



Maryland Water Resources Research Center

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Spring 2004 Dr. Allen P. Davis, Director Dr. Phil Kearney, Assoc. Director

From the Director's Desk

2003 was a good year for the Center. We were able to fund three research projects (one for the second year) and a summer fellowship. A very successful conference, "Maryland Water Policy- What Does The Future Hold?", was sponsored by the Center. Outstanding water experts from across the State focused primarily on future water supply issues. The agricultural, urban and industrial communities are going to be competing for the same limited water supply in the future. Drought years only exacerbate the future supply problem. In this regard, I want to call your attention to the RFP for the National Competitive Grants program announced in this newsletter. The thrust of this year's program is water supply. This program is funded at one million dollars. To our knowledge, Maryland has never been awarded one of these grants. To successfully compete for these funds, we would need to develop a cooperative proposal within the University and with some outside cooperators, like the U.S. Geological Survey. The Center is willing to facilitate in any way possible the development a successful proposal. Please contact us if you have any suggestions on how we could put together a winning program.

What Does the Future Hold?

On October 24, 2003, the Maryland Water Resources Research Center sponsored a Conference on "Water Policy in Maryland- What Does The Future Hold?", at the Stamp Student Union. Opening remarks were given

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by Nariman Farvadin, Dean, Clark School of Engineering. Allen P. Davis, Director Maryland Water Resources Research Center chaired the session. The Conference attracted an outstanding group of speakers, highlighted by the keynote speaker, Dr. M. Gordon Wolman of The Johns Hopkins University. University of Maryland faculty speakers included Dr. Matthias Ruth, Public Affairs; Dr. Doug Parker, Agriculture & Resource Economics; and Dr. James Cohen, Urban Studies and Planning Program. Water supply speakers included Dr. Roland Steiner, Washington Suburban Sanitary Commission, and Mr. Paul Swartz, Susquehanna River Basin Commission. Dr. Robert Summers,

Head of Water Management, Maryland Department of the Environment also spoke. One major issue discussed was that future urban, commercial and agricultural consumers will all be competing for the same limited water supply in the State.

A summary of several of the talks can be downloaded at the center website www.waterresources.umd.edu. Some selected observations from the Conference include:

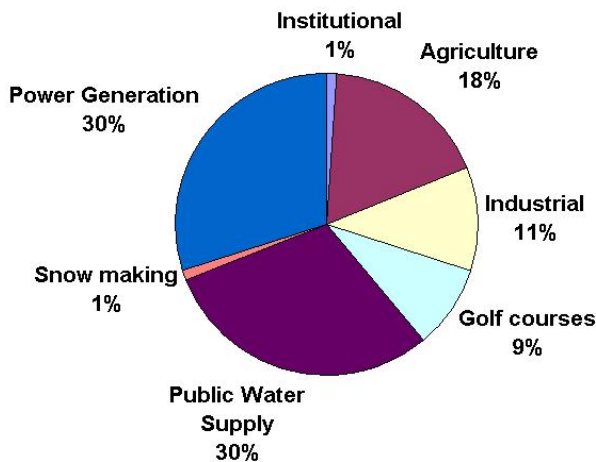
Users must be prepared to pay more for water in the future.

It will take decades to address some of the major water problems in the State

Many water problems exist in isolated areas without options or flexibility to solve these problems

Unlike Florida and New Jersey, Maryland does not have a comprehensive water supply plan prepared by any state agency

Based on a four states survey, including Maryland, there is currently a poor level of



coordination between water supply planning and growth management planning

Public water supply, power generation and agriculture are the major users of water from the Susquehanna River.

Conservation plans developed by the Washington Suburban Sanitary Commission shows that 4.2 million gallons per day (mgd) could be saved by the year 2009 (only 2.5 percent of current supply). The District of Columbia Water and Sewer Authority estimates that its water conservation plan will save 6 mgd by the year 2012.

The average flows from the Susquehanna River comprise over 50% of the freshwater inputs to the Bay, at an average rate of 18 million gallons per minute near Havre de Grace, Maryland.

Poster Contest Winners

As part of the Water Policy Conference, the Center sponsored a Poster Contest open to all graduate students. One of the objectives of



From top to bottom the winners are Holly Menninger, Eunyoung Hong and Rachel Gilker

the Contest was to provide conference attendees with a broad overview of the extensive water research programs underway at the University of Maryland. Seventeen posters were exhibited from an array of Colleges, Departments and Schools across the University

An outside panel of scientists judged the posters. The first prize winner was Holly Menninger, Department of Biology, *Terrestrial-Aquatic Linkages: Herbaceous Vegetation and Headwater Streams*, second prize was awarded to Eunyoung Hong, Department of Civil and Environmental Engineering, *Sustainable Oil And Grease Removal From Storm Water Runoff Hotspots Using Bioretention*, and third prize to Rachel Gilker, Natural Resources Sciences and Landscape Architecture, *Nitrogen And Phosphorus Concentrations In Surface And Groundwater Under Management Intensive Grazing*

RFP - National Competitive Grants Program

The U.S. Geological Survey in cooperation with the National Institutes for Water Resources requests proposals for matching grants to support research on the topics of water supply and water availability, which are issues of importance nationwide. Proposals are sought in not only the physical dimensions of supply and demand, but also quality trends in raw water supplies, the role of economics in water supply and demand, and institutional arrangements for tracking and reporting water supply and availability. For planning purposes, the amount available for research under this program is estimated to be \$1,000,000 in federal funds. Any investigator at an institution of higher learning in the United States is eligible to apply for a grant through a Water Research Institute or Center established under the provisions of the Water Resources Research Act of 1984, as amended. Proposals involving substantial collaboration between the USGS and university scientists are encouraged. Proposals may be for projects of 1 to 3 years

in duration and may request up to \$250,000 in federal funds. Successful applicants must match each dollar of the federal grant with one dollar from non-federal sources. Proposals must be filed on the Internet at <https://niwr.org/NIWR/> by 5:00 PM, Eastern Standard Time, March 1, 2004 and must be approved for submission to the National Competitive Grants Program by the MD WRRRC. The Government's obligation under this program is contingent upon the availability of appropriated funds.

2004 Funded Projects

Two new projects and one continuing project will be funded by the Center in 2004.

Leaf-Scale Hyperspectral Reflectance Models for Determining the Nitrogen Status of Freshwater Wetlands

David R. Tilley, and Andrew Baldwin,
Biological Resources Engineering

The objective of this project is to test the applicability of previously developed leaf-scale reflectance models over a broader nitrogen range and with other wetland species. Dr. Tilley and his co-principal investigator, Dr. Andy Baldwin, will develop models that predict wetland nitrogen conditions based on narrow spectral bands of visible and near-infrared radiation reflected from wetland plants. The photopigments (e.g., chlorophylls) of plants, which affect the reflectance pattern seen by the hyperspectral radiometer, are affected by nutrient conditions. In Dr. Tilley's earlier work in this area, he found that higher availability of ammonia could be detected from simple reflectance indices based on narrow spectral bands in the blue and red portions of the visible spectrum. The specific objective is to experimentally examine how narrow spectral band reflectance indices (e.g., PRI, RE, R678/R493) vary between three common species of wetland plants across a nitrogen gradient. This research project is an integral component of our larger goal of developing a boat-borne radiometer system for identifying nonpoint source pollution in wetlands.

***Beneficial Reuse of Baltimore Harbor
Dredging and Coal Fly Ash in
Engineering Applications and Effects on
the Chesapeake Bay***

Ahmet H Aydilek, Civil and Environmental
Engineering

Currently, a majority of the sediments dredged from the Chesapeake Bay are disposed on lands, such as Poplar Island. Dewatering of these disposed sediments has been a major issue for the Maryland Port Authority, and in some cases leaching of effluent with undesirable pH levels has occurred. Beneficial reuse of these sediments will reduce disposal by landfilling and provide the potential for conserving the environment. As part of the proposed study, reuse of the Chesapeake Bay sediments in two applications, slurry walls and landfill liners, will be evaluated. The stabilization of the dredged sediments can be obtained by addition of Class F fly ashes that have high organic carbon content. Widespread use of these fly ashes has not yet been realized. As a consequence, approximately 70% of the fly ashes are usually landfilled or stored in lagoons in Maryland. These applications have particular promise because fly ashes are fine-grained and thus impede the movement of contaminated liquids; that is, they generally have low hydraulic conductivity. Leaching of undesired constituents (i.e., metals) from the fly ashes into surface water has also been a concern; therefore it is believed that beneficial reuse of the fly ashes as part of landfill liners will prevent this problem. The proposed research focuses on developing a re-use for a waste material that is currently landfilled or impounded. It will be conducted in cooperation with a Maryland business (handling of the fly ash is managed by the Maryland Power Plant Research Program) generating the waste product. Concurrently, successful implementation of this research will address another important environmental issue-contamination of the Chesapeake Bay with inorganic and organic chemicals. Beneficial reuse of dredged sediments and fly ash will reduce landfilling

and will provide tremendous potential for conserving the environment.

2004 MWRRC Summer Fellow

Emily M. Deviller, a graduate student in Biological Resources Engineering has been awarded a Summer Fellowship by the Center. Her advisor is Dr. Jennifer G. Becker

***Using Bioaugmentation to Improve the
Biodegradation of Chlorinated
Compounds in Wetlands,***

Contamination of groundwater with chlorinated solvents, such as tetrachloroethene (PCE) and trichloroethene (TCE), is a serious problem at many sites within the United States. One such site is Aberdeen Proving Grounds. Discharges from several sources have led to extensive contamination of groundwater with a mixture of chlorinated organic pollutants. This is of concern because of the toxicity of the chlorinated pollutants to aquatic organisms. Natural attenuation is an inadequate treatment technology at these locations and engineered bioremediation approaches are needed to supplement naturally occurring anaerobic sediment and groundwater collected. The evaluations will be performed in the laboratory using anaerobic batch microcosms containing sediment and groundwater collected from a seep. The effect of bioaugmenting the seep with an enrichment culture will be evaluated by monitoring the concentrations of the parent and daughter compounds over time. The effect of the added enrichment culture on the structure of the seep bacterial community and its ability to survive in the seep system will be evaluated using a DNA fingerprinting technique, known as terminal-restriction fragment length polymorphism (T-RFLP). In T-RFLP, unique bacterial populations are distinguished based on differences in their 16S rDNA sequences. Thus, the loss of enrichment of specific populations following bioaugmentation should be evident in T-RFLP fingerprints of the total bacterial community processes at these locations. The effect of

bioaugmentation at a single seep that is contaminated with tetrachloroethane (TeCA) and TCE within the West Branch freshwater wetland area will be evaluated.

Common Household Water Uses*

Did you know how much water we use at home?

<u>Household Use</u>	<u>Amount Used</u>
Using tap water	1.5 gallons/min
Clothes washer	30-35 gallons/cycle
Dishwasher	25 gallons/cycle
Shower	2.5 gallons/min
Bathtub	50 gallons
Toilet	3.5 gallons/flush
Low-flow toilet	1.6 gallons/flush

* Taken from "Water-The Essential Resource," American Geological Institute, 2002

Update on Funded On-going Projects

Response of Macroinvertebrates to Road Salt Runoff in Headwater Streams

William Lamp, Entomology Department and Sandra Crane, MEES Graduate Student

We are studying the effect of road salt on macroinvertebrates in a headwater streams. Fourteen stream sites in Loudoun, Howard, and Montgomery counties, ranging from low suburban to high urban impact, have been selected to assess aquatic insect populations, and baseline and post-salting chloride and conductivity levels. Funded by USGS, the study is looking at environmental effects associated with increased salt levels in streams following snow and ice events in the metropolitan Washington, DC region. Unlike urban/suburban areas in northern latitudes, in this region, extensive salting of roads is often followed by relatively quick melting, which may lead to toxic levels of salt in streams. Osmoregulatory needs of freshwater macroinvertebrates make them vulnerable to acute levels of salinity, although species vary in their tolerance. NaCl addition experiments in an unimpacted stream and in the laboratory on different

species will provide information on mortality and drift responses. This study is also examining the relationship of conductivity and salinity across a series of streams draining different amounts of impervious surfaces and subject to different chemical inputs. While road salting is necessary to ensure safe winter travel, this study may identify adverse impacts to headwater stream systems that can be ameliorated by reducing the amount or timing of salting in suburban areas.

Fate of Alkylphenolic Compounds in Wastewater Treatment

Alba Torrents, Civil and Environmental Engineering and Clifford Rice, Environmental Chemistry Laboratory, USDA ARS, Beltsville, MD

Our group at the University of Maryland and the Environmental Quality Lab (USDA, Beltsville) is studying the fate of alkylphenolic compounds in wastewater treatment plants (WWTPs) and a subestuary of the Chesapeake Bay. These compounds are of interest to the environmental community because they are released into natural waters from WWTPs and other effluents, and they are suspected to interfere with the endocrine system of aquatic biota. We have developed state-of-the-art analytical methods to measure these compounds in water, sediment and sludge that have recently been published by the *Journal of Analytical Chemistry*. We are currently working to gain a better understanding of their transformations in WWTPs and receiving waters by studying them in local WWTPs and the Back River in Baltimore.

Some of our preliminary work clearly illustrates how the WWTP outflow contributes nonylphenol (NP) into Back River. We have observed that the amounts of the alkylphenol ethoxylates (APEOs) decreases as the distance from the WWTP outfall increases. The outfall in this case is in sample 7615, and the mouth of the Back River to the Chesapeake Bay is site 4660. At this point we don't know if this decrease is due to

degradation or partition to solids and sediment, or a combination of all factors. We have also observed important seasonal differences; these data are from January, in the summer the profile of the compounds is similar, although the concentrations are almost ten times lower. The ultimate goal of this research is to model the behavior of this family of pollutants in order to evaluate the impact of modifying operation parameters of the WWTPs in the amounts of alkylphenolic compounds released into the environment.

Featured Scientists

Dr. David Tilley



Dr. David Tilley is an assistant professor of ecological engineering in the Biological Resources Engineering Department and Natural Resources Management Program at the University of Maryland, College Park. David moved to Maryland in 2001 after working as an assistant professor of environmental engineering at Texas A&M University—Kingsville for two years. He was attracted to Maryland by an opportunity to join one of the nation's top ecological engineering graduate programs. Ecological engineering is a new field that combines natural and applied sciences, especially systems ecology, with the discipline of engineering to design, construct, analyze, and manage ecosystems and to develop eco-technologies.

David's academic program includes teaching several courses in ecosystems science and engineering, and advising undergraduate students in the newly created Environmental Restoration and Management major offered through the University's Environmental Science and Policy Program. This is an exciting new area for environmental students passionate about restoring the environment. David also teaches a computer applications course, Information Technology for Ecosystem Management, geared toward environmental students, which includes word processing, data analysis and management with spreadsheets, GIS, and simulation modeling. In Fall 2003 he taught a University Honors course, Ecology, Energy and the Future, which had the students review the role of the environment in shaping human history as a platform for thinking about our shared future. At the graduate level, David offers Ecological Decision Making through the Marine-Estuarine-Environmental-Science program. This Spring semester he will be leading a seminar entitled Created and Restored Wetlands where topics will include wetland design, vegetation effects on bacterial and nutrient removal, and wetland energetics and economics.

In the Ecosystem Engineering Design Lab, directed by Dr. Tilley, the research theme is to understand and design ecologically engineered systems and technologies that simultaneously benefit humans and nature. One area under investigation is the use of biofilters to remove carbon monoxide (CO) from contaminated air. CO is a deadly human poison responsible for 500 unintentional deaths and 21,000 poisonings in the U.S. each year. Bacteria and fungi growing on compost media in the biofilters use the CO as an energy source, thus removing it from the air. Early tests have shown promising results with removal efficiencies of over 50%. Priti Ganeshan, a master's of engineering candidate in Biological Resources Engineering, is conducting further experiments to expand on early results.

Dr. Matthias Ruth



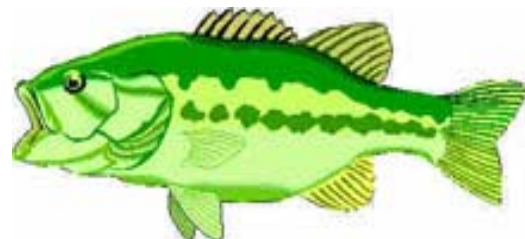
Dr. Matthias Ruth is the Director of the Environmental Policy Program at the School of Public Affairs and Professor of Environmental Economics and Policy, University of Maryland.

Dr. Ruth studies and helps Prepare for Climate Impacts on Urban Infrastructure. Infrastructures such as transportation networks, energy grids, water supply and flood control systems are vital components of any modern economy. They have typically low turnover rates, are costly to upgrade and replace, depend in their performance on each other, shape, and are continuously shaped by the social and economic landscape of which they are an integral part. Engineers have long recognized how infrastructures are affected by climate variability, though few have begun to collaborate with social scientists and decision makers to explore how climate change may affect infrastructure performances and how adverse impacts on one infrastructure system ripple through to affect others and the economy. A notable exception is the CLIMB ("Climate's Long-term Impacts on Metro-Boston") project funded by a US EPA STAR Grant and lead by Professor Matthias Ruth at The University of Maryland 's School of Public Affairs and Paul Kirshen of Tufts University's Department of Civil and Environmental Engineering.

"If, for example, the frequency and severity of adverse weather events change, yet our design criteria and standards for existing

and new infrastructures continue to be based on historical observations, then we will make our local and national economies increasingly vulnerable to major disruptions" says Ruth. In an effort to better understand potential impacts and to prepare for them, the more than a dozen researchers involved in CLIMB have closely collaborated with nearly 200 stakeholders from over a hundred communities in Metro Boston. "Our intent with CLIMB was not only to explore vulnerabilities of the metropolitan infrastructure to climate variability and change but to see how we may best anticipate and adapt to the changes in climate ahead. We are now in a position to deliver insights for investment and policy making "

As CLIMB meets its goals, Professor Ruth and his colleagues begin to expand their research to investigate climate impacts on infrastructure "at the southern end of the east coast megalopolis". With an eye towards follow-up projects, Ruth points out that "ultimately, we want to be in a position to know what is likely to happen here in the National Capital Region, and up in Boston, and much of what lies in between. This is economically, culturally, socially and politically too important a region to overlook the potential large-scale disruptions ahead."



Maryland Water Resources Research Center

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