The PSM Program in Water Resource Management: One Year and Growing

Assessing Lead and Copper in Drinking Water at the University of the District of Columbia

Recertification Symposium for Swimming Pools Helps Assure Safe Summer Recreation

The DC Area Water Issues Program Brings Focus to Water Education

A boat trip on the Anacostia River, documentary film premieres, and a river-themed art showing—all were part of the mix in the “DC Area Water Issues Program” (DCAWIP), a 14-session series of lectures and events organized by the University of the District of Columbia’s College of Agriculture, Urban Sustainability and Environmental Sciences (CAUSES). Offered as a pilot program during the Fall 2010 semester, DCAWIP was a comprehensive, multi-disciplinary exploration of the science, engineering, policy, and socioeconomic aspects of water and watersheds in the DC area.
Partnerships Mean Shared Success for Water Resources

The water resource issues and problems of the District of Columbia, like everywhere else, reflect their location, climate, and hydrology. And, as is true of most large municipalities, particularly in the northeastern states, DC faces challenges of maintaining high-quality drinking water, stormwater management, an increased need for watershed-based water resources management, aging infrastructure, and the ongoing demand for expanded water supplies in the face of population growth and the added pressures of climate change. But DC contends with other factors that present unique challenges—as well as also opportunities—for protecting and managing water resources. Establishing new and strengthening existing partnerships to leverage limited funds while solving DC water resources problem definitely means shared success for our stakeholders.

The Federal Factor
The District of Columbia has a total area of 68.3 square miles (177 km2), of which 61.4 square miles (159 km2) is land and 6.9 square miles (18 km2) (10.16%) is water. The federal government’s structure impacts the manner in which DC’s government institutions and agencies can manage and protect its water resources, as well as the manner in which water issues can be communicated to area residents. At the same time, it’s a major economic driver, accounting for about 27% of the jobs in Washington, DC in 2008.

A Shared Watershed
The District has three major natural flowing streams: the Potomac River and its tributaries, the Anacostia River and Rock Creek. (Tiber Creek, which used to flow through the National Mall, was fully enclosed underground during the 1870s.) The city is located on the north bank of the Potomac River and is bordered by the states of Virginia to the southwest and Maryland to the other sides.

DC is part of several regional watershed protection and management efforts. With its headwaters in West Virginia and Virginia, the Potomac River forms the western boundary of Maryland before reaching DC, where it forms the western boundary between DC and Virginia. The Anacostia flows from its headwaters in Prince George’s County, Maryland, before joining the Potomac River. As a downstream “state,” DC relies heavily on coordination with other states for protection of its source waters. After exiting DC, the Potomac River flows into the Chesapeake Bay. Thus, DC is also part of larger regional efforts for the protection of Chesapeake Bay.

Population Flows Across Borders
Commuters from surrounding Maryland and Virginia suburbs significantly impact water use in the city. DC has a resident population of 599,657, but during the workweek that population rises to over one million. The Washington Metropolitan Area, of which the District is a part, has a population of 5.3 million, the ninth-largest metropolitan area in the country. In an area of less than 70 square miles, the six major universities located in DC serve a large student population from across the region, the nation, and the world. These universities and other institutions provide employment and services to hundreds of thousands.

A Multicultural, International Mix
The city’s multicultural population makeup includes a high percentage of immigrants (along with foreign-born professionals and diplomats working in international organizations and embassies based in DC). The District’s population is more than 55% Black or African American; Hispanics of any race comprise 8.3%. An estimated 74,000 immigrants were living in Washington, DC in 2007, with major sources of immigration including El Salvador, Vietnam, and Ethiopia. This cultural mix, the level of transience, and the presence of language barriers complicate communicating about water issues to residential populations.

All of these factors cited make DC a vibrant, dynamic city with abundant natural and human resources that WRRI can draw on to fulfill our mission. UDC’s location provides an enviable position to share productive partnering opportunities with other fine leaders in research, outreach and education. WRRI works with DC-based and other regional partners across state and other jurisdictional lines to address our common water problems. The academic community, local and federal government water and environmental agencies, along with nonprofit advocacy organizations, are just a few of these partners working towards shared successes.

Please continue to follow our progress and support our endeavors to provide research-based solutions to water resources problems. Through communication of our findings in Water Highlights and other outreach media, we hope to increase the knowledge of the citizens and institutions of our city, thereby encouraging behavior that will sustain a healthy water environment in Washington, DC.
The DC Area Water Issues Program
BRINGS FOCUS TO WATER EDUCATION

A boat trip on the Anacostia River, documentary film premieres, and a river-themed art showing—all were part of the mix in the “DC Area Water Issues Program” (DCAWIP), a weekly series of lectures and events organized by the University of the District of Columbia’s College of Agriculture, Urban Sustainability and Environmental Sciences (CAUSES). Offered as a pilot program during the fall 2010 semester, DCAWIP was a comprehensive, multi-disciplinary exploration of the science, engineering, policy, and socioeconomic aspects of water and watersheds in the DC area.

“While the District of Columbia includes several major universities, there is no cohesive water research community, nor is there any individual university with a strong and multidisciplinary water research focus,” said Dr. Tolessa Deksisssa, the Principal Investigator of DCAWIP and the Director of the UDC Professional Master’s Degree in Water Resources Management. Gathering together and involving DC area water stakeholders on a regular basis through the DCAWIP provided a means for diverse members of the water community to exchange information, expertise, and solutions.

The Water Community Responds
Dr. Deksisssa, working with Dr. Cat Shrier, President of Watercat Consulting LLC, crafted the program around several broad themes:

- A “Getting to Know” DC Area Water Issues, including DC’s water resources and infrastructure overview, water quantity and quality, and the need for regional cooperation to address those issues
- Water workforce development and training, advocacy and volunteer opportunities, and funding water education and research projects
- Advanced topics related to wastewater treatment and reuse, and community-based water resiliency for a changing climate.

The WRRI Advisory Board was instrumental in the early planning stages, Dr. Shrier noted, while later speakers “were identified through extensive outreach, with help from university and Cooperative Extension staff, to area watershed groups, community and professional organizations.”

The final DCAWIP format included a lecture by a water specialist or organizational representative, followed by an open discussion with the audience and an informal reception. The weekly seminars and receptions were supplemented with several events designed to encourage greater appreciation for and understanding of DC area water issues. These cultural and literary dimensions of water issues reminded participants of the power of the imagination in finding creative approaches to water problems. As presenter Irv Sheffey of the Sierra Club stated, “If we can ‘re-story’ our rivers, we can restore our rivers.”

“I was very heartened by the support and participation of all of the lecturers, sponsors, and participants,” Dr. Deksisssa affirmed. “They gave generously of their time, enthusiasm, and in-kind support. Their contribution to the excellence of DCAWIP was enormous.”

Key Participation of Students
Part of CAUSES’s mission is to provide a sustainable bridge from college to the world, and for that reason the role of students was a centerpiece of the Water Issues program—and their support was critical to the success of the program. Internships and volunteer opportunities went to students from UDC, Catholic University and Howard University as well as the University of Maryland.

“Real World” Outcomes
Through the formal lectures and informal interaction among participants, several tangible results emerged from the Water Program including:

- Identification of funding opportunities for research, including funding for the National Capital Region Flood Risk Assessment Program
- DC Water Resources Research Institute grant proposals submitted based upon information received during DCAWIP programs, including the Metropolitan Washington Public Officials Water Leadership Program
WRRI Research Projects

As part of a federal/state partnership in water-related research, information transfer and education, WRRI provides interdisciplinary research support to identify water and environmental resources and problems in the Metropolitan DC area, and contribute to their solution. Listed below are summaries of Seed Grant-supported research completed in FY 2009.

**Dr. Seon Ho Kim’s** project, “Development of a Fast Optimization Technique using Interactive Spatial Join for GIS Application in Water Resources,” studied two statistical approaches for estimating spatial joins on quad-tree indexed raster data, namely, Probabilistic Joins (PJ) and Incremental Stratified Sampling Joins (ISSJ). The proposed framework combines two statistical approaches to allow fast interactive data explorations and the opportunity for the user to then drill down with full spatial joins if desired. Experimental evaluations on real and synthetic datasets showed that the proposed PJ method resulted in reasonably accurate results with near zero response time. The ISSJ method, while not as fast as PJ, provides results with bounded confidence intervals up to an order of magnitude faster than full quad-tree join. The framework can be used to build an end-user query visualization tool that allows true interactive exploration of large raster based GIS databases. This study used synthetic data for the evaluation of the proposed techniques. Future investigation includes evaluating the PJ method using real water resource dataset.

**Dr. Pradeep Behera**, in Phase II of his project, “Development of Web-based Rainfall Statistical Analysis Tools for Urban Stormwater Management Analysis,” developed a rainfall statistical analysis tool that is extremely useful for urban stormwater modeling, especially for analytical probabilistic models. This project addresses the often cumbersome analytical models of rainfall data. With this model, engineers and modeling professionals in any part of the nation can utilize the data to obtain the rainfall statistical parameters. Even though the application described throughout this paper is still in active development, there is already a short, but growing, list of feature requests. Chief among the requested features is the ability to upload files containing National Climatic Data Center (NCDC) data from multiple locations. The NCDC does provide consolidated files of this type already, so providing a mechanism by which these files can be utilized is a top priority. Incorporating this feature, and integrating a simple database of the locations of each station (latitude and longitude) stored by the NCDC, would allow other features, such as the ability to generate maps, to become realistic possibilities. While some differences in functionality between the command-line version of the application and the web-based interface still exist, in the near future these disparities will be rectified, bridging the gap between the two interfaces. It would also be extremely advantageous to bring the full suite of plotting functionality provided by the Matplotlib library into the user interface, allowing individuals to have much greater control of their graphical output.

**Dr. Byunggu Yu’s** project “Application of Spatiotemporal Informatics to Water Quality (Phase II),” investigated the problem of continuous monitoring of urban runoff at outfall points. This report presents the conceptual basis, technical details, and experimental results of a newly developed remote monitoring solution based on an advanced sensor platform. A prototype and accompanying algorithms were developed using the Sun SPOT as a sensor platform. Consequently, the collected accelerometer data were processed and analyzed in various ways to quantify the amount of water flow in the pipe. The experimental results demonstrated that this approach has great potential to measure the water quantity with any desirable precisions required in real applications of urban runoff monitor.

See Research Projects on page 7
The Professional Science Master’s (PSM) Program is a unique professional degree that combines graduate studies in water quality, water quantity, and environmental sciences with coursework in business, management or policy. Launched in Fall 2010, it is the first PSM in Environmental Science of any Historically Black College or University (HBCU) in the nation. It is one of three new graduate programs in the College of Agricultural, Urban Sustainability, and Environmental Science. The hands-on program prepares graduates with effective science communication, problem-solving, and entrepreneurship skills matched with the latest technical knowledge needed for the increasingly important field of water resource management.

A Flexible and Relevant Curriculum for a Field in Demand
The seven students who enrolled in the PSM inaugural class reflect the multidisciplinary nature of the program. They come from academic backgrounds and work experiences ranging from computer science, forestry, business, and environmental science to archeology and kinesiology. “There are so many fields that deal with water quality or quantity,” said PSM student Rachel Perry. “In this program we learn the gamut of skill sets that are necessary to manage water resources.”

PSM students hone their technical expertise in UDC’s new, state-of-the-art environmental quality laboratories. There are opportunities to attend and present at professional conferences and to participate in other special projects on the UDC or partner university campuses. Second-year PSM students gain practical experience in their chosen workplace internship.

Career opportunities in water resources are almost limitless, with employment prospects in data collection and analysis, water resource planning, river system management, water quality investigation, groundwater studies, project management, consulting, entrepreneurship, research and teaching.

Program Requirements
Working professionals who have a B.S. degree with a strong background in math, science or engineering are encouraged to apply. Applicants must also meet university-wide admission requirements. Admission criteria include but are not limited to the GRE, GPA, references, personal statements, and relevant work experience. Students must also have basic knowledge of information technology. A minimum of 35 credits is required to graduate, and the program can be completed in two years by full-time students.

For more information on the PSM program in Water Resources Management, please contact Program Director Dr. Tolessa Deksissa, psmwrm@udc.edu, (202) 274-5273 or visit www.udc.edu/causes/environmental/psm.htm
Recertification Symposium for Swimming Pools Assures Safe Summer Recreation

The summer months mean the arrival of hot weather in the D.C. area and the advent of vacation for the youngsters. With 25 outdoor pools, eight spray parks, and 10 indoor pools—and free admission for DC residents—DC swimming pools provide an attractive option for recreation and to beat the heat.

All those pools require cleanliness, safety and high maintenance standards for the benefit of the users. The Recreational Specialists of the DC Parks and Recreation Aquatics Division are the “frontline troops” for these important tasks, especially application of pesticides. Every year, these Specialists are required to participate in training sessions to keep their skills up to date and learn the latest District and federal pesticide regulations and enforcement policies.

On May 23 and 24, 28 specialists attended the Pesticide Applicators Recertification Symposium for Swimming Pools at the University of the District of Columbia. Donald “DJ” Wright, president of H.C. Harrington Company, a distributor of swimming pool equipment and supplies, provided an overview of aquatic safety, handling of pool chemicals, and pool mechanical systems. Alvin Harris from the Pesticide Division of the District of Columbia Department of the Environment presented on regulation and enforcement policies. The event was hosted by UDC’s Cooperative Extension Service and Water Resources Research Institute in the new College of Agriculture, Urban Sustainability, and Environmental Science (CAUSES).

Participants represented public and school pools, both indoor and outdoor. Throughout the symposium, the presenters stressed the importance of safety standards. The powerful chemicals necessary for pool sanitation require utmost care, management, and monitoring by the specialists (Pool chemicals are considered pesticides). Specialists must know how to identify and prevent mechanical hazards involving the pool circulation and filtration systems. They are responsible also for testing and adjusting the pool water for clarity and chemical balance, not only for desirable aesthetics, but to safeguard against the spread of infection from bacteria such as giardia, E. coli, and cryptosporidium.

All participants received a certificate of completion at the end of the symposium. “I learned a lot about the proper guidelines to follow,” said one participant. “It was very enlightening, and I’m glad I had the opportunity to participate.”

UDC is proud to be part of helping to keep community recreational facilities clean, safe, and enjoyable. Happy splashing!

Assessing Lead and Copper in Drinking Water at the University of the District of Columbia

WRRI is committed to supporting students in planning and carrying out their own research projects to gain research experience. The abstract below describes a recent project by UDC Electrical Engineering student Matthew Timmerman.

The purpose of this study was to assess and determine whether our university’s drinking water system met the EPA Lead and Copper Rule standard. Exposure to lead and copper may cause public health problems ranging from stomach distress to brain damage. The EPA published the Lead and Copper Rule in 1991, and amended it in 2007 as a standard for monitoring, treatment processes, public education, customer awareness, and lead service line replacement.

Lead and copper enter municipal drinking water primarily through the corrosion of lead-based service pipelines and other plumbing fixtures. Water characteristics, such as pH, hardness, and temperature affect the amount of leaching. Samples were collected randomly from water fountains as well as bathroom and lab faucets at different locations throughout the university, and analyzed for lead and copper concentrations using a Hach Lead/Copper Scanner, HSA 1000. Our preliminary assessments indicate that samples collected from frequently used water fountains and faucets meet the lead and copper EPA standards, while less frequently used water fountains and faucets were above the EPA limits of 15 ppb for lead. This study requires further comprehensive assessment to determine sources of lead contamination.
Future Plans
Follow-up surveys confirmed that DCAWIP was enthusiastically received by participants. The program consistently had at least 30 attendees, with two sessions each totaling more than 50 attendees.

Dr. Valbona Bejleri’s project, “Modeling Model Uncertainty for Storm Water Quantity and Quality Analysis in DC Urban Area,” investigates statistical methodologies aiming to model the uncertainty associated with parameters of an environmental model. An empirical Bayesian approach combined with Regression analyses was used to estimate the uncertainty associated with hydraulic model parameters of river water quality models. Reliability of estimates obtained from different models is directly related to the management decisions in environmental or water resource management, i.e., for reducing combined sewer overflows (CSO) or improving surface water quality in the District of Columbia. Due to their prediction capacity and cost effectiveness, mathematical models have become an attractive tool. Model output is an estimate of the real measurement and, therefore, its reliability depends partly on the relevance of model parameters and data gathered. This report presented some preliminary results that help to better understand the behavior of an environmental model. A method for estimating the amount of uncertainty in the hydraulic model parameters of river water quality model was introduced. Analysis shows that beta does not differ much among two segments, while alpha appeared to be very different.

In the project, “Clam Active Biomonitoring and POM Passive Monitoring for Anacostia Watershed Contaminant Point Sources,” Dr. Harriette L. Phelps confirmed and extended knowledge of chlorodane and PCB (Polychlorinated biphenyl) contaminant point sources in the Anacostia watershed. Use of POM (Polyoxymethylene) strips was explored as a new method for PCB congener analysis that could replace ABM (active biomonitoring). POM measured 86 PCB congeners while ABM measured 17 PCB congeners. POM detected mono congeners and ABM did not. POM plastic strips absorbed about twice the weight of PCBs as ABM clam tissue. However, if PCB congeners 5, 8 and 28 are not included, then ABM and POM results are statistically the same. PCB congeners 5, 8 and 28 were high for POM but not reported for ABM. POM and ABM detected a relatively similar pattern of di, tri, tetra, penta and hexa PCB congeners with an emphasis on the lower molecular weight congeners (di, tri, tetra). ABM did not detect mono chlorine PCB congeners. These heavier congeners are more toxic and found in fish. Publicity about these projects has generated increasing interest and involvement of citizen stream groups and the Maryland Department of the Environment in finding Anacostia watershed contaminant point sources. Point source contaminant remediation requires problem recognition by state environmental agencies, leading to EPA involvement. This has been an important first step towards controlling Anacostia River’s toxicity.

Dr. Xuequing Song’s project, “Specification of Some Triorganotin Compounds in Anacostia and Potomac River Sediments using NMR Spectroscopy,” the speciation of three tributyltin compounds (TBTs) --tributyltin chloride (TBTCl), Bis(tributyltin) Oxide (TBT0) and tributyltin acetate (TBT0Ac)-- was studied by NMR spectroscopy under varying pH conditions (5, 7 and 9) in both anaerobic and aerobic Anacostia River sediments. All TBTs were found to first convert to a hydrated TBT species, with further decomposition depending on the speciation time and the nature of the sediments. The 119Sn NMR chemical shifts of the spiked sediments indicated that changes in the pH did not affect the speciation of the tin compounds in either aerobic or anaerobic sediments. Dealkylation to mono/dibutyltin species was observed when speciation time is 4 weeks or longer. This dealkylation is very limited as the signal around -341 ppm is very weak for all sediment samples. This would suggest that the decomposition of toxic TBTs to low toxic DBT or MBT should take more than 8 weeks in sediment. A comparison of the strength of signal of dealkylation species and undecomposed TBT species revealed that only less than 5% was decomposed to less toxic DBT or MBT.
STAKEHOLDERS:
- Residents of the District of Columbia
- DC Local Government
- DC Bureau of Environmental Quality
- DC Water and Sewer Authority
- DC Local Schools and Universities
- DC Non-profit Environmental Organizations
- Water resources management private industries
- US Environmental Protection Agency (EPA)
- US Geological Survey
- US Department of Interior
- US Department of Agriculture
- Interstate Commission on the Potomac River Basin
- Anacostia Watershed Restoration Committee
- Chesapeake Bay Foundation
- Chesapeake Bay Program Scientific and Technical Advisory Committee
- The National Institute for Water Resources

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