17th Annual MWMC Conference

THINK BAYWIDE

MWMC
maryland water monitoring council

ACT STREAMSIDE

Implementing the Chesapeake Bay TMDL

The Maritime Institute

December 1 2011

North Linthicum Maryland

bbe moldaenke

PP SYSTEMS

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bbe Spectrofluoro meters
For real-time in situ and online measurements

One of the common ways to carry out measurements of phytoplankton biomass has been to collect samples and use extractive analysis in a laboratory, or take large, very bulky equipment to the field. These extractive analytical methods are usually time-consuming and require an experienced analyst. Such measurements can be carried out much more conveniently using in vivo fluorometry. This principle of the multi-wavelength excitation of algae to enable the measurement of spectral algal classes and total chlorophyll is used in all bbe fluorometers.

FluoroProbe

In situ Instruments

The bbe FluoroProbe (top right), a submersible depth profiler, is quick and efficient to use and enables spot sampling in remote areas. It uses technology similar to that used by common fluorometers, but is unique due to its application as an instrument for the measurement of different algal classes. It estimates phytoplankton concentrations by detecting the fluorescence from chlorophyll-a in situ, at different depths and in real time (via cable).The FluoroProbe can also used in the lab using the Workstation 25 benchtop holder and stirrer system. Numerous accessories are available.

AlgaeTorch

The AlgaeTorch (middle right) is a robust, handheld instrument for the detection of total chlorophyll and cyanobacteria with automatic turbidity correction. The BenthoTorch (below right) is a recent development of the AlgaeTorch for the measurement of benthic algae on different substrates with automatic background correction. These handheld instruments have GPS for location tracking.

BenthoTorch

Station Instruments

The AlgaeOnlineAnalyser (bottom left) is an online analyser with a chloropyhll sensor, pump and industrial PC and can be equipped with relays for alarm triggering.

The AlgaeGuard (bottom middle) is a smaller version of the AOA with a monochrome touchscreen display with pre-defined settings. It can be connected to an external PC for data evaluation and control.

Discrete samples can be analysed using the AlgaeLabAnalyser (bottom right), which enables multi-class analysis and includes Genty measurement for the measurement of photosynthesic activity.

AlgaeOnlineAnalyser

AlgaeGuard

AlgaeLabAnalyser

MARYLAND WATER MONITORING COUNCIL

17th Annual Conference

December 1, 2011

Welcome to the 17th Annual Conference of the Maryland Water Monitoring Council

This year we are happy to share our annual meeting with the Maryland Local Watershed Implementation Service (providing TMDL Watershed Implementation Plan technical support for Maryland local governments), formerly the Maryland Tributary Team Program, in what we believe is the ideal pairing for our 2011 theme of

Think Baywide, Act Streamside

We chose this theme to reflect the paradigm shift caused by the institution of the Chesapeake Bay "diet." As most everyone knows by now, EPA has prepared a Total Maximum Daily Load (the "diet") for nitrogen, phosphorus, and sediment to the Chesapeake Bay and is requiring states in the Bay watershed to complete Watershed Implementation Plans (WIPs) to meet this TMDL. These WIPs recognize the importance of conducting restoration efforts upstream in the watershed (i.e., "Streamside") if we are to restore the Chesapeake Bay (i.e., "Baywide"). Extension of restoration efforts to the Bay's tributary rivers and streams has long been a message of the MWMC. The Maryland WIP will comprise individual WIPs at the county level and include 2-year milestones and an accelerated 2020 implementation deadline. Thus water monitoring is at a crossroads as we transition from documenting the decline in watershed resource conditions to, hopefully, monitoring their restoration. We hope that this conference will raise the level of understanding in the Bay WIP process and highlight the key role water monitoring will play in its success.

What You Will Hear

We are fortunate this year to have two plenary speakers that perfectly frame the challenge of restoring the Chesapeake Bay watershed:

- Jeff Corbin, EPA Chesapeake bay Senior Advisor, will provide the federal perspective on this unprecedented federal-state-local partnership to meet the Bay TMDL
- Carl Herschner, Director of the Center for Coastal Resources Management, Virginia Institute of Marine Sciences, will address the central role of monitoring in Bay restoration

Our 18 current sessions and 24 posters will expand on the "Think Baywide, Act Streamside" theme with following technical, programmatic, and volunteer information:

- A series of three sessions on the Bay TMDL and WIPs
- A session on monitoring for the Chesapeake and Coastal Bays Trust Fund
- Five sessions on stormwater and other urban issues
- Five sessions on volunteer monitoring, environmental education, and environmental justice
- Four sessions on the ecological topics of nutrients, modified flows, stream macroinvertebrates, and urban fishes
- Poster topics ranging from "The Chesapeake Bay shallow water D.O. limbo stick" to "Leaves and bugs"

Continuing this year, we will be awarding the Carl Weber Award as a way to recognize the extraordinary contributions that Dr. Carl Weber made to the field of water monitoring. The Council presents this award in Carl's name as a lasting reminder of the affection and respect that we hold for Carl and his work, and to inspire others to emulate his passion, dedication, and good humor. Additional information on Carl and his contributions to water monitoring in Maryland can be found elsewhere in this program and at the MWMC's website.

What You Can Do

Finally, the MWMC is only as successful as the sum of the individuals who participate in Council activities. The MWMC continues today as an effective statewide collaborative body because of the many contributed hours that individuals and organizations have donated to furthering the Council's goal of serving as a vehicle for the effective collection, interpretation, and dissemination of environmental data related to issues, policies, and resource management objectives involving water monitoring. We encourage you to strengthen the MWMC by getting involved, communicating your needs to us, and using the Council to enhance your water monitoring programs, resource management, and environmental stewardship initiatives.

What does it take to be a member of the MWMC? It takes only a willingness to collaborate with others outside of your organization. As a member of the Maryland water monitoring/management community you can set the agenda for the Council's activities. Talk with a MWMC member at today's conference and find out how the Council can help you and how you can enhance water monitoring through the Council. To learn more about the MWMC, go to www.marylandwatermonitoring.org.

The Annual Conference is a "green" conference. The Maritime Institute has partnered with us to provide on-site recycling and motion activated lighting in the hallways.

Let's make this a great conference.

Mark Southerland
Chair, Maryland Water Monitoring Council

This project was funded in part by the US EPA Chesapeake Bay Implementation Grant.

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Cover design - Luke Roberson

The Carl S. Weber Award

For Vision and Leadership in Monitoring Maryland's Waters

Our vision for monitoring in Maryland…

The MWMC envisions a time when monitoring methods, programs, projects, and data are the product of collaboration and comparability among agencies and organizations. The resulting information will be accessible for use by all stakeholders and will facilitate sound decision-making in environmental management and protection.

Dr. Carl S. Weber. Among many other things, Carl was one of the founding Board members serving a term on the MWMC Board in the mid-1990s representing the academic community. Today we honor Carl's life and work and celebrate the qualities that made him such an important part of the Maryland monitoring community with the annual presentation of the Carl S. Weber Award. Beginning in 2007, the Award has been presented annually to an individual involved in water monitoring in Maryland who exhibits the spirit, vision and leadership so exemplified by Carl. One person can make a difference!

Carl was a founding member of the University of Maryland-Baltimore County (UMBC) Biological Sciences Department and taught there for nearly 40 years. Although his training was in biochemistry, he developed an interest in stream ecology in the 1980s and became a self taught aquatic biologist, eventually creating and teaching extremely popular courses on stream and river ecology at UMBC. Carl used Herbert Run, a Patapsco tributary that flows through UMBC, as a living classroom for his students that spurred research and restoration activities on the stream. In 2002, Carl won the UMBC 2002 Alumni Association Award for Mentoring. Many of the students Carl taught and mentored went on to internships and careers in the environmental protection field. Carl was instrumental in bringing the National Science Foundation's Long-Term Ecological Research Network to UMBC through the Baltimore Ecosystem Study. He also served as the first chair of the Patapsco Tributary Team.

Carl's entry into the monitoring world began when he got involved with the Friends of Gwynns Falls/Leakin Park in his home watershed. In 1989, he took on an amazing volunteer task—leading a unique and innovative new project for Maryland Save Our Streams and Baltimore County. "Project Heartbeat" was the first program in the United States to train volunteers to collect and analyze benthic macroinvertebrates and to assess physical habitat using EPA's 1989 Rapid Bioassessment Protocol. Carl jumped right in and became involved in every aspect of the program. Over a 10 year period, thousands of volunteers were trained to collect benthic samples and identify them to the taxonomic family level in a controlled lab setting. Through Carl, UMBC provided lab space and equipment, and for several years, Carl taught and supervised all the lab volunteers to ID 200-300 samples a year. He chaired both the community steering committee and the technical advisory committee, building a bridge among volunteers, watershed organizations, academia, the County, the State, EPA, and other stakeholders—all represented on these committees.

For years, Carl performed all the lab quality control and data analysis for Heartbeat. He co-authored Project Heartbeat's Quality Assurance Project Plan, the first of its kind for a volunteer biological monitoring program. In the 1990s, Project Heartbeat had a profound impact on volunteer water monitoring, environmental education, and watershed collaboration— not only in Maryland, but across the country. Because of this program, Baltimore County has a quality baseline data set on the health of its streams spanning more than 10 years. Project Heartbeat maintained a high level of scientific credibility and the program contributed to advances made in stream assessment and analysis methods within the Maryland Department of Natural Resources and the Maryland Department of Environment. Certainly the road to DNR's "Streamwaders" program was paved, in part, by Project Heartbeat's success. No one person is more responsible for any of these accomplishments than Carl Weber.

Remarks from some of us who knew Carl…

[Carl] made a strong and lasting impression on me… one of the really good guys in the stream monitoring and assessment world.

I had a great deal of respect for him since he took a rather atypical path for a university professor...placing himself squarely at the nexus of science, management and stewardship.

Carl understood that the highest potential of volunteer monitoring rested in combining its powerful educational value with scientific credibility.

[Carl] was widely known as the best teacher in the department. He had such a breadth of knowledge and passion in the classroom. He was so into the material that students couldn't help but be engaged.

He had one of those truly inviting personalities, and was a natural born teacher.

Through this award, we celebrate Carl's life and work by acknowledging others who share his generous spirit, his commitment to Maryland's waters, his vision for collaboration, and his leadership in advancing monitoring and assessment.

Previous winners:

2010 - Sally G. Horner
2009 - Peter Bergstrom
2008 - Ron Klauda
2007 - Susan "Abby" Markowitz and Dr. Paul Massicot

2011 Annual Conference Planning Committee

Dan Boward	Maryland Department of Natural Resources (Chair)
Ken Belt	USDA Forest Service
Clark Howells	Baltimore City Department of Public Works
Ron Klauda	Maryland Department of Natural Resources
Tom Parham	Maryland Department of Natural Resources
Mike Pieper	KCI Technologies, Inc.
Charlie Poukish	Maryland Department of the Environment
Matt Stover	Maryland Department of the Environment
Megan Ward	Nanticoke Watershed Alliance

Plus additional thanks to:

Luke Roberson	Maryland Department of Natural Resources (MWMC Web Master and Graphics Support)
Charlie Poukish	Maryland Department of the Environment (Vendor Coordinator)
Joanne Alewine and Donna Klein	Maryland Department of Natural Resources (Conference preparation and registration table)

We Asked, You Answered

By Ron Klauda

Who remembers Ed Koch? Good for you. For those who don't, he was a three-term Mayor of New York City from 1978 to 1989. He was also famous for walking the streets of the Big Apple asking cab drivers, shop owners, and passers by, "How am I doing?" He genuinely wanted to hear suggestions for improving his mayoral duties.

The planning committees for MWMC annual conferences have been asking you, the attendees, this same basic question. Why? For the same reason Ed Koch asked: to find out what worked, what didn't, and how to make things better next year.

For over 40 years, I've been attending technical conferences, symposia, meetings, and workshops. I've also helped plan quite a few of these gatherings, including several MWMC annual conferences. And I can tell with certainty that the amount of effort put forth by the folks who plan the MWMC annual conferences to find out how we're doing (and then use this information to design the next year's conference) far exceeds anything else I've experienced. Over the years, the planning committees have asked, urged, pleaded, cajoled, and even bribed MWMC annual conference attendees to complete annual conference evaluation forms—to let us know how we're doing. Beginning in 2010, we switched from paper evaluations to an online version at SurveyMonkey.com. Please check your email within a few days for a request to evaluate this 2011 conference.

In case you might have asked yourselves in the past or may be asking yourselves right now, "What answers have annual conference attendees given to questions asked on the evaluation forms?", please read on.

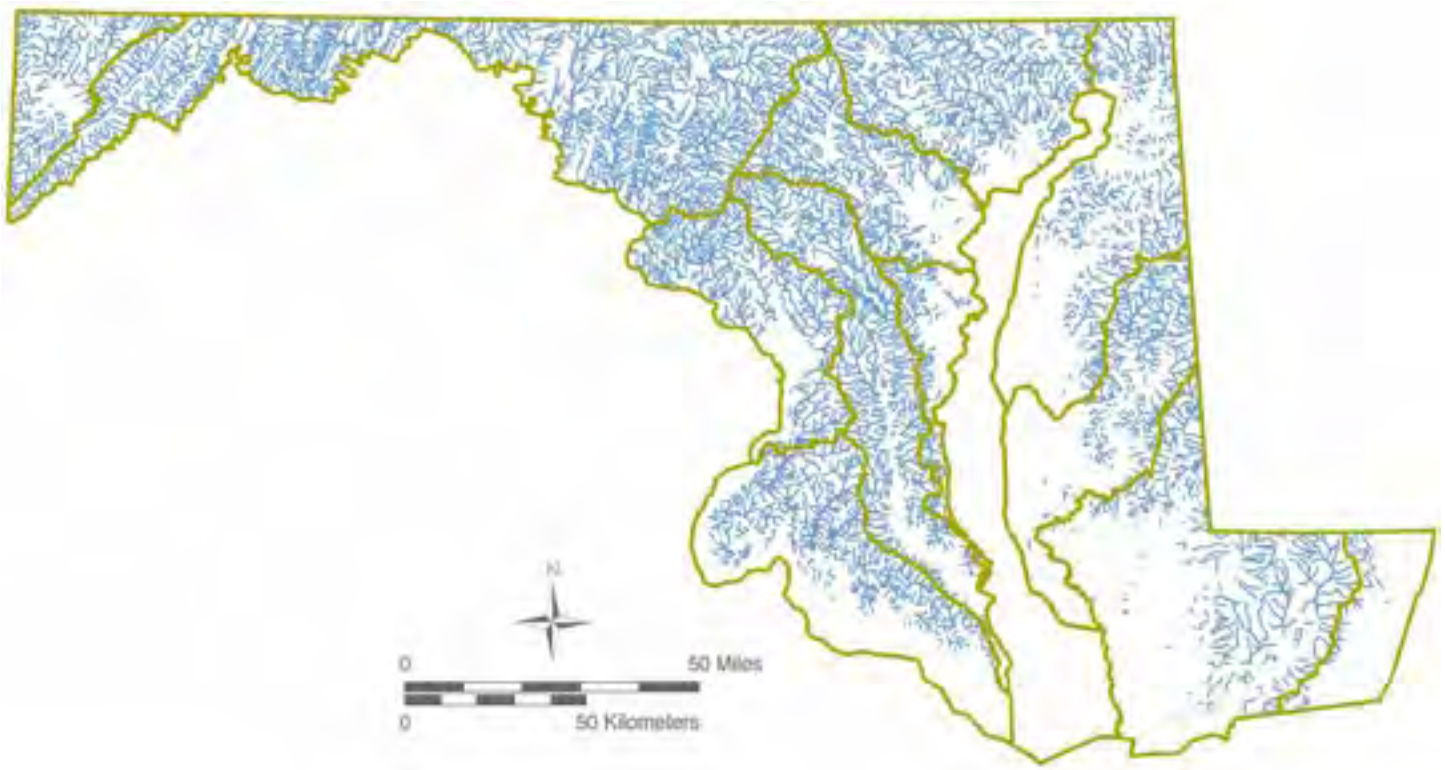
Here's a sample of your responses to the question, "How have you benefited from your association with the MWMC?", that was asked at the 2008, 2009, and 2010 conferences: renewing friendships, professional contacts, new information, introduction to the breadth of monitoring in Maryland, educational opportunities, always learn something, new equipment updates, vendor contacts, sales opportunities, suggestions for interagency partnerships, lunch, CEU's for my Sanitarian License, information to share with my non-profit group, links to watershed associations, and my favorite-—determine the source of the crazy and restrictive regulations coming down the pike. Quite diverse.

The evaluation forms have also asked conference attendees this question: "Did this year's conference meet your expectations?"-----to which you responded with this small sample of comments: it was as great as prior years, the presentations did not include a lot of new information for me, too many bureaucratic presentations, the conferences are always good, many of the papers I wished to hear were in conflict with one another, there wasn't any time to review the posters, the theme was excellent, not as many relevant talks, awesome, and another one of my favorites—too liberal. A mix of positive and……well, not so much.

Here's another question on the evaluation form that always stimulates interesting and helpful answers: "What 3 topics would you like to see explored at future conferences?". You collectively replied: moving data to policy, groundwater/surface water interactions, BMP implementation–what works/doesn't work, linking geomorphology assessments with biological assessments in streams, interaction of non-tidal wetlands and freshwater riverine systems, climate change and the future of stormwater management, communicating the need for habitat protection over restoration, biological effectiveness of stormwater BMPs, ICC development–should include one or more technical sessions on this topic, information transfer to the public, make counties accountable for water quality conditions, paleoecology, more success stories, water monitoring activities reaching K-12 students, remote sensing, and here's one that took me a few seconds to digest---socioeconomics of not protecting aquatic ecosystems. I think I get it.

As a member of the planning committee for this year's MWMC annual conference (the 17th), I ask you to fill out an evaluation form, again if you're a veteran of these gatherings, or for the first time if this is your first annual conference. To accommodate many papers, we had to schedule six concurrent technical sessions this year—a situation that will force you to

make tough decisions on which papers to hear. I expect you'll tell us about that on the evaluation. That's OK.
Be candid, but constructive. The planning committee wants to know what worked, what didn't, and what can be done better next year-------in other words, "How are we doing?"



MARYLAND WATER MONITORING COUNCIL

17th Annual Conference

December 1, 2011

Think Baywide, Act Streamside: Implementing the Chesapeake Bay TMDL

7:30 Registration/Poster Set-up/Continental Breakfast

Morning Plenary Session (8:30-10:00) in the Auditorium

8:30 Chairman's Call to Order – Mark Southerland; Chairman, MWMC Board of Directors

8:40 Plenary Speaker – Jeff Corbin – EPA Chesapeake Bay Senior Advisor

9:15 Plenary Speaker – Monitoring: the Ultimate Solution for Restoring the Chesapeake Bay - Carl Hershner; VIMS; Director, Center for Coastal Resources Management; Associate Professor of Marine Science

9:45 Carl S. Weber Award – Mark Southerland and Cathy Weber

10:00 Break/Poster Session – Authors present

Concurrent Technical Sessions

10:30-12:00 Session A-1 in Room A111/113

Chesapeake Bay Trust Fund Monitoring

Moderator: Paul Kazyak (Maryland DNR)

The Maryland Biological Stream Survey's Role in the Chesapeake and Atlantic Coastal Bays Trust Fund
Kenny Mack (Maryland DNR)

Our Best Chance to Show Restoration Success: Comprehensive Monitoring in Red Hill Branch Subwatershed, Howard County, Maryland
Beth Franks (Versar)

Urbanization and the Future of Aquatic Biodiversity in Maryland
Bob Hilderbrand (University of Maryland)

10:30-1200 Session A-2 in the Bridge Room

Volunteer Monitoring and Community Involvement

Moderator: Claudia Donegan (Maryland DNR)

Volunteer Monitoring Using Community Participatory Mapping (Im Rivers and Mappler Mobile Smartphone App)
Wansoo Im (Rutgers University); One hour session
Community Involvement: A Different Kind of Stormwater Best Management Practice
Jenni E. Woodward (A.D. Marble & Co.)

10:30-12:00 Session A-3 in Classroom 2

Urban Stormwater Management: Tools, Targets, and TMDLs

Moderator: Tom Parham (Maryland DNR)

Conceptual Framework for Incorporating Urban Watershed Functions Into Maryland's TMDL Program
Mark Southerland (Versar, Inc.)
Ultra-Urban Watersheds: Underground Streams, Hidden Pollutant Loads, and the Need for Infusion of Ecosystem Science Into Novel Stormwater Management Approaches
Ken Belt (USDA - Forest Service)
Performance of a Wet Infiltration Basin Managing Highway Runoff
Poornima Natarajan (University of Maryland)

10:30-12:00 Session A-4 in the Auditorium

Special Bay TMDL/WIP Session: Danger! Creativity Ahead! New Ways to Meet the Maryland Phase II WIP

Moderator: Chris Aadland (Maryland DNR)

Uncharted Territory: The Importance of Investing in New Ideas to Restore Water Quality
Sarah Lane(Maryland DNR)
The Changing Stormwater Paradigm in the Chesapeake Bay
Tom Schuler (Chesapeake Stormwater Network)
Assessing Emerging Technologies for Trading Programs
Olivia Devereux (ICPRB)

10:30-12:00 Session A-5 in Room A307

The Federal Urban Waters Initiative

Moderator: Ken Belt (U.S. Department of Agriculture Forest Service) and Ed Doheny (U.S. Geological Survey)

The Urban Waters Partnership: A National Perspective
Surabhi Shah and Alice Ewen (US EPA; USDA - Forest Service)
The Urban Waters Federal Partnership: Anacostia River Pilot
Cherie Miller (U.S. Geological Survey)

Federal-Local Interactions In The Baltimore Urban Waters Partnerships
Morgan Grove and Michele Romolini (USDA - Forest Service; University of Vermont)

10:30-12:00 Session A-6 in Room A-304

Creeks, Reservoirs, and Rivers: Science and Activism

Moderator: Cathy Wiss (Audubon Naturalists Society)

Does a Tale of Two Streams Tell the Future?
Bonnie Bick (Mattawoman Watershed Society)
Water-Quality Monitoring in the Baltimore Reservoir System, 1981-2007: Description, Review, Evaluation, and Modifications to Enhance Monitoring
Michael T. Koterba (USGS)
Spatio-Temporal Evolution of Hypoxia in Small Tributaries of Chesapeake Bay
Andrew Muller (US Naval Academy)

12:00-1:30 Lunch

1:30-3:00 Session B-1 in Room A111/A113

Nutrients: From the Highlands to the Coast

Moderator: Sally Hornor (Anne Arundel Community College)

Trends in Surface-Water Nitrate-N Concentrations and Loads from Predominantly-Forested Subwatersheds of the Chesapeake Bay Basin
Keith Eshleman (UMCES)
Application of Spatially-Explicit Empirical (Sparrow) Models to Chesapeake Bay Restoration
Scott W Ator (U.S. Geological Survey)
Coastal Bays Non-Tidal Nutrient Indicators & Thresholds for Use in an Annual Report Card
Carol McCollough (Maryland DNR)

1:30-3:00 Session B-2 in Room in the Bridge Room

Meet Me at the Intersection of NPDES and TMDL

Moderator: Mike Pieper (KCI Technologies, Inc.)

Finding Common Ground Between NPDES MS4 Permits and the Bay TMDL
Shannon Moore (Frederick County)
Source Data for TMDLs
Brent Reeves (KCI Technologies, Inc.)
Chesapeake Bay TMDL: Driver to Holistic Program Implementation
Heather Bourne (Limno Tech)

1:30-3:00 Session B-3 in Classroom 2

Ecological Flows

Moderator: Scott Stranko (Maryland DNR)

Evaluation of the Impacts of Water Withdrawals to the Hydroecological Integrity of Streams in the Fractured-Rock Region In Maryland, an Overview
Stacy Boyles (MDE)
Estimating Daily Streamflow at Ungaged Stream Reaches in Support of the Maryland Water Supply Studies Hydroecological Assessment of Aquatic Stream Integrity
Brandon Fleming and Stacey A. Archfield (USGS)
and
Generating Synthetic Streamflows for the Middle Potomac Watershed Assessment
Carlton Haywood (ICPRB)
Response of Stream Biota to Modification of the Natural Flow Regime
Matt Ashton (Maryland DNR)

1:30-3:00 Session B-4 in Auditorium

Special Bay TMDL/WIP Session: MASTified - Unlocking the Bay Model and Maryland's Planning Tool

Moderator: Claudia Donegan (Maryland DNR)

Maryland's Assessment and Scenario Tool (MAST)
Greg Sandi and Robin Pellicano (Maryland Dept. of the Environment)
Chesapeake Bay Program Watershed Model and The TMDL
Gary Shenk (Chesapeake Bay Program)

1:30-3:00 Session B-5 in Classroom A-307

Volunteer Monitoring

Moderator: Megan Ward (Nanticoke Watershed Alliance)

Successes and Challenges Associated with the Development and Implementation of a Right-Sized Volunteer Stream Monitoring Program for a Small Municipality
Amanda Matheny (City of Rockville)
CEDS Watershed Audits: How Volunteers Can Save 100 Feet of Waterway in an Hour
Richard Klein (Community & Environmental Defense Services)
Nanticoke Creekwatchers: Building Capacity, Cultivating Data, and Empowering Citizens
Beth Wasden (Nanticoke Watershed Alliance)

Session B-6 in Classroom A-304

**Baltimore Metropolitan Watershed Management Program –
Responding to TMDL Type Watershed Management Goals, Before Laws Required It!
An Example of Inter-jurisdictional Cooperation and Collaboration**

Moderator: Clark Howells (Baltimore County)

I. The Importance of a Regional Perspective to Reservoir Watershed Management (15 min.)

Introduction, Overview and History of the Reservoir Watershed Management Program
Jim Slater (Baltimore Metro. Council)

II. Jurisdictional Management Examples (30 min.)

Land Use Review and the Importance of Zoning to Reservoir Watershed Management
Don Outen (Baltimore County)
Development, Regulation and Watershed Restoration for Reservoir Watershed Protection
Tom Devilbiss (Carroll county)
The State's Role in Reservoir Watershed Management—How TMDL's are Integrated into the Reservoir Watershed Management Program
Tim Rule (MDE)
The Benefits of Regional Management to the State's Water Supply Regulatory Program
John Grace (MDE)

3:00-3:30 Break/Poster Session – Authors Present

3:30-4:30 Session C-1 in Room A-111/113

Stream Macroinvertebrate "How To" Session (One hour)

Moderator: Ken Belt (U.S. Department of Agriculture Forest Service)

From Alderflies to Zygotera – A Workshop on Stream Benthic Macroinvertebrates and Their Use in Environmental Education and the Assessment of Stream Health
Dan Boward (Maryland DNR), Ellen Friedman (Maryland DNR), and Ken Belt (USDA - Forest Service)

3:30-4:30 Session C-2 in the Bridge Room

Challenges to Fishes in Urban Streams

Moderator: Ron Klauda (Maryland DNR)

What's Missing from Baltimore's Urban Fish Communities and Why?: Evaluation of the Use of Fish Community Data in Guiding Stream Restoration Efforts
Stanley J. Kemp (University of Baltimore)
Protocol For Evaluating Exposed Sewers
Eileen Straughan (Straughan Environmental Services Inc.)

3:30-4:30 Session C-3 in Classroom 2

Responding to the Bay TMDL, Urban Sector Scenarios and Approaches to Implementation

Moderator: Sandy Hertz (Maryland State Highway Administration)

Watershed Resources Registry: An Integrated Approach to Watershed Management
Ralph Spagnola (US EPA)
Maryland State Highways Administration TMDL Efforts
Karuna Pujara (Maryland State Highway Administration)

3:30-4:30 Session C-4 in Auditorium

Special Bay TMDL/WIP Session: Bear Market with Bull Aspiration: Justifying and Financing the Bay Clean Up in Tough Economic Times (One hour)

Moderator: Carrie Decker (Maryland DNR)

Planning Estimates of Stormwater BMP Costs (and Benefits?)
Patrick Hagan (University of Maryland)

3:30-4:30 Session C-5 in Classroom A-307 (One hour)

Innovative Approaches to Environmental Education

Moderator: Charlie Poukish (MDE)

A Virtual Stream Sampler – An On-Line Volunteer Training Tool
W. Neil Gillies (Cacapon Institute)
The View Below: Using Creek Snorkeling to Connect People with Rivers
Keith Williams (North Bay)

3:30-4:30 Session C-6 in Classroom A-304

Environmental Justice

Moderator: Matt Stover (MDE)

Environmental Justice and Watershed Planning: Initial Results from an Assessment in Baltimore County
Jennifer Dowdell (Biohabitats) and Nancy Pentz and Rob Hirsch (Balto. Co.)
Environmental Justice: Forming a New Strategy
Lisa Nissley (MDE)

4:30 Adjourn

Posters

Note: Only Primary Authors are Listed

The Regional Flux of Nitrate From Groundwater to Coastal Plain Headwater Tributaries of Chesapeake Bay
Scott W. Ator (USGS)

How Low Can it Go? The Chesapeake Bay Shallow Water DO Limbo Stick
Eva Bailey (UMCES-CBL)

Applications of Real-Time Water Quality to Identify Episodic Pollution Events in Urban Streams in the Washington, D.C. Metropolitan Area
Joseph M. Bell (USGS MD/DE/DC Water Science Center)

Stream Temperatures in Urban Watersheds: Interactive Effects of Riparian Cover, Scale and the Built Environment
Kenneth T. Belt (USDA - Forest Service)

Ultra-Urban Baseflow and Stormflow Concentrations and Fluxes in a Watershed Undergoing Restoration (WS263)
Kenneth T. Belt (USDA - Forest Service)

Bioeyes' Your Watershed, Your Backyard: Teaching Our Children to be Responsible Stewards of Aquatic Resources
Valerie Butler (Carnegie Institution for Science)

Summary and Interpretation of Discrete and Continuous Water-Quality Monitoring Data, Mattawoman Creek, Charles County, Maryland, 2000-2010
Jeffrey G. Chanat (USGS MD-DE-DC Water Science Center)

Quantifying the Contribution of Small Scale Community and Homeowner Best Management Practices (BMPs) in the Chesapeake Bay Total Maximum Daily Loads (TMDL)
Jennifer Dindinger (University of Maryland Sea Grant Extension)

Mapping Headwater Streams in the Potomac River Basin
Steven M Guinn (University of Maryland Center for Environmental Science, Appalachian Laboratory)

Patapsco River Dam Removal Study: Assessing Changes in American Eel Distribution and Aquatic Communities
William Harbold (Maryland Department of Natural Resources)

Leaves and Bugs: Using Litterbags in Education and Stream Studies
Quin Holifield (USDA - Forest Service)

Use of Benthic Macroinvertebrate Taxa and Landscape Variables to Identify Stream Reaches Suitable for Brook Trout Reclamation in Maryland
Michael Kashiwagi (Maryland Department of Natural Resources)

Impacts of Hurricane Irene and Tropical Storm Lee on Streamflow Levels in Maryland, August-September, 2011
Wendy McPherson (USGS)

Effective Microorganisms: An Earth Saving Revolution
Linda Miyoshi (Teraganix LLC)

Nodal Point Pollution: Changing the Paradigm for Chesapeake Bay Restoration
Diana Muller (South River Federation)

Monitoring Of *Escherichia Coli* in the Jones Falls: Evaluation of the 3m™ Petrifilm™ Method
Wolf T. Pecher (University of Baltimore)

Masonville Dredged Material Containment Facility: Supporting Bay Health Through Mitigation and Remediation Projects
Stephanie Peters (Maryland Environmental Service)

Are Anacostia Toxics from DC or Maryland?
Harriet Phelps (University of the District of Columbia)

Community Metabolism in Chesapeake Bay: Historical and Contemporary Measures
Casey L. Sperling (UMCES Chesapeake Biological Laboratory)

Comparing the Fish and Benthic Macroinvertebrate Diversity of Restored Urban Streams to Reference Streams
Scott Stranko (Maryland DNR)

Historical and Current Assemblages of the Youghiogheny River Watershed: Implications for Determining Reference Conditions and Conducting Reference Conditions and Conducting Stream Restoration
Scott Stranko (Maryland Department of Natural Resources)

Nanticoke River 2010 Report Card: Community Outreach
Beth Wasden (Nanticoke Watershed Alliance)

Comparing Satellite Derived and Hand Drawn Impervious Land Cover Estimates
Sara Weglein (Maryland Department of Natural Resources)

Stream Burial Across the Potomac River Basin, USA
Roy Weitzell (UMCES – Appalachian Lab)

Assessing the Ecological and Human Health Status of Baltimore's Inner Harbor
Caroline Wicks (EcoCheck; NOAA-UMCES Partnership)

MARYLAND WATER MONITORING COUNCIL

17th Annual Conference

December, 2011

SPEAKER ABSTRACTS

(Listed alphabetically by lead speaker's last name)

Response of Stream Biota to Modification of the Natural Flow Regime

Matt Ashton
Maryland Department of Natural Resources
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Co-author: Claire Buchanan, PhD.

Aquatic species and communities evolved to withstand variation exhibited in the timing, magnitude, and frequency of stream flow that defines the natural flow regime. Instream habitats and chemical processes are also affected by flow and further influence the species found in a stream. The flow regimes of North American rivers have been modified for well over a century, most noticeably and directly by the construction of dams and diversion structures. Increasing surface and groundwater withdrawals for consumptive, industrial, and agricultural uses coupled with land use change ultimately affect hydrologic processes and have been implicated with the further alteration of streamflows and impairment of aquatic ecosystems. To meet societal demands for water while maintaining a desired level of ecological integrity studies that relate change in streamflows to a biological response, broadly termed environmental flow studies, have been developed. Recent advances have greatly improved the ability of managers to address issues of resource balance and protection. In this presentation, we briefly review major tenets of environmental flows and present results from two ongoing studies within the Chesapeake Bay. The Middle Potomac Watershed Assessment has developed flow alteration – ecological response relationships using an HSPF model to simulate flows for current and baseline conditions and macroinvertebrate samples to estimate ecological status. In its preliminary stage, Maryland's Fractured Rock water resource assessment has examined patterns of association between annual rates of surface and groundwater withdrawal to fish and macroinvertebrate community metrics. These relationships provide a foundation for further investigation and development of flow-ecology hypotheses.

Matt Ashton is a Natural Resource Biologist with DNR's Monitoring and Non-Tidal Assessment Division and serves as the freshwater mussel expert for the Maryland Biological Stream Survey. Prior to joining DNR's MBSS, Matt earned his M.Sc. from Tennessee Technological University where he researched the ecology of rare benthic fish and mussel communities in regulated rivers.

Application of Spatially-Explicit Empirical (Sparrow) Models to Chesapeake Bay Restoration

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Co-authors: John W. Brakebill and Joel D. Blomquist

Efficient nutrient management in support of Chesapeake Bay restoration requires a regionally-consistent, comprehensive, and spatially-explicit understanding of the sources, fate, and transport of nitrogen and phosphorus in the bay watershed that is available only through regional models. **Updated (version 4) spatially-referenced regressions on watershed attributes (SPARROW) models predict loads of nitrogen and phosphorus in each of 80,579 nontidal tributary stream reaches in the Chesapeake Bay watershed.** Agriculture (primarily fertilizer applications and crop fixation) contributes 54 percent of the 132,000 metric tons of nitrogen contributed annually from the watershed to the bay; annual phosphorus contributions of 9,740 metric tons are more evenly distributed among agricultural (fertilizer and manure applications) and urban (including point) sources. Natural mineral dissolution contributes 14 percent of the phosphorus load from the watershed to Chesapeake Bay. Estimates of locally-generated and delivered (to tidal waters) loads and yields from the SPARROW models are spatially-explicit at a relatively fine (1:100,000) resolution (mean incremental catchment area, 2.1 square kilometers), specific to particular sources, and include empirically-derived confidence intervals. The comprehensive accounting of nutrient sources and loads predicted by the models at relatively fine resolution can be used to target limited resources in support of local and regional surface-water restoration mandated by the Chesapeake Bay and other TMDLs. An online tool (http://cida.usgs.gov/sparrow/) allows users to interactively map and query the model results and to predict downstream effects of management scenarios in tributary watersheds.

Scott Ator has been a hydrologist with the U.S. Geological Survey in Baltimore, Maryland since 1994. He holds a BS in Geology from the University of Maryland and an MS in Environmental Science and Policy from Johns Hopkins University. His work focuses primarily on understanding the occurrence, sources, fate, and transport of nutrients, sediment, and pesticides in nontidal streams and groundwater.

Ultra-Urban Watersheds: Underground Streams, Hidden Pollutant Loads, and the Need for Infusion of Ecosystem Science into Novel Stormwater Management Approaches

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Watershed 263 is an old ultra-urban residential landscape in west Baltimore city that is undergoing comprehensive, long-term watershed restoration. Two small catchments monitored there **have both large above and below ground pollutant loads of nitrogen, phosphorus and other contaminants.** We discuss these export "hotspots", where a significant part of the load may be exported during baseflow in underground storm drains, effectively out of reach of surface based stormwater management efforts. Should these types of exports be common, they would be important for local governments to consider when developing pollution reduction plans and responding to TMDL criteria. Knowing more about these hidden loads from older urban centers, if related to aging infrastructure, would also speak to the importance of developing watershed plans that address long-term changes. **We will also discuss a current Forest Service effort to synthesize ecological science with stormwater management that may inform novel, integrated approaches to stormwater management in ultra urban areas.** The WS263 project likely provides fertile ground for pursuing novel stormwater management approaches as it already has a unique collaboration between City government, the USDA Forest Service, Parks and People Foundation, and a Long-term Ecological Research (BES LTER) project. This unique mix of useful, diverse experience and expertise may provide a context and foundation for merging non-traditional disciplines and organizations to facilitate new thinking. With continued synthesis efforts, stormwater management in these areas could become both a useful watershed tool, as well as a valued, integral component of urban communities.

Ken worked for Baltimore City DPW for 19 years on urban stormwater, reservoir limnology and watershed management monitoring and issues. For the last 13 years he has been a USDA Forest Service hydrologist and aquatic ecologist with the Baltimore Field Station and Baltimore Ecosystem Study. His education includes BSCE and MSEE degrees from Johns Hopkins University, and BS and MS degrees from Towson University (Biology and Aquatic Ecology); he is now a PhD candidate at the University of Maryland Baltimore County (Ecology.)

Does a Tale of Two Streams Tell the Future?

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Co-author: Jim Long

A pair of sister tributaries to Mattawoman Creek near Bryans Road, Maryland, present a textbook case of the impacts of urbanization on our waterways. An broad array of data was taken over a decade ago in conjunction with the controversial Chapmans Landing development. Included were benthics, fish species richness, icthyoplankton surveys, and continuous nutrient-level monitoring. The Mattawoman Watershed Society has recently updated data for benthics via the StreamWaders program, and the for icthyoplankton via ongoing surveys. The benthic status remains unchanged, with the more urbanized stream giving low scores, while the forested stream receives "good" marks. However, River Herring spawning does not occur as far upstream as in the past. This may reflect a dramatic decline in spawning activity in the non-tidal Mattawoman, a decline that is mirrored by low young-of-year abundance in the tidal estuary. These two streams present an apt example for regarding the effects of future land use policies in the Chesapeake Bay watershed. The high quality stream is threatened by a large expansion proposed for Bryans Road that includes locating a controversial industrial park on its forested headwaters. However, an alternative future is possible if a proposed progressive scenario is chosen for Charles County's new Comprehensive Plan that places new growth in existing urban centers rather than in rural and forested watersheds. It would be fitting if Smart Growth concepts, which were introduced to Maryland as a result of the campaign to save Chapman Forest, were to save a stream that played a role in the Forest's preservation. **On the larger scale, successful protection of Mattawoman could serve as an example of our ability to save the Bay.**

Bonnie Bick has been an environmental activist in Maryland for more than twenty years. Her work on issues affecting the Potomac River and Mattawoman Creek are exemplified by the successful campaign to save Chapman Forest. More recently, her efforts with the Mattawoman Watershed Society helped save a thousand additional acres when DNR purchased the Preserve at Greenspring. Presently she is working to instigate Smart Growth solutions to save Mattawoman by protecting its forested watershed. For her efforts to preserve Bay resources, Bonnie was recently recognized by the Chesapeake Bay Foundation as its Maryland Environmentalist of the Year.

Chesapeake Bay TMDL: Driver to Holistic Program Implementation

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The Chesapeake Bay TMDL is serving as a catalyst for strengthening regulatory programs and expectations on permitted entities within the watershed. **Requirements, such as those associated with more stringent MS4 permit TMDL implementation language, are necessitating a holistic approach to permit compliance that provides the opportunity to improve integration between local programs, improve synergy with other affected parties, and incorporate local priorities to most cost-effectively meet the permittee's needs.** Case studies will describe how several Maryland permittees are using this approach: Charles County is responsible for developing a strategy to meet Chesapeake Bay TMDL pollutant reduction targets for regulated and unregulated stormwater, wastewater, and septics. The County wanted to conduct internal planning prior to submitting a load reduction strategy through the state's planning tool so LimnoTech developed a series of spreadsheet models to: calculate load reductions from near-term and future planned projects identified in local planning documents, determine the "gap" between the loads reduced by planned projects and TMDL targets, and develop strategies to meet TMDL goals that got the "biggest bang for the buck". The Maryland State Highway Administration (SHA) holds a Phase I MS4 permit in nine counties and faces permit requirements for TMDL implementation planning. SHA was interested in an integrated approach to meeting permit requirements for both local TMDLs as well as the Chesapeake Bay TMDL. LimnoTech developed a TMDL planning approach that included evaluating: BMP and impervious surface GIS data, partnering opportunities with local entities, and the overlap of local and Chesapeake Bay TMDL goals to most effectively prioritize future restoration efforts.

Heather Bourne is a Project Scientist with LimnoTech's office in Washington, DC. She has 15 years of experience with NPDES permitting including developing and implementing Phase I and Phase II MS4 programs. She also has been providing guidance, planning support, and TMDL pollutant reduction scenario assistance to clients in association with the Chesapeake Bay TMDL for the past two years.

From Alderflies to Zygoptera – A Workshop on Stream Benthic Macroinvertebrates and Their Use in Environmental Education and the Assessment of Stream Health

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Most freshwater stream monitoring groups (i.e., agencies, consultants, watershed associations, educational institutions) that monitor the health of Maryland streams sample benthic macroinvertebrates. Some field, lab, and information management methods are comparable and some are not. This interactive workshop is intended for those who monitor benthic communities in streams and are interested in learning about Maryland Biological Stream Survey (MBSS) methods or are not yet monitoring and wish to use MBSS protocols once their program gets up and running. Field, lab and information management protocols will be discussed with the intent of providing attendees practical information they can use to facilitate data analysis and sharing.

In addition to their use as reliable stream health indicators, stream "bugs" are often used in aquatic educational projects. One such project involves the use of stream invertebrates in leaf litter processing experiments. Leaf litter falling in riparian zones is the basis for small stream food webs, provides habitat and is importantly to healthy stream ecosytems. These leaves also, through their breakdown products, provide food for downstream biota. We'll discuss the role of leaves in ecosystems, and describe methodology for doing simple litterbag experiments for use in stream health assessment and in education.

Evaluation of the Impacts of Water Withdrawals to the Hydroecological Integrity of Streams in the Fractured-Rock Region in Maryland, an Overview

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The fractured-rock region of Maryland constitutes the land area north and west of the I-95 corridor and serves as the source of water supply for approximately 4.4 million Marylanders, or about 76% of the State's population. While hundreds of thousands rely on wells, millions rely on surface water sources. In this region, geology, topography, land use, water withdrawals, impoundments, and other factors readily impact the water flow characteristics. The unconfined groundwater systems are closely interconnected with rivers and streams and are affected by seasonal and climatic changes. During droughts, groundwater levels decrease and stream flows can fall below the thresholds needed to support local ecology.

The Maryland Department of the Environment (MDE) is responsible for managing the State's water resources. In 2008, the Advisory Committee on the Management and Protection of the State's Water Resources reviewed the State's program and provided recommendations aimed at assisting the State in more effectively meeting its obligations. The Committee identified the need for studies in the coastal plain and fractured-rock regions of Maryland, to acquire the comprehensive data necessary to support complex water management and permitting decisions. In response to the Advisory Committee's recommendations, MDE has formed an interagency partnership with the Maryland Department of Natural Resources Monitoring and Non-Tidal Assessment division (MANTA), the Maryland Geological Survey (MGS), and the United States Geological Survey (USGS), to oversee and conduct these studies. The team has developed a science plan for the Comprehensive Regional Assessment of Water Supply in Areas Underlain by Fractured-Rock in Maryland. The science plan lays out five science goals, each with specific objectives, and proposed tasks to address them. The primary objective of science goal 4, **Evaluate the Impacts of Water Withdrawals to the Hydroecological Integrity of Maryland's Streams**, is to assess the relationship between water withdrawals and aquatic biota.

Although biological inventories and streamflow records have been collected from Maryland streams for many years, the relationships are not well understood. It is imperative that Maryland's water resource managers understand the characteristics of streamflow required to maintain the full complement of biological taxa and to ensure the ecological integrity of Maryland streams is not compromised. To accomplish this goal, an assessment will be performed to gain an enhanced understanding of surface and groundwater interactions and the potential impacts of water withdrawals.
Seven management questions have been developed to guide the assessment activities for science goal 4. Insight into these management questions will allow the MDE to (a) quantify hydrologic effects on stream dwelling animals, (b) identify locations of ecologically important areas for prioritization of environmental review, (c) provide an understanding of the potential environmental ramifications of hydrologic alteration, and (d) gain a comprehensive understanding which will aid MDE in the decision-making process for permit applications.

Stacy Boyles is a regulatory and compliance engineer with MDE's Water Supply Program. Ms. Boyles has served as co-project manager of the Comprehensive Regional Assessments of Water Supply in the Coastal Plain and Fractured Rock regions of Maryland since October, 2010. She received her B.S. and M.S. in Environmental Engineering from the University of Florida.

Environmental Justice And Watershed Planning: Initial Results From An Assessment In Baltimore County

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Co-authors: Rob Hirsch, Nicole Stern, Ted Brown, Steve Stewart

Environmental Justice (EJ) arose as a critical cross-cutting theme for all watershed planning and water quality related actions during the development of the Baltimore Watershed Agreement Phase 1 Action Plan (BWAAP) - an effort by Baltimore County, Baltimore City, and local NGOs to improve water quality in shared watersheds. The BWAAP requires the County and City to jointly "ensure environmental justice indicators are taken into consideration during major planning efforts." In July 2010, Biohabitats drew from initial research on environmental justice indicators and assessment methods to suggest an assessment methodology that would integrate environmental justice principles into watershed planning. The methodology uses GIS software to layer relevant EJ and watershed health indicator data including: demographic characteristics, human health indicators and watershed health indicators. Biohabitats developed this model in the following months for Baltimore County. **Initial results highlight several subwatersheds in Baltimore County where communities are at risk for environmental justice issues associated with water quality, based on the indicator model for environmental justice and water quality.** This presentation will introduce these maps and a short summary of the indicator assessment model. The resulting maps and associated report will be used in the county's small watershed action plans (SWAPs) as well as other watershed planning efforts to prioritize projects in neighborhoods with environmental injustice and poor water quality.

Jennifer Dowdell is a landscape ecological designer and planner whose work focuses on urban ecology, green infrastructure planning, and brownfield redevelopment. She has been part of the Biohbitats team working with Baltimore County on an environmental justice analysis white paper, the environmental justice assessment methodology, and the recent Public Health Roundtable Discussion on Water Quality and Bacteria in Baltimore City and Baltimore County.

Assessing Emerging Technologies for Trading Programs

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A mechanism to evaluate new technologies proposed for use in ecosystem markets is needed. While many best management practices (BMPs) are currently in use to reduce nutrient applications and decrease transport into waterways, new applications of existing practices and innovative technologies are continuously being developed. Currently, innovators are facing challenges with new technology adoption if the technology does not fit into an existing Chesapeake Bay Program-approved BMP. Another challenge faced by innovators is having to work through a process in each Chesapeake Bay Basin state to determine effectiveness ratings for the new technology. An efficient and effective mechanism to systematically review the effectiveness of these new technologies and new applications of existing BMPs is required. An evaluation board to review proposed new technologies or practices would help facilitate innovation by making it easier for innovators to have their technology and resulting nutrient and/or sediment reductions quantified. In this talk, the components of such a program and the benefits will be discussed. The expansion of the BMPs with approved effectiveness values in states' trading programs will help to reduce the cost of implementation to producers and the cost of credits to buyers.

Olivia Devereux is a Senior Environmental Scientist at the Interstate Commission on the Potomac River Basin (ICPRB) where she performs water quality assessments. Prior to joining ICPRB in 2009, she worked at the University of Maryland and at the Chesapeake Bay Program. At ICPRB, she is responsible for working with regional partners to develop market-based programs to reduce pollutant loads. She also performs data analysis for other on-going projects including a water demand study that considers future changes in consumptive use throughout the Potomac River Basin. Most recently, she and J7, LLC developed the Maryland, Chesapeake and Virginia Assessment Scenario Tool (MAST, CAST, and VAST) that estimates output from the Chesapeake Bay Program's Watershed Model and Scenario Builder and creates inputs to Scenario Builder. She received her B.A. from the University of Texas in 1991 and her M.S. in Environmental Science and Technology from the University of Maryland in 2006.

Development Regulations and Watershed Restoration for Reservoir Watershed Protection

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Development Regulations: In 2004, Carroll County adopted the Water Resource Management Chapter 218 of the Code of Public Local Laws and Ordinances. The purpose of this chapter is to protect and maintain the ground and surface water resources of Carroll County by establishing minimum requirements for the protection of groundwater and surface water resources that contribute to existing or future community water supplies, standards for review of development activities, management standards and design criteria for land use activities that occur subsequent to that review, and enforcement procedures for violations of standards adopted therein that contribute to or become a source of pollution.

Watershed Restoration for Reservoir Watershed Protection: In 1995, Carroll County was issued our first National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System Discharge Permit in accordance with the Clean Water Act. Requirements relating to the NPDES permit mandate the County to treat 10% of our untreated impervious area. Plans were then developed to address this requirement through implementation of Best Management Practices within the Liberty Watershed area.

Gale Engles has worked for Carroll County Government for 35 years, starting out in the Carroll Soil Conservation District. From there I went into the sediment control inspection arena. In 2010, the Bureau of Resource Management was established within the Department of Planning where I worked as the Chief, Environmental Inspector. I was then promoted to the Bureau Chief of Resource Management which is the position which I currently hold.

Trends in Surface-Water Nitrate-N Concentrations and Loads from Predominantly-Forested Subwatersheds of the Chesapeake Bay Basin

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Water quality monitoring data provide the "gold standard" by which progress toward achieving real reductions in nutrient loadings to Chesapeake Bay must ultimately be assessed. The most recent trend results posted at the Chesapeake Bay Program (CBP) website reveal that a substantial percentage of tributaries are now showing declines in flow-adjusted concentrations of nutrients and sediments. Of particular significance are trends for nitrogen: 22 sites showed statistically significant ($p < 0.05$) downward trends (1985-2010) in flow-adjusted concentrations, two sites showed upward trends, and eight sites showed no trend. Based on the data, the CBP has drawn the following conclusion:

> "At many monitored locations, long-term trends indicate that management actions, such as pollution controls for improved wastewater treatment plants and practices to reduce nutrients on farms and suburban lands, have reduced concentrations of nitrogen."

But could this conclusion be pre-mature? We recently undertook a comparable analysis of long-term nitrate-N trends for a different group of watersheds; this group includes nine watersheds that are predominantly (i.e., >75%) forested, plus five other Potomac River subwatersheds added for comparison. **Based on comparable data and analytical methods to those used by CBP partners and USGS, 13 of the 14 sites—including both Potomac River stations (Chain Bridge at Washington DC and Hancock, Maryland)—showed statistically significant ($7x10\text{-}12 < p < 3x10\text{-}3$) declines in annual flow-weighted nitrate-N *concentration*.** Only one station—the heavily agricultural Upper Monocacy River—did not show a statistically significant ($p < 0.05$) trend; several stations also showed downward trends in nitrate-N load, despite the fact that no station showed a trend in annual runoff owing to high inter-annual hydroclimatological variability. Additional research is needed to understand why nitrogen retention by forested lands may be increasing and thus helping restore water quality throughout the Chesapeake Bay watershed.

Dr. Keith N. Eshleman is Professor at the University of Maryland Center for Environmental Science based at Appalachian Laboratory in Frostburg, Maryland. Dr. Eshleman's professional expertise is in the field of watershed hydrology, having completed his Ph.D. in Water Resources at Massachusetts Institute of Technology in 1985. Dr. Eshleman also holds a B.A. degree in Environmental Sciences from the University of Virginia (1978) and an S.M. degree in Civil Engineering from M.I.T. (1982). Dr. Eshleman has published more than 50 peer-reviewed papers and dozens of technical reports in his career and is co-author of an undergraduate textbook entitled Elements of Physical Hydrology (with former colleagues from the University of Virginia, where Dr. Eshleman served on the faculty from 1988 through 1995). Dr. Eshleman's research interests are in the areas of watershed and wetlands hydrology, groundwater/surface water interactions, biogeochemical processes in upland and wetland ecosystems, hydrochemical modeling, and ecosystem responses to disturbance and land use change. Recent research projects have focused on the hydrological impacts of acid deposition, forest disturbances, and surface mining activities in the Appalachian Mountain region.

Estimating Daily Streamflow at Ungaged Stream Reaches in Support of the Maryland Water Supply Studies Hydroecological Assessment of Aquatic Stream Integrity

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Co-authors: Stacey A. Archfield

A goal of the Maryland Water Supply Studies is to gain better understanding of the relation between streamflow and ecologic response to flow alterations in Maryland streams. The Maryland Department of the Environment, Water Supply Program (MDE-WSP), Department of Natural Resources, Monitoring and Non-Tidal Assessments (DNR-MANTA), and the U.S. Geological Survey (USGS) are partnering to apply an Ecological Limits of Hydrologic Alteration (ELOHA) analysis to Maryland streams. Hydrologic and biological data are synthesized at common locations in a stream to identify ecological responses to changes in stream flow characteristics. This analysis requires streamflow metrics which can only be derived from daily streamflow records. **Locations where ecological data have been collected by the Maryland Biological Stream Survey (MBSS) rarely coincide with USGS stream gages; therefore daily streamflow must be estimated.** The Sustainable Yield Estimator (SYE) is a tool developed by the USGS to estimate daily streamflow at ungaged streams. This method estimates a flow duration curve (FDC) at an ungaged location by relating streamflow to basin characteristics through regression models. These basin characteristics include land cover, geology, topography, and climate information for the drainage basin of the stream gage. A reference streamgage is then used to transform the FDC into a time series of daily streamflow at the ungaged location. The estimated daily flow is used to calculate over 200 flow metrics for input to the ELOHA analysis.

Brandon Fleming is a hydrologist with the USGS MD-DE-DC Water Science Center. He received his Bachelor's degree in Geology from The University of Massachusetts, Amherst in 2002, and his Masters degree in Geology with a Hydrogeology concentration from The University of Massachusetts, Amherst in 2009. Brandon has worked for the USGS MD-DE-DC Water Science Center since 2008. His research interests include Fractured Rock Hydrology, Groundwater/Surface Water Interactions, Groundwater Flow Modeling, Geographic Information Systems and Applied Geophysics.

Our Best Chance to Show Restoration Success: Comprehensive Monitoring in Red Hill Branch Subwatershed, Howard County, Maryland

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The Little Patuxent Restoration Partners (Howard County and the Columbia Association) received grant monies from the Chesapeake and Atlantic Coastal Bays Trust Fund for restoration in the Little Patuxent Watershed. Since the Red Hill Branch subwatershed had been identified as a priority for restoration, Howard County focused a large portion of its restoration and monitoring efforts within this subwatershed, including stormwater management facility retrofit, bioretention, stream restoration, and a raingarden program. A monitoring program for the subwatershed was designed and initiated in 2009, prior to construction of restoration projects. Monitoring protocols were developed to evaluate pre- and post-restoration conditions of water quality, channel geometry and sediment load, and the integrity of benthic macroinvertebrate communities. Like the Chesapeake Bay TMDL, the Trust Fund program focuses on water quality and pollutant loadings, specifically nutrients and sediment. To accurately assess these components, we perform both dry-weather (base-flow) and wet-weather (storm-flow) monitoring. While a positive biological response to restoration is ideal, it is often confounded by ecosystem complexities and long time lags. Therefore, we included several geomorphic assessment techniques that might show responses in shorter time periods. These techniques include annual surveys of channel cross-sections and longitudinal profiles, particle size analyses, facies mapping, bar sample sieve analyses, and assessment of bank pins and scour chains. Sediment transport, both suspended sediment and bedload sediment, is monitored using siphon samplers and pit trap samplers. **This presentation will describe the design of this comprehensive watershed restoration monitoring program and detail the results of two years of pre-restoration monitoring.**

Beth Franks is an Environmental Analyst with Versar's Ecological Sciences and Applications group in Columbia, MD. She has been performing analyses on aquatic ecological data for more than twelve years. Beth holds a Master of Science degree in Fisheries and Wildlife Science from Virginia Tech, and a Bachelor of Science degree in Biology from the University of Maryland.

Colin Hill is an environmental scientist in the Natural Resource Management group at KCI Technologies, Inc. Over the last 11 years, he has been performing stream and watershed assessments throughout Maryland and in numerous states across the country. Colin holds a Master of Science degree in environmental science from Towson University, and a Bachelor of Science degree in Biology from Loch Haven University.

A Virtual Stream Sampler – An On-Line Volunteer Training Tool

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Co-authors: Jennifer Gillies, Frank Rodgers, Ben Alexandro

A Virtual Stream Sampler is part of a suite of watershed lessons at the online Potomac Highlands Watershed eSchool, serving the watershed education community in the Chesapeake Bay Watershed. ***A Virtual Stream Sampler*** **offers a realistic simulation of a volunteer stream assessment that includes water quality measurements, habitat assessments, and benthic macroinvertebrate collections.** This activity is based on real data collected in real streams by Cacapon Institute and agency partners. Two streams are currently profiled: a limestone spring fed stream and a restored AMD stream. **Water quality measurements** are collected with virtual testers for pH, temperature, dissolved oxygen, nitrogen, conductivity, and alkalinity. Students read the results off the measurement device, and then "enter" that data by selecting the range in which the answer falls. The **habitat assessment** section (embeddedness, algae, stream bed composition) involves selecting the right answers by interpreting visual clues. The **benthic macroinvertebrate (BMI) collection** begins by dipping a virtual kick net into the stream, sorting the debris out of the net, dragging organisms over to an ice cube tray, and identifying each organism off a list or using an animated dichotomous key. Visitors receive a detailed results page, with their score and stream scores using the Virginia and the West Virginia Save Our Streams methods. This activity is useful in the classroom, as well as for training adult volunteers. ***VSS*** was programmed by Jennifer Gillies and funded by NOAA BWET, The MARPAT Foundation, and Cacapon Institute's members. The eSchool is available 365/24/7, free of charge, at http://www.cacaponinstitute.org/e_classroom.htm.

W. Neil Gillies (Executive Director, Cacapon Institute, High View, WV) began his career as an environmental scientist in South Florida in the 70's with diverse studies ranging from estuarine invertebrate communities to studies on the endangered American Crocodile at a nuclear power plant. In 1996, Neil joined Cacapon Institute, a WV non-profit environmental organization where, among other things, he does water quality and quantity research, developed an innovative web-based e-school, participated in an economic experiment on agricultural incentives, is an active partner in WV's Tributary Team, and is studying how to keep deer out of riparian plantings. He has a B.S. from the University of Miami, Florida, and a M.S. from Florida International University.

The Benefits of Regional Management to the State's Water Supply Program

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Protecting drinking water sources is the goal of many of MDE's regulatory programs. The 1984 Reservoir Management Agreement recognized the importance of coordinating protection activities that encompassed multiple jurisdictions and including the State regulatory agency with authority over water pollution control. The Reservoir Management Agreement has assisted the Department in establishing stringent phosphorus limits in NPDES permits and review of Water and Sewer Plans for Baltimore and Carroll Counties. The Safe Drinking Water Act Amendments of 1996 recognized the importance of identifying risks to drinking water supplies by mandating source water assessments for every public water system in the nation. Maryland's assessments of the reservoir watershed reinforced the need for continued control of phosphorous and sediment to protect reservoir health, but also identified the connection between drinking water standards for disinfection by-products and reservoir eutrophication. The assessments also highlighted the need for ongoing comprehensive monitoring, the trend of increasing sodium levels in the water supply and risks of accidental discharges (spills) from transportation related accidents. Each of these issues has been incorporated into the 2005 Action Strategy, which was an outgrowth of the signing of the Reservoir Management Agreement of 2005. **The Action Strategy provides the roadmap for the signatories with respect to improving the safety and reliability of the Baltimore metropolitan's region water supply. The Reservoir Technical Group provides the necessary forum for the essential collaborative efforts to make progress in this essential public health mission.**

John Grace serves as the Division Chief of the Source Water Protection and Appropriations Division within the Water Supply Program in the Maryland Department of the Environment. He received his education in Environmental Science and Civil and Environmental Engineering when calculators were the new tool. He works to protect drinking water supply sources and to ensure that the water resources of Maryland are properly conserved and managed. John has been part of MDE's Water Management Administration for 25 years dealing with complex water supply and water pollution issues.

Federal-Local Interactions in the Baltimore Urban Waters Partnerships

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Morgan Grove, Research Scientist and Team Leader for the USDA Forest Service's Baltimore Field Station, and Michelle Romolini, University of Vermont, will provide a local perspective for how Federal Agencies are working with State and Local Agencies, non-profit organizations, community groups, and businesses. Grove will describe and illustrate the six ways that the federal agencies will collaborate: 1) Technical assistance; 2) Monitoring and assessment; 3) Existing programs; 4) New programs; 5) Regulatory innovation; and 6) Coordination of activities. Grove will conclude with a summary of current status and priority projects for the Baltimore Urban Waters Partnership.

No Bio Submitted

Planning-Level Estimates of Stormwater BMP Costs (And Benefits?)

Patrick Hagan
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This presentation will focus primarily on the results of a recently completed project, funded by Maryland Department of Environment (MDE), to develop planning level cost estimates for stormwater best management practices (SWBMPs) in Maryland counties. These SWBMP unit cost estimates can be used with MDE's recently released Maryland Assessment and Scenario Tool (MAST) to compare combinations of SWBMPs based on their costs as well as their potential contribution to meeting county TMDL targets.

The presentation will also address what is known about and what is being done to estimate the economic benefits of implementing TMDLs, and will address how estimates of overall county SWBMP costs can be used with other county data to estimate the potential county economic impacts on households and businesses of two potential SWBMP financing options – increasing county property taxes and establishing a stormwater or impervious area fee.

Actual SWBMP costs depend in critical ways on site and landscape conditions, project design characteristics, project scale, land costs, level of urbanization, and other factors that differ significantly from one Maryland County to another. The planning level cost estimates that resulted from our MDE project are not site-specific or project-specific and do not reflect these potentially important cost differences. For this reason, we produced spreadsheet programs that contain the same tables of pre-construction, construction, and post-construction cost estimates that are presented in our MDE report in a format that allows users with more reliable county-level or site-specific SWBMP cost data to adjust (override) component cost estimates and generate their own more reliable overall unit cost estimates. The presentation will include some caveats about using planning level SWBMP cost estimates, some methods for making them more accurate when additional cost data are available, and recommendations for making future SWBMP cost estimates more accurate and more useful. These recommendations include the use of a standard protocol for reporting SWBMP costs and including with them some information about project size, site and landscape conditions, project acre, and acres of drainage area and impervious area treated.

Patrick Hagan is a research associate at the University of Maryland Center for Environmental Science in Solomons, MD, and an associate at King and Associates, an environmental economics research and consulting firm. He received his M.S. from the University of Maryland Marine-Estuarine-Environmental Sciences in 1996. His research has included economic studies of urban stormwater best management practices, economics of coastal inundation prediction systems, valuation of natural resources, and environmental enforcement economics.

Along with Dennis King, he recently completed a project for the Maryland Department of Environment, Science Services Administration that resulted in planning level cost estimates of stormwater BMPs that Maryland counties may use to achieve TMDL-based nutrient and sediment discharge reduction targets.

Generating Synthetic Streamflows for the Middle Potomac Watershed Assessment

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Co-authors: Heidi Moltz, Jim Palmer, Claire Buchanan

The Middle Potomac Watershed Assessment is intended to develop information and tools that will assist the Potomac watershed jurisdictions in protecting environmental flows (the seasonally variable flows of water that sustain healthy river ecosystems and the goods and services that people derive from them.). The project is funded principally (75%) by the USA COE, with The Nature Conservancy as the local cost share (25%) sponsor and ICPRB as the technical partner. **A principal objective of the project is to quantify the impact of withdrawals, impoundments, and land use change on stream flows and then develop ecological response relationships for flow alteration.** Biological data are available for many locations representing different physiographic regions, watershed sizes, land use characteristics, and other factors that may impact flows, but gaged flow data are available for relatively few sites. The HSPF model coupled with the VADEQ WOOOMM model was selected to generate synthetic stream flow time series for current conditions at ungaged locations and also to generate stream flows for modeled baseline (no or little human impact) and predicted future conditions scenarios. From these simulations, over 250 flow statistics were calculated, and flow alteration was calculated as (Current – Baseline) / Baseline, or (Future – Current) / Current, for each statistic. The resulting measures of flow alteration are used with biometric data to develop flow alteration – biological response relationships. Multiple approaches were used to test model performance with results suggesting that flow statistics generated from simulated flows, with a few exceptions, could be used to represent the variety of conditions being compared in this project.

Carlton Haywood is the Director of Program Operations at the Interstate Commission on the Potomac River Basin, where he has worked since 1982. Before joining ICPRB, he taught Physical Geography at Colgate University. He has a B.A. in Geology and Environmental Studies from Macalester College and did graduate work in the Department of Geography and Environmental Engineering at The Johns Hopkins University.

Urbanization and the Future of Aquatic Biodiversity in Maryland

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Co-authors: Ryan M. Utz, Scott A. Stranko, Richard L. Raesly

Urbanization causes major declines in native aquatic biodiversity in Maryland's streams. Among benthic macroinvertebrates, approximately one-half of taxa are negatively affected by increasing impervious surfaces. Many of these taxa are effectively absent from streams whose upstream area contains more than 5% impervious surfaces. Similarly 45-75% of fishes are negatively affected by increasing impervious surfaces. Across regions, taxa found in the Piedmont show greater vulnerability to similar levels of urbanization than they do in the Coastal Plain. Unchecked development could result in the disappearance of as many as 60% of the benthic macroinvertebrate taxa by the time impervious surfaces reach 15% of the watershed. Application of our results to buildout scenarios in the Middle Patuxent River watershed forecast the disappearance of up to 50% each of fish and invertebrate taxa. The data strongly suggest that maintaining aquatic biodiversity in Maryland's streams will require better planning in the face of expanding human populations.

Robert Hilderbrand is an associate professor at the Appalachian Laboratory, University of Maryland Center for Environmental Science in Frostburg, MD. His main research interests revolve around the conservation and management of fish and benthic macroinvetrebrates in headwater streams.

Volunteer Monitoring Using Community Participatory Mapping

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Volunteer water monitoring encourages community awareness, involvement, participation in planning process, and public health advocacy. The inclusion of **Community Participatory Mapping** can enhance similar benefits by engaging the community in the mapping process. Today, information technology has evolved and is integral to daily life that most people have access to the smart-phone. By using readily available smart phone technology, volunteers can map various water related data with a GPS enabled phone and upload information without any technical difficulties or additional expenses. The information gathered can be viewed instantly on an interactive website or smart phone, where information can be accessed immediately. The collected data can be instantly compared spatially with other environmental data. This presentation will show how the community participatory mapping concept can be applied to volunteer monitoring and also to discuss its potential

Dr. Wansoo Im is the founder of VERTICES, LLC, a geospatial information services company providing innovative and interactive map-based solutions. In addition to VERTICES, he is an assistant professor at the department of Family and Community Medicine at Meharry Medical College. He is an adjunct faculty at Bloustein School of Planning and Public Policy at Rutgers University. He specializes in developing decision support systems using a public participatory approach and interactive web-based geographical information systems. Dr. Im received his Masters in Urban and Regional Planning from the University of North Carolina at Chapel Hill and his Ph.D. from the Edward J. Bloustein School of Planning and Public Policy. Since 1991, Dr. Im has taught GIS courses for various schools including the Department of Urban Studies and Community Health at Rutgers University, and the Department of Civil & Environmental Engineering/Institute for Transportation Studies at New Jersey Institute of Technology. Dr. Im is most proud of his web portal, http://www.imrivers.org, which is currently being used by multiple environmental organizations across the United States. His work on community participatory internet mapping was featured in The New Yorker magazine in 2006 and The New York Times in 2008.

What's Missing from Baltimore's Urban Fish Communities and Why?: Evaluation of the Use of Fish Community Data in Guiding Stream Restoration Efforts

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Understanding the impact of urbanization on aquatic biological communities is central in evaluating and guiding ecosystem restoration efforts. Assessments of ecosystem health using fish assemblage data are frequently accomplished using metrics such as the Index of Biotic Integrity (IBI). Alternative approaches (e.g. Target Fish Community) use the same data to construct an expected fish assemblage of a particular waterway from similar reference streams which is compared with existing waterway fish assemblages. Results of a conceptually similar comparison on fish species assemblages from two urbanized Baltimore waterways (Gwynns Falls and Jones Falls) and area reference streams are presented here. A discriminant analysis was performed between fish assemblages of urbanized and reference sites. The analysis produced a significant discrimination between target and reference sites (P= .00002, Trace statistic permutation test), and had a classification accuracy rate of 89% (Leave-one-out Allocation test). Species strongly associated with reference sites showed some general natural history similarities, including the fact that all but one were lithophilic spawners. Of five species most associated with urbanized sites, only one was a lithophilic spawner. Pollution tolerances tended to match expectation though there was variation in these two groups, suggesting that site specific effects were important. Results from this analysis are compared with insights from the basic Target Fish Community approach on the specific Jones Falls and Gwynns Falls. **Detailed analysis of fish communities combined with species-specific natural history information can provide insight into the individual deficiencies and needs of watersheds, and can be used to guide restoration efforts.**

Stanley Kemp is an assistant professor at the University of Baltimore. His current research focus is on understanding effects of urbanization on aquatic ecosystems and their restoration.

CEDS Watershed Audits: How Volunteers Can Save 100 Feet of Waterway in an Hour

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Restoring the Bay and other Maryland waters through TMDLs and Watershed Implementation Plans is predicated upon a high degree of compliance with limits on nutrient and sediment releases. Unfortunately, far too many of our existing pollution control measures are not working as well as they should. The CEDS Watershed Audit (ceds.org/audit) provides a way for volunteer and professional clean water advocates to quickly identify failing control measures. For example, a recent Severn River Preliminary Audit found that a third to all existing stormwater BMPs were failing to a degree that little pollutant retention was being achieved. An Audit of BMPs in the Saint Mary's critical area documented a similar degree of failure. With the new CEDS Equitable Solutions (ceds.org/eqs) approach, advocates can quickly negotiate a positive strategy for improving pollution control. Through this workshop advocates will learn how to assess clean-water law compliance with regard to: point source discharges, Environmental Site Design (ceds.org/esd) for proposed development, Forest Conservation, stormwater BMP maintenance, construction site erosion and sediment control, rapid low-cost chemical and biological methods for pin-pointing undocumented pollution sources, and more.

Richard Klein worked for DNR water quality monitoring and fishery management units for eight years then served as the executive director of Maryland Save Our Streams for ten years. In 1987, he left the Department to launch Community & Environmental Defense Services (CEDS) which helps people throughout the nation resolve a wide variety concerns about issues affecting neighborhoods or the environment.

Water-Quality Monitoring in the Baltimore Reservoir System, 1981-2007: Description, Review, Evaluation, and Modifications to Enhance Monitoring

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Co-authors: Marcus C. Waldron and Tamara E.C. Kraus

The City of Baltimore and parts of five surrounding Maryland counties obtain potable water from Loch Raven and Liberty Reservoirs; a third reservoir, Prettyboy, resupplies Loch Raven Reservoir. Management of this reservoir system is a shared responsibility among City, County, and State jurisdictions; guided by their (2005) Reservoir Watershed Management Agreement (RWMA). The RWMA called for continued and improved monitoring in the reservoirs and watersheds to address water-quality conditions that impair designated uses in the tributaries and (or) reservoirs, including drinking-water supplies. These conditions include elevated sediment, nutrient, sodium, chloride, and bacterial concentrations in selected tributaries; and sedimentation and eutrophication (algal blooms, deep-water anoxia, and elevated metals) in the reservoirs. **The U.S. Geological Survey conducted a review of the current monitoring program and existing data, and suggested changes to improve RWMA managers understanding of the relations between watershed and reservoir water-quality conditions, and the effects of management actions on water-quality conditions.** Proposed changes include the collection of short-term data—on local daily precipitation and type, tributary stormflows and quality, reservoir late-winter/early-spring algal blooms, and selected reservoir daily water-quality and hydrodynamic conditions—to address identified limitations in historical data. Monitoring could include available and total forms of nutrients. Statistical methods and formal models were suggested to better describe tributary water-quality conditions, reservoir water-quality, biotic, or trophic conditions, and relate the former to the latter through time. Development of a comprehensive quality assurance program plan could improve the management, qualification, and archival of data, which historically were questioned by investigators attempting to address RWMA concerns.

Mike Koterba has been a Hydrologist with the U.S. Geological Survey (USGS) for over 25 years, and specializes in water-quality investigations in ground and surface waters. He enjoys working on water-quality contaminant studies. His body of work includes studies on nutrients, pesticides, mercury, and (or) trace metals at local, regional, and national scales. Locally, he has conducted several studies on groundwater quality on the Delmarva Peninsula and in Washington, D.C. Nationally, he has enjoyed working on the development aspects of monitoring programs—helping to develop groundwater sampling protocols, the quality-assurance program, and the National synthesis on trace elements design, for the USGS National Water-Quality Assessment Program as well as the national security plans for dams and water under a detail to the Department of Homeland Security, and the Chesapeake Bay Observing System (CBOS). As its initial Director, he helped develop CBOS into one of the first formally recognized IOOS sub-regional and functional observing systems. Currently, Mike is stationed at the Chesapeake Bay Program (CBP) in Annapolis, MD, and assisting CBP Data Management staff in the development of Federally compliant enterprise architecture.

Uncharted Territory: The Importance of Investing in New Ideas to Restore Water Quality

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Bay watershed states have developed strategies to reduce nutrient loads, yet gaps remain and States are looking to new ideas to reduce nutrients. Maryland's Innovative Technology Fund was established with the goal of accelerating riverine, estuarine and coastal water quality restoration through the development of new innovative technologies to reduce nonpoint source pollution. A secondary goal is to support the development of successful businesses while creating green jobs in Maryland. **Maryland is using this fund to develop new technologies that reduce nitrogen, phosphorus and sediment.** The Innovative Technology Fund includes two tracks. One addresses the need for additional research and development, and the second supports fledging companies in industry and technology related to Bay restoration and protection. A number of projects have been supported under the Innovative Technology Fund spanning the various nonpoint source sectors of agriculture, urban stormwater, air emissions and natural filters. The Innovative Technology Fund takes a system approach to solving nutrient and sediment runoff. It also validates the nutrient and sediment benefits of new technologies. By supporting innovation, the State demonstrates their commitment to investing in research and development as a way to improve efficiency and maximize return on investment. This presentation will cover the project selection process, supported projects, lessons learned and challenges to implementing the Innovative Technology Fund.

Sarah Lane is the University of Maryland's liaison to Maryland's Department of Natural Resources. Her main duties are to evaluate policy and program effectiveness, prepare and negotiate policy positions, coordinate research and reporting of data related to the progress of Maryland's protection and restoration programs. Sarah manages the state's Innovative Technology Fund to develop new technologies for Bay restoration while improving efficiency and maximize return on investment. The relationship between the University and DNR provides a platform for Sarah to initiate and maintain relationships with the academic, nonprofit and business community to enhance restoration by evaluating emerging science, management tools and practices and assisting in their development and implementation.

The Maryland Biological Stream Survey's Role in the Chesapeake and Atlantic Coastal Bays Trust Fund

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In November of 2007 Governor O'Malley and Maryland lawmakers created the Chesapeake and Atlantic Coastal Bays Trust Fund in an effort to improve the water quality in the Chesapeake Bay. By identifying nutrient impaired watersheds and focusing cost effective restoration in those watersheds non-point source pollution can be reduced. Monitoring the effects of the restorations is an important aspect of the Trust Fund. **The Maryland Biological Stream Survey is involved with several aspects of monitoring.** MBSS has taken a leading role in monitoring data acquisition and analysis, assisting local governments with monitoring plans, and providing targeted monitoring. Working in conjunction with local governments, MBSS is targeting biological monitoring in two streams undergoing restoration funded by the Chesapeake and Atlantic Coastal Bays Trust Fund. The two streams are Redhill Branch, in the Little Patuxent watershed, and Wheel Creek, in the Atkisson Reservoir watershed. In addition to watershed scale sampling, BMP specific sites have been sampled to assess changes resulting from individual BMPs. Data collected in these watersheds represents baseline conditions.

Ken is currently a Natural Resources Biologist for the Maryland Biological Stream Survey. He works extensively on monitoring The Chesapeake and Atlantic Coastal Bays Trust Fund restoration projects. Prior to his time at DNR, Ken earned a bachelors of science, in conservation biology, from State University of New York College of Environmental Science and Forestry, and worked as a biological technician across the United States.

Successes and Challenges Associated with the Development and Implementation of a Right-Sized Volunteer Stream Monitoring Program for a Small Municipality

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The City of Rockville's SOS Volunteer Stream Monitoring program began in 2009 as a partnership between resident volunteers and Environmental Management Division (EMD) staff. Initial program goals included empowering citizens with limited training to collect important data on Rockville streams, identifying methodology that allowed for easy on-site data collection and analysis, and promoting a "no-kill" macroinvertebrate collection program. Given program goals, the collaborative group determined, rather than using a single existing program, an effective strategy for Rockville would involve combing elements from a number of local stream monitoring programs. What resulted is a volunteer program that is right-sized for Rockville and serves to monitor the condition of Rockville's streams while also connecting citizen volunteers to their local watershed. Since the program's inception, many of the initial program goals have been successfully realized. However, the program has not been implemented without challenge. Lessons learned include understanding and readjusting the necessary staff commitment to maintain such a program and how the collected data can be used by other organizations. **Rockville's SOS Volunteer Stream Monitoring program is a great case study on the successes and challenges associated with right-sizing a volunteer stream monitoring program for a small municipality.** This presentation will focus on the accomplishments as well as lessons learned in the development and implementation of such a program in the City of Rockville.

Amanda Matheny is a Watershed Protection Specialist with the City of Rockville in Maryland. In her role, she coordinates a number of stormwater related programs including SOS Stream Monitoring, Storm Drain Marking, Adopt a Stream, Rockville RainScapes Rewards and others. As a Maryland native, Amanda has always treasured her local streams and rivers. She enjoys educating the public on environmental topics and strives to engage volunteers to participate in environmental stewardship activities. She holds a B.S. in the Biological Sciences and a M.S. in Environmental Science from the University of Maryland-College Park.

Coastal Bays Non-Tidal Nutrient Indicators & Thresholds for Use in an Annual Report Card

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Co-authors: Carol Cain, Roman Jesian, and Cathy Wazniak

An annual 'state of the Coastal Bays' report card has been produced since 2008 by the Maryland Coastal Bays Program in partnership with MD-DNR and other organizations, similar to the Chesapeake Bay report card. A standard set of indicators provides an annual snapshot of the health of the Bays focusing on water quality, along with several living resources indicators important in the Coastal Bays. Multiple thresholds for each indicator are used to provide a goal attainment continuum and a means to construct a grading scheme. During 2010, we recognized that non-tidal data were inappropriately combined with tidal data to determine attainment of water quality goals, and that separate non-tidal indicators and thresholds should be identified. Because several partners collect water quality data used by the report card, these indicators must be common to all. Total nitrogen and total phosphorus were chosen, and several methods to identify multiple threshold values for determining goal attainment have been explored. **Eastern Shore Coastal Plain MBSS BIBI scores were used to bin nutrient scores, but this resulted in unexpected inverse relationships, where high BIBI scores were associated with undesirable high TN values, and no pattern associated with TP values. Grouping sentinel vs. non-sentinel sites without reference to BIBI scores produced reasonable patterns of nutrient scores associated with statistics P10 through P90.** Here we present results of these trials and request feedback from the MWMC community with reference to statistical validation of this method, or suggestions for watershed-specific criteria to use in defining thresholds.

Carol McCollough is a Natural Resources Biologist with Tidewater Ecosystem Assessment within MD-DNR's Resource Assessment Service, and a member of the Mid-Atlantic Tributary Assessment Coalition.

The Urban Waters Federal Partnership: Anacostia River Pilot

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The Urban Waters Federal Partnership was formed to support President Obama's America's Great Outdoors initiative. The goals of the partnership are to ensure that Federal, State, local, and non-government agencies are collaborating efficiently to revitalize selected urban streams and to connect citizenry with these vital waterways. **Based on its location in an overburdened and economically disadvantaged urban area, and on the high degree of current local government and organized community involvement, the Anacostia River was selected as one of seven pilots across the United States.** Projects such as stream restoration, improved stormwater management, economic development, and enhanced park trails with access to the rivers are already underway throughout the watershed. The U.S. Geological Survey has developed a mapping tool to identify stream reaches with the strongest need for improvements and where there is already a strong Federal presence. Thus far, spatial data for the mapping tool include U.S. EPA Superfund and Resource Conservation and Recovery Act (RCRA) sites, brownfields, and sewer outfalls; Fish and Wildlife Service habitat sites; NPS and local parks, trails and restoration areas; NOAA remediation studies; and U.S. Army Corps of Engineers restoration projects. While it is beneficial to connect people to the rivers, it is equally important that the water quality and stream habitat are improved for the health and safety of the people and biota that use them. An improved Federal presence and government partnerships will engage the local citizenry in projects to improve the Anacostia River and educate the public about its value.

Cherie Miller is a hydrologist with the U.S. Geological Survey and Acting Deputy Director for the MD-DE-DC Water Science Center in Baltimore, Maryland. Previously, she was an assistant professor for geochemistry at Franklin and Marshall College. Schools attended include University of Maryland, Johns Hopkins, University of Virginia, and Rollins College.

Finding Common Ground Between NPDES MS4 Permits and the Bay TMDL

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NPDES MS4 permits have moved into a new era. Permit renewals will include stormwater sector allocations from the Chesapeake Bay TMDL, along with minimum percent retrofit requirements. TMDL requirements are often more stringent than retrofit requirements of the permits. MDE has developed new accounting standards for impervious area retrofits in the permits that give significantly less credit than the Chesapeake Bay Program does for projects that meet the TMDL. How can jurisdictions address decreasing credit for practices, meet costly new requirements, protect and restore water quality, and remain in compliance in an atmosphere of stricter regulatory enforcement and third party interest? Challenges and solutions will be presented in the spirit of moving towards a cleaner Bay.

Shannon Moore is the Acting Manager of Sustainability and Environmental Resources at Frederick County Government. The Watershed Management Section within her office coordinates compliance with the NPDES MS4 Permit Requirements. Shannon holds a Master's Degree in Environmental Science and Management from the Bren School at the University of California, Santa Barbara.

Spatio-Temporal Evolution of Hypoxia in Small Tributaries of Chesapeake Bay

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One of the classic problems in geosciences is that when developing a monitoring program over large areas, spatial or temporal resolution is sacrificed. **This basic problem of either having clusters of data points in time or space coupled with the differences in the nature of spatial and temporal dimensions makes it difficult to translate from individual spatial and temporal domains into the spatio-temporal domain. In this study, we are able to make the jump to the spatio-temporal domain by treating time as a spatial dimension.** This is accomplished by using multiple platforms including weekly Hydrolab casts, buoy data, and a REMUS AUV to extensively sample the South and Severn Rivers. The results show significant differences in the evolution and nature of hypoxia in these tributaries despite their physical similarities. In particular, the Severn River appears to develop hypoxia in late spring throughout most of the sub-estuary over the course of the entire summer, whereas the South River displays more temporal controls with hypoxic events expanding and contracting over time. As a result, the concept of hypoxic squeezing can be extended into the spatio-temporal domain which may potentially allow for the prediction of fish kills.

Andrew Muller currently is employed at the United States Naval Academy as a Professor of Oceanography. He received his undergraduate degree in Geology, then went on the receive a Master's and Ph.D. in Oceanography from Old Dominion University. Andrew spent his career studying coastal ocean dynamics, spending up to 3 months at a time on the Grand Banks in the North Atlantic. He then spent many years researching the physical and geological sediment dynamics in the Chesapeake Bay, Coastal Bays. Currently, his studies include Chesapeake Bay and tidal tributaries physical and chemical dynamics, modeling, and wavelet modeling.

Performance of a Wet Infiltration Basin Managing Highway Runoff

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Wet infiltration basins are stormwater control measures (SCMs) for managing urban stormwater runoff. Over the years, field inspections have demonstrated that these SCMs exhibit progressive failure. However, the environmental functionality of such "failed" wet basin SCMs in managing runoff has not been documented. A failed wet infiltration basin treating highway runoff in Maryland has been continuously monitored for flow characteristics and water quality during and for time periods subsequent to rainfall events since summer 2009. The performance data collected so far suggest that the **failed wet basin appears to have both hydrologic management and water quality functions.** Runoff flows monitored during 95 rainfall events show that the basin captured the entire inflow volume and did not produce any outflow for 47% of the events. The mean volume reduction achieved through the basin for all events was 56%. Peak attenuation and flow delays were observed in the outflows from the wet basin. Runoff water quality (total suspended solids, total phosphorus, nitrogen, and total copper, lead, and zinc) at the basin have been observed during 24 rainfall events. The event mean concentrations of the outflows satisfy the established water quality goals for all pollutants except total phosphorus. While pollutant mass reductions were observed for all pollutants during 22 events; export of nutrients and heavy metals was observed, especially during winter. Seasonal trends in hydrology and water quality performances of the basin have also been observed throughout the monitoring period.

Ms. Poornima Natarajan is a Ph.D. candidate in the Department of Civil and Environmental Engineering at University of Maryland, College Park. Her research interests are stormwater management technologies and green engineering principles. Her current research focuses on evaluating the performance of infiltration basins in managing urban stormwater runoff, particularly hydrology and water quality benefits. She received her Master's degree in Environmental Engineering from University of Maryland in 2008, during which she conducted field monitoring and evaluation of an underground stormwater detention facility in mitigating stormwater runoff temperatures and flows. She obtained her Bachelor's degree in Civil Engineering from India in 2006.

Environmental Justice: Forming a New Strategy

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While MDE is the home for Environmental Justice, the issue crosses many state agencies and all levels of government. The Department's challenge as a regulatory agency is to protect the environment and the communities surrounding regulated facilities within the confines of local zoning and state law. **Currently, MDE is engaging a review of its own practices to be sure the Department is communicating with its stakeholders-regulated industries, community members, local government, advocates, and other decision makers-about permit applications and the benefits of Environmental Justice in the most efficient and meaningful way.** Lisa Nissley will present on the issues at hand and the strategy MDE is using to address EJ.

Lisa Nissley serves as the Environmental Justice Coordinator and Legislative Liaison at the Maryland Department of the Environment. Previously, she worked for five years in the Maryland State Senate as the Legislative Aide to the Senate Chairman of Education, Health, and Environmental Affairs concentrating on a variety of health and public health issues. Lisa has also managed electoral campaigns. She graduated from UMBC with a degree in Political Science in 2001 and recently earned a Masters degree in Strategic Public Relations at The George Washington University.

Land Use Review and the Importance of Zoning to Reservoir Watershed Management

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Land use planning and zoning policies have been included in the Reservoir Watershed Management Agreement's Action Strategy since its adoption in 1984. The zoning policies include that the current extent of agricultural and conservation zoning will be maintained and that additional urban development zoning will be limited insofar as possible. For each of Baltimore County's quadrennial Comprehensive Zoning Map Process (CZMP) cycles, beginning with the 1988 CZMP, the Reservoir Technical Group has reviewed all zoning reclassification petitions in the three reservoir watersheds. **The RTG has provided consistent, strong support for Baltimore County's long-standing regional commitment to use its land use powers to protect the quality of metropolitan Baltimore's drinking water supplies.** The regional zoning review function provides visibility and accountability to a traditionally local process where such decisions impact the management of an inter-jurisdictional resource. RTG's Water Resources Program Manager regularly testifies at the CZMP hearings at both the Planning Board and County Council level, in addition to providing written recommendations to the public record for each zoning reclassification petition. As the County enters the 2012 CZMP, Resource Conservation zoning still covers 92.6% of the reservoir watersheds in Baltimore County.

Donald C. Outen, AICP, has worked for 38 years in Maryland in land use planning and environmental management at the state, regional, and local levels of government and in academia. He is currently a Natural Resource Manager with the Baltimore County Dept. of Environmental Protection and Sustainability, where he focuses on forest sustainability and reservoir protection.

Maryland SHA TMDL Efforts

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As an urban sector entity, the Maryland State Highway Administration (SHA) is committed to meet the requirements of the Chesapeake Bay TMDL, issued December 29, 2010. This will be accomplished through compliance with the requirements established in Maryland's Watershed Implementation Plan for the Chesapeake Bay Total Maximum Daily Load (WIP I), issued December 3, 2010, and conditions to be included in the next individual MDE NPDES MS4 discharge permit for medium and large jurisdictions (Phase I MS4 permit) issued to SHA as well as the conditions to be included in the next MDE NPDES General Permit for Discharges from State and Federal Small MS4s (Phase II MS4 permit).

SHA maintains MS4 permit coverage for the SHA roadway storm drain systems in nine Maryland MS4 Phase I counties and in two MS4 Phase II counties. The MD WIP treatment and WLA requirements imposed on SHA for each of these counties will require not only an overall reduction in pollutant loads, it will also require the restoration of 30% of pre—1985 impervious surface in Phase I coverage areas and the restoration of 20% of impervious surface in Phase II coverage areas. The challenge for SHA will be achieving these goals within a confined footprint and like all other stakeholders, within the established timeframe. The focus of this presentation will be on how we are preparing ourselves to meet the challenge and the approach we will take to site selection, cost effective planning, targeting for local and Bay TMDLs, and treatment strategies that are being considered.

Karuna Pujara, PE, is Division Chief of Highway Hydraulics Division and has been with the Maryland State Highway Administration for nearly 18 years. Her expertise is focused on Hydraulics/Hydrology, drainage, Water Quality, NPDES, Stream Restoration, Stormwater Management, and Erosion and Sediment Control.

Source Data for TMDLs

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Assessing TMDL compliance for non-point sources in a watershed begins with good base data. Three of the most important parameters for estimating whether runoff pollutant loading meets TMDL limits are the area treated by stormwater controls, the type of treatment, and the amount of impervious area within each drainage area. To delineate drainage areas, spatially accurate topography and storm drain mapping is mandatory. Removal efficiencies of existing stormwater controls are needed to estimate the degree of treatment, so it is important to have an up-to-date and accurate database of BMPs. The third parameter, an accurate assessment of impervious cover, can be more difficult to obtain, but is just as critical. Without this proper base data, pollutant loading calculations are unlikely to be a reliable indicator of compliance.

When base data is missing or incorrect, field verification of stormwater infrastructure and drainage divides may be required. If detailed planimetric mapping of buildings and pavement is not available, automated delineation of impervious cover using recent aerial imagery can provide accurate estimates for loading calculations. This presentation will discuss the process for generating accurate drainage areas and estimates of imperviousness with and without good base data, including lessons learned and tips that will help to determine compliance with a wide range of data quality. Examples of issues encountered as well as successes will be discussed throughout.

Brent Reeves is a GIS Analyst with KCI Technologies. Mr. Reeves manages and performs the collection of data for storm drain infrastructure and drainage area delineations for multiple agencies in Maryland. Mr. Reeves is efficient in the stormwater data collection process including database design, field verification, and drainage area delineation. He is currently working on projects to generate impervious cover and BMP drainage areas that will be used to help demonstrate TMDL compliance throughout the state of Maryland.

Bill Frost is a Water Resources Engineer with experience in watershed planning and stormwater quality studies, in both the public and private sectors. His project work focuses on watershed restoration, retrofitting stormwater management into developed urban areas, and identifying solutions to restore aquatic resources and water quality. Current work includes developing watershed plans throughout the Bay watershed which will help permittees show progress towards meeting TMDL goals.

State's Role in Reservoir Watershed Management—How TMDLs are Integrated Into the Reservoir Watershed Management Program

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Section 303(d) of the federal Clean Water Act requires each State to assess its waters, determine if they meet their designated use, and to develop Total Maximum Daily Loads (TMDLs) for those that do not. The Loch Raven and Prettyboy Reservoirs were listed under Section 303(d) of the Clean Water Act as impaired by nutrients and sedimentation (Loch Raven), and by nutrients (Prettyboy), by the State in 1996. The nutrient impairment in each case was caused by total phosphorus. These listings resulted in the requirement of the State to develop TMDLs to address the impairments in these reservoirs. Maryland Department of the Environment (MDE) is responsible for TMDL development in the state. MDE has long had membership in the Baltimore Metropolitan Council's Reservoir Technical Group (RTG). In developing these TMDLs, **MDE worked with the RTG to facilitate a cooperative and coordinated approach, involving Baltimore City and the surrounding Counties.** Since the two reservoirs are both impoundments of the Gunpowder River, a single, linked, watershed/water quality modeling system was developed to address these three impairments and determine the maximum allowable load of the respective impairing substances to each water body. A method was developed to apply the State's dissolved oxygen standard to stratified impoundments, and the development and application of a numeric chlorophyll a TMDL endpoint specifically tailored to drinking water protection was conducted. Water quality standards, criteria, the TMDL process and modeling approach are briefly described.

Timothy Rule holds a Bachelors degree in Biology from the College of Wooster and a Masters degree in Marine-Estuarine-Environmental Science from the University of Maryland. He has been with the Maryland Department of the Environment, primarily in the TMDL program, for fifteen years. His areas of expertise include eutrophication issues in freshwater and estuarine areas, mercury in fish tissue, and various issues regarding lake and reservoir management. He also taught Environmental Science at the Maryland Institute College of Art for ten years.

Maryland's Assessment and Scenario Tool (MAST)

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Maryland's Assessment and Scenario Tool, or MAST, was developed as a strategic planning tool to allow state and local governments to look at various strategies for completing a Plan to meet loading reductions to comply with the Chesapeake Bay TMDL. The tool was developed for Maryland by the Interstate Commission on the Potomac River Basin (ICPRB) and J7 Inc. to mimic the Scenario Builder tool and estimate the results that would come from the Chesapeake Bay Watershed model created by USEPA. The tool brings transparency by opening up what for the lay person is the "black box" of the EPA models through the practical application of these complex modeling systems.

The Maryland Dept. of the Environment (MDE) and local government partners have been using MAST to help develop the state strategy for Phase 2 of the Watershed Implementation Plan designed to meet Bay goals for lowered Nitrogen, Phosphorus and Sediment in the years 2017 and 2020. The development of MAST has enables local planners, decision-makers and stakeholders to assemble nutrient and sediment load reduction strategies in the form of quantified assemblages of best management practices to meet the pollution reduction goals of the Chesapeake Bay TMDL and the State's Phase II WIP. This session will provide an overview of the tool including scenario creation, BMP application and a description on how to assemble and evaluate different scenarios.

Gregorio Sandi has been a Natural Resources Planner within the MDE Science Services Administration for 3 years. Prior to MDE, he spent 5 years in a private Engineering consulting firm working in groundwater remediation.

Robin Pellicano has been a Natural Resources Planner within the MDE Science Services Administration for 6 years. Prior to MDE, she spent 5 years with the Department of Natural Resources.

The Changing Stormwater Paradigm in the Chesapeake Bay

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Increasing concerns about high nutrient loads and urban stream degradation have prompted Bay states to fundamentally change their paradigm for managing stormwater at new development, redevelopment and existing development. **More stringent stormwater regulations now promote higher levels of on-site runoff reduction, and new stormwater permits require greater levels of nutrient reduction from existing development, driven in part by the Bay-wide TMDL.** Tom will describe these changes and their profound implications for localities, with respect to maintenance, nutrient accounting, and enhanced design criteria.

Tom currently serves as the stormwater technical coordinator for the EPA Chesapeake Bay Program. Tom founded the Center for Watershed Protection in 1992, and launched the Chesapeake Stormwater Network in 2007 as a new organization whose mission is to improve on the ground implementation of more sustainable stormwater management and environmental site design practices in each of 1300 communities and seven states in the Chesapeake Bay Watershed. He has conducted extensive research on the pollutant removal performance, cost, and longevity of stormwater control measures.

The Urban Waters Partnership; A National Perspective

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Surabhi Shah, USEPA Office of Water and Alice Ewen, USDA Forest Service, Urban & Community Forestry will provide a national perspective on the Urban Waters Federal Partnership (urbanwaters.gov). This partnership of eleven agencies is committed to revitalizing urban waters and the communities that surround them, transforming overlooked assets into treasured centerpieces and drivers of urban revival. By improving coordination among federal agencies and collaborating with community-led revitalization efforts, this partnership seeks to improve our Nation's water systems and promote their economic, environmental and social benefits. Specifically, the Partnership seeks to:

- Break down federal program silos to promote more efficient and effective use of federal resources through better coordination and targeting of federal investments.
- Recognize and build on local efforts and leadership, by engaging and serving community partners.
- Work with local officials and effective community-based organizations to leverage area resources and stimulate local economies to create local jobs.
- Learn from early and visible victories to fuel long-term action.

Partners include:

- U.S. Department of Agriculture
- Department of the Army (Civil Works/U.S. Army Corps of Engineers)
- U.S. Department of Commerce (Economic Development Administration and National Oceanic and Atmospheric Administration)
- Corporation for National and Community Service
- U.S. Environmental Protection Agency
- U.S. Department of Health and Human Services (U.S. Centers for Disease Control and Prevention and National Institute of Environmental Health Sciences)
- U.S. Department of Housing and Urban Development
- U.S. Department of the Interior
- U.S. Department of Transportation

Surabhi Shah leads EPA's Urban Waters Program which seeks to support local community efforts to access, restore and benefit from their urban waters and the surrounding land. This program supports the Urban Waters Federal Partnership. For over two decades, Surabhi has worked on environmental restoration and local stewardship issues in Canada, India and the United States. She holds a Bachelor's degree in Systems Design Engineering and a Master's degree in Environmental Engineering from the University of Waterloo in Canada.

Chesapeake Bay Program Watershed Model and the TMDL

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The Chesapeake Bay Program Partnership's Watershed Model has been in continual use and development over more than 2 decades. The watershed model estimates the amount of nitrogen, phosphorus, and sediment that are delivered to the tidal waters of the Chesapeake from point and nonpoint sources from the basins and jurisdictions within the watershed. This estimation is made for current, past, and future scenarios. The current version of the CBP watershed model has been developed with extensive partnership and scientific input. The decision-making process used by the partnership for the Chesapeake TMDL relied on the use of the entire suite of environmental models of the Chesapeake ecosystem.

Gary Shenk is the integrated analysis coordinator for the Chesapeake Bay Program where he has been involved with the development and application of the watershed model for 16 years.

Conceptual Framework for Incorporating Urban Watershed Functions Into Maryland's TMDL Program

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Coauthors: Lee Currey, Anna Kasko, Beth Franks, Lisa Methratta, Ray Morgan, and Steve Schreiner

The TMDL program of the Maryland Department of the Environment (MDE) must address all state waters on the Clean Water Act 303(d) list of impaired waters. To date, TMDLs have been developed for specific, identified pollutants such as PCBs, bacteria, pH, and nutrients. In Maryland, however, 8-digit watersheds are also listed on the 303(d) list as impaired based on the proportion of streams that possess degraded biological communities. This biological approach allows MDE to identify impairments from unmeasured stressors and comprehensively address watershed degradation across the state. The challenge is to apply a TMDL program designed for specific pollutants to unidentified or multiple stressors that may be causing watershed-scale impairment. In 2006, MDE developed a threshold for sediment impairments based on the normalized sediment load (beyond the all-forest condition) that correlated with degraded instream biological and instream habitat conditions. Following in 2009, MDE developed a Biological Stressor Identification (BSID) methodology that used a case-control, risk-based approach to identify categories of stressors (sedimentation, habitat conditions, and water chemistry). While the BSID makes maximum use of field monitoring data obtained statewide by the Maryland Biological Stream Survey (MBSS), it cannot address all stressors present in urban environments, as stressors such as flow are not adequately characterized by the MBSS. **This project synthesizes the literature on the "urban stream syndrome" with the latest research on surrogate urban stressors, such as impervious cover, into a conceptual framework that provides a consistent and comprehensive approach to addressing all "limiting factors" affecting Maryland streams.** Specifically, the framework addresses each potential limiting factor through a series of management metrics. The primary management metric (in this case the core TMDL target) is the amount of "effective impervious area" (EIA) in the subwatershed. EIA is the amount of imperious area that produces runoff after subtractions are made for attenuation and treatment of runoff. Additional metrics address (1) condition of the riparian area, (2) physical habitat in the stream channel, (3) transportation-related contaminants, and (4) invasive species effects. Ultimately, the urban TMDL would provide targets for each limiting factor to be addressed in a watershed management plan.

Mark Southerland, Ph.D., PMP, CSE, has been supporting federal, state, and local water quality programs since 1988. He was the lead author of the EPA national program guidance on biological criteria and has been the lead consultant on the Maryland Biological Stream Survey for the Maryland Department of Natural Resources (DNR) since 1993. He also supports the impaired waters, stressor identification, and TMDL programs for the Maryland Department of the Environment (MDE). Mark currently serves as chair of the Maryland Water Monitoring Council Board and is an original member of the Howard County Environmental Sustainability Board.

Watershed Resources Registry: An Integrated Approach to Watershed Management

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The WRR was developed as a national pilot by the EPA, the US Army Corps of Engineers and multiple State and Federal stakeholders to identify watershed-based conservation, enhancement, and mitigation opportunities and priorities. The purpose of the WRR is to assist with improving the regulatory process efficiency and to provide a sound scientific basis to planning and regulatory decision. The WRR is a comprehensive mapping tool and a replicable framework that is transparent, predictable, reliable, and transferable.

For the development of the WRR, an interdisciplinary/interagency Technical Advisory Committee was created to determine the appropriate data layers to use, and to identify and refine the criteria used in the suitability analyses and model creation. These criteria and suitability analyses were determined by the agencies to address their individual regulatory or planning needs. This has resulted in a highly adaptable and flexible tool for identifying preservation areas, avoiding sensitive environmental areas, or targeting areas for restoration and mitigation.

Since the WRR was developed by an interagency group of regulators and planners with varied disciplines, such as, stormwater engineering, hydrology, wetland science, watershed planning, and ecosystem protection, it should be helpful to land-use planning agencies in the many aspects of project implementation including: preliminary design of facilities; streamlining the environmental review and permitting process for projects; and identifying preservation and mitigation opportunities for addressing regulatory requirements. More specifically, the WRR can be useful in identifying possible mitigation opportunity sites which could play a significant role in TMDL implementation requirements.

Ralph Spagnolo is Region III's Watershed Restoration Program Manager; Ralph is EPA's National Representative on the National Hydric Soils Committee, National Advisory Team for the Corps' Wetland Delineation Manual, and Chair of the Mid-Atlantic Hydric Soils Committee.

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Protocol for Evaluating Exposed Sewers

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As stream channels erode and incise in response to changed hydrology, utility infrastructure previously installed in the floodplain is often exposed and damaged by fallen trees and other debris that can be carried in-stream during flood events. In addition to the obvious risk of sewage overflows to water quality and the negative effect of non-sewage inflows to the sewer on system capacity, exposed sewers in the stream bed form barriers to fish passage, affecting the ability of native fishes to access upstream habitat for reproduction. This presentation addresses **a watershed study of barriers to fish passage resulting from stream erosion-induced exposed sewers and presents an index to evaluate and rank the restoration potential** of multiple barriers within the Beaverdam Creek watershed in the urbanized area of Prince George's County, Maryland. Streams in this coastal plain watershed exhibit characteristics typical of streams in urban watersheds, including incised channels that have led to exposure of active sewer transmission pipes. Thirty-seven sites where exposed sewer pipes and manholes posed fish migration barriers were evaluated. Information collected included the site's position within the watershed, the quality of upstream riparian habitat, and specific data regarding the nature and severity of the migration barrier. At each site, an index value was calculated for each characteristic to demonstrate the severity of that characteristic. Restoration was prioritized using an equation that weights the relative importance of each characteristic and integrates the index values into an overall numerical rank. The highest priority restoration projects receive the highest overall rank number.

Eileen Straughan is founder and president of Straughan Environmental, a Maryland-based firm providing environmental planning, analysis and design services. Ms. Straughan is a multi-disciplinary environmental scientist with 29 years' experience in conducting environmental analysis and design. She has significant experience in stormwater management and stream restoration design and is expert in erosion control, avoidance and minimization of wetlands impacts, stream diversions, natural channel design, and mitigation site monitoring plans. Ms. Straughan serves on the Board of Directors for the Maryland Chapter of the U.S. Green Building Council (USGBC) and is a member of USGBC's Northeast Corridor Regional Task Force.

With nearly 1,000 state, local and federal projects completed, Ms. Straughan believes—and can prove—that taking a holistic and sustainable approach from the beginning of a project—and not just addressing issues of mandatory compliance—will produce better outcomes. Her model of sustainable practices save time, money, other value resources, and ensure a higher level of community acceptance.

The View Below: Using Creek Snorkeling to Connect People with Rivers

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At first glance, the idea of snorkeling most of our mid-Atlantic streams may seem a bit odd. But once we look below the reflective plane of our local stream a whole new world is revealed. Creek snorkeling is one of the most powerful experiences we can have with a stream. **This presentation will discuss what life below the surface looks like**, will provide an overview of stream snorkeling programs, **and will discuss how creek snorkeling can be used to engage monitoring volunteers and the larger community.**

Keith Williams is the founding Director of Education at NorthBay an environmental education facility on the upper Chesapeake Bay. He also runs Creek Snorkeling Adventures, an educational stream snorkeling outfitter. He has a BS in Environmental Biology and MS in Ecological Teaching and Learning From the Lesley University Audubon Expedition Institute. Keith currently serves as the treasurer for the Maryland Association of Environmental and Outdoor Educators and was appointed to the Maryland Governors Working Group for Environmental Literacy. Keith lives in Conowingo, near the lower Susquehanna River with his wife and three kids, and sticks his face in creeks every chance he gets.

Community Involvement: A Different Kind of Stormwater Best Management Practice

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Forest Heights, Maryland wants to be the first town in the Metropolitan DC area to become a "Zero-Runoff" Community. For much of the last century, drainage systems in Forest Heights have been engineered to quickly collect runoff in underground pipes and carry it away using an "out of sight, out of mind" approach.

Urban and suburban runoff pollutes thousands of miles of streams in Maryland and adds to the problems caused by flooding. Suburban runoff from this community carries chemicals, sediment, fertilizers and other pollutants directly into Oxen Run; and eventually the Chesapeake Bay. Seventeen million people live on the land that drains into the Chesapeake Bay, and the actions that all residents take in their daily lives have a big impact on the environment. We all can make a difference in the health of this national treasure. The residents need to think about the choices they make in their community, their businesses, their roadways, their yards, even their dinner tables.

This paper will focus on a new Best Management Practice; Community Involvement. Sustainable Stormwater Management will not succeed unless the participating community is educated on the impacts of stormwater and how they can contribute to Pollution prevention. This paper will describe how structural BMP's can be understood and applied at the homeowner level, how to encourage residents to be actively involved, and how township ordinances need to be modified to promote and enforce stormwater management.

Jenni E. Woodworth, PE has over 12 years of Water Resource experience. She is a Certified Professional in Erosion and Sediment Control, Certified Professional in Stormwater Quality and is a licensed engineer in 4 states. She specializes in the field of Water Resources as it relates to Transportation enhancement projects.

MARYLAND WATER MONITORING COUNCIL

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POSTER ABSTRACTS

(Listed alphabetically by lead author's last name)

The Regional Flux of Nitrate from Groundwater to Coastal Plain Headwater Tributaries of Chesapeake Bay

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Groundwater discharge provides nitrogen (primarily as nitrate) along with the majority of flow to Coastal Plain streams. The regional flux of nitrate from groundwater to nontidal headwater streams of the Coastal Plain in the Chesapeake Bay watershed was estimated as part of a wider study of the Northern Atlantic Coastal Plain (NACP), New Jersey through North Carolina. Flux estimates are based on population estimates from an unequal-probability random survey of 174 streams sampled during late-winter or spring 2000 base flow, rather than empirical models. Groundwater discharge as base flow contributed an estimated 21,200 kilograms per day (kg/d) of nitrate to NACP headwater streams during that period. Extensive nonpoint (primarily agricultural) sources and hydrogeologic conditions that promote the movement of nitrate through groundwater contribute to particularly large base-flow flux from the Eastern Shore to Chesapeake Bay. Although the Eastern Shore of the watershed is only 9 percent of the NACP, headwater streams from that area account for 59 percent (12,400 kg/d) of the entire base-flow nitrate flux from such streams in the NACP. **On the Eastern Shore, more than 10 percent of total nonpoint nitrogen applications are transported through groundwater to streams, and base-flow nitrate flux represents 70 percent of the total nitrogen flux in streams.** This is in sharp contrast to the Western Shore Coastal Plain portion of the bay watershed which is more than twice the size of the Eastern Shore, but contributes less than one-seventh (1,600 kg/d) of the nitrate flux from the Eastern Shore to Chesapeake Bay.

How Low Can it Go? The Chesapeake Bay Shallow Water DO Limbo Stick

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Co-authors: Walter Boynton (UMCES-CBL), Matt Hall (SAS)

Starting in 2003 (and in subsequent updates) the U.S. Environmental Protection Agency (EPA) established dissolved oxygen (DO) criteria for the Chesapeake Bay and its tidal tributaries. EPA defined habitats based on designated uses and tailored DO criteria to account for different spatial and temporal conditions. Until the last decade, water quality monitoring in Chesapeake Bay and tributary rivers was largely based on monthly or bi-monthly sampling at fixed stations located over the deeper (channel) portions of these systems. This design was helpful for developing seasonal and inter-annual scale indices of water quality status and trends, but inadequate for addressing habitat criteria for shallow near-shore areas. About 10 years ago a new program was initiated to add measurements of water quality in shallow waters focused on submerged aquatic vegetation (SAV) habitat quality. The program was named ConMon to indicate the near-continuous monitoring feature of the methodology. The program uses in-situ sensor systems designed to take measurements of a suite of water quality variables every 15 minutes. The considerable spatial extent (encompassing sites with water quality varying from quite good to very poor) of these data sets allows for comparative analyses where relationships between near-shore water quality and management actions can be found. **Analysis of ConMon data showed in shallow water habitats the primary factors controlling diel DO dynamics and criteria failure were algal biomass, water temperature and light attenuation.** In addition, DO criteria failures were more common in areas proximal to large diffuse and point sources of nutrients, especially nitrogen.

Applications of Real-Time Water Quality to Identify Episodic Pollution Events in Urban Streams in the Washington, D.C. Metropolitan Area

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Continuous real-time water-quality data collection may function as part of an early warning system in urban streams by identifying episodic changes in water chemistry and physical conditions. Multi-parameter datasondes, along with stage-monitoring equipment and automatic samplers, where used to capture rapidly changing stream conditions and water chemistry in several low-order urban streams within the Capital Beltway, and surrounding Washington, D.C. Metro area. Additionally, pollution events that degrade water quality and disrupt biological productivity were captured. Water-quality data were collected at North East Branch Anacostia at Riverdale, MD (U.S. Geological Survey Station 01649500), North West Branch Anacostia near Hyattsville, MD (01651000), and Paint Branch near College Park, MD (01649190) from as early as 2003 through 2010. Data from Mattawoman Creek near Pomonkey, MD (01658000), a stream in a less-developed watershed in Charles County, MD, is presented for comparison to the urban streams. Some examples of dynamic stream water-quality events include disruption of normal diurnal pH and primary productivity patterns due to point-source discharges of petroleum-based substances, episodic daily and annual interference with natural patterns of surface-water conductivity due to road salt applications, anthropogenic spikes in normal baseflow turbidity levels, and shifts in multiple parameters from broken sewer lines. Such events can be observed on the U.S. Geological Survey Water Alert service (http://water.usgs.gov/wateralert); a useful tool for automated early warning of rapidly changing or unusual water conditions. Continuous real-time water-quality data collection aids communities, agencies, and partnerships, such as the Urban Waters Federal Partnership, in attaining urban watershed and waterway revitalization goals.

Stream Temperatures in Urban Watersheds: Interactive Effects of Riparian Cover, Scale and the Built Environment

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Co-authors: Belt, K.T., Noonan, E. and Groffman, P.

Stream temperatures in urban watersheds are highly dynamic and spatially and temporally complex due to modulation by extensive impervious and vegetated cover that is greatly connected by "engineered" drainage networks. We measured water temperature continuously in over twenty small catchments with varying riparian forest and impervious surface cover in the Gwynns Falls and Gunpowder River in Baltimore, MD.

The largest differences in daily mean temperatures between forested and urbanized sites were in the summer (ca 3-5 C), with little separation in the winter. Sites with similar structures but differing amounts of hardscape and forest cover showed large differences in summer temperatures (e.g., ca 4-7 C difference.) Generally, downstream sites had higher temperatures, e.g., the Gwynns Falls at Carroll Park (26 C), which had less riparian canopy cover and was located at the warm end of the urban-rural heat gradient. However the highest temperature occurred in Dead Run (27 C) which although it is a small catchment, has a lot of hardscape and little riparian cover. In buried streams, temperatures were cool (ca 19 C), cooler than forested streams (16-20 C) but in ultra urban areas were warmer and more variable (ca 22-24 C). During summer storms, urban headwater catchments experienced large temperature spikes (up to 13 C); these were more frequent and larger than at downstream sites. Urban landscapes not only induce a heat island effect on ambient stream temperatures, but also introduce thermal disturbance regimes that are not trivial to biotic communities.

Ultra-Urban Baseflow and Stormflow Concentrations and Fluxes in a Watershed Undergoing Restoration (WS263)

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Watershed 263 is an ultra-urban landscape in west Baltimore city that is the site of comprehensive watershed restoration efforts. We discuss the high baseflow and stormwater concentrations of nutrients and sulfates seen in two 15 ha headwater stormdrain subcatchments sampled ca. 2004-2010. We also present preliminary concentration and loading results
In the "Balt" catchment, half or more of the load for SO4, NO3-N, TN, PO4-P and TP was carried in the baseflow load, whereas in the "Lanv" catchment these were smaller carried only by stormwater runoff, suggesting that in Balt there may be inputs of sewage. The Balt average annual load was much greater than for Lanv (e.g., for TN, 57 vs 6.1 kg/ha/yr), due to the lack of a large Lanv baseflow load and unexplained low rainfall-runoff ratios there. The Balt TN and TP loads were much greater than loads previously measured for suburban, forested and agricultural small streams in the BES network, e.g., for TN by factors of 6.3, 28.6, and 1.5 respectively. The Balt catchment is a "hot spot", generally with loads that resembled those of an agricultural watershed more than a suburban watershed.

Balt concentrations and loads in the latter part of the record (2004-2006 vs.2007-2010) decreased for all constituents, by about one third to two thirds, far in excess of load reductions expected from stormwater runoff BMPs suggesting a complicated hydro-chemical system in which groundwater plays an important role with large changes over time.

BioEYES' Your Watershed, Your Backyard: Teaching Our Children to be Responsible Stewards of Aquatic Resources

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BioEYES is an education outreach program for Baltimore-area 5th, 7th, and 10th graders. **Our 7th grade curriculum, Your Watershed, Your Backyard, fosters connections between local watersheds, the Chesapeake Bay, and the students' everyday actions.** Our assessments show increases in students' environmental literacy and stewardship. This two-week program involves three field trips and teacher professional development. Students attend a water quality field trip to test stream sites in their subwatershed and attend nine in-class periods where they learn about watershed ecology, science careers, and stewardship actions that impact local streams and the Chesapeake Bay. Students then conduct an experiment where they raise zebrafish embryos in stream samples they have collected in order to study how pollution affects the development and mortality of organisms. In partnership with Blue Water Baltimore, students also implement a service-learning activity—a planting, stream cleanup, or storm drain stenciling, and in partnership with Trout Unlimited, they raise trout embryos to the fingerling stage for later release in streams near their school. With grantmaker support we deliver this program free to schools. The Carnegie Institution provides teacher training, educators, zebrafish, and laboratory materials, including specialized microscopes. Our partners include Blue Water Baltimore, Earth Force, General Motors, Trout Unlimited, and the Baltimore City Public Schools.

Summary and Interpretation of Discrete and Continuous Water-Quality Monitoring Data, Mattawoman Creek, Charles County, Maryland, 2000-2010

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Co-authors: Cherie V. Miller, Joseph M. Bell, Mitchell R. Donovan, Brenda Feit Majedi, and David P. Brower

Discrete samples for sediment and nutrients, representative of monthly low-flow and targeted storm conditions (n = 360), along with 15-minute observations of discharge, specific conductance (SC) and turbidity, were collected from the non-tidal portion of Mattawoman Creek (USGS 01658000) between October 2000 and January 2011. The creek's watershed, situated on the Atlantic Coastal Plain, is experiencing development pressure due to its proximity to Washington, D.C. The most readily evident water-quality indicators of development in the watershed are episodic spikes and seasonal patterns in SC, likely indicative of road salting; however, the degree of inferred impact is small, viewed in light of similar patterns observed at sites in more highly-urbanized watersheds. The median total nitrogen concentration, 0.68 mg/L, was the lowest among five similarly-sized basins, distributed throughout Maryland, with comparable records. Median total phosphorus and suspended sediment concentrations (0.070 mg/L and 24 mg/L, respectively) were the third- and second-highest, respectively, of the five comparison basins. However, cross-channel water-quality gradients revealed by a second sonde, deployed temporarily in 2011, suggest that measurements of particle-associated constituents in this study may be biased upward, relative to true conditions in the Mattawoman Creek mainstem, by episodically more turbid inflow from a small tributary upstream of the sampling location. Rankings of sediment and nutrient fluxes among the comparison watersheds were generally consistent with rankings based on concentration. The data illustrate the value of a dedicated ongoing monitoring program, and highlight both the strengths and limitations of interpreting fixed-station observations to detect the impacts of watershed-scale land-use change.

Quantifying the Contribution of Small Scale Community and Homeowner Best Management Practices (BMPs) in the Chesapeake Bay Total Maximum Daily Loads (TMDL)

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At the current time, there is no mechanism to account for the installation and performance of private small scale/residential BMP's. Therefore, under the current TMDL situation, there is no incentive for investment in these BMP's even though they may be a cost-effective way to achieve nutrient and sediment restoration goals. The ability to count and track these small scale residential/private BMP's toward achieving the TMDL will create quantifiable water quality benefits across the state of Maryland. Actions on these smaller properties such as the installation of rain barrels, rain gardens, green roofs, and changing of lawn fertilization practices on an individual property may have perceived insignificant effects on nitrogen, phosphorus and sediment pollution, but these reductions may be significant in the aggregate. However, there is no mechanism for them to be accounted for in the Chesapeake Bay TMDL process. **This project seeks to find a credible and verifiable way to account for these practices so they can be included as part of local Watershed Implementation Plan Phase II strategies.** Maryland DNR Chesapeake and Coastal Program will assist in defining barriers to BMP accounting and work with the PIs to develop strategies to overcome these barriers. Towson University Center for Geographic Information Sciences will be contacted to provide the interactive web and tracking platform.

Mapping Headwater Streams in the Potomac River Basin

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The point of stream initiation, or channel head, is the point on the landscape where concentrated overland flow or groundwater seepage is sufficient to cause bank erosion and sediment transport. **Accurate mapping of channel heads is needed to correctly represent stream location, density and length.** Currently the most comprehensive, and most commonly used, stream map in the US is the high resolution National Hydrology Dataset (NHD). Despite its wide use, studies have shown that the NHD consistently underrepresents both stream length and density by as much as 64%, with the majority of errors accumulating along small headwater streams. Recognizing the need for headwater stream mapping methods that can be implemented efficiently over broad regions, we developed a workflow that predicts stream presence and absence from field observations of forested headwater stream channels and terrain variables that are continuously accumulated along hydrologic flowpaths derived from a 10-m digital elevation model. As a statistical framework, the method employs maximum entropy models (MaxEnt) commonly implemented in biogeographical studies to model species distributions. We have applied this method to Maryland watersheds west of the Chesapeake Bay and to the entire Potomac River watershed. In validation, the model correctly predicts the presence of 91% of all 10-m stream segments, and rarely miscalculates tributary numbers. The resulting map is the first comprehensive map of Maryland streams and shows that the NHD under predicts stream length by a factor of 1.8 and channel head density by a factor of 6.

Patapsco River Dam Removal Study: Assessing Changes in American Eel Distribution and Aquatic Communities

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The Maryland Biological Stream Survey (MBSS) in collaboration with American Rivers, NOAA, and the DNR Fisheries Service, is performing biological monitoring in the Patapsco River as part of the removal of Simkins, Union and Bloede dams. The goals of this project are to determine the potential impacts of dam removal on the distribution of American eels (Anguilla rostrata) and other diadromous fish species, as well as on other fish and benthic macroinvertebrate communities in the Patapsco River. Sampling was conducted at 26 sites in spring and summer of 2009-2011 and will continue through 2012. Removal of Union Dam was completed in September of 2010 and the removal of Simkins Dam was completed in January 2011. **American eels were present at all sites except a small tributary just upstream of Simkins Dam, but eels decreased in abundance with increasing distance upstream.** What caused this distribution pattern or how the pattern might change once the dams are gone is not known. **Seven species of diadromous fish were collected in the river in spring 2011, but only two of those species were collected above Bloede Dam- indicating that the structure may be a migration barrier. Preliminary statistical analysis of benthic macroinvertebrate data has shown a change in benthic communities throughout the study area following Simkins Dam's removal.** Continued monitoring in 2012 combined with the three years of data already collected will be helpful in determining dam removal effects on water chemistry as well as fish and benthic macroinvertebrate communities in the Patapsco River.

Leaves and Bugs: Using Litterbags in Education and Stream Ecosystem Studies

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Leaf litter that falls into headwater streams is the basis for food webs, provides habitat for biota in these crucially important streams and are crucial to downstream food webs. Ecologists use litterbags, usually mesh bags filled with leaves, that to represent the leaf packs that form in streams naturally to study leaf decomposition in streams and forests. The experimental possibilities are endless; for example litterbags can also be used to address biodiversity, bioassessment of stream health, etc. **A key advantage for education however, is the flexibility they offer in allowing many different experiments to be designed within one exercise, and so they offer an excellent platform for doing student inquiry based work that uses both a field and a lab setting.** Litterbags are also ideal for incorporating field projects since bags can be installed and picked up quickly in two trips to the field. The colonized bags then provide live critters that can be kept alive, examined, counted and analyzed in the lab. Lastly, a key advantage is safety. Since urban streams are often contaminated with bacteria and have metal and glass in the sediments they can sometimes be a potential hazard to students disturbing sediments to get at macroinvertebrates. **The bags, since they serve as colonizing platforms, minimize student contact with water and sediments and so provide a safer method to collect macroinvertebrates while offering more opportunities to teach about ecosystem functions.** We describe basic methods for doing litterbag studies and potential uses in research and education in Baltimore streams.

Use of Benthic Macroinvertebrate Taxa and Landscape Variables to Identify Stream Reaches Suitable for Brook Trout Reclamation in Maryland

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In Maryland, brook trout have been extirpated from 62% of their historic habitat range. Historic land use conversions, mining, urbanization, competition with introduced fish species, and thermal impacts are some of the major factors leading to the loss and degradation of brook trout populations. Remaining brook trout populations are highly fragmented and restricted to headwater stream reaches in a few watersheds in the western and central regions of the state. However, we hypothesize that environmental conditions in some streams within these regions have improved and can now support brook trout as a result of broad, landscape scale changes and effective implementation actions, but are isolated from source brook trout populations for recolonization. The presence of certain benthic macroinvertebrate taxa can be used as indicators of high quality stream reaches that could potentially support brook trout. These benthic macroinvertebrate taxa may capture the niche requirements (e.g., thermal regime, physical habitat and water quality conditions) of brook trout. Using data from the Maryland Department of Natural Resources, Maryland Biological Stream Survey, we identified benthic macroinvertebrate taxa and land use characteristics strongly associated with brook trout presence. This information has been used to identify eight stream reaches in Maryland that would be good test sites to attempt brook trout reintroduction, or streams that could support brook trout after minimal low cost restoration actions. The results of this study will assist multiple entities currently working to preserve and restore Eastern brook trout populations.

Impacts of Hurricane Irene and Tropical Storm Lee on Streamflow Levels in Maryland, August-September, 2011

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U.S. Geological Survey

At the end of August 2011, Hurricane Irene dropped heavy rain over large parts of Maryland. Additional rainfall from Tropical Storm Lee and several more days of rain in September led to the wettest 2-month period (August and September) on record in Baltimore with 23.70 inches. September 2011, with 13.32 inches of precipitation was the wettest September on record.

The weather systems responsible for the rain moved in a south to north direction in this region for an extended period, resulting in large amounts of runoff and high streamflows. The record-setting rainfall led to record-high flows for five streams in August and six streams in September, as measured at U.S. Geological Survey streamgages in central Maryland and the upper Delmarva Peninsula. The Choptank River and St. Clement Creek set new peaks of record for flow in addition to record-high monthly mean streamflows.

Based on USGS streamflow data at three reference streamgages, the estimated monthly mean streamflow entering the Chesapeake Bay during September 2011 was 193,000 ft3/s (cubic feet per second), which is the highest September flow and the third highest monthly flow since record-keeping began in 1936.

Effective Microorganisms: An Earth Saving Revolution

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The presentation will explain how microbes can be used to clean the environment. In particular, EM or Effective Microorganisms developed by Professor Higa of Japan will be explained, a special combination of microbes developed in the 1980's will be discussed in relation to how they can help meet new TMDL requirements. Ongoing research, partnerships, and current uses will be presented. EM is currently being used for water remediation, neutralizing nutrient overloads, giving farmers a tool to be able to meet new environmental requirements. More efficient farming practices using EM will be discussed. EM's role in manure disposal, composting and septic issues will be also be discussed.

Nodal Point Pollution: Changing the Paradigm for Chesapeake Bay Restoration

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The South River is an estuarine tributary of the Chesapeake Bay on the western shore in Anne Arundel County, Maryland in the United States. The South River watershed covers approximately 66 square miles, including approximately 500 miles of non-tidal streams, and 15 square miles of open water with approximately 66,00 residents living in the watershed. Recent intensive data collected by the South River Federation's South RIVERKEEPER® from the South River indicate that the tidal tributaries are the root cause of hypoxia and anoxia in the main stem of the South River. These tributaries act as confluences of stormwater from the non-tidal streams which create nodal points of nutrients, sediments, and organic matter loading. Therefore, they can and should be treated as point sources of pollution. Identifying the nodal points allows prioritization for restoration, reducing pollutant loading and eventually reducing the hypoxia and anoxic events in the main stem of the South River. This model suggests that working locally to fix these targeted areas rather than the traditional regional approach may be more effective in restoring the Chesapeake Bay and its tidal tributaries.

Monitoring of *Escherichia Coli* in the Jones Falls: Evaluation of the 3M™ Petrifilm™ Method

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Two culture methods, Coliscan Easygel®, and 3M™ Petrifilm™ are widely used to monitor the presence of the fecal indicator bacterium *Escherichia coli*. Both methods use chromogenic substrates to discriminate between *E. coli*, other coliforms, and non-coliform bacteria. In addition, the 3M™ Petrifilm™ method traps gas produced by bacterial colonies. Therefore, since *E. coli* ferments lactose and release CO2, only blue colonies that produce gas should represent *E. coli* on 3M™ Petrifilm™ plates. Here we report on the accuracy of the 3M™ Petrifilm™ method to identify *E. coli* in water samples collected from a perennial outfall of the Lower Jones Falls in the fall of 2011. 51 blue colonies cultured on 3M™ Petrifilm™ plates were isolated and subjected to an *E. coli* specific PCR assay based on the *uid*A gene. Using color and gas production as a criterion, 32 (63%) of the 51 blue colonies were identified as *E. coli*. In contrast, 40 (78%) of the 51 blue colonies were identified as *E. coli* by the PCR based assay. These results suggest an overestimation of the *E. coli* count by 22% if color alone is used. A similar result was reported for the Coliscan Easygel® method (Belt et al. 2007. J. Water Health 5: 395), indicating that the accuracy of the 3M™ Petrifilm™ method is comparable to the Coliscan Easygel® method. However, the use of **color and gas formation to identify E. coli with the 3M™ Petrifilm™ method may result in an underestimation of E. coli counts.**

Masonville Dredged Material Containment Facility: Supporting Bay Health Through Mitigation and Remediation Projects

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As a component of the Masonville Dredged Material Containment Facility (DMCF) project, the Maryland Port Administration (MPA) was required to construct several environmental mitigation projects to offset filling about 130 acres of waters of the Patapsco River, which is a major tributary to the Chesapeake Bay. Mitigation projects were evaluated using a habitat condition analysis to ensure sufficient mitigation measures were undertaken. Onsite mitigation projects include tidal wetland enhancement, tidal wetland creation, non-tidal wetland creation, reef and fish habitat creation, shallow water habitat substrate improvement, fringe wetland creation, water quality monitoring, sediment/contaminant encapsulation, and terrestrial habitat enhancement. Offsite mitigation projects include funding of: stream restorations, shad and herring population restoration, and trash interceptor installation. In addition to mitigation projects, existing site contamination required extensive remediation of over 26 acres of upland soil. Remediation is occurring through the installation of an environmental cap and planting of native flora. **Through these mitigation and remediation projects, the MPA's Masonville DMCF project will help to reduce local, urban sources of nitrogen, phosphorus, sediment, and trash into the Chesapeake Bay.**

Are Anacostia Toxics from DC or Maryland?

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The Anacostia River is one of the three most highly toxic areas in the Chesapeake Bay. Over 60% of its native fish have tumors due to polycyclic aromatic hydrocarbons (PAHs) and it has fishing advisories due to high concentrations of polycyclic aromatic hydrocarbons (PCBs) and pesticides, mostly Chlordane, in their tissues. Ten years ago a large EPA/NOAA study studied toxics in sediments of the 10 km tidal Anacostia River that concluded sediment toxic "hotspots" near the city of Washington were responsible for 50% of contamination and recommended capping. The more recent University of the District of Columbia study used local clams in active biomonitoring (ABM) to survey for bioavailable toxics at 45 sites in both the tidal and nontidal Anacostia watershed. The clams accumulate contaminants mostly from the suspended sediments in water that carry over 90% of toxics. Results were somewhat different. The ABM study found the most contaminated River site was upestuary at Bladensburg Marina (MD) where, especially during dredging, the bioavailable PAH and Chlordane levels were up to twice the "hotspot" sites near the city of Washington. ABM at nontidal sites in five major tributaries identified 15 upstream areas with bioavailable PAH, PCB and Chlordane higher than in the tidal Anacostia and which contaminated entire downstream watersheds. Blacknose Dace minnows at one upstream site had chlordane levels similar to ABM and the solid sediment was highly contaminated. Downstream from a pond the bioavailable chlordane fell to reference level. The Anacostia Restoration Plan is focusing on possible toxic source remediation in DC. Major sources of bioavailable DC toxics appear to be in Maryland. Toxic suspended sediment remediation actions possible in Maryland could include halting Baltimore Marina dredging, and placing holding ponds or cisterns downstream from the small upstream high-chlordane source areas identified in four subtributaries and which appear to have heritage chlordane dump site origin.

Comparing Satellite Derived and Hand Drawn Impervious Land Cover Estimates

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There is growing recognition that impervious land cover has drastic effects on aquatic ecosystems. But, several different methods have been used to estimate impervious land cover in a watershed. These differences could complicate the determination of ecologically important thresholds. It is important for state and local agencies to use a common currency when communicating about impervious land cover affects and limits, especially as they pertain to land use planning. Many agencies rely on the National Land Cover Database (NLCD) to determine impervious surface area for use in making important decisions regarding resource management. The NLCD uses satellite imagery and classifies 30m pixels into 101 possible values (0% - 100%) according to its imperviousness. The impervious surface area of a given watershed can also be determined by hand drawing over impervious surfaces on an aerial photo. To investigate possible differences between these two methods, we compared hand drawn and satellite derived estimates of impervious land cover in several watersheds. **We found the estimates from each method to be vastly different.** While the hand drawn always exceeded satellite derived estimates, there did not appear to be a consistently quantifiable difference so that the two estimates could be adjusted and compared.

Community Metabolism in Chesapeake Bay: Historical and Contemporary Measures

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Data generated from Maryland DNR Continuous Monitoring (ConMon) stations located throughout Chesapeake Bay is amenable to calculating community metabolism rates because it is collected at high frequency intervals (15 minutes; April – October). In addition to ConMon data, we found and developed a rare high frequency data set spanning the period 1964-1969, a time prior to serious eutrophication of Chesapeake Bay. An algorithm was developed to allow rapid computation of community primary production and respiration. **Results from the algorithm show that metabolism rates from the mid 1960s were lower than all contemporary sites and much lower than those in nutrient enriched sites.** The seasonal pattern has also changed. Primary production in the 1960s peaked early in the year (May-June) and now peaks during July-September. In preliminary work we have found strong relationships between nitrogen loads and community metabolism with no indication of "nutrient memory" at most locations. Community metabolism may prove to be a useful metric for evaluating the success of the Chesapeake Bay Program in reducing nutrient loads to this system and improving water and habitat quality.

Historical and Current Assemblages of The Youghiogheny River Watershed: Implications for Determining Reference Conditions and Conducting Stream Restoration

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Based on land use, habitat, and water quality conditions, the Youghiogheny River and many of its tributaries currently qualify as high quality "reference" streams. However, the ecology of this river and many tributary streams was drastically altered in 1929 due to pervasive and severe acid coal mine drainage, leaving the river almost devoid of life for more than 40 years. Active and passive lime dosers were placed throughout the Youghiogheny watershed in the 1960s and 1970s and Maryland DNR has documented substantial water quality improvements as a result. However, a dam and waterfall have limited the potential for natural re-colonization of the river by native fishes. Reintroducing extirpated species may be possible if those species that once lived in the river can be definitively identified. But, there are few reliable records of fish species found in the Maryland portion of the Youghiogheny River and its tributaries prior to 1929. However, experts agree that many fewer species inhabit the river currently than likely did historically. There are dozens of fish species that have been mentioned by ichthyologists as potentially occurring historically in the Maryland portion of the river, but there is no agreement about what species have definitely become extirpated. We plan to use empirical models and the limited historical information that is available, along with input from regional ichthyologists, to develop a tentative list of fishes that most likely lived in the river historically. We hope to use the results to determine biological reference conditions and to plan potential ecological restoration. **This effort illustrates the importance of considering legacy impacts when choosing ecological reference sites and the difficulty in reliably reconstructing historical assemblages.**

Comparing the Fish and Benthic Macroinvertebrate Diversity of Restored Urban Streams to Reference Streams

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Substantial losses to stream biological diversity have been documented throughout the mid-Atlantic region of the United States due to urban-related impacts. Stream restoration has been used to improve stream conditions and, in part, to ameliorate these losses. However, it is not yet clear if biological diversity is recovering in streams within this region as a result of restoration activities. Our objective was to critically examine the efficacy of urban stream restorations with regard to biological diversity. To do this, we compared restored urban stream sites to urban non-restored, non-urban (streams without substantial urbanization, but with evidence of other sources of degradation such as agricultural, water quality, or physical habitat impacts), and reference (minimally degraded by any potential perturbation) stream sites using five measures of fish and five measures of benthic macroinvertebrate diversity. Using both multivariate and univariate statistical analyses, we show that **biological diversity of restored urban streams was not different from non-restored urban streams and was lower than non-urban and reference streams.** Over time, restored urban sites also showed no apparent increase in biological diversity, while it decreased at two of the reference streams coincident with an increase in urban development within the site catchments. The results of this study indicate that the restoration approaches used in the urban streams we studied, which are commonly deployed in the mid-Atlantic, are not leading to recovery of native stream biodiversity. This along with recent findings from other studies indicates a need for dramatic changes in restoration approach, and we argue for a large-scale, watershed focus that includes protection of the least impacted streams and the implementation of other land-based actions such as increased stormwater management, riparian replanting, and reforestation within the watershed where possible.

Nanticoke River 2010 Report Card: Community Outreach

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The Nanticoke Watershed Alliance drafted its second river report card in 2011. Using data collected by Nanticoke Creekwatchers, the report card follows EcoCheck's standard report card format and provides easy-to-understand grades and explanations about the health of the river and its tributaries. Learn about the health of the Nanticoke and its creeks during the 2010 calendar year.

Stream Burial Across the Potomac River Basin, USA

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Stream burial, the process of directing streams into culverts, pipes, concrete-lined ditches, or simply paving them over during urbanization, alters the primary physical, chemical, and biological processes in streams. Knowledge of the cumulative impacts of reduced structure and function within buried stream networks is crucial for informing management of stream ecosystems, in light of continued growth in urban areas and the uncertain response of freshwater ecosystems to the stresses of global climate change. To address this need, we utilized recently improved stream maps for the Potomac River Basin (PRB) to describe the extent and severity of stream burial across the PRB. Observations of stream burial made from high resolution aerial photographs (1% of total basin area), and a decision tree using spatial statistics from impervious cover data were used to predict stream burial at four time-steps (1975, 1990, 2001, 2006). **Of the roughly 95,550 km of stream in the PRB, approximately 4551 km (4.76%) were buried by urban development as of 2001. Consistently higher rates of stream burial were observed for small streams, decreasing linearly with stream order.** Headwater streams (1st and 2nd order) are disproportionately affected, with nearly 5% of headwaters buried basin wide, a rate which has increased over time in relation to larger stream orders. Analysis of county-level burial patterns shows some counties (e.g., Loudon Co., VA) with burial rates increasing more rapidly between 1990 and 2001, while others (e.g., Montgomery Co., MD) show a slowing trend in stream burial during the same period.

Assessing the Ecological and Human Health Status of Baltimore's Inner Harbor

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Co-authors: Heath Kelsey, Laurie Schwartz, Bill Stack, William Dennison, Sara Powell

Baltimore's Inner Harbor and its watershed is a highly urbanized area in the mid-Atlantic region of the United States. Baltimore was founded in the 1700s, with the population spreading out into adjacent lands over the last three centuries and continuing to expand into suburban and exurban areas today. This study assessed water quality and biotic parameters as ecological health indicators of Baltimore's Inner Harbor and its watershed. Bacteria and trash were assessed as human health indicators. Assessment of each indicator is based on methodologies validated through peer-reviewed scientific articles and years-long development of indicators for assessing the health of Chesapeake Bay via the Chesapeake Bay Program. Each indicator is compared against a threshold value and scored on a 0-100% scale, which is a gradient from Very Poor to Good health. **The study found most water quality indicators to be either poor or very poor in the Inner Harbor. Additionally, bacteria and trash in the Inner Harbor were rated as poor.** The watershed health was better than the Inner Harbor receiving waters, with water quality indicators and bacteria scoring from good to poor. Lack of spatial and temporal coverage of basic water quality data in the Inner Harbor was a major hindrance to accurately assessing its health. Future plans to remedy these problems will be discussed. This study is a component of the Waterfront Partnership of Baltimore's Healthy Harbor Initiative, which describes sustainability and restoration goals as well as an implementation plan that will restore the health of Baltimore's Harbor.

MARYLAND WATER MONITORING COUNCIL

17th Annual Conference

December 1, 2011

STANDING COMMITTEE REPORTS

Maryland Water Monitoring Council
Monitoring and Assessment Committee
2011 Annual Report

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John Clune	USGS
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Wayne Davis	US EPA
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Cherie Miller	USGS
Rob Mooney	Sutron Corporation
Marian Norris	National Park Service
Rich Pfingsten	Ecological Analysts
Doug Redmond	M-NCPPC
Mark Southerland	Versar, Inc.
Keith Van Ness	Montgomery County DEP

2011 Accomplishments

A. Since the 2010 MWMC Annual Conference, the M&A Committee met only once, on December 8, 2010. At this meeting, the Committee decided to prepare and distribute a questionnaire to the Directors of County Planning and Zoning Departments. The purpose of the questionnaire was to determine how water monitoring information is/is not linked with land use planning at the local level. A draft Questionnaire was sent to Dave Brownlee (Calvert County), Susan Overstreet (Howard County), and Sue Veith (St. Mary's County) on December 20, 2010, seeking comments on how to refine the questions. A revised version of the Questionnaire was then reviewed by the M&A Committee, revised several times, and was finally sent out to all County Planning and Zoning Department Director and MD State Highway Administration staff on July 22, 2011. These 11 questions were asked:

1. Does you county collect water monitoring data?
2. If "Yes" to #1, what individuals or groups (county agency staff or consultants or others) within your county collect these data?
3. If "Yes" to #1, how and where are these data stored?
4. If "Yes" to #1, do you share monitoring data with adjacent counties and/or state agencies?
5. Do you use water monitoring data in your planning activities?
6. If "Yes" to #5, what kinds of water monitoring date do you use?
7. What kinds of water monitoring data are or would be of most use to you?
8. Have you heard of the Maryland Water Monitoring Council (MWMC)?
9. If the MWMC provided access to water monitoring data collected in your jurisdiction on its website, would you use these data?
10. Which groups or individuals within your county use or would use these data?
11. Would you be willing to work with the MWMC to help make water monitoring data more available?
    a. By attending a workshop?
    b. By answering more questions and providing advice?

To date, the M&A Committee has received responses to the Questionnaire from only five counties (Carroll, Harford, Howard, Kent, Prince Georges) and SHA.

B. M&A Committee members Dennis Genito, Ron Klauda, Mark Southerland, Ken Belt, and Clark Howells organized and/or moderated technical sessions at the 2010 MWMC Annual Conference on November 18.

C. Several M&A Committee attended the Stream Roundtable, sponsored by the MWMC, on February 25, 2011, and coordinated by Andy Becker.

D. Ken Belt, Clark Howells, and Ron Klauda served on the Planning Committee for the 2011 MWMC Conference.

E. Mark Southerland, Ron Klauda, and Ken Belt organized and moderated technical sessions at the Third Maryland Streams Symposium and Mid-Atlantic Volunteer Monitoring Conference on August 10-13, 2011. Dennis Genito led a benthic macroinvertebrate workshop at this meeting.

2012 Goals

A. In early 2012, the M&A Committee will develop a better communication strategy and re-send the Questionnaire to County Planning and Zoning Department Directors. We're hopeful that this effort will increase the number of counties who respond. If successful, the Committee will evaluate the responses and decide if the next step should be a follow-up questionnaire or organizing a workshop.

B. The M&A Committee will meet in early 2012 to talk about other important issues related to water monitoring and assessment in MD that the Committee could tackle.

Submitted by Ron Klauda, November 18, 2011.

Maryland Water Monitoring Council
Information Management and Communication Committee
2011 Annual Report

Co-Chairs

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Ken Belt	US Forest Service
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Matt Rowe	Maryland Department of the Environment
Keith Van Ness	Montgomery County DEP

2011 Accomplishments

1. Committee members developed some long-term goals for the new committee. These include (1) exploring existing data management procedures employed in Maryland and developing recommendations for data management and quality assurance; (2) create and maintain an interactive Google Earth map of current and past monitoring activities that would replace the previously developed MWMC Clickable Map; (3) organize, make available, and subsequently maintain an inventory of data, metadata, on the web with appropriate contact information for all data sets, and years of applicability; (4) develop and maintain a database of reports and papers in PDF format on the web; and (5) encourage people in the local water resources community to make data and reports available online so they can be linked and maintained in the MWMC inventory.

2. Ed Doheny and other IMC Committee members attended the Maryland Water Monitoring Council Stream Monitoring Roundtable held at the USGS Water Science Center Office in Baltimore in March 2011.

3. Wayne Davis, Ed Doheny, and Mark Southerland (MWMC Board of Directors Chairman) began exploring potential sources of funding for initiating a data management project for Maryland.

4. Wayne Davis and Ed Doheny began exploring existing online data finders that the MWMC could potentially modify and use as a pilot for a Maryland data finder. The data finder would be hosted on the MWMC website.

2012 Goals

1. In 2012, the IMC Committee will seek to expand membership, particularly in the skill areas of Geographical Information Systems and web design. Anyone with an interest in working on the committee should contact Wayne Davis or Ed Doheny, using the contact information at the top of this report.

2. In January 2012, the IMC Committee will be demonstrating two existing online data finders for the MWMC Board of Directors at the quarterly board meeting, with a goal of deciding on necessary features for a Maryland data finder that would be hosted on the MWMC web site, and determining the steps forward to order to implement it during 2012.

3. The IMC Committee will meet during the spring of 2012 to begin mapping out paths to make progress on some of the other committee goals that were established during 2011.

4. The IMC Committee, with help from the MWMC Board of Directors, will continue to seek funding opportunities for a data management project that would be piloted for Maryland by the MWMC and would be based on the goals outlined above.

Submitted by E.J. Doheny, November 11, 2011

Maryland Water Monitoring Council
Indicators Committee
2011 Annual Report

Organizer

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2011 Accomplishments

Environmental indicators are fundamental to the interpretation of water quality and our efforts to maintain or improve conditions. During 2011 I explored a limited number of water quality indicators to investigate the feasibility and utility of eventually organizing as many as possible into a central depository. This effort began by developing a categorical prototype that is limited in scope, for the moment, to MDE standards. A brief presentation of this prototype will be presented at the next board of directors meeting on January 17, 2012 at DNR.

2012 Goals

The MWMC is actively seeking new members to become actively involved with this workgroup.

Submitted by Charles Poukish, November 7, 2011.

Maryland Water Monitoring Council
Communication and Outreach Committee
2011 Annual Report

Co-Chairs

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Accomplishments

- Improved, updated, revamped and revitalized the MWMC website: improvements include
- Style and format follows that of the DNR website
- Includes upcoming events / announcements / related links / employment
- MWMC headlines / Board Meeting schedules / agendas / minutes
- Carl Weber Award

Goals

- Continue to build on and improve communication through the website
- Focus in on target audience – citizens, students, colleagues not only from MD but also from surrounding states – what can we learn from each other!
- Develop / include feature articles from MWMC board members and post news / video clips from speakers from the annual conference / success stories
- Provide links for existing clickable maps and 'go to' people and web sites for hot topics
- Include updated volunteer watershed organizations / what is available to citizens

Maryland Water Monitoring Council
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