Maryland Water Resources Research Center

Department of Civil & Environmental Engineering
University of Maryland
College Park, Maryland 20742

Fall 2002 **Dr. Allen P. Davis- Dir.** **Dr. Phil Kearney- Assoc. Dir.**

Water Resources Research in Maryland: Highlights & Needs.

A full-day colloquium sponsored by the Maryland Water Resources Research Center will address *"Water Resources Research in Maryland: Highlights and Needs."* It is scheduled for Friday, October 25, 2002 in the Baltimore Room, Stamp Student Union at the University of Maryland, College Park. The program is slated to include:

- **J. Charles Fox , Secretary, Maryland Department of Natural Resources;**
- **Robert M. Summers, Director - Water Management Administration, Maryland Department of the Environment;**
- **Robert J. Shedlock , Associate Chief, U.S. Geological Survey**
- **Amy Guise , Corp of Engineers, Baltimore District**

University faculty speakers will include:

- **Dr. Margaret Palmer, Biology**
- **Dr. Alba Torrents, Civil and Environmental Engineering;**
- **Dr. Adel Shirmohammadi, Biological Resources Engineering**

The objective of the conference is to present a broad view of the accomplishments of State, Federal and University water science programs and to identify our most urgent needs. The conference will address many important water issues in Maryland.
The conference is open to all faculty, graduate students and other water professionals. We can only accept participants that register at the center web site prior to the conference. The colloquium will be free of charge and will include lunch and breaks. Formal program announcements are being distributed.
For further information contact Phil Kearney, Associate Director at pk56@umail.umd.edu or 301-405- 6829

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Maryland Water Resources Research Center
A.P. Davis - Director
Tel- 301-405-1958
Email: apdavis@eng.umd.edu
website ;
http://www.cee.umd.edu/water_resources/home.html

From the Directors Desk

I hope everyone had an enjoyable and productive summer. It certainly is an engaging time for the Water Center. We have been working on a number of projects, both small and large. Our web site continues to be upgraded, including the faculty expertise section. We have enhanced the newsletter, and I hope that these upgrades will keep everyone informed on happenings related to water research and education.

One of the new projects that we are currently working on is the *Water Resources Research in Maryland* colloquium that the Center is sponsoring next month. This event will bring together a number of groups that have interest in Maryland water problems and research and resources necessary to address some of these problems. I hope you can participate with us for this discussion day.

The Center continues to support excellent research with its limited funds. We have four small projects underway. We also supported two excellent graduate students through summer fellowships, as well as a third student through a USGS fellowship. In addition, we continue to explore other approaches to support water research at College Park and other institutions throughout the state.

As always, I welcome your comments and suggestions.
Allen P. Davis

Campus Initiatives to Address Storm Water Pollution using Innovative Low Impact Technologies

With support from the Prince George's County Department of Environmental Resources, the University has begun several initiatives to reduce the quantity and improve the quality of stormwater runoff leaving the campus. These initiatives are part of a novel environmental management concept, known as Low Impact Development (LID), that is receiving attention throughout the US and other parts of the world.

Storm water runoff is a concern on campus because of the large areas of impervious rooftops and parking lots. Pollutants are mobilized and the water moves quickly into the nearest storm drain. Resulting high flows in Campus Creek and Paint Branch Creek can cause severe erosion, cutting away land, destroying trees, and carrying sediment. The resulting pollutants and sediments harm the ecology of the creeks. The new initiative will construct several types of LID facilities in the northwest part of the campus, in the area of the new Comcast Arena.

The primary focus will be on installing bioretention facilities, also known as rain gardens, in this area. A bioretention facility is designed to receive runoff and infiltrate it through a layer of sandy soil and organic compost. A layer of mulch and a mixture of plants, including grasses, flowers, shrubs and small trees is placed on the surface. Underneath, infiltrated water is collected in a perforated pipe and sent to the storm drain, and ultimately to the creeks. Water directed through the rain garden can have a major impact on improving the water quality and ecology of the creeks and other downstream resources. First, bioretention slows the water down, allowing infiltration into the surrounding soils. Just as important is that by allowing the water to move through the mulch and soil, many of the pollutants are removed, including sediment, metals and hydrocarbons. Microorganisms and plants can break down some pollutants once they are captured. Significant improvements in water quality are expected.

LID techniques have been championed by the County Department of Environmental Protection. Working with the County, Allen Davis, Scott Angle, and Pat Kangas have been investigating the water quality benefits of LID practices. The philosophy behind LID technologies is to have many different facilities and practices dispersed throughout an area, rather than just a few large control practices. The bioretention facilities on campus will be designed so that water quality and flow can be monitored to provide proof of the ineffectiveness of the technology. This proof is necessary so that these techniques will be more readily accepted by the general

stormwater community. Moreover having these facilities on campus will allow their use for classes, showing natural habitats and ecosystems employed for environmental benefit.

Request for Proposals

Proposals for 2003 Maryland Water Resources Research Center funds are now being solicited. Faculty from any institute of higher education in Maryland are eligible to apply. To encourage diversity, a broad range of research proposals related to Maryland water issues will be considered.

In 2003 the Center will have funds of about $70,000 to award. In addition to research proposals we will fund one or more summer fellowships, which are considered in another section of this newsletter.

Only a limited number of proposals can be funded. Each federal dollar provided by this program must be matched by 2 non-federal dollars, which can include tuition waivers, faculty time, forgiven overhead, etc. Overhead is not chargeable to the sponsor. The institution applying for support must certify that the matching funds are available at the time of submission. Cooperative programs involving U.S. Geological Survey personnel are encouraged.
All proposals submitted to the Maryland Water Resources Research Center will receive external peer review.

To submit a proposal, please contact the Maryland Water Resources Research Center. You may call us at 301-405-6829 or e-mail pk56@umail.umd.edu. For information on how to prepare a proposal, go to the our web site at *http://www.cee.umd.edu/water_resources/home.html*

Proposals are due in the WRRC office (1147 Martin Hall, University of Maryland, College Park, 20742) by close of business (4:30 PM) on November 15, 2002.

2003 Summer Fellowship Program.

For the third year, the Center will offer summer fellowships to selected outstanding graduate students working with faculty at College Park on research relevant to Maryland's water resources. We are making this early announcement to facilitate our budget planning process. The 2:1 match required by Federally funded projects will be generated from the within the Center.Graduate Students from institutions other than the University of Maryland , College Park may be considered, but the 2:1 funding match must be supplied by their home institution.
For further information contact
Phil Kearney -Assoc Director
Maryland Water Resources Research Center
at pk56@umail.umd.edu.
The deadline for applications is Nov 15, 2002

UMCP Joins Hydrologic Science Consortium

The University of Maryland has become a member of the Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI). CUAHSI was founded in 2001 to foster advancements in Hydrologic Science in its broadest sense: an interdisciplinary Earth Science devoted to a quantitative understanding of the water cycle and its interactions with the earth system and biota. In service of this mission, CUAHSI's objectives are to:

- **Develop, prioritize, and disseminate a research and education agenda;**
- **Identify the resources needed to advance this agenda, and mobilize the community to obtain these resources;**
- **Enhance the visibility, appreciation and utility of hydrologic science through education, outreach, and knowledge transfer.**

As an expression of the interdisciplinary nature of water-related research and education at Maryland, the campus membership has been sponsored by the Maryland Water Resources Research Center and by Provost W. Destler. Dr. Kaye Brubaker, Assoc. Prof. of Civil & Environmental Engineering, has volunteered to serve as UMCP's representative, and was elected to CUAHSI's Board of Directors in August 2002. CUAHSI's web site is *http://www.cuahsi.org/*

"Bioretention for Storm Water Management"- Workshop

The Center is co-sponsoring a short course on Bioretention for Stormwater Management to be given September 18, 2002.This informative course is designed for professionals interested in land development and environmental issues. Bioretention is a best management practice for stormwater management that is an integral part of the Low Impact Development concept. This soil- and plant-based technology enhances the quality of downstream water bodies and also provides some control of the volume and timing of stormwater runoff.

The course is sponsored by the Maryland Water Resources Research Center, Maryland Cooperative Extension, and the Department of Biological Resources Engineering, and will be held on the University of Maryland College Park campus. The cost of the course is $150.

Registration and other additional information may be found at *http://www.bre.umd.edu/shortcourse/bioretention.htm.*
Questions concerning course content should be directed to Jennifer Becker (Dept. of Biological Resources Engineering) at jgbecker@wam.umd.edu or (301) 405-1179.

2002 Summer Fellowship Program

The Center was pleased to award two Fellowships for 2002.The two awardees are Carey Nagoda, Department of Biological Resources Engineering , Advisor -Dr Jennifer Becker and Holly Menninger, Department of Biology, Advisor-Dr Margaret Palmer. Here is a brief synopsis of their research.

Effect of wetland plant rhizosphere aeration capacity on the biodegradation of a model contaminant, *cis*-1,2-dichloroethene

Carey Nagoda

The objective of this project was to gain insight into the relationships between wetland plant characteristics and microbial transformations of anthropogenic contaminants in the rhizosphere.

Specifically, it examines the effect of wetland plant rhizosphere aeration capacity on the biodegradation of a model contaminant, *cis*-1,2-dichloroethene (*cis*-DCE). The first objective of my research was to quantify and compare the amounts of oxygen released into the rhizospheres of several wetland macrophyte species that have different morphologies and are commonly used in constructed wetlands. A fundamental problem with the colorimetric method for assaying dissolved oxygen losses from plant roots was discovered. I developed a modified approach for measuring O_2 losses which took a significant amount of time.

Quantification of O_2 released to the rhizosphere is achieved colorimetrically, using a Ti^{3+}-citrate solution, which changes from a purple-blue color to colorless as Ti^{3+} is oxidized to Ti^{4+}. However, absorbance measurements made periodically over 24 hours, showed a gradual decrease in absorbance and, therefore, oxidation of the Ti^{3+} over time. Because the experiments involving plants were designed to last for 24 hours, this was unacceptable, so I began systematically evaluating and ruling out potential causes of the change in color over time. I considered the possibility that one or more constituents of Hoagland's nutrient solution, used to grow the plants, were reacting with the Ti^{3+}. To test this theory, the absorbance of standards prepared with deionized water was monitored and did not change significantly within 24 hours. Because plants must, at a minimum, be supplied with macro-nutrients in order to survive the duration of the experiment, I endeavored to make a simple solution that met these needs and did not react with Ti^{3+}. A new growth solution containing diammonium phosphate ($(NH_4)_2HPO_4$) was prepared and tested for use in the experiment. A standard curve was successfully created using the $(NH_4)_2HPO_4$ growth solution. The interference caused by

nutrient solution was apparently overlooked in previous studies using the colorimetric method because standards were either prepared with deionized water or measured only at a single point in time.

The amount of oxygen released by the roots of several wetland plants: softstem bulrush (*Schoenoplectus tabernaemontani*), Pennsylvania smartweed (*Polygonum pennsylvanicum*), and soft rush (*Juncus effuses*) was measured using an experimental system that I developed for this purpose. The plant was exposed to 12h of light and 12h of dark, and the absorbance of the solution in each flask was measured at regular intervals. No significant oxidation was observed in the root only controls; however, significant oxidation of the rhizosphere was observed in the flasks containing intact plants. Based on the maximum water depths tolerated by the wetland plants listed above, I predicted that the following trend in rhizosphere oxidation capacity would be observed: *Typha latifolia* > *S. tabernaemontani* > *J. effuses* > *Sagittaria latifolia* > *P. pennsylvanicum*. The rhizosphere oxidation capacities of the plants tested to date are consistent with this prediction.

The effects of the removal of herbaceous vegetation along the stream edge on aquatic invertebrate community structure and ecosystem function.

Holly Menninger

The objective of this project was to determine how the removal of herbaceous vegetation from stream edges 1.) affects the diversity and abundance of aquatic insects in the stream channel and 2.) alters the rates of key ecosystem processes that fuel aquatic food webs (primary production, organic matter decomposition, nutrient uptake). It was predicted that streams where vegetation was removed would experience higher primary production by algae and lower decomposition rates of organic matter than streams with intact edge vegetation.

Six headwater stream sites were selected for study. In each pair, one stream was designated the experimental stream in which herbaceous vegetation would be removed and the other designated a reference stream. I decided to use a before-after-control-impact design to measure changes in invertebrate community structure and ecosystem processes before and after vegetation removal as well as to account for natural variability over time during the course of the experiment.

Prior to vegetation removal, I measured rates of decomposition and algal production at all sites. Six leaf packs of dried grass were attached to each stream bottom and collected and weighed over time to determine rates of decomposition. These rates ranged from 0.0287 to 0.0649 day^{-1}, breakdown rates considered fast as compared to those known for other non-woody plants More importantly, the decomposition rates were not significantly different within each paired stream. This pattern is expected to change following the removal of vegetation from the three experimental sites. Using tile substrates, I assayed algal growth at all sites. There appeared to be variation in algal growth within individual streams. Algae seemed to grow in discrete patches where light passed through the overhanging vegetation, analogous to the growth of understory plants in forest light gaps.

In addition to decomposition and primary production, the uptake of essential nutrients, specifically ammonium and phosphate, by benthic organisms was measured. We calculated an uptake length, or the average distance a molecule travels in the water column before being removed, for each nutrient in each stream. Uptake lengths for ammonium ranged between 50 and 500 m, somewhat surprising for such small densely vegetated streams.

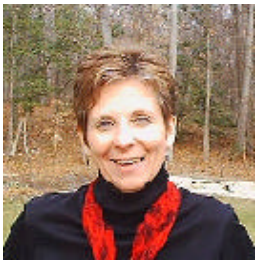
Following vegetation removal in early August, I began post-removal experiments. Currently, I am completing analyses on the pre-removal

data and have begun characterizing the aquatic invertebrate community. Ultimately, the results from this study will enable me to develop and test hypotheses about proximate mechanisms for changes following vegetation removal and the specific role herbaceous plants play at the stream edge.

Featured Scientist:

Dr Margaret Palmer
Department of Biology

Margaret Palmer has an B.S. degree in Biology (1977) and a PhD in Coastal Oceanography (1983). She began her research career working on oceanographic questions that bridged hydrodynamics and the ecology of bottom-dwelling invertebrates. She was the first to demonstrate that small marine invertebrates (meiofauna) are passively dispersed by ocean currents and that one could model their movements using boundary layer theory developed to predict sediment transport. In the late 1980's she became interested in asking if she could apply such concepts to freshwater streams – could the dispersal of small stream invertebrates also be modeled as passive particles? She showed that this was the case and soon began devoting her research time to freshwater ecology. She was a player in the development of the field of "hyporheic ecology" – the study of fauna inhabiting hyporheic zones (where groundwater meets surface waters beneath streambeds) and contributed to our understanding of the importance of hyporheic biota to stream ecosystems.



In more recent years, Dr. Palmer's work has focused on the interplay between hydrodynamics and geomorphology in structuring invertebrate communities in streams and in influencing their ability to recover from anthropogenic disturbances. Her interests in the latter have led her to focus on applying basic ecological theory to the restoration of stream ecosystems. She recently organized a conference on the linkage between ecological theory and restoration in practice at the 2002 Ecological Society of American and Society of Ecological Restoration joint meetings. The conference and its implications for the burgeoning business of restoration were highlighted in the August 11 issue of *The Economist* magazine.

Dr. Palmer and collaborators Dr. David Allan (University of Michigan) and staff from *American Rivers* have just recently organized a major effort to synthesize the scientific basis of riverine restoration in the United States. This project is being supported by NSF and several private foundations. This extremely ambitious undertaking involves Palmer and Allan leading a team of eminent freshwater scientists (C. Dahm, S. Gloss, P. Goodwin, D. Hart, M. Kondolf, J. Meyer) to evaluate restoration efforts in 9 geographic regions around the nation. This work is expected to have broad significance scientifically and in the area of watershed management and conservation. The project will take at least 3 years with an expected completion date sometime in late 2004.

Palmer is also known for her work in urban streams and how disturbances generated from rapid land use change in Maryland influence running-water ecosystems – not only their biota but also basic ecological processes such as rates of primary production. This collaborative research involves close working relationships with campus colleagues (Glenn Moglen in Civil Engineering and Nancy Bockstael in Agricultural and Resource Economics) and scientists from the Montgomery County Department of Environmental Protection and the University of Delaware. This project includes empirical work at over 70 stream sites within Maryland and the development of economic, hydrological, geomorphic and ecological models that will be linked to determine how land-use patterns and history of development influence local ecological conditions . Using innovative predictive models, they hope to forecast future development patterns and the ecological impacts.

Dr. Palmer has made major contributions to several scientific societies. While President of the Aquatic Section of the Ecological Society of America (ESA), she initiated an electronic newsletter, organized annual business meetings, and established an endowed award in the name of a beloved aquatic ecologist (Tom Frost) who died in a tragic accident. She has also served on the Publications Committee of ESA, is currently nominated for the Governing Board of ESA. She also serves on the Scientific Advisory Boards of NSF's National Center for Ecological Analysis and Synthesis (UC-Santa Barbara), the Grand Canyon Monitoring and Research Center, and on the editorial board for several journals.

Maryland Water Resources Research Center Co-Sponsors Hites Lecture

The Center is pleased to co-sponsor, with the Department of Chemistry, the lecture of Professor Ronald Hites, University of Indiana, Bloomington, IN.
The lecture is entitled:
"Temporal and Spatial Trends of Atmospheric Persistent Organic Pollutants (POPs) near the Great Lakes Since 1991."
Date: Friday Oct 25, 2002
Time: 3:00 PM
Place: Room 0012, Chemistry Building

Professor Hites' research group applies organic analytical chemistry techniques to the analysis of trace levels of potentially toxic environmental pollutants. His research centers around four main areas: effects of pollutants on people; polychlorinated dibenzodioxins and dibenzofurans; anthropogenic organic pollutants in the Great Lakes and mass spectrometric techniques for the analysis of environmental contaminants. Professor Hites teaches environmental chemistry for the School of Public and Environmental Affairs. Prior to 1979, Professor Hites was an associate professor of Chemical Engineering at the Massachusetts Institute of Technology. In 1991, he won the American Chemical Society's Award for Creative Advance in Environmental Science and Technology; in 1993, he won the Society of Environmental Toxicology and Chemistry's Founders Award. He is a Fellow of the American Association for the Advancement of Science.

Recent Center Publications

Published journal articles:

M.L.Rock, B. R.James , and G.R.Helz, "Hydrogen peroxide effects on chromium oxidation state and solubility in four, diverse, chromium-enriched soils." ***Environ. Sci. Tech. ,2001 35,4054-4059.***

B. Liu , L. L. McConnell , A.Torrents "Hydrolysis of Chlorpyrifos in Natural waters of the Chesapeake Bay" , ***Chemosphere 2001 ,44,1315-1323***

G. R. Helz , J. M. Adelson , C. V. Miller, J. C. Cornwell , J. M. Hill, M. Horan , R. J. Walker
"Osmium Isotopes Demonstrate Distal Transport of a contaminated Sediments in Chesapeake Bay." ***, Enviro. Sci. Tech, 2000 ,34, 2528-2534***

J. M. Adelson , G. R. Helz, C. V. Miller "Reconstructing the rise of recent Coastal Anoxia: Molybdenum in Chesapeake Bay Sediments" **,** ***Geochim. Cosmochim. Acta , 2001, 65 (2) 237-252***

J. F. W. Mosselmans , G. R. Helz , R. A.D. Pattrick , J. M. Charnock And D. J. Vaughan
"A study of Speciation of Sb in Bisulphide solutions by X -ray Absorption Spectroscopy" ***Applied Geochemistry , 2000, 15 (6) 879-889***

B. E. Erickson and G. R. Helz "Molybdenum (VI) Speciation in Sulphidic Waters : Stability & lability of Thiomolybdates" ***Geochim. Cosmochim. Acta, 2000 ,64 (7) 1149-1158***

M. B. Clarke and G. R. Helz "Metal-Thiometalate Transport of Biologically active Trace Elements in sulfidic Environments. 1. Experimental evidence for Copper Thioarsenite Complexing" ***, Environ. Sci. Tech 2000 ,34 , 1477-1482.***

B. Liu , L. L. McConnell , A. Torrents "Herbicide and Insecticide Loadings from the Susquehanna River To the Northern Chesapeake Bay",*Agri Food Chem* Accepted

Abstracts and Conferences

N. A. Baer and W.O. Lamp..*"Macroinvertebrate community structure vs. leaf decomposition: a comparison across two Maryland coastal plain streams." Bulletin of the North American Benthological Society. 18(1): 232 ,2001*

N. A. Baer and W. O. Lamp. 2001. "Macroinvertebrates and Leaf decomposition: a comparison Across two Maryland coastal plain streams." *Chesapeake Bay Conference to be held September 23-26, 2002.*

L. R. Begoon, and B. R. James. "Assessing the redox status of soils through thermodynamic approaches using colorimetric methods." *Soil Sci. Soc. Am. Annual Meetings. Anaheim, CA October, 1997*.

Chernikov, S., and B. R. James. "Chromate reduction by humic substances in soils and simple systems." *Soil Sci. Soc. Am. Annual Meetings, Anaheim, CA. October, 1997.*

M.L.Rock, B.R. James, and G. R. Helz. "Chromium (III) oxidation in soils by hydrogen peroxide." *Soil Sci. Soc. Am. Annual Meetings, Anaheim, CA. October, 1997.*

E. Hong, E. A. Seagren, and A. P. Davis. "Sustainable Oil and Grease Removal from Stormwater Runoff Hotspots using Bioretention." *PennTec 2002 Annual Technical Conference and Exhibition 74th annual conference of the PWEA*

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