO.comments@epa.gov).

For more information on Delaware's Nutrient Management Program contact William Rohrer, Program Administrator, Delaware Department of Agriculture (phone: 1-800-282-8685), or visit <http://www.state.de.us/deptagri/About Us/nutrient.htm>.

**Free Nutrient Management Certification  
Classes at UD -- Expanded Offerings**

Visit <http://www.rec.udel.edu/nutrient/page3.html>  
for complete course schedule and information

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An estimated 5,000 Delawareans require nutrient management certification by the mandated deadline of January 1, 2004. To meet this need, UD has added additional free certification classes this year for nutrient generators, private nutrient handlers, and commercial nutrient handlers, to the existing schedule of classes for nutrient management consultants. Since January 2001, more than 1,200 people have trained to receive general "Session I" nutrient management certification. The DNMC has certified 63 nutrient management consultants through reciprocity with MD, VA, or PA certification and attendance in UD's Session I class, and also 229 nutrient generators who went on for the second session of training. Nearly 200 have attended all three courses offered by UD to date in order to be certified as private nutrient handlers. During the fall of 2001, several additional training classes were held at all three Delaware county extension offices.

Leading the training sessions are Dr. Greg Binford and Dr. Dave Hansen, both nutrient management and water quality specialists in the UD Department of Plant and Soil Sciences. They may be contacted at [binfordg@udel.edu](mailto:binfordg@udel.edu) / 302-831-2146, or [djhansen@udel.edu](mailto:djhansen@udel.edu) / 302-856-7303, respectively.