Water HIGHLIGHTS

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WATER RESOURCES RESEARCH INSTITUTE
Community Outreach & Extension Services
University of the District of Columbia

PHOTO BY MARY FARRAH

FEATURE

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The DC Water and Sewer Authority (WASA) has introduced the addition of Orthophosphate (H_3PO_4) into the city's drinking water supply as a means to control and prevent lead from leaching into treated municipal water.

PHOTO BY MARY FARRAH

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Community Outreach and Extension Services • University of the District of Columbia
4200 Connecticut Avenue, N.W. • Washington, DC 20008

Director's **MESSAGE**

In an effort to assist in ascertaining and maintaining high drinking water quality in the District of Columbia, the Water Resources Research Institute (the Institute) awarded two seed grants for research projects; one was to determine the economic impact of DC drinking water quality on the residents and the other to develop a biosensor for advanced detection of drinking water pollution. The Institute is also working with the DC Cooperative Extension Service, the School of Arts and Sciences and the School of Engineering and Applied Sciences to establish an EPA certified Water Quality Testing Laboratory. We anticipate that the lab will be fully functional after the 2006 summer and will proceed to achieve EPA certification in five years. This lab will allow the Institute and the Extension Service Water Quality Education Program the opportunity to serve as an unbiased monitor of DC drinking water quality through random sampling and testing of residential homes and public/private facilities.

The environmental quality of our Anacostia River continues to be the most urgent long term water resources problem in the District, hence three seed grants were awarded for research projects in this area. The importance of storm water management and reducing runoff has also become even more critical thus, the Institute, in conjunction with the School of Engineering and Applied Science has hired Dr. Pradeep K. Behera through a tenure-tracked teaching/research faculty joint appointment. Dr. Behera possesses a vast research experience in the area of storm water management and his scientific findings have been published in peer reviewed journals and books. He will be working closely with the Institute as a Research Associate Professor. Dr. Tolessa Deksissa has also joined the Institute as a full-time Research Associate. He will work with modeling software for predicting the movement of pollutants into DC water resources. His research interests include water quality analysis and modeling, environmental risk assessment, organic contaminant transfer in environment and the dynamic integrated modeling of fate and effect of conventional pollutants and organic contaminants in surface waters. His scientific findings have been published in peer-reviewed journals and books.

The Institute collaborated with the School of Engineering and Applied Sciences at the University of the District of Columbia to sponsor the International Conference on Renewable Energy for Developing Countries (ICREDC-06) held April 6-8, 2006 at the OMNI Shoreham Hotel. This was one of the first conferences of this kind, addressing not only the needs and importance for renewable energy sources in the developing world but also what designs are available. Various applications were presented that could literally transform the lives of people, especially in the area of water availability. Mr. David Garman, the Under Secretary of Energy from the U.S. Department of Energy and Congressman Mike Honda (D) of California were guest speakers. The School of Engineering and Applied Sciences Center of Excellence for Renewable Energy (CERE) was inaugurated. A demonstration site, with a combination of a solar photovoltaic panel that can reposition itself to face the direction of maximum sun exposure and a wind powered turbine that can generate energy to pump water from a depth of more than 100 feet, was also highlighted. The Institute and the Cooperative Extension Service will add a solar powered weather station to the site this fall.

> **"The Cooperative Extension Service/Water Quality Education Program Extension Agent, Ms. Wellela Hirpassa, has had a significant impact on the Institute's information transfer and outreach capacity."**

The Cooperative Extension Service/Water Quality Education Program Extension Agent, Ms. Wellela Hirpassa, has had a significant impact on the Institute's information transfer and outreach capacity. She has prepared and distributed water quality education brochures and fact sheets to DC residents, conducted workshops on water quality education at various DC Recreation Centers and Public Schools, and visited DC Water and Sewer Authority (DCWASA) Water Quality Division for potential collaboration. She has also collaborated with USDA\CSREES National Water Program to enhance the Water Quality Education Program and is a member of the Mid-Atlantic Regional Water Quality Program Steering Committee. In order to ensure consistency and continuity in programs, the Institute has hired a Project Assistant that will assist in coordinating its day to day activities. Ms. Mary Farrah, a former two year student intern with the Institute, is a 2006 summa cum laude graduate from the University of the District of Columbia with a BS in Environmental Science and an Associate degree in Water Quality. Mary will provide regular information for our website update and our newsletter. The DC Water Resources Research Institute will continue to provide the District with inter-disciplinary research support to both identify and contribute to the solution of DC water resources problems. ■

WILLIAM HARE
Director of the Water Resources Research Institute

Orthophosphate:
A DOUBLE EDGED SWORD?

In 2004 the Washington Aqueduct introduced the addition of orthophosphate (H_3PO_4) into the District's drinking water treatment process as a means to prevent lead from leaching into treated municipal water (DC WASA). In this treatment process orthophosphate acts as a corrosion inhibitor, preventing water from dissolving the leaded service lines by precipitating into a protective coating inside the pipes, creating a physical barrier. This process was initiated in response to detecting lead levels exceeding the EPA Action Level of 15 ppb in 2002 in some of DC's drinking water (DC WASA). High concentrations of lead were found in 10 percent of tap water samples in the District. Orthophosphate is added as phosphoric acid, which is a Food and Drug Administration certified food-grade chemical (FDA). Orthophosphate has been successfully used to treat drinking water in many other cities throughout the country, but what are some of the other effects of orthophosphate?

When there is no precipitation, all the untreated wastewater is carried through a combined sewer system to the District's Wastewater Treatment Plant located at Blue Plains. The wastewater is cleaned and treated to EPA standards before the effluent is released into the receiving Potomac River. The District's CSO infrastructure was built in the 1920's to accommodate a population of approximately 300,000-350,000 residents. However, it has been observed that the capacity of the existing combined sewer system is inadequate, resulting in overflows during rainfall events ranging from as little as 0.1 to 1.7 inches (DC WASA). These untreated overflows are released through sewer outfalls into the Potomac and Anacostia Rivers, as well as Rock Creek and its tributaries. In addition to the phosphorus content present in untreated wastewater from biological functions and detergents containing phosphate, there is now the load of our lead free drinking water containing orthophosphate.

Phosphorous is an essential nutrient required for many biological functions in living systems, but what are the environmental ramifications of an increase in phosphorous? Because phosphorous is often found in forms that are chemically bound in a way that plants are unable to utilize- it can be the limiting nutrient and can therefore limit the amount of plant growth, particularly in fresh water systems. Orthophosphate as phosphoric acid is in a water soluble form that is readily available for plant use. The abundance of available nutrients, such as phosphorus, can cause algae to grow in proportions so large that it can potentially cause the body of water to become eutrophic. Eutrophication occurs when excessive nutrients in a body of water cause a dense growth of phytoplankton on the water's surface. The eventual decomposition process of the plant material depletes the dissolved oxygen content of the water, resulting in an environment where subterranean animals are unable to survive. This process can occur over a long period of time or it can happen at an accelerated pace due to the influence of human activities.

PHOTO BY MARY FARRAH

Combined sewer overflow (CSO) outfall in Rock Creek Park.

PHOTO BY MARY FARRAH

Downstream of CSO outfall in Rock Creek Park.

PHOTO BY MARY FARRAH

CSO outfall sign.

See Orthophosphate page 7

Dean's MESSAGE

Greetings,

As the Acting Dean of Community Outreach and Extension Services I am pleased to extend greetings on behalf of the University of the District of Columbia. I encourage you to read and really utilize the beneficial information in this issue of "Water HIGHLIGHTS" published by the DC Water Resources Research Institute (WRRI).

Under the astute leadership of William Hare, Director of WRRI, with the assistance of his highly qualified team – the Institute is providing quality services to District residents. The Institute works on cutting edge research to help improve the water conditions in the city, thereby improving the quality of life for its residents.

Please take a moment to read key articles in this second volume of "Water HIGHLIGHTS." Such articles cover an array of issues including "Low Impact Development Projects in the District of Columbia." Additionally, this issue highlights our newest WRRI team members Dr. Tolessa Deksissa whose focus is on innovative water resource tools, and Dr. Pradeep K. Behera whose research focus includes Water Resources Engineering and Urban Storm Water Management. The University continues its efforts towards improving conditions along the Anacostia Waterfront, as indicated in the article entitled "Institute Attends Anacostia Watershed Restoration Committee Meeting." You will also find that WRRI is active not only locally, but globally, as the University sponsored the International Conference on Renewable Energy for Developing Countries.

Again, it is my pleasure to extend greetings on behalf of the University. I trust that you will enjoy reading this second volume of "Water HIGHLIGHTS." The Water Resources Research Institute has provided a quality publication that is an informative and helpful tool in the effort to improve the conditions of the city's water resources.

Kind regards.

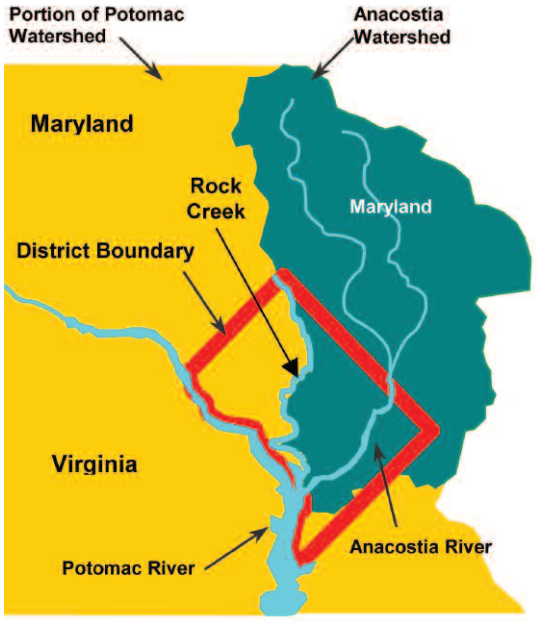
GLORIA WYCHE-MOORE, PH.D
Acting Dean
Community Outreach and Extension Services, University of the District of Columbia

Low Impact Development Projects in the District of Columbia

"Low Impact Development (LID) is an innovative storm water management approach with a basic principle that is modeled after nature."[1] It is used to "manage rainfall impact at the source using uniformly distributed decentralized micro-scale control."[1] Modeling "techniques that infiltrate, filter, store, evaporate, and detain runoff close to its source," rather than managing it at the end of sewer pipe is imperative to solving the ongoing water quality degradation of the urban environment.[1] The DC Water and Sewer Authority (WASA) will spend billions of dollars to implement the Combined Sewer System Long Term Control Plan (LTCP). The LTCP depends entirely on an "end of the pipe" technical solution and does not address problems associated with the District's sewer infrastructure, or the storm water problems caused by an increasing amount of impervious surfaces. Whenever it rains as little as 0.1 inches, the rainwater that cascades off streets, parking lots and other impervious surfaces overwhelm the present Combined Sewer Overflow System. This polluted runoff, along with garbage, sediments and raw sewage, is released directly into our water resources through 60 outfall pipes. In all, over 3 billion gallons of polluted storm water and raw sewage is released into these waterways each year. The Anacostia River alone receives two-thirds of these pollutants.

"LID addresses storm water problems through small, cost-effective landscape features located at the lot level. These landscape features, known as Integrated Management Practices (IMPs), are the building blocks of LID."[1] IMPs are the tools used in a Low Impact Development project for water quality treatment and flow control. The District of Columbia has the potential to implement IMPs. They include "rooftops, streetscapes, parking lots, sidewalks, and medians. LID has various benefits and advantages over conventional storm water management approaches. It is a more environmentally sound technology, and a more economically sustainable approach to addressing the adverse impacts of urbanization in the Washington DC area. By managing runoff close to its source through intelligent site design, LIDs can enhance the DC environment," minimizing storm water

See Low Impact Development page 15



WRRI Joins Casey Trees Endowment Funds' Community Tree Planting Program

The Casey Trees Endowment Fund was established in May 2001, and has done much to accomplish its mission of restoring the tree cover of the District of Columbia. They have cooperated with neighborhood residents and community organizations, city government, federal agencies, and others.

PHOTO BY MARY FARRAH

Casey Trees Endowment Fund plants trees on UDC Campus.

To date they have inventoried every street tree in the city, planted more than 1000 trees and seedlings in projects throughout the city, attended community meetings, and trained several hundred volunteers in the Citizen Forester program. They are presently engaged in a community tree planting program. The group was gracious enough to come to our very own campus here at the University of the District of Columbia. The staff members and interns of WRRI took the opportunity to take part in this event, at the invitation of Dr. Gloria Wyche-Moore. Dr. Wyche-Moore is the Dean of the Community Outreach and Extension Services family here at the University.

From 9:00am Saturday morning to 1:00pm that afternoon, the team from Casey Trees, the WRRI staff, and a host of other volunteers and trainees worked and enjoyed the day and the camaraderie. All attendants were given a quick lesson in the art of planting trees, and the techniques used by the professionals. Everyone who took part was afforded the opportunity to assist in every part of the tree planting process. The members of Casey Trees stayed close by at all times, offering advice and a helping hand every step of the way.

Chegon James, Rosana Aquilera-Becker, Mary Farrah, and William Hare volunteer with Casey Trees.

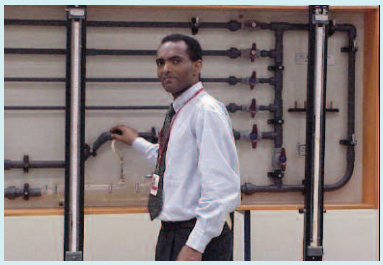
In all, 12 trees were planted. We are extremely grateful, having been able to participate in such an important event. WRRI would like to thank The Casey Trees Endowment Fund for a job well done. We are confident that this endeavor will go a long way in keeping the campus and city green and beautiful. ■

BY CHEGON E. JAMES

NEW TEAM MEMBER

Dr. Tolessa Deksissa just joined the Water Resources Research Institute at the University of the District of Columbia. As a research associate, he will be working on the development of innovative tools pertaining to water resource management.

Dr. Deksissa obtained a B.S. in agronomy in 1991 at Alameya University, Ethiopia; Master of Science in Environmental Sanitation at Ghent University, Belgium; and his doctorate degree



in Applied Biological Science: Environmental Technology at Ghent University, Belgium.

Dr. Deksissa is a highly trained research scientist who combines strong academic and site study experience in water quality assessment and management. His research interests include water quality analysis and modeling, environmental risk assessment, organic contaminant transfer in environment and dynamic integrated modeling of fate and effect of conventional pollutants and organic contaminants in surface waters. His scientific findings have been published in peer-reviewed journals and books. He is an associate member of Society of Environmental Toxicology and Chemistry (SETAC), International Water Association (IWA) and River Network.

TOLESSA DEKSISSA, PH.D., RESEARCH ASSOCIATE, Water Resources Research Institute • University of the District of Columbia • 4200 Connecticut Avenue NW • Building 42/Room 111 • Email: tdeksissa@udc.edu • 202-274-5273

The Potential Role of Dendrimer Nanotechnology in Water Treatment

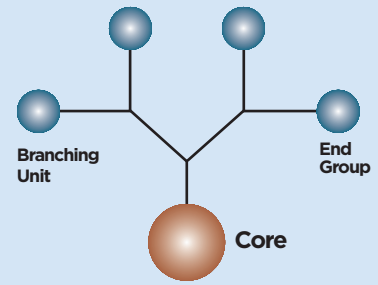
RECENTLY, DENDRIMER MOLECULES HAVE taken a major part in the emerging fields of science and technology, most specifically, nanotechnology. This is defined as the study, design, creation, synthesis, manipulation, and application of functional materials, devices, and systems through control of matter at the nanometer scale, in other words, at the atomic and molecular levels (Salamanca-Buentello). The rapid development of dendrimers is a critically needed nanoscale building block for the manufacturing of high performance materials that can have multiple applications.

The term dendrimer refers to a macromolecule with a highly branched structure and precise weight. Dendrimers are three-dimensional polymers and they consist of four main components: - a central core unit, - arms of identical size, - linking or branched points, and - end functional groups (Russell). Two major chemical environments are characteristic of a dendrimer: one including the exterior with the functional end groups, and the other including the interior of the sphere, also known as voids (Russell). The most important trait of these molecules is that they can accept guest elements in these mentioned voids and introduce the elements into an environment. In the case of water treatment, the guest molecule can be a dissolved ion or an organic molecule (Russell).

Unlike traditional polymers, which usually have a straight-chain design (one-dimensional), dendrimers have "discrete, quantifiable bundles" that are known to be mathematically precise (Russell). Thus, it is possible to design a specific dendrimer with the characteristics needed to target a determined molecule and the result is then more reliable and predictable, which is very advantageous in the control of chemical processes occurring in water.

The fact that dendrimers have a considerably large surface area makes them even more valuable since this implies that they would have a higher loading capacity. This, in turn, can help in controlling a wider range of organic or inorganic compounds, and metals. Another advantage in the use of dendrimers is their higher uniformity, lower toxicity, and multi-dimensional functionality when compared to "flat" homopolymers (Russell).

FIGURE 1. Main Components of a Dendrimer Molecule



> "The fact that dendrimers have a considerably large surface area makes them even more valuable since this implies that they would have a higher loading capacity."

In a recent report of the University of Toronto Joint Centre for Bioethics about Nanotechnology and the Developing World, it was stated that the third major application for this technology was water treatment and remediation. The report was published in April 2005, and it addressed the importance of nanotechnology as a powerful tool for solving major problems in the near future.

Currently, the National Water Research Institute is funding a project that studies the use of dendrimer nanotechnology to improve water treatment processes. The project, called "Recovery of Metal Ions from Membrane Concentrates by Dendrimer-Enhanced Filtration," seeks to

See Dendrimer Nanotechnology page 14

NEW TEAM MEMBER

Dr. Pradeep K. Behera recently joined the distinguished faculty of the School of Engineering and Applied Science at the University of the District of Columbia. As an Associate Professor, he is currently teaching Civil and Environmental Engineering courses.

Dr. Behera obtained a B.S. in Civil Engineering in 1987; a Master of Engineering degree in Hydraulics and Irrigation Engineering from Sambalpur University, India; and he earned his doctorate degree in Environmental Engineering from the University of Toronto, Canada. He was a recipient of the Canadian Commonwealth Scholarship. After his Ph.D., he was working as a water resource engineer in Toronto, Canada. Prior to his Ph.D. he was working as a faculty member in the National Institute of Technology, Rourkela, India.

Dr. Behera possesses a vast research experience and his scientific findings have been published in peer reviewed journals and books. His recent journal published papers include, "Runoff Quality Analysis of Urban Catchments with Analytical Probabilities Models" in the ASCE Journal of Water Resources Planning and Management, Vol. 132, No. 1 January- February 2006 issue. His research areas of interest include water resources engineering, urban storm water management, non-point source pollution, probabilistic and statistical modeling and sustainable urban water systems. He has been practicing engineering for the last 15 years. He is a Professional Engineer in Maryland, U.S. and Ontario, Canada and is an Associate Member of American Society of Civil Engineers. He will be working closely with the DC Water Resources Research Institute as a Research Associate and as a Professor.

PRADEEP K. BEHERA, PH.D., PE, ASSOCIATE PROFESSOR, Department of Engineering, Architecture & Aerospace Technology • University of the District of Columbia • 4200 Connecticut Avenue, Building 42 Room 213H • Washington, DC 20008
Tel: 202-274-6186 Fax: 202-274-6232 • Email: pbehera@udc.edu

UDC Sponsors the International Conference on Renewable Energy for Developing Countries

On April 6-7 of 2006, the School of Engineering and Applied Sciences at the University of the District of Columbia sponsored the International Conference on Renewable Energy for Developing Countries (ICREDC-06) at the OMNI Shorham Hotel. This was one of the first conferences of this kind, addressing not only the need and importance for renewable energy sources in the developing world but also what designs are available, economically feasible and how they could literally transform the lives of the people they touched.

Some of the speakers were David K. Garman, the Under Secretary of Energy from the U.S. Department of Energy, and Congressman Mike Honda (D). There were many choices of oral presentations, with topics ranging from the microfinance aspect of renewable energy to the use of solar-photovoltaics and thermal wind energy; from pico-hydropower plants and their applications to solar ovens.

The second day included at trip to the UDC Campus for the Inauguration of the Center of Excellence for Renewable Energy (CERE). The CERE has a solar photovoltaic panel that can reposition itself to face the direction of maximum sun exposure and a wind powered turbine, making it capable of harnessing enough energy to pump water from a depth of 100 feet. ■

BY MARY FARRAH

Views of CERE Solar Photovoltaic Panel and wind powered turbine.

PHOTO BY MARY FARRAH

PHOTO BY MARY FARRAH

PHOTO BY MARY FARRAH

PHOTO BY MARY FARRAH

Orthophosphate, from page 3

Another effect of the phosphorus presence in our water is an increase of bacteria. This can occur in the distribution system and in the receiving waters of CSO effluent, which are already contaminated with bacteria from the CSOs (Friends of the Earth). It's been found that microbially available phosphorus (MAP) was found to be a nutrient that limits bacterial growth (Polanska). According to a DC WASA press release in October of 2004, a routine test showed an increase in coliform bacteria that resulted in a violation of a federal drinking water standard. This occurred just months after incorporating orthophosphate into the water treatment process. The EPA, the DC Department of Health, and the Washington Aqueduct say that the increase in bacteria is probably caused by the addition of orthophosphate...and the warm summer weather (DC WASA).

In 2004, WASA and the federal government reached an agreement on how to limit CSO overflows. The agreement includes the construction of a series of tunnels under the city that will serve as storage for stormwater until it can be processed by Blue Plains and the elimination of 14 CSOs- among other actions (DC WASA). New developments and construction projects in the District now require separate storm water and sanitary sewers, thus preventing the overflow during rain events. While human health is the primary concern, environmental health is also an important issue that can affect the health of humans and the District resident's quality of life.

BY MARY FARRAH

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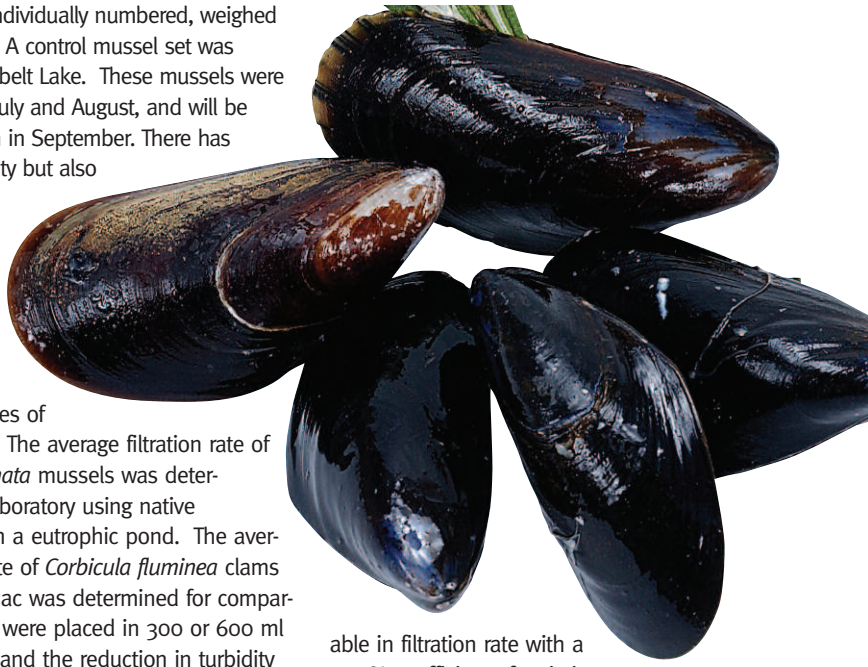
Use of Freshwater Mussels to Improve Water Quality within the Reflecting Pool at Constitution Gardens.

This is a one-year (2004-5) grant from the National Park Service to study the use of native freshwater mussels to improve water quality at the Constitution Gardens Reflecting Pool (next to the Lincoln Memorial Reflecting Pool). In the fall, the Constitution Gardens Reflecting Pool becomes turbid with dense microalgal blooms due to warm temperatures, extended daylight hours, and runoff from lawns, leaves, and goose droppings. The Asiatic clam *(Corbicula fluminea)* populations of the nearby Potomac River have been associated with reduction of Potomac microalgae blooms through filtration. The objectives of this project were to make observations on water quality of the Constitution Gardens Reflecting Pool, determine if native mussels can survive and grow in the Pool, determine filtration efficiency of native mussels, and estimate the biomass of mussels needed to reduce summer algae in the Pool.

For this project, in November 2004 three continuous recording temperature monitors were placed in the Constitution Gardens Reflecting Pool. In June 2005, the common local mussel, *Elliptio complanata,* was collected from the Potomac River and placed in shellfish bags at Constitution Gardens Reflecting Pool sites. The mussels were individually numbered, weighed and measured. A control mussel set was placed in Greenbelt Lake. These mussels were remeasured in July and August, and will be measured again in September. There has been no mortality but also no increase in mussel weight or size at any location.

There is little public information on the filtration rates of native mussels. The average filtration rate of *Elliptio complanata* mussels was determined in the laboratory using native microalgae from a eutrophic pond. The average filtration rate of *Corbicula fluminea* clams from the Potomac was determined for comparison. Molluscs were placed in 300 or 600 ml of algal culture and the reduction in turbidity recorded over two hours. The *Elliptio complanata* native mussels had a filtration rate average of 1.33 ml/hr/gm. The *Corbicula fluminea* clams had a filtration rate average of 10 ml/hr/gm, almost ten times the mussels. The native mussels were more than twice as variable in filtration rate with a 39.3% coefficient of variation compared to the Asiatic clam CV of 15.5%. ■



(Funded by the National Park Service)

Principal Investigator: Dr. Harriette L. Phelps

New Water Quality Testing and Environmental Simulation and Modeling Laboratories at the University of the District of Columbia

The DC Water Resources Research Institute, in partnership with the Cooperative Extension Service/Water Quality Education Program, the School of Engineering and Applied Science, and the Department of Biological and Environmental Sciences, has been working towards becoming an unbiased monitor of surface water, groundwater and drinking water quality in the District of Columbia. In order to achieve such goals, two environmental laboratories are being developed at the University. The two new laboratories will serve the research and training needs of our faculty,the students, as well as the training opportunities for water and wastewater quality operators for the DC Local Government Agencies.

Student Interns Bonnie Herriott and Gallus Balla-Ndoh.

With new and serviced equipment, the 'Water Quality Testing Laboratory' presently has the capacity to perform qualitative and quantitative analysis on water, soil and plant diagnostic parameters. The atomic absorption spectrophotometer has the capability to test quantitatively for metals in water, sediments, soils and plants while two new advanced au-

See New Laboratories on page 14

Institute Attends Anacostia Watershed Restoration Committee (AWRC) Meeting

The Anacostia Watershed Restoration Committee (AWRC) was established by the 1987 Agreement to support a coordinated and cooperative interagency partnership to restore water quality and habitat within the tidal river and its tributaries. On Monday September 19th, a meeting of AWRC was held at the Metropolitan Washington Council of Governments Board Room at 10 am.

Dr. Harriette Phelps, a Professor at the University of the District of Columbia, and researcher with the Water Resources Research Institute, invited former WRRI Student Intern, and UDC College of Arts and Sciences Graduate, Rosana Aguilera-Becker, to accompany her to the AWRC meeting. Ms. Aguilera-Becker holds her Bachelors of Science degree in Environmental Science, and was serving as the Institute's Project Assistant.

The session started with the rotation of AWRC chairs, the entering chair being Mr. Jim Collier, Chief of the Bureau of Environmental Quality, Department of Health. Among the people present at the meeting were members George Harman (former chair), Maryland Department of the Environment (MDE); Dr. Jonathan Essoka, EPA Region III, Dr. Ted Graham, Council of Governments (COG), representatives from the U.S Geological Survey (USGS), Chesapeake Bay Foundation, Army Corps of Engineers, and other alternates.

One of the issues discussed at the meeting was the MDE Anacostia Bacteria Total Maximum Daily Load (TMDL) update, presented by Mr. Harman, who explained that the fact that different standards between jurisdictions for TMDL for fecal bacteria in the Anacostia River was creating a bit of a controversy. Nevertheless, once the EPA has approved a TMDL, implementation of best management practices (BMPs) is expected to take place.

Chair Collier reported about the progress being made by the District of Columbia to create, by October 2005, a new Department of the Environment. Attendees expressed their concern about storm water management, and whether this new Department would promote more involvement in such a tangible problem in the District. Mr. Collier was reluctant to address this issue, which was referred to by one of the attendees as the "big elephant head on the table" that nobody talks about.

> "Attendees expressed their concern about storm Water Management, and whether this new Department would promote more involvement in such a tangible problem in the District."

Mr. Doug Siglin, Director of the Anacostia Program of the Chesapeake Bay Foundation, reported on recent attempts to reintroduce the Anacostia Watershed Initiative Act. The 2005 bill proposes an amendment to the Federal Water Pollution Control Act and Water Resources Development Act of 1992 as a means of "aggressively addressing the Anacostia's water quality restoration challenges primarily through the development of a mandatory action plan, as well as the authorization of funding for an advanced sewer and storm infrastructure," (Kaia J. Moyer).

The United States Geological Survey (USGS) scientist, Ms. Brenda Majedi, reported on the current status of two monitoring stations that belong to the project on Automated Water Quality Monitoring on the Northwest and Northeast Branch. The necessity of continuing this project beyond Spring 2006 was expressed by the presenter and evaluated by the attendees, who in its majority questioned the importance and future benefits of the data acquired at the monitoring stations due to the high costs of this project. Dr. Harriette L. Phelps, agreed with other scientists about continuing and implementing more monitoring programs on the Anacostia River's water quality, and mentioned that if costs were the main problem, bio monitoring could be a much less expensive option. Dr. Phelps has been working successfully with clams in the Anacostia to determine the levels of pollutants such as PCBs, PAHs, and Chlordanes.

Other subjects discussed during the session were the Anacostia Governance, where Dr. Essoka and Dr. Graham summarized the AWRC retreat and EPA-led "Transition Team" meeting highlights and the governance models discussed to date. A representative of the Army Corps of Engineers reported on the status of the Anacostia Reconnaissance Study and planning efforts related to the development of a plan for the restoration of the Anacostia watershed. The meeting was adjourned approximately at 1:30 pm. ■

BY CHEGON E. JAMES

A Study of the Effects of Aluminum-Laden Sediment on Potomac River Benthos

The purpose of this two-year (2004-2005) project is to assess the effects of DC water treatment plant discharge on native mollusc populations in the freshwater Potomac River estuary. Aluminum hydroxide floc used by the Army Corps of Engineers to purify Potomac River water is discharged into the Potomac at the water treatment plant below Great Falls. Ionic aluminum is known to be toxic to plants and fish. This study is funded by the National Park Service and carried out in connection with a US Geological Survey study on native mussel populations in the Potomac River.

Earl Greenidge weighs mussels.

The Asiatic clam, *Corbicula fluminea*, is an introduced species that has become a major molluscan component of the Potomac River benthos. Adult *Corbicula* are resistant to many pollutants, which accumulate in their tissues. The clams are used to study the bioavailability of freshwater contaminants. In 2004, this project examined aluminum in *Corbicula* tissues and shells above and below the Great Falls DC water treatment plant discharge site. Aluminum analytical variability was determined in shells and tissues. Clam shell aluminum concentrations were not significantly different among sampling sites. Clam tissue aluminum concentrations were significantly increased below Great Falls. Aluminum concentrations in Potomac River sediments were also determined. Below Great Falls, clams in mud had significantly lower tissue aluminum than clams in sand. Aluminum concentrations among clam tissues and the nearby sediments were not correlated.

Factors such as acidification and complexation are known to influence the effects of aluminum addition in fresh water. Laboratory studies were conducted with *Corbicula* exposed to aluminum sulfate (alum) 0.1 - 0.001 mg/l at pH 5 - 9. Highest tissue aluminum was at pH 7 but there was no consistent pattern of accumulation. In 2005, sediments were collected at 16 sites along the Potomac River below and one site above the DC water treatment plant discharge. Native mussels *(Elliptio complanata)* were collected at four sites. Asiatic clams *(Corbicula fluminea)* were collected at six sites. Aluminum concentrations in mussels, clams and sediments are being determined and will be examined for correlations. This data will be coordinated with the Potomac freshwater estuary mussel and clam population survey being conducted by the USGS Leetown Science Center. It is hoped to determine if aluminum levels in sediments are affecting molluscs in the Potomac below the Washington, DC water treatment plant discharge. Citation: Phelps, H.L. 2005. Effects of Aluminum-laden Discharge on Benthic Organisms of the Potomac River near Washington, DC: Year One. Studies with the Asiatic Clam, *Corbicula fluminea*. National Park Service, Washington, DC 8 pp. ■

(Funded by the National Park Service)

By: Dr. Harriette L. Phelps

Effect of Pelletized Poultry Manure on Vegetable Production and Vadose Zone Water Quality

The Chesapeake Bay Agreement signed by leaders of Delaware, Maryland, Washington DC, and Virginia promises a 40% reduction in the Bay's nitrogen and phosphorus level by the year 2010. This reduction campaign was initiated particularly because of a pfeisteria scare induced by the Bay's excess phosphorus and nitrogen levels from over application of chemical fertilizer and poultry manure in crop production areas. Eutrophication, caused by excess nitrogen and phosphorus, has also reduced the Bay's subaquatic vegetation significantly. The most recent Chesapeake Bay report, July 2002, indicates no improvement in the Bay's water quality. On a scale of 100, the Bay's environmental quality was graded as 27, which is extremely low. In fact, this grade did not change from the previous year regardless of clean up efforts.

Poultry manure produced from the Delaware, Maryland, and Virginia (DELMARVA) poultry industries is applied on farmland along with chemical fertilizer for crop production. However, a significant amount of unused manure is stored for future usage or remains to be disposed of. Perdue AgriRecycle, Inc. has cleaned, sterilized, and pelletized poultry manure for easy handling and movement in crop and vegetable production. This material has been analyzed for nutrient content; however, not much data is available to demonstrate it's effectiveness in crop and vegetable production as well as its effect on ground water quality or pfeisteria proliferation.

Residents of Washington, DC grow vegetables in their backyards and could potentially

Dr. Allen examines a lettuce head grown from an experimental plot.

use this material as a soil amendment. Therefore, this experiment is designed to determine the effectiveness of pelletized poultry manure as a soil amendment in vegetable production

See Effect of Pelletized Poultry page 11

USGS Internship Program:

Phosphorus Geochemistry in Reservoirs Historically Treated with Copper Sulfate for Control of Algae

Although Eric Morgan's research started with a study of nutrient cycling in rivers of the Eastern Shore of Maryland, changes in available funding made it necessary to shift Eric's work to a study of Lee Hall and Harwoods Mill Reservoirs that supply drinking water for the Newport News, VA, area. For the past 30 plus years, copper sulfate has been spread in the waters of these reservoirs to eliminate algal growth that interferes with water filtration and which is thought to affect the smell and taste of the drinking water produced by the treatment plants.

Algal mats are found in the area of pumped inflow from the Chickahominy River to Hall Reservoir.

As a result, large concentrations of copper, a metal that can be highly toxic, are found in the sediment. Phosphorus comes into the reservoirs with the Chickahominy River water that is pumped in to optimize water levels. Pumpage is as much as 40 million gallons per day from the Chickahominy River. There are algal mats in the area of the reservoir where pumpage occurs (Figure 1). Also, large concentrations of phosphorus are found in the bottom sediments of the reservoirs. Under conditions of low dissolved oxygen, bottom sediments can release phosphorus to the overlying water column. At issue is whether the major portion of phosphorus that fuels the growth of algae is coming from Chickahominy River water that is pumped into the reservoirs or from bottom sediments.

Collection of bottom sediment from reservoir using a box corer.

To determine the contribution of bottom sediments to the phosphorus concentrations in the water column, bottom material was collected using either a grab sampler (resembles the working unit on a steam shovel) or a box corer (Figure 2). The sediment was freeze-dried, ground and sieved to produce very small, uniform particles. This called for dedicated work by Eric. Samples were analyzed for total phosphorus and phosphorus bound by poorly crystalline iron, and from these numbers organic phosphorus was determined. Auxiliary information included iron, copper, aluminum, manganese, and calcium concentrations in sediment samples.

Examination of the data indicated that there are very large concentrations of copper in the bottom sediments and that the bulk of the phosphorus is bound with the poorly crystalline iron oxides. The phosphorus that is bound with the poorly crystalline iron oxides will release phosphorus only when sediment bacteria no longer have oxygen or nitrate available as electron acceptors and turn to ferric iron as an electron acceptor. The use of insoluble ferric iron as an electron acceptor produces ferrous iron which is much more soluble. The reduction of iron releases phosphate from the solid to the aqueous phase and can fuel the release of phosphorus from bottom sediment to the overlying water column. ■

Principal Investigator: Dr. Nancy Simon, Research Chemist; USGS Student Intern: Eric Morgan 2005 graduate, Environmental Science & Visual Arts, The American University

An Economic Impact Analysis of DC Drinking Water Quality

Principal Investigator: Sharron L. Terrell, Ph.D. Department of Accounting, Finance, and Economics, University of the District of Columbia.

In January 2004, District of Columbia Residents learned the drinking water supplied by the D.C. Water and Sewer Authority (WASA) was contaminated with lead (Swartz 2004 and Cohn 2005). The DC government immediately responded by forming the Interagency Task Force on Lead in Drinking Water (The Task Force) to investigate the problem and propose corrective action (Press Release, April 22, 2004). As a short-term solution to the lead leaching problem, The Task Force distributed water filters and test kits to some DC residents (Press Release, April 22, 2004) and informed households by mail and other media how to purify drinking water and water used for sanitation purposes (Williams and Swartz, C., April 22, 2004).

Congress responded to the DC lead leaching problem by establishing the Lead-Free Drinking Water Act of 2004 (The ACT). The Act revised regulations regarding the acceptable level of lead in drinking water as well as legally established DC residents' rights to "a safe, lead free supply of drinking water," (Lead-Free Drinking Water Act of 2004). In testimony presented to the U.S. House of Representatives' Committee on Government Reform, Paul Swartz testified about negative health consequences to DC residents exposed to lead contaminated drinking water (Swartz, P., 2004). This study will assess household and commercial economic impacts implicit in the discussion of DC's drinking water problem.

Effect of Pelletized Poultry, from page 10

and its potential effect on DC water resources. Information generated will be used for extension and outreach to benefit the residents of Washington, DC. ■

Principal Investigators: James Allen, Ph.D
Agricultural Experiment Station
University of the District of Columbia

Air-Deposited Pollutants in the Anacostia River Watershed

In the early 1970s, at the inception of the Clean Air and Water Act the issues of air and water pollution were considered two distinct, separate and unrelated problems. Research in meteorology and geophysical fluid mechanisms have revealed over the years that there is a constant exchange of mass, energy, and momentum between air and sea brought about by hurricane activities. Furthermore, more recent research on the health of the major waterways in the area, such as the Chesapeake Bay, have yielded a better understanding of the link between air pollutants and land-based and water-based pollution resulting from atmospheric induced contaminant deposit in the major water ways.

Dr. Lily Rui Liang, Dr. Abiose Adebayo, Dr. Katya Verner

Two major sources of water pollution emanating from atmospheric dynamics are nitrogen and phosphorus. This present investigation aims to focus on the contribution of aviation jets efflux to the adverse environmental poisoning of the Anacostia watershed. The combustion of aviation fuel, especially at take-off and landing, leads to the build-up of nitrogen oxide (NOx) or airborne nitrogen. In addition to the aviation-generated environmental pollution, household equipment, boats, trains and cars are also additional sources of environmental pollution of the major watersheds. This type of air pollution does not fall directly into the waterways; rather it gets washed out of the air as rain, snow or fog—commonly known as wet deposition or as gases and tiny particles (aerosol)—dry deposition. Some of the land precipitation gets transported to rivers by storm water runoff or through groundwater flow.

Since the late 1980s computer models have shown that approximately 25% of nitrogen entering the Bay, for example, results from air pollution. The environmental quality of the Anacostia River continues to be the most urgent long-term water resources problem in the District of Columbia. Studies continue to show stagnation or worsening in the health of the Anacostia River. The health of the Anacostia River has great influence on the overall ecosystem, including the vegetation, marine life, and the quality of life of the communities that depend on the Anacostia River. It is widely accepted that cleanup of the Anacostia River will lead to economic resurgence in the region, restoration of marine life and their habitats, improvement in water quality and clarity, and the overall health of the surrounding population.

> “Two major sources of water pollution emanating from atmospheric dynamics are nitrogen and phosphorus.”

At present, assessing the proportion of pollution induced locally by aircraft is a challenging task.

■ Complexity of Domain. Once pollutants are released into the air they may breakdown or combine with other chemicals in the air and be transported short or long distances. Some of the factors that determine how far pollutants can travel through the air include, the makeup of the pollutant, weather conditions (wind, temperature, humidity), type and height of emission source (smokestack, automobile tail pipe), and the presence of other chemicals in the air. If the wind carries the plume of pollution high enough in the air, it may travel for hundreds of miles before being brought to earth. This is known as long-range or long-distance transport. Airborne pollutants fall to the earth's surface by wet deposition, or dry deposition. Airborne pollutants that deposit on the landscape can be transported into streams, rivers, and the Bay by runoff or through groundwater flow [1].

■ Uncertainty of Data and model [3]. High overall persistence and long-range transport potential have been recognized as hazardous characteristics for chemicals that might be released to the environment and used in various contexts for the assessment of the hazard posed to the environment by chemicals. However, it is difficult to directly measure these two descriptors of chemical fate in the environment. Multimedia models have been found to be appropriate tools for calculating numerical values for these two characteristics. The results of these calculations are subject to two main types of uncertainties. First, they are influenced by parameter uncertainty that is due to uncertainty in the measurement methods for chemical substance properties as well as due to natural variability of the environmental parameters within the large areas represented by the multimedia models. The second major uncertainty is due to differences between the various multimedia models available for the calculation.

■ Measuring techniques cannot be used to differentiate between pollutants emitted by road traffic and airport activities as a whole, and those discharged by aircraft on the ground [2].

■ Pollution knows no frontiers. The airport is surrounded by other sources of pollution (roads, other companies, etc.) [2]. ■

Principal Investigator: Dr. Abiose Adebayo, Department of Engineering & Aerospace Technology. University of the District of Columbia, Washington, DC

Integrated Data Acquisition and Sensor Design for Biomonitoring Systems

THE MAIN THEME FOR THIS RESEARCH, education and training proposal is environmental stress assessment for watershed management, ecological quality, and drinking water security. Today, more than ever before, maintaining our Nation's water quality mandates careful and exact assessment that requires a thorough understanding of contaminant and stressor characteristics, basic ecological processes and principles, transport rates and fate of substances within ecosystems, and health and ecological effects.

Contaminants become a risk to living systems as a result of the dose or concentration they are exposed to and the duration of exposure. Because a large number of factors can contribute to this problem in an ecological system, continuously monitoring for potentially dangerous elements using analytical chemical methods alone is expensive, time consuming, and is not practical. An innovative approach to resolving the periodicity of the analytical sampling problem in a cost effective manner would be to develop a continuously operable, remote, automated biological system; a coordinated monitoring system incorporating both physical/chemical and biological methods that could be networked into a coordinated surveillance plan for risk assessment and ecological quality control.

This research proposes the design and implementation of an integrated wireless, low-power embedded biosensor monitoring system for the acquisition and transmission of biological functions from aquatic animals. These signals can be used to measure the stress induced in aquatic animals due to water pollution. Over the past decade, research has been active in developing methods of measuring the levels of stress in aquatic animals for the purpose of monitoring water pollution. The minimization of power consumption is a critical issue in the design of electronic systems for portable battery-operated applications or remotely powered applications as employed in biomonitoring systems.

In the proposed study, a MEMS-based biosensor will be integrated with a mixed-mode ASIC chip comprising of preamplifier, band-pass filter, analog amplifier, D/A module, modulator, transmitter, and a digital controller. The design will integrate MEMS, wireless communication, VLSI, and system-on-chip (BioSilico) technologies in the design of a low power environmental monitoring device. The system will be designed as a battery-powered device. Techniques for analyzing the acquired data will also be developed. The embedded integrated sensors are to be used in the on-line acquisition of myoneural signals from aquatic animals such as bivalve molluscs, blue gill fish, and other fish species. This design is expected to miniaturize several discrete modules and eliminate coaxial cables used in existing biomonitoring setups, and in a significant reduction in the overall system power consumption. A receiver system will be used to receive the signal transmitted from the sensor device. The receiver system will be designed and built using off-the-shelf components. When completed the design will automate the process of *in situ* environmental data gathering needed to monitor the safety of the drinking water resources. Details of the design will be made available through conference and journal papers.

The proposed research is in collaboration between the Electrical Engineering Department, Biology, and the Environmental Science Department. Students from Electrical Engineering, Biology, and Environmental Science will work in a multidisciplinary research environment to design the biomonitoring system. The project will produce highly qualified graduates with multidisciplinary research experience.

Principal Investigator: Dr. Esther T. Ososanya
Co-principal Investigator: Dr. Wagdy Mahmoud
Dept. of Electrical Engineering and Computer Science, University of the District of Columbia

An Analytical Study of the Anacostia and Potomac Rivers

Principal Investigator: Dr. Julius Anyu Ndumbe, School of Business and Public Adminstration, University of the District of Columbia

The Anacostia and Potomac Rivers run through Maryland, Virginia and Washington DC. This study will focus exclusively on the segments of the rivers that run through the District of Columbia. Both rivers are important tributaries of the Chesapeake basin. In recent years, there has been the increased demand for the restoration of urban rivers. This demand has been sparked by increased pollution levels of rivers; thus culminating to environmental degradation and other adverse effects. Over the years there has been an increasing focus on cleaning rivers in the United States. Urban rivers that have undergone restoration include the Bronx River in New York and the Charleston River in South Carolina. Heavily polluted rivers, such as the Anacostia, have not received greater attention until recently. This reluctance in action and attitudes by planners and policy makers raises serious concerns. There are those who question the efficacy of existing policies vis-à-vis the restoration of urban rivers and those who attribute slow governmental efforts to environmental inequity. Whatever the case; the central issue is how to arrest the pollution levels in the Anacostia and Potomac rivers and restore a sustainable life for these rivers. River pollution occurs because industrial and agricultural chemicals and waste are poorly managed and disposed of, as well as increased urbanization. Pollution levels adversely affect the environment and cause serious health problems. To mitigate these problems, policy makers, researchers and planners must understand the gravity, nature and scope of the problem. This study will use content analysis to investigate the problem. The researcher will peruse through the body of literature to understand the character and nature of the pollution levels in these rivers. An analysis will be carried out and some recommendations will be provided. This study will address the following areas:

1. Present state of the Anacostia and Potomac rivers.
2. Sources of Pollution and its effect on the life of the rivers.
3. Government action
4. Recommendations

These issues raised provide a compelling justification for a critical examination to be conducted.

New Laboratories, from page 8

PHOTO BY MARY FARRAH

PHOTO BY MARY FARRAH

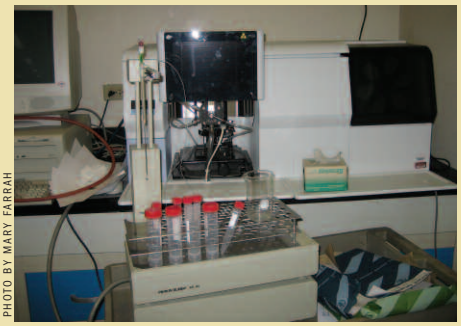


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PHOTO BY MARY FARRAH

totitrators can determine inorganic nutrients including phosphate, orthophosphate, carbonate, and bicarbonate as well as total chlorine and chlorine residues like chlorine dioxide, chlorite, and free chlorine. In addition, we have the capacity to monitor water pH, dissolved oxygen, turbidity and temperature in the field and in lab. The new lab also has the capability of testing quantitatively for total coliform and E.coli, microorganisms extremely important for public health safety compliance. We have requested funds to purchase a gas chromatograph/mass spectrometer, which can qualitatively and quantitatively analyze for residues of pesticides, pharmaceutical products and other organic pollutants in air, water and soil. The current goal is for this laboratory to become fully EPA certified within 5 years.

The 'Environmental Simulation and Modeling Laboratory' is the predictive and simulation component of our endeavor to impact efforts directed at improving the District's water resources quality and quantity. The Storm Water Management Modeling (SWMM) Software System and Worldwide Engine for Simulation and Training (WEST®) are the two modeling and simulation systems that have been acquired. The SWMM Software is an Urban Stormwater Management Tool used to analyze and design existing and future drainage systems. The capability of these software systems include assessment of urban area stormwater runoff quantity and quality, design of stormwater quantity and quality control systems, modeling of urban drainage systems including storm sewer systems & combined sewer systems, and it can evaluate the performance of Best Management Practices such as Low Impact Developments and stormwater management ponds. The WEST® software offers a user friendly platform for the modeling and simulation of urban wastewater treatment plants, fermentation processes, river watersheds, catchments, and ecological systems. This software is a useful tool for design and comparison of different plant configurations and water quality management plans, existing process evaluation, optimization and cost analysis, and investigation of different types of "what-if" scenarios.

A rainfall simulator which simulates rainfall and runoff potential under various scenarios is in the Laboratory. We have added a wireless solar powered weather station which collects weather data (temperature, rainfall, humidity etc.) and will be installed on campus near the Center for Renewable Energy demonstration site. These simulations and modeling software will go far in enhancing our capacity for training, teaching, and research. ■

Dendrimer Nanotechnology, from page 6

take advantage of the dendrimers' traits and make them useful in the removal of hazardous substances present in water that undergoes filtration through membrane treatment.

Possibly, both dendrimers and metals or contaminants could be recyclable, which gives this study greater importance and raises the expectations in the field of environmental nanotechnology. As stated by Don Phipps, Research Director of the Orange County Water District's Research and Development Group, dendrimer nanotechnology has "great promise ... I think we are actually seeing just the tip of the iceberg right now in regards to what we can do with dendrimers. ■

BY ROSANA AGUILERA-BECKER

1) Russell, David L. "Dendrimer-Based Chemistry Offers Challenging Alternative". Professional Water Technologies, Inc. 2004. http://www.pwtinc.com/RussellDWRArticle.htm

2) Salamanca-Buentello, Fabio. "Nanotechnology and the Developing World". University of Toronto Joint Centre for Bioethics. Updated March 31, 2005. http://www.utoronto.ca/jcb/home/documents/PL05_nanotech.pdf

Low Impact Development, from page 4

problems, reducing stream erosion, and improving public health.[1]

A project to identify and develop a Geographic Information System (GIS) map that includes all LID projects in the District was initiated this summer (2006) as a collaborative effort with the University of the District of Columbia (UDC) Cooperative Extension Service (CES) and Water Resources Research Institute (WRRI); DC Department of Health (DOH)/Watershed Protection Division, and USDA CSREES Mid-Atlantic Regional Water Quality Program. The ultimate goal of this endeavor is to educate and encourage the District policy-makers and residents to increase the use of LID as an alternative mechanism of enhancing the District's surface water quality.

This summer, three UDC CES student interns identified the exact location of existing LID practices in the District using a global positioning system (GPS) unit. At each location, a questionnaire was answered to describe and determine the utility of each LID. These GPS coordinates were placed in a GIS map of the District along with information gathered. With a potential grant from the Mid Atlantic Regional Water Quality Program, this process will continue during the fall of 2006. Presently, 24 green roofs and 19 rain gardens were identified, described and mapped in addition to 20 new LID projects in development. The Watershed Protection Division at the DC DOE has developed identification tags for each drainage inlet located on streets throughout the city, highlighting information on which waterway pollution through public education at visible sites. When completed, the Water Resources Research Institute will assess the effectiveness and efficiency of the various LID projects along with recommendations.

In an effort to promote LID in Washington DC Public Schools, The CES\Water Quality Education Program and the Kamit Institute for Magnificent Achievers Public Charter School (KIMAPCS) have agreed to partner in establishing a green roof and rain garden as a LID demonstration site. Public education about the impact of LID will eventually promote its utilization. Demonstrating its effectiveness is essential in schools to encourage the younger generation to understand water quality problems. ■

By Wellela Hirpassa, Extension Agent; Bonnie Herriott, Student Intern; Gallus Balla-Ndoh, Student Intern; Deddeh Bedell, Student Intern

[1] Introduction to Low Impact Development (LID): Frequently Asked Questions [online]; Low Impact Development Center, Inc.; Updated: May 16, 2003; http://www.lid-stormwater.net/intro/background.htm

WRRI FY 2006 Seed Grant Awards

The following five proposals were submitted and approved for FY 2006 grant.

Title of Award:	Nutrient Flow and Biological Dynamics in the Anacostia River
Principal Investigator:	Dr. Stephen E. MacAvoy Assistant Professor, Department of Biology American University
Grant award:	$15,000.00

Title of Award:	Assessment of Waterborne Contamination with Human Pathogens in Tributaries of the Anacostia River Using Asiatic Clams *(Corbicula fluminea)*
Principal Investigator:	Dr. Thaddeus K. Graczyk Associate Professor, Department of Environmental Health Sciences, Division of Environmental Health Engineering, and Department of Molecular Microbiology and Immunology Johns Hopkins Bloomberg School of Public Health
Grant award:	$15,000.00

Title of Award:	Effect of Best Management Practices on Contaminant Levels in Storm Water Runoff to the Anacostia River
Principal Investigator:	Dr. Charles C. Glass Assistant Professor, Department of Civil Engineering Howard University
Grant award:	$15,000.00

Title of Award:	Silica and Siliceous Surfaces as Hosts for Hazardous Metals in Water
Principal Investigator:	Dr. Aaron Barkatt Professor, Department of Chemistry The Catholic University of America
Grant award:	$15,000.00

Title of Award:	Wet-Weather Flow Characterization for the Rock Creek through Monitoring and Modeling
Principal Investigator:	Dr. Pradeep K. Behera Associate Professor, Engineering, Architecture & Aerospace Technology University of the District of Columbia
Grant award:	$15,000.00

WATER RESOURCES RESEARCH INSTITUTE

Community Outreach & Extension Services
University of the District of Columbia

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- 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
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Rosana M. Aguilera-Becker, Environmental Science, Project Assistant
Mary E. Farrah, Environmental Science, Project Assistant
Janelle Gaye,Undergraduate Student Intern
Chegon E. James, Management Information Systems, Undergraduate Student Intern
Holly Graphics Design & Print Management

ADDRESS AND CONTACT INFORMATION

Water Resources Research Institute
Building 52 Room 416G
4200 Connecticut Avenue NW
Washington DC 20008
(202) 274-7139
whare@udc.edu
Visit our website at www.udc.edu/dc_water_resources/about_us.htm