Maryland Water Resources Research Center
Department of Civil & Environmental Engineering
University of Maryland
College Park, Maryland 20742

www.waterresources.umd.edu

Fall 2005 Dr. Allen P. Davis, Director Dr. Phil Kearney, Assoc Dir.

Robert Hirsch: Keynote Speaker for the Fall 2005 Conference on Urbanization

Dr. Robert M. Hirsch will be the keynote speaker at the upcoming conference on *Urbanization: Stresses on Maryland's Water Resources,* November 18, 2005, Benjamin Banneker Room, in the Stamp Student Union. The Maryland Water Resources Research Center and Maryland Sea Grant will sponsor this 1-day conference. Seven eminent speakers have been invited.

Dr. Hirsch, Associate Director for Water, is responsible for all U.S. Geological Survey (USGS) water science programs. These programs encompass research and monitoring of the nation's ground water and surface water resources including issues of water quantity and quality. He has served as the leader of USGS water programs since 1994. As Associate Director he represents the interests of the USGS in scientific, technical, and leadership aspects of hydrology and serves as the Director's principal advisor on water-related issues. In his capacity as spokesperson for the USGS and its water resources mission, Hirsch holds the title of Chief Hydrologist.

"We are pleased to have a scientist of the stature of Dr. Hirsch as our keynote speaker. USGS plays a key role in funding the 54 Water Resources Research Centers in the University systems across the United States" said Dr. Allen P. Davis, Director of the Maryland Water Resources Research Center. The conference is open to anyone interested in State water issues. The Center will cover all costs, including registration, breaks and lunch. An electronic registration website is set up at www.waterresources.umd.edu. Registration is required to attend. The full conference agenda is presented on page 5.

Inside this Newsletter

Maryland Water Resources Research Center
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From the Director

The University of Maryland is home to a major research effort in water resources. However, because this research is dispersed among 5 or 6 colleges, the magnitude and strength of this research in many cases is not given its proper due. The Center is currently undertaking a survey to gauge the level of research in water resources at the University of Maryland. Several faculty members have responded to our requests for information and I would like to express my gratitude for your assistance.

Based on preliminary data, over 99% of campus water resources funding is provided by assorted governmental agencies. Sources of this funding are varied and include federal agencies (NSF, EPA, NASA, FEMA, USDA, USDOT), state agencies and programs (MDWRRC, MD Sea Grant, MD State Highway), and local government (Prince George's County, DC Department of Health). Most of the grants are relatively small.

Once all of our information is compiled, I expect that the results will be striking and informative. It is clear that several million dollars of water resources research is being done each year on campus. We will continue to gather information and by the end of the year hope to provide a comprehensive view of water resources research and funding at the University of Maryland.

Request for Proposals - 2005 Funding

Proposals for the 2005 *Maryland Water Resources Research Center* funds are now being solicited. The Center is seeking requests for three types of proposals this year (with their estimated funding levels): regular research projects ($15k to $30k), summer graduate fellowships ($3.6k) and seed research projects ($2k to $5k). Requirements for the 2005 summer fellowship program are presented below. The seed project program solicits proposals aimed at developing exploratory projects, with the deliverable being a major proposal for submission to another agency such as the National Competitive Grants program. The PI would be the team leader in developing a broad-based project on a high priority subject.

For information on proposal preparation, go to our web site at www.waterresources.umd.edu.

Specific questions may be addressed to the Associate Director at (301-405-6829) or e-mail *kearneyp@umd.edu.* *Proposals are due in the WRRC office (1147 Martin Hall, University of Maryland, College Park 20742) by close of business (4:30 PM) on Monday, November 14, 2005. Proposals must be signed by an authorized University Representative.*

2005 Summer Fellowship Program

For the fifth year, the Center will offer summer assistantships to selected outstanding graduate students. Selection of awardees will be made in late November based on: a) evaluations of student's records, b) strength of advisor's recommendation, and c) prospects that the research will benefit our understanding and management of Maryland's water resources. The most important benefit of this project will be simply its contribution to the educational mission of the Center. Interested applicants should contact Dr. P. C. Kearney for details at *kearneyp@umd.edu.* Summer Fellowship proposals must be submitted to our office by November 14, 2005. Guidelines can be found at the Center website.

Research Projects Supported in 2005

Three research projects are funded by the Center for 2005. Synopses of these ongoing works are presented below.

***"Fingerprinting Sediment to Determine Sources in an Urban Watershed."* Brian Needelman and Olivia Devereux. Department of Natural Resouces and Landscape Architecture. University of Maryland.**

This project was designed to determine the source of sediment that enters the North East Branch, which drains to the Anacostia River and the Chesapeake Bay. The objectives included:

1. **Identify and quantify the source types and locations of suspended sediments.**
2. **Apply a composite sediment fingerprinting model for an urban watershed.**
3. **Perform a soil survey of the subwatershed.**

In year one, we obtained soil samples of streambanks and upland areas. In addition, we have obtained samples of all land areas and an overbank sample from a well-timed 10-year storm, which is

representative of suspended sediment. The soil survey indicates that banks may be a primary source of erosive material. Given this hypothesis, the streambanks must be differentiated from the other sources by the fingerprint components. Should the banks prove to be the primary source of sediment, then the implication is that the primary eroding force is the stream itself, not overland flow. Should this prove to be true, then there are important implications for low impact development and stream management.

Another objective for this year was determining a composite fingerprint for each source type and area. Fingerprints that will be tested include: Lead -210, Cesium-137, Beryllium-7, Carbon-13, Nitrogen-13, total carbon, total nitrogen and phosphorus, and heavy metals (copper, zinc, and total lead).

As there is a growing awareness of the importance of headwaters, we hope this research sheds light on the source of sediment and the key role that headwaters play in erosion and sediment storage. We are pleased to be working so closely with the USGS and ARS-USDA as their expertise lends great strengths to the project.

"Chemical and Biological Availability of Zinc in Road Runoff Entering Stormwater Retention Ponds." Ryan Casey. Urban Environmental Biogeochemistry Laboratory at Towson University.

We are investigating the transport of zinc from a highway into a stormwater retention pond and determining the speciation of zinc in both road runoff and retention pond sediments. Our goal is to evaluate the geochemical forms of anthropogenic zinc and determine the potential for impacts on biota inhabiting stormwater ponds. Because of its prevalence in road runoff, we are also focusing on copper fate in this project.

After the first five months of work, we have determined that Zn and Cu levels in soils surrounding the retention pond do not vary substantially. We did not observe a gradient of metal concentration with distance from the roadway. Instead, levels were generally in the expected range of background soils. In contrast, pond sediments are greatly elevated in Zn and Cu as is road dust collected from the retention pond's drainage area. The <4 mm clay fraction of road dust contained an average of 1140 mg Zn kg^{-1} and 360 mg Cu kg^{-1}. This road dust component can be considered the high end member in a pond system that involves mixing of background soils with suspended particulates brought in through runoff. We will determine particulate and dissolved metal contributions directly by sampling storm events in the near future. An automated water sampler has been deployed at the site and is currently being calibrated and optimized for storm sample acquisition.

Initial sequential extractions of the pond sediments suggested that both Zn and Cu are predominantly present in the more refractory fractions with much smaller amounts in the readily exchangeable fraction. This suggests that the bioavailable fraction of metals may be substantially less that the total extractable metal content in the sediments.

"Theoretical and Experimental evaluation of Acetate Thresholds as a Monitoring Tool for *in situ* Bioremediation." Dr. Jennifer G. Becker, Department of Biological Resources Engineering, Dr. Eric A. Seagren, Department of Civil and Environmental Engineering, and Dr. Hubert J. Montas, Department of Biological Resources Engineering.

In situ bioremediation approaches offer great potential for cost-effective clean-up of environmental contamination. However, demonstrating the success of *in situ* bioremediation can be challenging due to the heterogeneous, dynamic, and inaccessible nature of the subsurface. The consumption of oxygen and electron acceptors during bioremediation of petroleum hydrocarbons and other contaminants can result in shifts in the predominant respiratory or terminal electron-accepting processes (TEAPs), which may be useful for monitoring the microbially-

mediated destruction of contaminants. Because traditional assessment tools have disadvantages, an accurate and easy-to-use indicator of the predominant TEAP in complex environmental samples is still needed. This study is designed to test the hypothesis that characteristic ranges of acetate thresholds may exist for different TEAPs and, therefore, acetate concentrations may be useful for monitoring bioremediation. A threshold is the concentration below which a substrate cannot be utilized by a microbial culture. Acetate thresholds established by pure microbial cultures that couple the oxidation of acetate to different TEAPs (including reduction of Fe(III), nitrate, tetrachloroethene, Mn(IV), sulfate, and CO_2) are measured in batch systems, along with the concentrations of biomass and oxidized and reduced forms of the electron acceptor over time. The importance of kinetic and thermodynamic factors in controlling acetate thresholds is being evaluated using a mechanistic model. Model parameters are obtained by fitting the model to the experimental data. The usefulness of acetate thresholds as indicators of bioremediation will be evaluated by measuring acetate concentrations in contaminated sediments and comparing measured values to model-predicted concentrations. Supida Piwkhow and Gayle Davis, both M.S. students in the Department of Civil and Environmental Engineering, are conducting the experiment.

The USGS Internship Program - Cooperative Opportunities

Several opportunities for collaborative work with Federal agencies are available through the Center. First, is the USGS internship program. USGS personnel are able to fund student interns through the Maryland WRRC. Generally, the research project is a collaborative endeavor between a USGS scientist and a University faculty member. Several Maryland internships have already been supported with the Baltimore and Reston, VA USGS offices. Details on the internship program can be found at the USGS website (water.usgs.gov/wrri/internship.html) and by contacting the Maryland director.

Additionally, a mechanism is in place to easily allow funds from Federal agencies to be transferred to universities through the water centers. The Maryland Center has facilitated such a partnership between a University of Maryland faculty member and the U.S. Army Corps of Engineers. Other Centers have used this arrangement for research with U.S. EPA and other agencies. Again, details can be found by contacting the Maryland director.

Maryland Water Resources News:

Personnel Updates:

- Dr. Scott Angle is the new Dean and Director of the University of Georgia College of Agricultural and Environmental Sciences effective August 15.
- Dr. Frank Coale is now Chairman of the Department of Natural Resources and Landscape Architecture.
- Dr. Margaret Palmer is now the Director of Chesapeake Biological Laboratory, UMCES Solomons, MD.
- Dr. Andrew Baldwin is the Interim Chair for the Department of Biological Resources Engineering.

Awards:

- Dr. Jennifer Becker received the 2005 Young Engineer of the Year Award at the NABEC 2005.
- Dr. Adel Shirmohammadi was given the 2005 Leadership Citation for the Soil and Water Division of ASAE.
- Dr. Adel Shirmohammadi was named an ASAE Fellow for the 2004-2005 Society year.

Urbanization: Stresses on Maryland's Water Resources

Sponsored by:
Maryland Water Resources Research Center
Maryland Sea Grant College

November 18, 2005
Benjamin Banneker Room
Stamp Student Union Building
University of Maryland
College Park, MD 20742

As Maryland's population continues to grow, water supplies and natural water ecosystems are increasingly stressed. Novel ideas are needed to address increased demands on water use and impacts from land development due to urbanization. This one-day seminar will discuss current issues in urban non-point source discharges, water supply concerns, current research on these issues, and ways to address these water problems.

8:50 - 9:00	**Welcome + Opening Remarks**
9:00 - 9:40	**Keynote Speaker - "*Urbanization Impacts on Water Resources: Perspectives from USGS Studies Nationwide,* " Robert Hirsch, Assoc. Director of Water, U.S. Geological Survey, Reston, VA.**
9:40 - 10:10	***"Urbanization in Maryland: Looking Forward, Looking Back,"* Gerrit Knapp, Director, National Center for Smart Growth Research and Education, University of Maryland, College Park, MD.**
10:10 - 10:25	***Break***
10:25 - 10:55	***"Stream/River Restoration in the Chesapeake Bay Watershed with a focus on Urban Streams,"* Margaret Palmer, Director, University of Maryland Center for Environmental Science, Chesapeake Biological Laboratory, Solomons, MD.**
10:55 - 11:25	***"Factors affecting the quality of Urban Streams,"* William Stack, Program Administrator, Baltimore Water Quality Management Section, Department of Public Works, Baltimore, MD.**
11:25 - 11:55	***"Creating "Low Impact" Storm Water,"* Allen Davis, Director, Maryland Water Resources Research Center, Department of Civil and Environmental Engineering, University of Maryland, College Park, MD.**
11:55 - 1:15	***Lunch***
1:15 - 1:45	***"Urbanization, Imperviousness, and Hydrologic Change in Maryland and Beyond,"* Glenn Moglen, Department of Civil and Environmental Engineering and the National Center for Smart Growth Research and Education, University of Maryland, College Park, MD.**
1:45 - 2:15	***"Highest Obtainable Use for Urban Water Quality: Science and Community Expectations,"* Richard Eskin, Director, Technical and Regulatory Services, Maryland Department of the Environment, Baltimore, MD.**
2:15 - 2:45	**Wrap Up and Discussion**

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Featured Scientist
Dr. Jennifer Becker

Dr. Jennifer Becker is an assistant professor of bioenvironmental engineering and extension specialist in the Department of Biological Resources Engineering at the University of Maryland, College Park. Before joining the University of Maryland faculty in 2000, Jennifer was an assistant professor in the Department of Civil and Environmental Engineering at Lehigh University. She obtained her Ph.D. in environmental engineering from Northwestern University in 1998.

The overall goals of Jennifer's research in the area of environmental biotechnology are to improve fundamental understanding of the factors affecting microbial biodegradation of organic contaminants and apply this information in the development of sustainable bioremediation practices. A major focus in Jennifer's research group is on the bioremediation of chlorinated aliphatic compounds, especially the common groundwater contaminant tetrachloroethene (PCE). PCE is biologically recalcitrant under aerobic conditions, but under anaerobic conditions, certain bacteria can respire PCE and related compounds. Theoretically, complete detoxification of PCE under anaerobic conditions is possible. However, in practice, biodegradation is often incomplete and results in the accumulation of toxic intermediates. Integrated modeling and experimental studies in Jennifer's lab are supported by a Presidential Early Career Award for Scientists and Engineers (PECASE) from the National Science Foundation and are evaluating how competition between PCE-respiring populations for contaminants and other growth substrates can affect the anaerobic fate of PCE in different bioremediation scenarios. Other studies focus on understanding and enhancing the intrinsic capacities of natural wetlands to detoxify PCE and other chlorinated aliphatics, especially through plant- and bacteria-mediated processes. Some of this work is being done as part of a larger project led by Dr. Michelle Lorah and other researchers at the USGS. The monitoring and evaluation of bioremediation processes is another area of interest to Jennifer. Her work in this area is currently supported by a grant from the Water Resources Research Center and involves a collaboration with Dr. Eric Seagren (Civil and Environmental Engineering) and Dr. Hubert Montas (Biological Resources Engineering).

Jennifer's extension programs cover a broad range of biological treatment applications, including groundwater bioremediation; biological treatment of stormwater, especially bioretention; and the treatment and management of manure and other agricultural, industrial, and municipal residuals. She has organized and developed a number short courses, field tours, and other educational outreach activities related to these topics. Most recently, her work has focused on increasing awareness among regulators and within animal production industries of the potential for animal production facilities to emit ammonia and contribute to the production of particulate matter and educating these groups about best management practices for reducing total ammonia emissions from a farm. Agricultural ammonia emissions are of increasing concern because deposition of atmospheric ammonia can contribute to the acidification of ecosystems and/or over enrichment of ecosystems with nitrogen, and particulate matter is an air pollutant that can contribute to respiratory disease, as well as haze and other air quality problems. This fall, Jennifer is planning on holding a short course on monitoring intrinsic bioremediation processes. The course will include lectures, software modeling exercises, and demonstrations of sampling and monitoring techniques in the laboratory and field. In addition to her extension and research activities, Jennifer periodically teaches a graduate-level course on Biodegradation and Biocatalysis, which covers microbial and enzymatic processes involved in the destruction and synthesis of organic compounds.

Featured Scientist
Dr. Matthew Hare

Dr. Matthew Hare has been studying the eastern oyster since 1991, but his focus on Chesapeake Bay populations started when he joined the University of Maryland faculty as an Assistant Professor in 2000. With funding from NOAA/Sea Grant and the Maryland Water Resources Research Center, Matt has worked with his students and colleagues to trace the movements of Chesapeake oysters over a single generation and through evolutionary time. Oysters only disperse during the two to three weeks they spend as pelagic larvae before settling onto hard substrate. It's next to impossible to tag the larvae and find them again, so Matt uses the innate variability of the DNA among individuals and populations to trace oyster dispersal. In a study conducted by Colin Rose, a PhD student in the Hare lab, genetic differentiation among Chesapeake oyster populations was shown to be a function of physical distance—nearby populations had fewer differences than more distant populations. This pattern is consistent with a stepping-stone pattern of migration, mostly within tributaries or from one tributary to the next. Long range dispersal was rejected. This was good news for oyster restoration because it means that local efforts will have local pay-offs. Also, the dispersal pattern appears to be general, not conditional on tributaries with 'trap-like' hydrography.

Matt's studies of natural oyster reefs in the Chesapeake provided guidance on the average scale of larval dispersal, a critical parameter for designing self-sustaining sanctuaries. However, huge oyster restoration efforts are being focused in just a few places, and it has been Matt's goal to monitor and evaluate these intensive efforts using similar genetic tools. Because disease pressure is thought to be one of the most serious impediments to oyster recovery, especially in Virginia, sanctuary reefs are being seeded with native juvenile oysters bred for disease tolerance. When this practice started in 1999, Matt saw an opportunity to track individual larvae as if they had radio collars. The artificial selection that produced disease tolerance in this strain also changed the genetic composition of many nonfunctional DNA segments relative to wild Chesapeake oysters. Many such markers, taken together, provide a sort of bar code that identifies a larva, or a newly-settled juvenile oyster, as the progeny of selected strain parents or wild parents. Millions of the selected strain oysters have been planted, but only in a few places. Thus, by genetically surveying each year's juvenile cohort, Matt can determine the abundance of oyster offspring generated by restoration efforts as well as their spatial distribution. This work has been in collaboration with restoration biologists and geneticists at Maryland's Horn Point Lab and the Virginia Institute of Marine Science. In 2002, the most recent year in which substantial oyster recruitment has been seen, Matt's approach identified ten percent of juveniles in the Great Wicomico River, VA, as having at least one selected-strain parent (i.e., resulting from matings between selected strain and wild oysters on the restoration reef). This 10% enhancement of wild recruitment was found upstream from the restoration reef, demonstrating larval retention within the tributary.

Matt's expertise in oyster biology and genetics was recently provided as testimony before the U.S. House of Representatives Resources Committee at a hearing on the merits of adding *C. virginica* to the endangered species list (http://www.newsdesk.umd.edu/um_in_news/clips/july22q.cfm).

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