

PROCEEDINGS

VIRGINIA WATER CONFERENCE
2009



“MEETING VIRGINIA WATER
CHALLENGES”

Please see our Web site at <http://www.vlwa.org>

CONTENTS

Welcome.....	1
Gold Sponsor – Woolpert.....	3
Silver Sponsors – AMEC Earth and Environmental, Michael Baker Jr., Inc.,	4
CH2M Hill	5
Acknowledgements.....	6
2008 VLWA Leadership	7
<i>Program</i>	9
Summaries of Papers Presented	14
Session 1A.....	15
Session 1B.....	17
Session 1C.....	23
Session 1D.....	29
Session 1E.....	35
Session 2A.....	41
Session 2B.....	47
Session 2C.....	53
Session 2D.....	55
Session 2E.....	61
Session 3A.....	67
Session 3B.....	73
Session 3C.....	79
Session 3D.....	85
Session 3E.....	91
Session 4A.....	97
Session 4B.....	103
Session 4C.....	109
Session 4D.....	115
Session 5A.....	121
Session 5B.....	125
Session 5C.....	131
Session 5D.....	137
Session 6A.....	147
Session 6B.....	153
Session 6C.....	157
Session 6D.....	163
Pre-Registered Conference Attendees.....	167

WELCOME

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March 8, 2009

Dear Water Conference Participant and VLWA Member:

I want to take this opportunity to thank all of the presenters and exhibitors for sharing their ideas, experiences, and products with the VLWA membership. This conference continues to be a tremendous success thanks to your efforts on our behalf. Our program covers issues of interest to a wide range of lake and watershed stakeholders, including: stormwater management, floodplain management, dam safety, regulatory matters, watershed management, lake maintenance, water quality, lake ecology, permitting, and other topics.

As always, the Board of Directors has been a tremendous help in planning the conference. The Board meets every three months, and we welcome interested parties to attend our meetings. I encourage each and every member to actively participate – please let us know how we can better serve you and/or how you can assist us in serving our membership.

The Virginia Floodplain Management Association (VFMA) is a valued partner once again this year, and we have five floodplain management sessions thanks mainly to their efforts. We look forward to strengthening this partnership in the future and leveraging booth organizations' talents for the benefit of our membership and the Commonwealth of Virginia.

Finally, I'd like to thank Donna Pearson. Donna has been handling the administrative duties associated with this conference for years and has performed admirably. As many of you know, Donna's husband Dave lost his battle with pancreatic cancer last March, just after our last conference. Dave was a driving force behind the scenes at the conference for over a decade. He was the guy you'd see running around making sure the equipment was working and that the facilities met our needs. This year we have added the Dave Pearson Watershed Excellence Award to honor Dave's commitment to VLWA and our core mission of protecting Virginia's water resources. Dave was a special person and a great friend – he is missed by all who knew him.

Sincerely yours,



Stu Stein, PE

VLWA President/VLWA and VFMA Conference Coordinator
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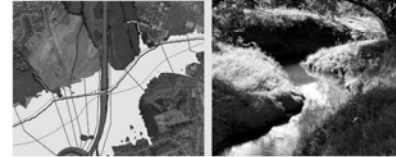
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PROGRAM

SUNDAY, MARCH 8, 2009

- 2:00 – 6:00 pm Exhibitors' Display Set Up (Exhibitors' Area)
4:00 – 6:00 pm Registration (Conference Reception Desk)
5:00 – 6:00 pm Meeting of VLWA Board of Directors
6:30 – 8:00 pm Exhibitor and Early Registrant's Reception

MONDAY, MARCH 9, 2009

- 7:00 – 8:00 am Registration and Check-In (Conference Reception Desk)
7:30 am Coffee and Pastries
8:00 – 9:00 am Welcome to the Conference, Stuart Stein, Conference Chair and President of VLWA

9:15 – 10:30 First Concurrent Sessions

Session 1A • Stormwater Management 1 • Moderator – Drew Gould

Upcoming Stormwater Management Regulation Changes: Panel Discussion – Chris Pomeroy, General Counsel VAMSA, Mike Flagg, Hanover County Director of Public Works, Jeff Perry, Henrico County Environmental Services Manager, Lee Hill, VA DCR; Drew Gould, Timmons Group

Session 1B • Stormwater Management Models and Practices • Moderator – Deva Borah

Selecting BMPS for Retrofit in Stafford County – Marissa Soule, Woolpert, Inc., Steve Hubble, Stafford County

Water Quality Modeling of the Middle Potomac Watersheds – Jack Wall, Woolpert, Inc.

Issues with SWMM and HEC-RAS Models: Program Differences or Gremlins in the Computer? – David Powell, Woolpert, Inc.

Watershed Models for Storm Water Management: Comparing Hydrologic and Hydraulic Procedures – Deva Borah, Woolpert, Inc.

Session 1C • Dam Safety 1 • Moderator – James Robinson

NRCS Federal Dam Program Throughout Virginia – Jerry Wright, USDA-NRCS

Visualizing an Incremental Damage Analysis – Paul Welle/Anthony Grubbs, Schnabel Engineering

Incremental Damage Analysis-Establishing the Appropriate Spillway Design Flood for an Existing Dam – Robert Bowers/N. Johan Anestad, O'Brien & Gere Engineers, Inc.

Determining Required Spillway Design Flood-Incremental Damage Analysis – James Robinson, VA DCR

Session 1D • Water Quality 1 • Moderator – Dr. Carolyn Thomas

Tidally Influenced New Orleans Canal Network Benefits from Accurate Water Level, Conductivity, and Temperature Data – Jason Evans, In-Situ Inc.

Investigations into the Effects of External Electron Acceptors on Sediment-Water Interactions in the Occoquan Reservoir – Francisco Cubas, Virginia Tech Occoquan Watershed Monitoring Lab

Zonation of the Occoquan Reservoir Using Virginia DEQ Lake Zonation Guidelines – Niffy Saji, Fairfax Water

Is Reservoir Water Quality Important in Hydroelectric Power Generation? – Dr. Carolyn Thomas, Ferrum College

Session 1E • Living Shorelines • Moderator – Rebecca Francese

Living Shoreline Techniques for Shoreline Stabilization and Habitat Development – Karen Duhring, Virginia Institute of Marine Science

Design Criteria for Planting Living Shoreline Wetlands – Walter Priest, NOAA Fisheries Restoration Center

Implementation of “Living Shoreline” Erosion Control in Norfolk, VA-Successes, Failures, and Challenges for the Future – Kevin DuBois, Bureau of Environmental Services, City of Norfolk
Haven Creek Pathway and Living Shoreline-Design Constraints Along a Confined Waterfront in Norfolk, VA – Rebecca Francese, Waterway Surveys & Engineering, Ltd.

10:30 – 10:45 Coffee Break

10:45 – 12:00 Second Concurrent Sessions

Session 2A • Stormwater Management 2 • Moderator – Doug Moseley

The Economics of Managing Stormwater: What We Know, What We Need to Know – David Sample/Kurt Stephenson, Virginia Tech

Virginia Stormwater Management Technical Criteria – Application and Assessment – Douglas Beisch/Joseph Battiatia, Williamsburg Environmental Group

The Virginia BMP Clearinghouse – Opportunities for BMP Research and Improved MS4 Program Effectiveness – Joseph Battiatia, Williamsburg Environmental Group

Virginia Stormwater Management Regulation Amendments: Applications and Impacts on Local Stormwater Management Programming – Doug Moseley, GKY & Associates, Inc.

Session 2B • Floodplain Management 1 • Moderator – Jeff Smith

Approximate Floodplain Development for Virginia Flood Insurance Studies – Srikanth Koka, Tamrat Bedane, Dewberry

Comparison of Two Station Method with Other Methods: A Case Study – Nanda Meduri/Jeff Smith, Dewberry

Two-Dimensional Models: Updating NFIP FISs and FIRMs – Jeff Smith/Mathini Sreetharan, Dewberry
Effect of Map Changes on Flood Insurance – Dr. Shane Parson, URS

Session 2C • Dam Safety 2 • Moderator – Ken Turner

Recent Dam Safety Regulation Changes: Panel Discussion – Michael Claud, Timmons Group, Scott Cahill, Watershed Services, Tillman Marshall, Schnabel Engineering, Jim Robinson, VA DCR, Ken Turner, VA DCR

Session 2D • Water Quality 2 • Moderator – Liz Scheessele

Development of Estimated Clay Fractions Associated with Sediment Output from the Lynnhaven River Water Quality Models – Will VonOhlen, URS Corp.

Dispersive Flux in the Lower Reaches of the Elizabeth River Estuary – Byron Tracy, Old Dominion University

Biological Response and Recovery to a Polymer Release in a Headwater Stream in Chesterfield County – Laura Barry/Weedon Cloe, Chesterfield County Dept. of Environmental Engineering

Representation of Biosolids Application Using Hydrologic Simulation Program – Fortran, Nanney Creek Basin, Virginia Beach – Liz Scheessele, URS Corp., Steve McLaughlin, City of Virginia Beach Public Works

Session 2E • Stormwater Pollution Prevention • Moderator – Jeff Waller

Hard Armor-Innovative Vegetated Erosion Control Solutions – Jim Nadeau, CONTECH Construction Products

Mastering Stormwater Pollution Prevention-A Framework for Municipal Programs – Ken Dierks, REM, Kimley-Horn and Associates

Construction SWPPP Template Document Development - Lessons Learned – Karl Mertig, CPESC. Kimley-Horn and Associates, Inc.. Frank Janes, City of Virginia, Public Works Operations

Database for Management of Wetlands and Construction General Permits – Jeff Waller, PE, City of Virginia Beach Public Works Engineering

12:15 – 1:15 Luncheon

Keynote Address: “Moving Forward: Improving Stormwater Management and Dam Safety in Virginia” - Joseph H. Maroon, Director, VA DCR

Watershed Excellence Award Winner

MONDAY AFTERNOON, MARCH 9, 2009

1:30 – 2:45 PM Third Concurrent Sessions

Session 3A • Stormwater Management 3 • Moderator – Elizabeth Krousel

Construction of BMPs on City Owned Property – Esther Dornin, City of Virginia Beach Dept. of Public Works

Cleanwater Town USA – Diane Beyer, Tri-County/City Conservation District, Kevin Utt, City of Fredericksburg

Is your locality on the cutting edge of stormwater management? Let us show you how Southampton County is leading the pack ... – Michelle Virts/Aislinn Creel, Timmons Group

City of Winchester – Making Every Dollar Count...Methods for Achieving Compliance on a Limited Budget – Kelly Henshaw, City of Winchester; David Powers/Elizabeth Krousel, Michael Baker Jr., Inc.

Session 3B • Floodplain Management 2 • Moderator – Matthew Breen

In-Stream Flow and Floodplain Inundation Modeling in the Lower Roanoke River Corridor, 1997-2007 – Loren Wehmeyer, USGS

Floodplain Management in Urban Districts – Laura Mwirigi, Timmons Group

Automated, Iterative HEC-RAS Floodway Modeling Using GIS – Siva Selvanathan/Dr. Randy Dymond, Virginia Tech

Risk Communication in the Digital Age – Visualization Tools for Communities – Matthew Breen/Taylor Smith, AMEC Earth and Environmental, Inc.

Session 3C • Dam Safety 3 • Moderator – Robert VanLier

Lake Townsend Dam Replacement Project, Greensboro, NC – Tillman Marshall, Schnabel Engineering

Changing Hazard Classification of Todd Lake Using Computational Tools – Kelly Ramsey, NRCS

Dam Safety-Sources of Free, Public Domain, & Pertinent Information on Current Practices for Dam Design Criteria, Rehabilitation, Maintenance, and Inspection – Thomas Roberts, VA DCR

Greene Acres Dam POA Develops Novel Approach to Finance Repair of Dam – Robert VanLier, VA DCR

Session 3D • Water Quality 3 • Moderator – Cheryl Wapnick

Pollutant Target Load Study: Lake Simcoe & Nottawasaga River Watersheds, Canada – Dr. Raed El-Farhan, Louis Berger Group

Total Maximum Daily Load Implementation Strategies: Are They Working? – Lisa Bass/Martin Malone/Katherine Perkins, Old Dominion University

Identification of Sources of Fecal Coliform Contamination – Cheryl Wapnick, PBS&J

Session 3E • Stormwater Infrastructure • Moderator – Glenn Bottomley

Assessing the Condition, Need, and Funding Requirements for Virginia's Infrastructure – Glenn Bottomley, PB America's, Inc.

Urban Areas Face Stormwater Infrastructure Challenges – City of Richmond Perspective – Berry Wright, City of Richmond

NRCS Assisted Flood Control Infrastructure in VA-Issues, Opportunities and Action – Mathew Lyons, NRCS

Grading Dams and Stormwater Management and Conveyance Systems for the ASCE Infrastructure Report Card – Ingrid Stenbjorn, ASCE Infrastructure Report Card Committee

How You Can Make A Difference – Glenn Bottomley, PB America's, Inc.

2:45 – 3:15 Coffee Break

3:15 – 4:30 PM Fourth Concurrent Sessions

Session 4A • Stormwater Management 4 • Moderator – Bill Johnston

Stormwater Retrofit: Lessons Learned – Seth Brown, RKK Engineers, Matt Meyers, Fairfax County

61st Street Stormwater Pump Station and Ocean Outfall – Michael Mundy, City of Virginia Beach Dept. of Public Works

The Integrated Stormwater System of an Urban Project – Tracy Ruff, Timmons Group

Partnering with Private Organizations for Better Public Education – Bill Johnston, City of Virginia Beach

Session 4B • Floodplain Management 3 • Moderator – Jeff Smith

*Beyond Map-MOD and 2-D Floodplains: Developing Flood Depth Maps – James Mawby, Dewberry
GeoTerrain: Supporting Seamless Floodplain Modeling and Mapping – Srikanth Koka/Milver Valenzuela,
Dewberry*

*Unsteady State Flow Analysis for Dam Break and Incremental Damage Assessments – Kaveh Zomorodi,
Dewberry*

*Reviewing Your Community's DFIRM Mapping, Bedford County's Experience Through the Map
Modernization Initiative – Kevin Leamy, Bedford County*

Session 4C • Dam Safety 4 • Moderator – Lisa Cahill

*Corrugated Metal Pipes: Inspection, Repair, Abandonment, and Replacement – Lisa Cahill, Watershed
Services, Inc.*

The Team Approach to Dam Repair Projects: With and Without – Scott Cahill, Watershed Services, Inc.

Hogan Dam Inspection: Solving a Historic Riddle – Cameron Smith, Watershed Services, Inc.

Corrugated Metal Pipe Failure at Johnsons Dam – Austen Bander, Watershed Services, Inc.

Session 4D • Watershed Management 1 • Moderator – Clint Boschen

*Value and Benefits of a Centralized Watershed Planning System in Fairfax County, VA – Fred Rose, Kate
Bennett, LeAnne Astin, Matthew Meyers, Fairfax County Dept. of Public Works and Environmental
Services, John Zastrow, Clint Boschen, Tetra Tech*

*Hydrologic and Water Quality Modeling for Watershed Management Planning in Fairfax County, VA –Kate
Bennett, Fred Rose, Fairfax County Dept. of Public Works and Environmental Services, Clint Boschen,
Tetra Tech*

*Development of a Subwatershed Ranking Approach for Watershed Management in Fairfax County, VA –
LeAnne Astin, Fred Rose, Kate Bennett, Fairfax County Dept. of Public Works and Environmental
Services, Clint Boschen, Tetra Tech*

Difficult Run Watershed Management Plan – William Frost, KCI Technologies, Inc.

MONDAY EVENING, MARCH 9, 2009

4:45 – 6:00 PM Reception

6:00 – 6:30 PM Virginia Lakes and Watersheds Association Business Meeting

TUESDAY MORNING, MARCH 10, 2009

7:00 – 8:00 AM Virginia Floodplain Management Association Meeting

8:30 – 9:45 AM Fifth Concurrent Sessions

Session 5A • Stormwater Management 5 • Moderator – Steve McLaughlin

*The Nuts and Bolts of Manufactured Treatment Systems: An In-Depth Look at Critical Design Variables –
Jennifer Steffens, CONTECH Stormwater Solutions, Inc.*

*Advanced Bioretention Media for Enhanced Bacteria Removal from Stormwater Runoff. A Discussion of the
Benefits, Mechanisms and Efficiencies for Bacteria Removal – Mindy Ruby, Filterra Bioretention Systems*

*Phosphorous – Advanced Removal Mechanisms and Amended Design for Stormwater BMPs – Scott Perry,
Imbrium Systems Corp.*

*Virginia Beach Trial Use of a Bacterra™ BMP – Steve McLaughlin, City of Virginia Beach Dept. of Public
Works*

Session 5B • Floodplain Management 4 • Moderator – Shane Parson

*GIS Hydrology for Northern Virginia – Joni Calmbacher, Michael Baker Jr., Inc., Dr. Michael Casey,
George Mason University*

*Cameron Run: Unintended Consequences of In-Stream Flood Mitigation in Urban Watersheds – Hunt Loftin,
Tom Heil, RKK Engineers, Elsie Parrilla-Castellar, Michael Baker Jr., Inc.*

*Cost Effective Stormwater Model Calibration – Sean Bradberry, URS, Sam Sawan, City of Chesapeake,
John Paine, URS*

Conducting a Stormwater Study in a Watershed with Aging and Deteriorating Infrastructure – **Stephanie Hood, URS**

Session 5C • Hydrology and Dam Safety • Moderator – Geoffrey Cowan

Hydrologic Model Calibration Using Field Measured Bankfull Discharge – **Troy Biggs, AMEC Earth & Environmental, Randy Sewell, Vanasse Hangen Brustlin, Inc.**

Characterizing the Magnitude and Frequency of Peak Flows and Magnitude, Frequency, and Duration, of Low Flows in Virginia Streams – **Samuel Austin/Ute Wiegand, USGS**

Lake Barcroft Probable Maximum Flood Inundation Mapping – **Aaron George/Brett Martin, GKY & Associates, Inc.**

Comparison of PMP Storm Distributions for Spillway Design Flood Development in Virginia – **Geoffrey Cowan/Kaveh Zomorodi, Dewberry**

Session 5D • Watershed Management 2 • Moderator - Dr. Steve Gorzula

Residential RainScapes: Helping Homeowners Go Green in Montgomery County, MD – **Melissa Bernardo Hess/Erin Morsheimer, URS Corp.**

Regional Watershed Improvements Through Coordinated Restoration Efforts-Town of Warrenton, VA – **Jason Murnock, Angler Environmental**

Total Water Management: Sustainability of Existing Water Resources – **Thomas Singleton, PBS&J**

Virginia Watershed Management in an International Context – **Dr. Steve Gorzula, Harmony Ponds, Inc.**

9:45 – 10:15 Coffee Break

10:15 – 11:30 Sixth Concurrent Sessions

Session 6A • Stormwater Management 6 • Moderator – Seshadri Iyer

Is Street Sweeping an Effective Best Management Practice (BMP) – **Lamont “Bud” Curtis/John Whitelaw, Parsons Brinkerhoff**

Storm Water Pollutant Removal Using Lightweight Aggregates – **Peter W. Schmidt, Southern Aggregates, LLC**

Bacteria Concentrations in Stormwater and Current BMP Design Methods – **Lewis White, KCI**

Summary of Historical Dry Weather Field Screening Results – **Seshadri Iyer, URS Corp., Steve McLaughlin, City of Virginia Beach Public Works Engineering**

Session 6B • Floodplain Management 5 • Moderator – Mark Slauter

Flooding: Tools for Maintaining Situational Awareness – **Mark Slauter, VDEM**

FEMA’s Map Modernization Status – **David Gunn, VA DCR, Rich Sobota, FEMA**

FEMA’s New Elevation Certificate – **Charley Banks, VA DCR**

The NFIP in Virginia, Status and Trends – **Alison Mitchell, VA DCR**

Session 6C • Lake and Dam Maintenance • Moderator – Davis Grant

The Rehabilitation of the Cow Creek Mill Dam, Gloucester County, VA – **Robert Cooper, Williamsburg Environmental Group, Inc.**

Monitoring Invasive Aquatic Plants in Smith Mountain Lake, VA – **Dr. Delia Heck/Dr. Bob Pohlan, Ferrum College**

Reservoir Hydrographic Surveys Using a Linked Differentially Corrected GPS and Acoustic Depth Sounding System – **Harold Post, Virginia Tech Occoquan Watershed Monitoring Lab**

Managing a Cyclical Lake Dredging Program in an Urban Setting: Lake Barcroft’s Experience – **Davis Grant, Lake Barcroft WID**

Session 6D • Stream Restoration • Moderator – Gerry Hammel

Dynamics of Dragonfly Colonization of New Lentic Habitats – **Richard Groover, J. Sargeant Reynolds Community College**

Nuttree Branch Stream Restoration and Channel Improvements – **David Wilmoth/Michael Claud, Timmons Group**

Environmental Permit Compliance Through the Use of an Independent Environmental Monitor – **Gerry Hammel, McCormick Taylor, Inc.**

11:45 – 1:00 PM Luncheon

Keynote Address: “*Update on National Floodplain Management Actions Impacting Communities and States*” - Larry Larson, Executive Director, Association of State Floodplain Managers

SUMMARY

Session 1

- (A) Stormwater Management 1*
- (B) Stormwater Management Models and Practices*
- (C) Dam Safety 1*
- (D) Water Quality 1*
- (E) Living Shorelines*

Session 2

- (A) Stormwater Management 2*
- (B) Floodplain Management 1*
- (C) Dam Safety 2*
- (D) Water Quality 2*
- (E) Stormwater Pollution Prevention*

Session 3

- (A) Stormwater Management 3*
- (B) Floodplain Management 2*
- (C) Dam Safety 3*
- (D) Water Quality 3*
- (E) Stormwater Infrastructure*

Session 4

- (A) Stormwater Management 4*
- (B) Floodplain Management 3*
- (C) Dam Safety 4*
- (D) Watershed Management 1*

Session 5

- (A) Stormwater Management 5*
- (B) Floodplain Management 4*
- (C) Hydrology and Dam Safety*
- (D) Watershed Management 2*

Session 6

- (A) Stormwater Management 6*
- (B) Floodplain Management 5*
- (C) Lake and Dam Maintenance*
- (D) Stream Restoration*

SESSION 1A

STORMWATER MANAGEMENT 1

Upcoming Stormwater Management Regulation Changes: Panel Discussion

Chris Palmeroy, VAMSA, Mike Flagg, Hanover County, Jeff Perry, Henrico County, Lee Hill, VA DCR, Drew Gould, Timmons Group

SESSION 1B

STORMWATER MANAGEMENT MODELS AND PRACTICES

Selecting BMPs for Retrofit in Stafford County
Marissa Soule, Woolpert, Steve Hubble, Stafford County

Water Quality Modeling of the Middle Potomac Watersheds
Jack Wall, Woolpert

Issues with SWMM and HEC-RAS Models: Program Differences or Gremlins in the Computer?
David Powell, Woolpert

Watershed Models for Storm Water Management: Comparing Hydrologic and Hydraulic Procedures
Deva Borah, Woolpert

SELECTING BMPs FOR RETROFIT IN STAFFORD COUNTY

Marissa Soule¹, PE, Woolpert, Inc., Steve Hubble², Stafford County

Stafford County was awarded a grant to evaluate existing BMPs within the County to determine which BMPs would be appropriate candidates for retrofit to improve or add water quality treatment. An inventory of the stormwater BMPs in Stafford County was conducted in 2005. This project used the data from the inventory along with GIS data from Stafford County to evaluate the County's BMPs.

The first task of the study was to score and prioritize the BMPs based on the information available. A variety of selection criteria were chosen, and then scores for each BMP were developed based on a weighted system to determine the suitability of the BMPs for retrofits. Once all of the scores had been tabulated, the top fifteen BMPs received further evaluation for their retrofit potential.

Next, an in-depth look at the information available for each of the remaining BMPs was performed. The top five BMPs were selected based on the inventory photos, the drainage areas of the ponds, and the types of retrofits that could reasonably be applied to each BMP.

Five stormwater detention structures were selected for conceptual water quality retrofit designs. Existing data on the stormwater management structures was provided from as-built and design drawings and from GIS data. Conceptual design drawings were developed for the top five BMPs and estimated construction costs were created as well.

¹ Water Resources Engineer, Woolpert, Inc., 2800 S Shirlington Road, Suite 405, Arlington, VA 22206, Marissa.Soule@woolpert.com

² Stafford County Department of Code Administration, P.O. Box 339, Stafford, VA 22555, SHubble@co.stafford.va.us

WATER QUALITY MODELING OF THE MIDDLE POTOMAC WATERSHEDS

Jack Wall¹, PE, Woolpert, Inc

Streams, rivers, and ultimately large bodies of water such as the Chesapeake Bay are impacted by non-point source pollution from existing commercial and residential development. One of the key initiatives in protecting these waters is to first establish a plan that can be used as a guide in reducing the pollutants in stormwater. This is what was done for the Middle Potomac Watersheds in Fairfax County, Virginia. Part of the plan for the Middle Potomac Watersheds involved predicting the pollutant loadings for both the existing and future land use conditions, identifying acceptable structural controls that could reduce the pollutants in stormwater runoff, and then determining the effectiveness of these controls on improving water quality.

The water quality modeling effort is typically done using a computer model that predicts stormwater runoff and the build up and washoff of pollutants and then routes both runoff and the pollutants downstream. In this case, XP-SWMM was the computer model used. The modeling effort for the project followed a consistent method established for consultants for developing watershed models in Fairfax County. This consistent effort included the use of specific pollutant characteristics based on land use, removal fractions for structural controls, and methodology for setting up the hydrologic and hydraulic models.

This topic will present the water quality constituents that were modeled and describe the methods that were used to predict the build-up and wash off of the pollutants and the effect of the change in land use on the loadings in the water quality. It will describe the model simulation results including the total load, the average loadings, and the maximum daily load, and how they were used to support the overall watershed management plan. It will describe the structural and non-structural measures that were modeled, the overall achievements of the modeling effort, and the lessons learned.

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ISSUES WITH SWMM AND HEC-RAS MODELS: PROGRAM DIFFERENCES OR GREMLINS IN THE COMPUTER?

David Powell¹, PhD, Woolpert, Inc.

With the increasing reliance on computer models and the corresponding increase in the number of models available, conversions becomes a necessary evil. Whether it is because of the preferred modeling software being different from the required deliverable or simply updating the version of an existing model, problems and discrepancies inevitably crop up. This presentation will specifically look at XP-SWMM versions 10.5 and 10.6 as compared with EPA-SWMM 5.0 (SWMM5). Also, HEC-RAS versions 3.1.3 and 4.0 will be compared.

Sometimes there are conversion and export utilities built into a software package, such as XP-SWMM 10.6 to SWMM5, which can be both helpful and frustrating. However, it is impossible to provide conversion utilities for each program due to the proprietary nature of software. Different kinds of issues will be shown and discussed. They include:

- Version updates (newer means different, not always better)
- Omission (did not import)
- Format/Organization issues (information not contained in the same place/feature)
- Unit conversion errors (self-explanatory)
- Accuracy (significant digits, truncation)
- Computation methods (different calculation procedures)

Sometimes these issues can cause significant frustration in getting identical results from what appears to be identical inputs. The purpose of this presentation is to show different instances of this in some commonly used software and to discuss these issues.

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WATERSHED MODELS FOR STORM WATER MANAGEMENT: COMPARING HYDROLOGIC AND HYDRAULIC PROCEDURES

*Deva Borah¹, PhD, PE, Jamie Weist², PE, Jack Wall³, PE, and David Powell⁴, PhD,
Woolpert, Inc.*

Watershed models are useful analysis tools to interpret, quantify, and assess complex natural processes, such as storm water runoff resulting from precipitation and its interactions with the soil and its land use covers, erosion of upland soil and stream bed and bank, sedimentation, and contamination of runoff from chemicals and bacteria. The models are useful to evaluate land use changes and best management practices towards solving or alleviating potential problems, such as flooding, excessive erosion, sedimentation, and water pollution. Many watershed models are available today and those are diverse with various complexities, strengths, and weaknesses. Selecting the most appropriate model to achieve the most accurate and efficient solution possible is a challenging task.

The primary objective of this investigation is to review available watershed models used for storm water management and provide insightful information not readily available and understanding of those for the end users, particularly water resource managers, so that an informed decision in selecting a model suitable for an application can be derived.

Twenty one watershed models simulating storm event runoff, some including sediment and chemicals, were reviewed, evaluated, and presented earlier. Eight tables were developed summarizing, categorizing, comparing, and ranking the models. The ranking was based on the water routing schemes adopted in the models, which were basically the hydraulic procedures.

The above investigation is expanded here for fourteen of the models to include the hydrologic procedures, such as the initial loss of precipitation, interception, infiltration, and finally the rainfall excess. The specific flow routing procedures adopted for subwatersheds or overland areas (hydrologic model) and the channel or stream network (hydraulic model) are identified, compiled, and ranked separately.

The models are basically mathematical models and their basic mathematical facts are often overlooked due to high demands on model applications at ease using graphical user interfaces (GUI) and geographic information system (GIS). Therefore, the reviews and compilations presented here will be helpful to managers and modelers, who often rely heavily on model marketers, to understand the models better, select the most suitable model for a project or an application, and use it to its full potential.

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SESSION 1C

DAM SAFETY 1

NRCS Federal Dam Program Throughout Virginia
Jerry Wright, USDA-NRCS

Visualizing an Incremental Damage Analysis
Paul Welle/Anthony Grubbs, Schnabel Engineering

Incremental Damage Analysis-Establishing the Appropriate Spillway Design Flood for an Existing Dam

Robert Bowers/N. Johan Anestad, O'Brien & Gere Engineers, Inc.

Determining Required Spillway Design Flood-Incremental Damage Analysis
James Robinson, VA DCR

URBAN AREAS FACE STORMWATER INFRASTRUCTURE CHALLENGES - CITY OF RICHMOND PERSPECTIVE

Jerry Wright¹, USDA-NRCS

Stormwater collection and treatment infrastructure are among those being evaluated in ASCE's Infrastructure Report Card. Older urban areas, such as the City of Richmond, have particular challenges with the conveyance, collection and treatment of stormwater. Portions of the stormwater conveyance system in Richmond are more than a century old. Parts of the City are still served by combined sewer. The City has made some considerable strides in managing the combined sewer systems by constructing retention facilities for combined flows to be treated after rain event. Other challenges the City faces are older facilities that have been over loaded during large storm events. The speaker for this session will present the City of Richmond's progressive solutions to these and other challenges it is presented regarding stormwater.

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VISUALIZING AN INCREMENTAL DAMAGE ANALYSIS

Paul I. Welle¹, PE, Anthony W. Grubbs, EIT², Schnabel Engineering

The new Virginia Dam Safety regulations provide new challenges and opportunities for dam owners in the Commonwealth. One such addition is a provision for an incremental damage analysis to reduce the required Spillway Design Flood (SDF). The potential to reduce a SDF can have a huge impact to the cost of a new dam or dam rehabilitation. The incremental damage analysis allows a dam owner the opportunity to demonstrate that a dam can be constructed that provides no additional threat to downstream persons or property even though it does not convey the full SDF for its hazard classification.

Understanding the potential impacts below the dam is the basis for completing a defensible incremental damage assessment. The regulations define additional downstream threat in terms of water depth and the product of water depth and velocity. The impacted area must be analyzed three dimensionally to reveal the full extents of the potential damages. Having the right tools to demonstrate and document the analysis is crucial. The ability to visualize the velocity distribution, depth of flow, and their product throughout the floodplain allows the dam owner to defend a SDF reduction. The combination of river hydraulics and GIS software is one effective tool set to meet these needs.

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INCREMENTAL DAMAGE ANALYSIS – ESTABLISHING THE APPROPRIATE SPILLWAY DESIGN FLOOD FOR AN EXISTING DAM

Robert R. Bower¹, PE, N. Johan Anestad² PE, O'Brien & Gere Engineers, Inc./Dam & Water Resources Division

For existing dams, it is generally recognized that the relationships between valley slope and width, total reservoir storage, drainage area, and other hydrologic factors have a critical bearing on establishing the safe spillway design flood (SDF). When appropriate, rational selection of a reduced SDF for specific site conditions based on quantitative and relative impact analysis may be found acceptable. The process of establishing the reduced SDF is commonly referred to as an “incremental hazard evaluation” or, in VDCR terms, an “incremental damage analysis”.

The revised Virginia Soil and Water Conservation Board Impounding Structure (Dam Safety) Regulations that were signed into law in November 2008 now include a section (4VAC50-20-52) entitled Incremental damage analysis which states “When appropriate, the SDF requirement may be reduced by the Board in accordance with this section.” This section essentially allows for a reduction in the SDF level if the increased downstream damage resulting from a failure of the dam would not be significant in comparison with the flood damage resulting from just the storm itself. A dam owner can realize substantial cost savings when undergoing a dam safety improvement project, if the incremental damage analysis indicates that a reduced SDF would be appropriate. However, the owner must also recognize that designing for a lower SDF could increase the possibility of a dam failure during an extreme storm event and the associated loss of the lake/reservoir and potential liability that comes with that failure.

This presentation will outline the steps involved in performing an incremental damage analysis and will discuss a few case studies where these types of analyses were performed. It will also explore the factors that led to a successful reduction of the SDF in some cases and the reasons that the SDF could not be reduced in other cases.

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DETERMINING REQUIRED SPILLWAY DESIGN FLOOD-INCREMENTAL DAMAGE ANALYSIS

James M. Robinson¹, PE, Virginia DCR

The Revised Virginia Impounding Structures Regulations (9/2008) allow for the reduction of the required Spillway Design Flood (SDF) through a process termed "Incremental Damage Analysis". Once the required SDF for dam has been determined, further analysis can be performed comparing damages associated from a dam break and the flow associated with a reduced SDF. This analysis may determine a lower required SDF due to the limiting flood condition for incremental damages downstream. This presentation will demonstrate this procedure.

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SESSION 1D

WATER QUALITY 1

Tidally Influenced New Orleans Canal Network Benefits from Accurate Water Level, Conductivity,
and Temperature Data

Jason Evans, In-Situ, Inc.

Investigations into the Effects of External Electron Acceptors on Sediment-Water Interactions in the
Occoquan Reservoir

Francisco Cubas, Virginia Tech Occoquan Watershed Monitoring Lab

Zonation of the Occoquan Reservoir Using Virginia DEQ Lake Zonation Guidelines

Niffi Saji, Fairfax Water

Reservoir Water Quality Important in Hydroelectric Power Generation?

Dr. Carolyn Thomas, Ferrum College

TIDALLY INFLUENCED NEW ORLEANS CANAL NETWORK BENEFITS FROM ACCURATE WATER LEVEL, CONDUCTIVITY, AND TEMPERATURE DATA

Jason Evan¹, In-Situ Inc.

Since Hurricane Katrina hit the Gulf Coast in August 2005, New Orleans city canals have been fortified with control gates, pumping stations, and a district-wide water level monitoring network rooted in the continuous readings from In-Situ[®] Inc. Level TROLL[®] 500 and Aqua TROLL[®] 200 sensors. These devices improve management of water levels throughout the Southern Louisiana Hurricane Protection System. Continuous water level monitoring helps synchronize pumping and assures that all elements of the water level control system are within proper ranges. Level TROLL 500 sensors monitor and record water level and temperature, and offer the multiple communication options required for a real-time monitoring network. Aqua TROLL 200 sensors monitor and record water level, temperature, conductivity, and salinity data. The sensors automatically and continuously correct depth and level parameters for changes in water density due to salinity fluctuations. This dramatically improves the accuracy of depth and level measurements in waters where tides and rainfall continuously affect local salinity. Over 100 water level and water level/conductivity instruments are deployed at sites along outfall canals (Orleans Avenue Canal, London Avenue Canal, and the 17th Street Canal) where the major breaches occurred that flooded the city during Hurricane Katrina. Level TROLL 500 instruments also maintain surveillance at monitoring stations around Lake Pontchartrain, along the Gulf Intracoastal Waterway, and at groundwater monitoring sites throughout the district. This paper will give an overview of the monitoring network and how Level TROLL and Aqua TROLL instruments are integrated into the Southern Louisiana Hurricane Protection System.

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INVESTIGATIONS INTO THE EFFECTS OF EXTERNAL ELECTRON ACCEPTORS ON SEDIMENT-WATER INTERACTIONS IN THE OCCOQUAN RESERVOIR

Francisco Cubas¹, Virginia Tech Department of Civil and Environmental Engineering

The Occoquan Reservoir is an artificial impoundment which was constructed to serve as a drinking water source for the suburbs of Washington DC in northern Virginia. An advanced water reclamation plant (WRP) discharging to one of the principal tributaries to the reservoir supplements natural streamflow to increase the safe drinking water yield of the system. In addition, the WRP discharge contains high concentrations of nitrate, which has been shown to play a role in managing the release of undesirable substances from the deposited sediments of the reservoir. Continuous flow microcosm studies were used to replicate typical summer conditions that prevail in an deep waters of an area of the reservoir close to the dam in order to study the effects of nitrate concentration on sediment nutrient release, and also to investigate the importance of water volume to sediment surface area ratio in the behavior of such model systems.

Continuous flow, completely-mixed bench-scale reactors were constructed to simulate the lower reaches of the Occoquan Reservoir. The reactors were operated with selected concentrations of nitrate prepared in realistic mixtures natural streamflow and reclaimed water discharge. Results showed that nitrate concentrations of 3 mg/L entering the test microcosm were insufficient to prevent the onset of truly anaerobic conditions, or to prevent the release of phosphorus (P), iron (Fe), and manganese (Mn) from the deposited sediments. When initial concentrations of nitrate were increased, the period of time taken to reach an anaerobic state was delayed, and when inflow concentrations exceeded 5 mg/L as N, anaerobic conditions were prevented, with the result that low concentrations of phosphorus, iron, and manganese were maintained in the water column. Results also suggested that varying the water volume to sediment area ratio affected the rate of nutrient release from the sediments. Under similar feed water conditions, observed nutrient release rates were inversely related to the effective depth. No correlation was found between the rate of ammonium release and the concentration of nitrate in the system. In fact, results showed that sediment ammonium release was different for every inflow nitrate concentration, and was also affected by the water volume to sediment area ratio, which suggested that the mechanism of ammonia release from sediments is different from those of phosphorus, iron and manganese.

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ZONATION OF THE OCCOQUAN RESERVOIR USING VIRGINIA DEQ LAKE ZONATION GUIDELINES

Niffy Saji¹, Fairfax Water

Reservoirs are created for a variety of reasons, including, but not limited to, the principal uses of flood control, recreation, and water supply. Such artificial impoundments are generally created by constructing dams at appropriate locations in existing natural river channels. The upper reaches of a reservoir, termed the riverine zone, are generally narrow and winding like the parent river, and have somewhat higher water velocities. By contrast, reservoirs are generally found to be deepest and widest in the zone nearest the impounding dam. At this location, termed the lacustrine zone, lake-like conditions prevail and the water is more quiescent. The transitional zone, which separates the lacustrine and riverine zones, generally has characteristics that are intermediate between the riverine and lacustrine zones.

In most lakes and reservoirs, the observed physical, chemical, and biological conditions are related to the characteristic zone. This is further complicated in artificial impoundments where relatively short residence times and variations in pool elevation may cause seasonal shifts in the characteristic zones. In order to facilitate water quality data interpretation in lakes and reservoirs, it is useful to have a standard methodology to identify the riverine, transition, and lacustrine zones.

The Occoquan Reservoir is located in Northern Virginia and is bordered by Fairfax County on the north, and Prince William County on the south. It is an artificial impoundment and is a primary source of drinking water to more than one million residents of the region. The Reservoir and the surrounding parkland areas are also widely used for recreational activities.

A standard zonation methodology based on thermal stratification, dissolved oxygen, and reservoir bathymetry was developed from an analysis of local water quality, as well as a survey of the limnological and water quality literature. The developed methodology was successfully applied to the Occoquan Reservoir, and resulted in a satisfactory definition of the riverine, transitional and lacustrine zones.

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IS RESERVOIR WATER QUALITY IMPORTANT IN HYDROELECTRIC POWER GENERATION?

Carolyn L. Thomas¹, Ferrum College

Water quality parameters have been monitored on Smith Mountain Lake, Virginia for 22 years. The parameters measured include total phosphorus, chlorophyll-*a*, water clarity, dissolved oxygen, pH, conductivity and temperature. All of these parameters are important but the lake profile measurements of dissolved oxygen, pH, conductivity and temperature are most significantly affected by power generation. In 2007 the water quality parameters indicated good water quality but the lake levels were lower than desired by residents and the power company. In previous years the water quality parameters indicated a decreasing level of water quality and the dissolved oxygen profiles showed very low oxygen concentrations in the hypolimnion. Although chlorophyll-*a* (4.3 ppb) and water clarity (2.3 m Secchi depth) both indicate that Smith Mountain Lake is not nutrient enriched, total phosphorus (34.5 ppb) is high enough in Smith Mountain Lake to be considered nutrient enriched. Information will be presented describing the nutrient status of Smith Mountain Lake.

Another water quality parameter which influences useful reservoir life is siltation rate. Data will be presented to demonstrate the correlation between the measured siltation rate and the model predicted rate of siltation.

The Smith Mountain Lake power generating project is going through relicensing with the Federal Energy Relicensing Commission and the report has been considering and monitoring the effect of hydroelectric power generation on the reservoir. Reservoir stratification, epilimnion and hypolimnion chemical characteristics are directly and indirectly affected by the management of power production. The effect of water quality on reservoir management will be discussed.

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SESSION 1E

LIVING SHORELINES

Living Shoreline Techniques for Shoreline Stabilization and Habitat Development, *Karen Dubring, Virginia Institute of Marine Science*

Design Criteria for Planting Living Shoreline Wetlands
Walter Priest, NOAA Fisheries Restoration Center

Implementation of “Living Shoreline” Erosion Control in Norfolk, VA – Successes, Failures, and Challenges for the Future
Kevin DuBois, Bureau of Environmental Services, City of Norfolk

Haven Creek Pathway and Living Shoreline - Design Constraints Along a Confined Waterfront in Norfolk, VA
Rebecca Francese, Waterway Surveys & Engineering, Ltd.

LIVING SHORELINE TECHNIQUES FOR SHORELINE STABILIZATION AND HABITAT DEVELOPMENT

*Karen Duhring¹, Center for Coastal Resources Management,
Virginia Institute of Marine Science*

Living Shorelines utilize the designed placement of plants, stone, fill, and other materials to both reduce erosion and enhance wetland habitat. They are ecologically beneficial in that they maintain a natural connection between the water, the shoreline and the uplands to provide better habitat. A properly designed Living Shoreline can provide important ecological services such as shelter and food for a wide variety of organisms, and reduce the amounts of nutrients, sediments, and other pollutants carried by runoff and groundwater from uplands to rivers and the bay. Natural shorelines can be a source of sand for beaches, can provide flood and erosion buffering for low lands, provide recreational opportunities and are aesthetically pleasing.

Living shorelines have been implemented for over twenty years in the Chesapeake Bay; however, much debate still exists over certain design criteria such as sill height, distance offshore, marsh slope, bank stabilization, and even what types of sites are appropriate for this practice. This paper attempts to present practical guidelines for the successful construction of Living Shorelines. The process begins with site characterization, e.g. fetch, water depth, bank height, to determine the appropriate Living Shoreline strategy. These strategies can range from non-structural, such as wetland planting or beach nourishment, to hybrid methods which involve these natural features in conjunction with modest structures. Living Shorelines continue to be an evolving methodology that involves ongoing experimentation with various techniques to improve effectiveness and ecological value.

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DESIGN CRITERIA FOR PLANTING LIVING SHORELINE WETLANDS

Walter Priest¹, NOAA Restoration Center

The design and construction of tidal wetlands can often be a perplexing, mystifying process. Many of the techniques are solely the domain of practicing professionals which leaves many individuals and organizations at a loss when contemplating a project. This paper presents practical guidelines that can be used by the lay person, as well as restoration practitioners for the successful construction of tidal wetlands. These guidelines include screening criteria for site selection that will help avoid inherent problems with a particular site and design criteria to guide the development of wetland hydrology and the successful establishment of wetland vegetation.

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IMPLEMENTATION OF “LIVING SHORELINE” EROSION CONTROL IN NORFOLK, VA – SUCCESSES, FAILURES, AND CHALLENGES FOR THE FUTURE

Kevin R. Du Bois¹, P.W.S., City of Norfolk

In 2005, the Virginia Marine Resources Commission clarified their Wetland Mitigation-Compensation Policy and Guidelines. The Policy cited permanent losses of wetlands related to the installation of erosion control structures and reiterated the Commonwealth’s Policy of minimizing wetland losses and the adverse ecological effects of all permitted activities by incorporating all reasonable mitigating actions into a permit proposal. In December 2006, a group of government agencies, researchers, and NGOs hosted the Living Shorelines Summit as a forum to discuss less damaging shoreline protection alternatives. Following the Living Shorelines Summit, City of Norfolk staff have embraced Living Shoreline strategies for shoreline protection, erosion control, and wetland restoration and enhancement projects.

The presentation will review residential, commercial, governmental, and community projects approved by the Norfolk Wetlands Board and implemented throughout the City involving wetland planting alone, bank regrading, and “hybrid” approaches using native vegetation in conjunction with coconut fiber “biologs” or rock sill structures. Challenges to implementation and lessons learned will also be discussed.

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HAVEN CREEK PATHWAY AND LIVING SHORELINE – DESIGN CONSTRAINTS ALONG A CONFINED WATERFRONT IN NORFOLK, VA

Rebecca Francese¹, Waterway Surveys & Engineering, Ltd.

The proposed Haven Creek Pathway and Living Shoreline is planned as a community waterfront enhancement immediately adjacent to the Colonial Place subdivision and the East Haven Creek channel in Norfolk, Virginia. East Haven Creek was a small, natural tributary that was later dredged and channelized for navigation. It is a federal navigation project, but has not been dredged in more than twenty years. An eroded asphalt pathway runs parallel to the shoreline restricting the natural, daily tidal flow along the waterfront. As a result, marginal wetlands with invasive species such as phragmites have developed around the asphalt pathway. The shoreline is currently in a degraded condition and offers very little in the form of habitat, buffering, or erosion protection.

The purpose of the project is to improve the aesthetics at the site and to create a Living Shoreline by increasing the size of the low marsh, as well as enhancing the function and value of the existing wetland environment. The basic components of this project include the removal of the asphalt path and remnants of a wooden bulkhead and concrete revetment. The area between the residential property and the shoreline will be regraded and wetland vegetation will be established to create a Living Shoreline. A new raised, timber, pathway shall be constructed in much the same footprint as the asphalt path and a series of low rock sills will be added to protect the wetlands.

There are several constraints associated with this project that have hindered the design and ultimately the construction. The primary obstacle has been addressing concerns by property owners adjacent to the proposed Living Shoreline, as well as establishing the historical location of ownership and municipal easements. Additionally, the available land for construction is narrow, resulting in design constraints on the width of the low marsh. Sizing the rock sill has also been challenging since in this situation, potential siltation from the marsh and uplands into the federal channel must be minimized, while protecting the created marsh from excessive wave impacts due to storms and boat wake. Finally, determining the elevation of the low marsh has been difficult due to the lack of natural vegetation to evaluate a benchmark.

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SESSION 2A

STORMWATER MANAGEMENT 2

The Economics of Managing Stormwater: What We Know, What We Need to Know

David Sample/Kurt Stephenson, Virginia Tech

Virginia Stormwater Management Technical Criteria – Application and Assessment

Douglas Beisch/Joseph Battiata, Williamsburg Environmental Group

The Virginia BMP Clearinghouse – Opportunities for BMP Research and Improved MS4 Program Effectiveness

Joseph Battiata, Williamsburg Environmental Group

Virginia Stormwater Management Regulation Amendments: Applications and Impacts on Local Stormwater Management Programming

Doug Moseley, GKY & Associates, Inc.

THE ECONOMICS OF MANAGING STORMWATER: WHAT WE KNOW, WHAT WE NEED TO KNOW.

David Sample¹ and Kurt Stephenson², Virginia Tech

Virginia has begun to implement a new stormwater management regulatory strategy which shifts from control and management of peak flows to an approach that focuses upon stormwater volume and land development practices. This strategy employs a three-tiered strategy known as the Runoff Reduction Method, which includes: 1) Environmental Site Design (ESD) practices, intended to minimize impervious surface generation and maximize conservation practices, 2) runoff reduction, which allows implementation of Low Impact Development (LID)-based practices to reduce runoff volume, and 3) Pollutant Removal, consisting of Best Management Practices (BMPs) to treat remaining flows in order to reduce nutrient concentrations of discharges to receiving waters. This is an extensive effort that will, if successfully implemented, alter the land development practices throughout the state. Implementation of these controls will incur costs to State and local government, land developers, homeowners associations, and ultimately, homeowners. The performance and cost effectiveness for many stormwater controls varies substantially, and LID practices, being relatively new, are no exception. Case studies of the cost of LID versus traditional development indicate that capital costs may be reduced, yet operation and maintenance and inspection/enforcement costs may be higher than conventional systems.

In order to address these issues and facilitate LID as part of its Green Infrastructure Action Strategy, the US EPA is currently engaged in multiple research and outreach initiatives, including development of cost databases and modeling tools to enhance life cycle analysis and optimize systems of BMPs, and improve both cost and performance over time. It is likely, that in addition to cost and performance prediction, new management and ownership structures will be required for successful implementation due to the decentralized nature of LID practices. Some studies suggest that LID practice may have a beneficial effect on property valuation. These studies are generalized and do not focus upon individual parcels. Because some properties may receive an additional maintenance burden, these costs should be compared with parcel level benefit. Because of the many potential equity issues, involved, we assert that economic analysis needs to include evaluating benefits and costs from multiple, rather than a single perspective.

Several “Design Charrettes” were recently held in Virginia to facilitate the understanding and adoption of the Runoff Reduction Method by practicing land development engineers and designers. We use data from the Design Charrettes to evaluate the new beta-versions of US EPA’s life cycle cost analysis tool and assess benefits and costs of LID from multiple perspectives. We assess the potential for a tradeoff between upfront capital expenditures and long term operation and maintenance costs, and discuss potential incentives. The available data are assessed with respect to uncertainty. Methods for reducing and/or incorporating uncertainty, and extending the analysis to a watershed level approach are presented as recommendations for further work.

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VIRGINIA STORMWATER MANAGEMENT TECHNICAL CRITERIA – APPLICATION AND ASSESSMENT

*W. Douglas Beisch, Jr.¹, P.E., Joseph G. Battiata², P.E.,
Williamsburg Environmental Group*

Williamsburg Environmental Group was actively engaged in the Virginia Department of Conservation and Recreation's (VDCR) Technical Advisory Committees (TAC) charged with developing the stormwater management technical criteria for the Virginia Stormwater Management Program (VSMP) Permit Regulations. The proposed regulations include new criteria for addressing stormwater quality and quantity (stream channel erosion and flooding), and references a design tool in the form of a spreadsheet to assist in computing compliance.

These new criterion have been reviewed and assessed through the TAC process (3 separate TACs were convened) as well as a series of design charrettes. These processes have concluded, allowing the Administrative Processes Act procedural review and public comment process to commence. Concurrently, Williamsburg Environmental Group conducted a series of site assessments in the interests of evaluating the relative impact of these new rules on development and redevelopment projects.

This is a two part presentation that will start with a detailed discussion of the proposed water quality and quantity criteria, including the Runoff Reduction Method (RRM) developed by the Center for Watershed Protection. The second part will present an overview of the site assessments and will provide a discussion of possible policy guidance and clarification that may be useful in improving the effectiveness of new criteria.

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THE VIRGINIA BMP CLEARINGHOUSE – OPPORTUNITIES FOR BMP RESEARCH AND IMPROVED MS4 PROGRAM EFFECTIVENESS

Joseph G. Battiata¹, P.E., Williamsburg Environmental Group

The Virginia BMP Clearinghouse is a new initiative developed through the Virginia Department of Conservation and Recreation (VDNR) in partnership with the Virginia Water resources Research Center (VWRRC). The genesis of the initiative was to develop a research extension of VDNR to support the evaluation and approval of proprietary Best Management Practices (BMPs). The BMP Clearinghouse Committee, consisting of numerous experts in the fields of engineering, aquatic biology, hydrology, hydraulics, stream geomorphology, etc., was convened to serve as the technical expertise that would ensure the quality of posted studies and information, and develop consensus on the approval of BMPs. The Clearinghouse website was envisioned to be a portal for posting and updating information related to ongoing monitoring projects. As such, the Virginia BMP Clearinghouse represents a model for a collaborative approach to managing a very complex and dynamic area of research and development: Stormwater quality.

Significant pressure is being applied at the MS4 level to ensure program compliance with the water quality goals of the Chesapeake Bay. Very strong language regarding compliance with Waste Load Allocations (WLAs) is being added to municipal permits. Yet the mechanisms for evaluating the efficacy of the new technical standards, including the Runoff Reduction Method (RRM), Environmental Site Design (ESD), and other innovative watershed based programs such as stream restoration, are costly, complex, and likely outside the reach of any one MS4 operator or state. Thus, it is becoming apparent that there are numerous opportunities to utilize the VA BMP Clearinghouse model to foster research collaboration on a multi-state watershed (read Chesapeake Bay) level to support the evaluation of these practices and programs.

This presentation will explore the idea of gathering the leading experts in stormwater research to form a monitoring consortium, supported through shared funding by Chesapeake Bay watershed states (utilizing funds that would otherwise be spent on outfall monitoring that typically yields little value). The supporting argument is that such collaboration can accelerate the scientific response component of the elusive adaptive management process, and that a consortium of experts can promote better science, while also providing a more efficient and effective use of limited funds.

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**VIRGINIA STORMWATER MANAGEMENT REGULATION
AMENDMENTS: APPLICATIONS AND IMPACTS ON LOCAL
STORMWATER MANAGEMENT PROGRAMMING**

Douglas H. Moseley, III¹, AICP CFM, GKY & Associates, Inc.

This presentation will focus on the impacts on local stormwater programs from updated stormwater management regulations at the state level and visit some of the programmatic issues associated with implementation of qualifying local programming using Virginia as a case study. Virginia has recently presented significant changes in its stormwater management law and attendant regulations for public comment, with adoption slated prior to the end of 2009. The impacts of Virginia's proposed, amended regulations are broad, covering the development community with proposed changes to the state's water quality and quantity management criteria, as well as localities, be they either currently operating a qualifying local stormwater management program or weighing the option to do so. The session will highlight examples of local program impacts from the new regulations, including impacts to local MS4 programming, construction site permitting and inspection, and post-construction inspection program decisions and the anticipated impacts of those decisions from localities throughout Virginia. The session will also present alternatives that localities may wish to consider as the regulations move forward towards final adoption and implementation.

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SESSION 2B

FLOODPLAIN MANAGEMENT 1

Approximate Floodplain Development for Virginia Flood Insurance Studies

Srikanth Koka/Tamrat Bedane, Dewberry

Comparison of Two Station Method with Other Methods: A Case Study

Nanda Meduri/Jeff Smith, Dewberry

Two-Dimensional Models: Updating NFIP FISs and FIRMs

Jeff Smith/Mathini Sreetharan, Dewberry

Effect of Map Changes on Flood Insurance

Shane Parson, URS Corporation

APPROXIMATE FLOODPLAIN DEVELOPMENT FOR VIRGINIA FLOOD INSURANCE STUDIES

Srikanth Koka¹, EIT/Tamrat Bedane², CFM – Dewberry

Availability of digital terrain, soil and land use information as well as the development of graphical user interfaces for processing geospatial data in ArcGIS has reduced the data manipulation and processing times. Increasingly, Approximate Floodplain (Zone A) are developed using methodologies applied for detailed floodplain studies. Embracing the GIS technology, Dewberry has developed its own state of art GIS system called GeoFIRM. GeoFIRM is built around ArcGIS, consisting of databases and interfaces, to support flood insurance studies in a very efficient way while meeting the quality standards. The hydrology and hydraulics modules, within the GeoFIRM system have been applied to several counties in FEMA Region III, especially in the states of Pennsylvania and Virginia, for Zone A analyses. Harnessing the power of the computers and technology for doing flood studies has facilitated us in providing Zone A analyses of higher accuracy, unthinkable of achieving within the constraints of a Zone A project scope with other traditional methods. By letting the computer process what it can do best, which is data crunching and manipulation, engineers and modelers are empowered with more resources to concentrate on critical problems in a project.

GeoFIRM-hydrology toolset provided the platform for conducting terrain processing and discharge computations. The toolset is built around ArcHydro data model, developed by University of Texas. ArcHydro compatible geodatabase are produced by the tool for data storage. The USGS 10 meter DEMs were used for delineating streams and contributing drainage areas. The discharge computation routines used the effective regression equations as the basis for the 1% chance peak flow discharges computed at selected locations. Though regression equations present simplistic methods for computing discharges, the analysis using them can become complex, especially when a watershed crosses multiple regression regions and multiple states. Additional complexity could be added when multi-parameter equations are used. A case study illustrating this scenario would be presented.

The output from hydrology toolset, which is ArcHydro Geodatabase forms the basis for hydraulic analyses. The GeoFIRM hydraulics toolset, which is built around HEC-GeoRAS, was used for the analysis. The toolset enabled automatic placement of cross section, banks, Flowpaths and extraction of channel roughness coefficients. A subsidiary toolset called GeoTerrain enabled extraction of channel geometry. GeoTerrain is a recent addition to our GeoFIRM system, developed to provide tools to work with the latest topographic data storage mechanism called 'Terrain', developed by ESRI. By utilizing Terrain datatype, a full county's worth of data could be stored in one seamless dataset. Terrain provides tremendous advantages over traditional DEMs and TINs in terms of storage, visualization and manipulation. Tools enabled extraction of a single HEC-RAS model reflecting the Zone A study reaches located within the entire county or within individual HUCs. HECRAS models thus exported are executed and the flood elevations computed by the HEC-RAS models at the cross sections in combination with the terrain databases and GeoTerrain enabled the delineation of Zone A floodplains. The floodplain delineation module not only provides the ability to delineate the flood boundary but also facilitates the verification of compliance with FEMA's floodplain boundary standards (FBS).

Approximate hydrologic and hydraulic analyses can form the basis for future detailed studies. They can be converted to detailed studies by incorporating survey data taken to determine the under water cross sections and structure dimensions. If this data is made available to the general public through data requests, they can form the basis of Letter of Map Revisions.

Because of the availability of digital geospatial data, it is feasible to utilize detailed study methods to develop approximate floodplain analyses. Approximate floodplain studies should be preserved so that they can form the basis of new detailed studies or LOMRs.

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COMPARISON OF TWO STATION METHOD WITH OTHER METHODS: A CASE STUDY

Nanda Meduri¹, EIT, CFM/Jeff Smith², PE, CFM - Dewberry

The Two Station Method, as outlined in Bulletin 17B, may be used to improve the mean and standard deviation (and consequently the equivalent period of record) of a statistical analysis of surface water gage station data through use of adjacent gage data. Where applicable, the method can result in more accurate flood discharge estimates. This presentation will discuss how the Two Station Method was used to improve discharge estimates along the Virgin River in St. George, Utah, through comparison and discussion with several other analytical approaches.

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TWO-DIMENSIONAL MODELS: UPDATING NFIP FISS AND FIRMS

Jeff Smith¹, PE, CFM/Mathini Sreetharan², PhD, PE, CFM

Use of two-dimensional (2D) hydraulic models, such as RMA2 and MIKE Flood, for National Flood Insurance Program (NFIP) flood studies is gaining popularity. This paper will briefly discuss theory and practice of 2D modeling, to include discussion of why 2D models are preferred for some flood studies. It will also discuss some of the benefits and drawbacks of using 2D models. Lastly, the paper will discuss ways in which 2D model output may be translated from the model to stakeholders, primarily in the form of NFIP Flood Insurance Studies (FISS) and Flood Insurance Rate Maps (FIRMs) published by the Federal Emergency Management Agency (FEMA). This will include discussion of pertinent guidelines and specifications published by FEMA as well as several case examples.

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EFFECT OF MAP CHANGES ON FLOOD INSURANCE

Dr. Shane Parson¹, PE, CFM, URS Corporation

This presentation will focus on how changes to Flood Insurance Rate Maps (FIRMs) can affect flood insurance rates. As FIRMs are updated through the FEMA Map Modernization program, many flood insurance customers will see their flood insurance rates change due to several factors. In some cases, their FIRMs will have more detailed flood risk information that can be used to provide a more up-to-date flood insurance rate. Sometimes, the rates may go down, but in most cases the rates may go up, due to increased flood elevations from increased developed and better flood modeling methods. The presentation will detail what options current and future homeowners and other flood insurance customers have for their flood insurance rates. This includes a discussion of grandfathering rules for maintaining existing flood insurance rates even when the new FIRMs indicate a change in risk for a location.

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SESSION 2C

DAM SAFETY 2

Recent Dam Safety Regulation Changes: Panel Discussion

Michael Claud, Timmons Group

Scott Cabill, Watershed Services

Tillman Marshall, Schnabel Engineering

Jim Robinson, VA DCR

Ken Turner, VA DCR

SESSION 2D

WATER QUALITY 2

Development of Estimated Clay Fractions Associated with Sediment Output from the
Lynnhaven River Water Quality Models

Will VonOhlen, URS Corp.

Dispersive Flux in the Lower Reaches of the Elizabeth River Estuary

Byron Tracy, Old Dominion University

Biological Response and Recovery to a Polymer Release in a
Headwater Stream in Chesterfield County

Laura Barry/Weedon Cloe, Chesterfield County Dept. of Environmental Engineering

Representation of Biosolids Application Using Hydrologic Simulation Program – Fortran,
Nanney Creek Basin, Virginia Beach

Liz Scheessele, URS Corp., Steve McLaughlin, City of Virginia Beach Public Works

DEVELOPMENT OF ESTIMATED CLAY FRACTIONS ASSOCIATED WITH SEDIMENT OUTPUT FROM THE LYNNHAVEN RIVER WATER QUALITY MODELS

Will VonOhlen¹, URS Corporation

In spring of 2007, hourly sediment output from the Lynnhaven River Watershed Hydrologic Simulation Program – Fortran (HSPF) models was provided to the Virginia Institute of Marine Science (VIMS) for use as input to their hydrodynamic and water quality models. After introducing the provided sediment data into their model, VIMS indicated that better calibration results could be attained if the clay content of the sediment was identified. To that end, URS has performed an analysis combining data from the Soil Survey Geographic (SSURGO) Database and soil sampling to determine the portion of sediment classified as clay at each outfall location where hourly sediment output was provided.

The Lynnhaven River Watershed has experienced significant development within the past several decades. While soil survey data was accurate at the time of collection in 1985, it is believed that many of the native soil areas have since been disturbed. Therefore, in order to best estimate the proportionate extent of sediment-associated clay available for removal by runoff, the watershed was divided into seventy-eight (78) drainage areas and the areal-weighted percent clay for each drainage area was determined using SSURGO soil component data. Representative soil sampling was conducted at twenty (20) locations to provide a comparison between SSURGO soil data and actual site soil conditions.

Results from the representative soil sampling do, in fact, verify the accuracy of the SSURGO-provided percent clay parameters. With the exception of two (2) soil samples, clay content values resulting from the sieve and hydrometer analyses are within the expected range for their corresponding SSURGO map units.

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DISPERSIVE FLUX IN THE LOWER REACHES OF THE ELIZABETH RIVER ESTUARY

Byron Tracy¹ and Jaewan Yoon²

Congress has mandated under Section 303(d) of the Clean Water Act that Total Maximum Daily Loads (TMDL's) be established for impaired water bodies to further identify and regulate their waste assimilative capacity. To establish a TMDL, the sources of waste loading or pollutants must be identified, and a method of determining how each should be limited or removed must be developed. Using a water quality model is a typical method for determining these limits, and since new or changed limits will likely impact local businesses, industry, agriculture, and local and state government budgets, the model must be as accurate as possible. For most tidal systems larger than small coastal basins, these models are ineffective without performing an accurate in-situ assessment of how pollution is specifically dispersed, which is often deemed impractical because traditional methods entail modeling the entire estuary. This requires near simultaneous sampling across the estuary to achieve model calibration and verification, which in turn requires either extensive remote sensing capability or a significant amount of manpower.

In order to meet the robust requirements of the TMDL process, more practical methods for performing these assessments is needed. This paper describes and evaluates a method for assessing dispersive flux on a meso-scale or smaller as a more practical alternative to modeling the entire estuary. A model at this scale can be applied to predict the localized effects of specific point sources, calibrated under different environmental conditions to compare seasonal and storm-event variations, and performed with a limited financial budget.

This study site was a 3.3 kilometer-long segment of the lower reaches of the Elizabeth River, Virginia, in the vicinity of one of the Hampton Roads Sanitation District (HRSD) wastewater treatment plants, using field-measured salinity data and the U.S. Environmental Protection Agency (USEPA) Water Quality Analysis Simulation Program (WASP) model software. A longitudinal, one-dimensional, two-segment model is developed using ArcView GIS software, and then a WASP model is manually calibrated using dispersion coefficients calculated by two mass-balance methods using vertically-averaged, high-tide salinity data measured over a five-day period. Freshwater flow for the model is estimated from data provided by the Norfolk District U.S. Army Corps of Engineers, HRSD, and point discharge data available on the USEPA Permit Compliance System (PCS) database available through the "Envirofacts" Data Warehouse Internet website.

The salinity values predicted by the WASP model using different dispersion coefficient estimates, as well as those predicted using values determined in previous water quality models of the Elizabeth River, are then statistically compared to the measured salinity data. A Wilcoxon Rank-Sum non-parametric procedure was used for the statistical comparison and showed that the predicted salinity values for model runs using the manually calculated dispersion coefficient values met a 0.05 level of confidence (p-value). Model runs using dispersion coefficient values from the most previous modeling studies of the Elizabeth River, however, did not, likely because of significant changes in hydrography, point sources, and shoreline structures over the last 30 years. The study concludes that this is a practical, low-cost method which has potential for future applications and recommends further development and verification.

Keywords: Estuarine Flux, Dispersion Coefficient, Elizabeth River

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BIOLOGICAL RESPONSE AND RECOVERY TO A POLYMER RELEASE IN A HEADWATER STREAM IN CHESTERFIELD COUNTY

Laura Barry¹ and Weedon Cloe², Chesterfield Co., Dept. of Environmental Engineering

On November 13, 2007, an asphalt plant in Chesterfield County discharged approximately 15,000 gallons of styrene/butadiene co-polymer latex mixed with water into a first order perennial stream. This unnamed tributary to the James River originates and flows through the Richmond National Battlefield Park - Drewry's Bluff. The discharge was found by a park ranger and reported to the Environmental Protection Agency (EPA), Virginia Department of Environmental Quality and Chesterfield County. Enforcement actions were initiated by all agencies and the stream and associated soils were cleaned of the product residue.

As part of Chesterfield County's immediate response, Water Quality Section staff performed a benthic macroinvertebrate assessment of the stream. The initial assessment indicated the benthic macroinvertebrate community was devastated as a result of the discharge. Staff decided to continue monitoring the stream's recovery from the spill by documenting the benthic macroinvertebrate community recovery over the course of one year. This monitoring would allow staff to determine when and how well the stream recovered from this event.

Richmond National Battlefield-Drewry's Bluff is located in the eastern portion of Chesterfield County along the Jefferson Dave Highway Corridor. The benthic macroinvertebrate community was assessed using the EPA Rapid Bioassessment III Protocol. Instream water quality chemistries (temperature, pH, dissolved oxygen, conductivity, and total dissolved solids) were also measured by the county. Bioassessments were completed immediately following the discharge, four months later (March 2008) and will be assessed once more this year (November 2008). The resulting macroinvertebrate data was characterized using Chesterfield County's Bioassessment Scoring Criteria and the Virginia Stream Condition Index. The water chemistry data was compared to current state water quality standards.

The water chemistries tested by the county did not indicate any violations of state standards either immediately following the discharge or at four months. However, there was a noted decline in conductivity and total dissolved solids at the four month interval.

The initial macroinvertebrate sample yielded all dead animals, save for two individuals. Based upon the dead animals found, the stream was determined to have been moderately impaired prior to the spill. The four month assessment indicated a nearly complete recovery of the community to its previous moderately impaired status. However, the March sample demonstrated a slight shift in community composition. The repopulation was dominated by opportunistic, pollutant tolerant taxa such as *Chironimidae* and *Oligacheates*. Surface dwelling macroinvertebrates, notably water striders (*Gerris sp.*), were well represented despite their absence from the initial sampling.

There are complicating factors to consider when assessing the recovery of this stream. The quality of the stream was impaired prior to the spill and those elements which degraded the stream, excluding the impacts of the discharge, continued to affect the stream while it recovered. Therefore when considering the recovery rate and the quality of the recovery, this stream would not be gauged against a pristine or high quality stream. The stream in question will only recover, at best, to its previously impaired condition. Whether the low expectation of recovery allowed for the stream to demonstrate recovery faster as compared to the recovery of a higher quality stream, remains to be seen.

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BIOSOLIDS APPLICATION USING HYDROLOGIC SIMULATION PROGRAM – FORTRAN - NANNEY CREEK BASIN, VIRGINIA BEACH

*Liz Scheessele¹, PE, CFM, URS Corporation and Steve McLaughlin², PE,
City of Virginia Beach*

The Nanney Creek Basin in Virginia Beach, Virginia drains to the Back Bay and eventually the Atlantic Ocean. Segments of Nanney Creek have been designated by the State as impaired waters for fecal coliform contamination; the river water quality is in sufficient violation of bacterial standards for its prescribed designated use of primary contact recreation. As a result, segments of the river are listed as impaired on *Virginia's 303(d) Total Maximum Daily Load Priority List*. To aid the City in identification of bacterial sources leading to the impairment, a rural application of Hydrologic Simulation Program – Fortran (HSPF) has been developed. The main focus of the model is simulation of land-based fecal coliform loading and delivery to the creek. Sources addressed include point and nonpoint sources including septic system discharges, livestock loadings, manure application, biosolids application, domestic animal loadings, and wildlife loadings.

As opposed to other sources of fecal coliform loading to the watershed that are simply deposited on the land surface, biosolids are incorporated into the soil shortly after application. This factor affects the availability of the bacteria to wash off the fields and be delivered to the creek. While the biosolids bacterial density and application locations and rates in the study area were readily available for inclusion in the model simulation, the impacts of biosolids application in agricultural field runoff was not. In order to ensure accurate model representation of biosolids application in the Nanney Creek Watershed, runoff data and surface water quality monitoring results from test plots at the Hampton Roads Sanitation District (HRSD) Progress Farm were used to develop an additional HSPF model for the sole purpose of calibrating model parameters affecting the availability of the bacteria applied as biosolids for runoff from the fields.

This presentation will describe the biosolids application calibration process and pertinent conclusions.

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SESSION 2E

STORMWATER POLLUTION PREVENTION

Hard Armor-Innovative Vegetated Erosion Control Solutions

Jim Nadeau, CONTECH Construction Products

Mastering Stormwater Pollution Prevention – A Framework for Municipal Programs

Ken Dierks, Kimley-Horn and Associates

Construction SWPPP Template Document Development – Lessons Learned

Karl Mertig, Kimley-Horn and Associates, Inc, Frank Janes, City of Virginia Beach, Public Works Operations

Database for Management of Wetlands and Construction General Permits

Jeff Waller, City of Virginia Beach Public Works Engineering

HARD ARMOR – INNOVATIVE VEGETATED EROSION CONTROL SOLUTIONS

Jim Nadeau¹, Contech Construction Products

Hard armor, in particular Articulating Concrete Blocks (ACB's) offer the highest level of erosion control protection with the option of a vegetated finish. Vegetation has been deemed by the EPA as the preferable storm water BMP in many cases and owners are desiring a green finish where high levels of erosion control protection are required. Typical applications of ACB's include shoreline wave attack protection, dam overtopping applications, high velocity channels, pipe outfalls and river bank slope stabilization projects. Hard armor can be used as a stand alone or in conjunction with soft armor solutions for a green solution meeting the design performance criteria in the most economical fashion. This presentation will outline several projects in the myriad of applications where ACB's and other hard armor solutions have been used effectively.

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MASTERING STORMWATER POLLUTION PREVENTION – A FRAMEWORK FOR MUNICIPAL PROGRAMS

Ken Dierks¹, REM, Kimley-Horn and Associate

The control of pollution from stormwater at construction sites is an essential environmental compliance element for local government capital construction projects. The Virginia Stormwater Law contains a General Permit authorizing the discharge of stormwater from construction sites but requires that discharges seek coverage under the Stormwater General Permit provided a Stormwater Pollution Prevention Plan (SWPPP) has been developed. SWPPP compliance is also a key element of compliance with the Municipal Separate Storm Sewer (MS4) program and the State Erosion and Sediment Control Program.

The development of, and adherence to, SWPPPs is a key environmental challenge for localities managing capital construction projects. The City of Virginia Beach has been a leader in the effort to ensure that its project managers and inspectors are fully versed in the requirements of the state stormwater law, understand how to ensure that SWPPPs are properly prepared and, working with construction contractors, how to conduct effective inspections for stormwater compliance. The City has implemented an aggressive training program designed to ensure full awareness of the requirements of the Stormwater General Permit requirements on the part of its project managers and inspectors.

This presentation will discuss the approach and elements to the City's training program and provide a framework for other localities to adopt such a program.

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CONSTRUCTION SWPPP TEMPLATE DOCUMENT DEVELOPMENT – LESSONS LEARNED

Karl Mertig¹, CPESC, Kimley-Horn and Associates, Inc., Frank Janes², City of Virginia Beach, Public Works Operations

VSMP Construction general permitting for stormwater discharges can be required for land disturbance activities ranging from a 2,500 square foot swimming pool to a several hundred acre master planned development. Each project covered under the state general permit must have its own project specific Stormwater Pollution Prevention Plan (SWPPP) developed prior to the initiation of land disturbing activities.

SWPPPs are the mechanism by which the control of construction site stormwater runoff is documented. They are intended to provide the contractors in the field with information regarding their roles and responsibilities in ensuring that pollutants are segregated from stormwater runoff. This planning goes far above and beyond traditional erosion and sediment control and must reflect the realities of each site as well as the type of construction proposed. Special attention must be paid to the sequencing of land disturbing activities and the types of pollutants expected to be generated during the site development activities. How can an entity prepare a SWPPP template to ensure its projects are consistent with the requirements of seemingly ever changing regulations?

Even though each land disturbing activity has its own set of unique challenges, the fundamentals of a successful SWPPP are relatively consistent. Since 2004, the City of Virginia Beach has had a City-wide SWPPP template for Public Works projects and has had the opportunity to evaluate the effectiveness of a “one size fits all” approach to SWPPP preparation. This presentation will focus on the recurring themes that must be addressed in each SWPPP regardless of the type and size of land disturbance project and strategies for successful communication of roles and responsibilities of the entity who ultimately prepares the site specific SWPPP from a SWPPP template document.

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DATABASE FOR MANAGEMENT OF WETLANDS AND CONSTRUCTION GENERAL PERMITS

Jeff Waller¹, PE, City of Virginia Beach Department of Public Works Engineering

During the project management of its various roadway, building, coastal, and stormwater projects, the City of Virginia Beach Public Works Engineering division (PW/Engineering) obtains numerous wetlands and general construction permits. To help comply with the permitted monitoring and reporting requirements, PW/Engineering has developed a Team Track database. This database will be accessed by the appropriate project managers to input, review, and update information and track permit milestones. The database can be also accessed by PW/Engineering administration to help in program management. This is one of the components of the City's strategy to protect and enhance the Waters of the Commonwealth and the United States within the City of Virginia Beach.

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SESSION 3A

STORMWATER MANAGEMENT 3

Construction of BMPs on City Owned Property
Esther Dornin, City of Virginia Beach Dept. of Public Works

Cleanwater Town USA
Diane Beyer, Tri-County/City Conservation District, Kevin Utt, City of Fredericksburg

Is your locality on the cutting edge of stormwater management?
Let us show you how Southampton County is leading the pack . . .
Michelle Virts/Aislinn Creel, Timmons Group

City of Winchester – Making Every Dollar Count...Methods for Achieving
Compliance on a Limited Budget
Kelly Henshaw, City of Winchester. David Powers/Elizabeth Krousel, Michael Baker Jr., Inc.

CONSTRUCTION OF BMPS ON CITY OWNED PROPERTY

Esther Dornin¹, City of Virginia Beach Department of Public Works

This presentation will review the City efforts during the first year of a program to build BMP wet and dry (extended detention) ponds for treatment of the Lynnhaven River. The focus of this Stormwater Program of BMP placement is the retrofit locations on City owned property such as schools and parks. The special challenges and goals which we faced include: these properties are currently developed, are located within neighborhoods, are currently in use by the public and are managed by City forces. This presentation will offer a “lessons learned” look at how we might improve our strategy while encouraging Schools and other departments to allow the use of their property for treatment of the Lynnhaven River.

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CLEANWATER TOWN USA

Diane Beyer¹, Tri-County/City Conservation District, Kevin Utt², City of Fredericksburg

The Cleanwater Town USA project is a partnership between the Tri-County/City Conservation District and the City of Fredericksburg . The overall mission of the project is to identify water quality issues posed by increasing development and population growth, and to improve public, and public servant awareness, of these issues. The project will focus on the problem of increased stormwater runoff and its effects on stream banks and river life. Major components of the project are:

- A public relations campaign identifying the project and its images,
- Public education with a demonstration of LID practices implemented on area school grounds and other City property,
- Environmental education programs that get students out of classrooms and learning about stormwater runoff, water quality issues, and LID practices.

Other major components include identifying stormwater inlets, a stream restoration effort in the headwaters of Smith Run, and conducting stream monitoring in order to build a database and assist with restoration decisions. This effort will serve as an example of what can be achieved and the basic principals will be reproducible in other streams in the area.

The timeline for this project extends into 2011 and is in the concept plan and design stages of implementation. Additional funding partners are being sought within the community to expand the Cleanwater Town USA project to reach more homeowners, business owners and developers and demonstrate what can be done to address water quality issues."

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IS YOUR LOCALITY ON THE CUTTING EDGE OF STORMWATER MANAGEMENT? LET US SHOW YOU HOW SOUTHAMPTON COUNTY IS LEADING THE PACK...

Michelle Virts¹, P.E, Timmons Group/Aislinn Creel², EIT, Timmons Group

Stormwater management is of increasing concern as development in Virginia is on the rise. Responsible stormwater management can mean the difference between dangerous flash flooding and controlled water containment, between a clean and plentiful water supply and one that is depleted by pollution and displacement. A crucial balance exists between the preservation of natural hydrologic systems and the development of sites that are safe for human use. DCR recognizes this balance and is currently working on revamping State regulations for stormwater management. Once the new regulations are adopted some localities, such as those with existing Chesapeake Bay programs or MS4 permits, will be required to create local stormwater management programs. All other localities will have the opportunity to take stormwater management into their own hands, at the local level, or have the State administer the program for them.

In order for a locality to be authorized by the State to issue coverage under the VSMP Construction General Permit, the locality must have an approved stormwater management program in place. The approved program is to include administration, plan review, inspection, enforcement, reporting, and record keeping. The first step of the process; however, is typically to create and adopt a local ordinance giving the authority for such procedures a legal home in the locality's Code. Several localities have already taken advantage of this opportunity by adopting Stormwater Management ordinances into their County Code. This presentation will be a case study of the ordinance development process in Southampton County.

Ordinance development in Southampton County started with establishing the authors; Timmons Group believes an effective ordinance is one that has been well thought out and is customized to fit the specific needs of the locality. During the Southampton County ordinance development, Timmons Group started the process by assembling a localized steering committee consisting of representatives from County staff, the local planning district commission, DCR, local community activist groups, and the engineering/development community. Allowing input from the inception of the ordinance development by those voices which the ordinance will directly impact helps to speed the process through adoption.

Once the steering committee was established, the authors set about a process of draft development, review, discussion, and finally acceptance of each piece of the ordinance. By utilizing the model ordinance published by DCR, the authors ensured that all minimum state standards were incorporated into the local ordinance, including sections dealing with the specifics of an approved program. The major benefit of creating the ordinance and ensuing local program; however, comes with the specifics of customizing the ordinance to meet the needs of the individual locality. For example, Southampton County wished to encourage Low Impact Development (LID), and incorporated a stream buffer component to ensure the health of the land, watersheds, and waterways in the County. Once the Stormwater Management ordinance was drafted, Timmons Group reviewed and strengthened existing Erosion and Sediment Control, Zoning, and Subdivision ordinances to control the negative impacts of erosion and sedimentation during construction and to ensure consistency with the new Stormwater Management ordinance. Finally, Timmons Group prepared and presented the finalized ordinance to the County Planning Commission and the County Board of Supervisors for adoption into the Code of Southampton County.

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CITY OF WINCHESTER - MAKING EVERY DOLLAR COUNT...THE CITY OF WINCHESTER'S METHODS FOR ACHIEVING COMPLIANCE ON A LIMITED BUDGET

Kelly Henshaw¹, PE, City of Winchester Public Services Department, David Powers², PE, PH, and D.WRE/Elizabeth Krousel³, PE, Michael Baker Jr., Inc.,

Local governments across the nation are facing significant challenges achieving regulatory compliance on increasingly limited budgets. The challenges are compounded by escalating regulatory requirements. The City of Winchester is one such local government. They are facing budget limitations and increased requirements with their Virginia Stormwater Management Program (VSMP) permit for stormwater discharges from small municipal separate storm sewer systems (MS4). In response, the City has identified creative methods to achieve compliance and manage their stormwater program. Examples include:

- Partnering with the Environmental Studies Program at Shenandoah University. Benefits of this partnership include involving the University staff and students in educating the public on stormwater issues (spreading the word about the City's stormwater hotline, Adopt-A-Stream program, etc.); obtaining the students assistance in identifying any illicit connections that they may come across during field studies; and acquiring reports on water quality studies developed by the university staff and students.
- Identifying Co-Sponsors for a "Make and Take" Rain Barrel Workshop. The workshop is aimed at educating citizens on water conservation and prevention of stormwater pollution. It includes giving participants the rain barrel that they construct during the workshop. An industry located within the City (O'Sullivan Films) donated 50 drums for the workshop. O'Sullivan Films is adding this donation to their list of community outreach activities as part of their Environmental Management System (EMS) program.
- Cross-Training Public Services Staff to Achieve Multiple Compliance Objectives. Public Services staff (including engineering, environmental maintenance, etc.) were trained on illicit discharges and illicit connections so that they can assist with identification/elimination of illicit discharges and connections while fulfilling their routine maintenance and other duties.
- Obtaining Assistance from the General Public. This City is refining their private best management practice (BMP) maintenance program for all privately owned water quality and water quantity BMPs so that the responsibility for maintenance is shared with the community.
- "Piggy-backing" on Existing Public Events. Instead of expending funds to organize and hold their own public meetings for stormwater education purposes, the City participates in existing public meetings and events (such as the Wellness Festival and Earth Day Event) distributing outreach materials


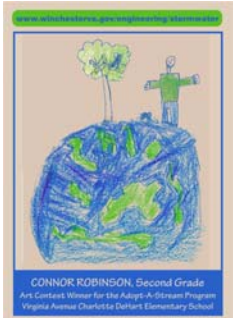


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(including brochures on the Stormwater Hotline, Adopt-A-Stream Program, Pet Waste Disposal, Prohibition of Geese Feeding).

- Utilizing Existing Public Outreach Conduits. The City takes advantage of existing public outreach methods by publishing articles in the local newspaper, the Winchester Star, to educate citizens on stormwater issues and the City's stormwater program activities.
- Taking Advantage of Freely-Available Stormwater Education Materials. The City uses stormwater education materials provided by EPA and other organizations. For example, the City distributes customizable public outreach brochures provided by EPA. In addition, the City is airing the "After The Storm" video on public access TV, provided at no charge to the City by National Service Center for Environmental Publications (NSCEP).
- Partnering with Local Organizations in Need of Community Projects. The City partnered with a local boy scout troop to achieve a stormwater compliance objective. Troop 3 was searching for an Eagle Scout Project for the troop. Therefore, the troop volunteered to install decals on the City's stormdrains indicating that the storm drains were connected to a local watersway.
- Identifying Other City Activities that May Count Toward Compliance. The City has discovered other City activities that may count toward compliance. For example, an elementary school in the City (Virginia Avenue Charlotte DeHart) has a program to educate 4th graders on watersheds including the definition, the names of the two major watershed systems, the meaning of "We all live downstream" and the identification of the school's watershed address. In addition, the program educates on the differences between natural and man-made resources; the difference between rivers, lakes and bays; recognition of the importance of Virginia's mineral resources, natural and cultivated forests, as well as soil and land uses.
- Sponsoring Community Activities Aimed at Stormwater Education. The City sponsored an art contest for students in a local elementary school to involve and educate the students and staff on stormwater issues. The winning design is illustrated on the back of T-shirts that the City is providing to Adopt-A-Stream Program volunteers. This was a relatively inexpensive way to enlist enthusiasm for the program. In addition, the City gets the benefit of the program advertizing when volunteers wear the T-shirts around the community (which includes the website address for the City's stormwater program).

The final presentation will include additional details on these cost-saving measures along with information on other aspects of the City's stormwater program (such as the update of the City's registration statement and MS4 Program, investigation of a potential illicit connection, recommendations for reporting spills and illicit connections as well as recommendations for enforcement of erosion and sediment control).

SESSION 3B

FLOODPLAIN MANAGEMENT 2

In-Stream Flow and Floodplain Inundation Modeling in the Lower Roanoke River Corridor,
1977-2007

Loren Wehmeyer, USGS

Floodplain Management in Urban Districts

Laura Mwirigi, Timmons Group

Automated, Iterative HEC-RAS Floodway Modeling Using GIS

Silva Selvanathan/Dr. Randy Dymond, Virginia Tech

Risk Communication in the Digital Age – Visualization Tools for Communities

Matthew Breen/Taylor Smith, AMEC Earth and Environmental, Inc.

IN-STREAM FLOW AND FLOODPLAIN INUNDATION MODELING IN THE LOWER ROANOKE RIVER CORRIDOR, 1997-2007

Loren Wehmeyer¹, U.S. Geological Survey

The lower Roanoke River corridor downstream from Roanoke Rapids Dam supports a large and diverse population of nesting birds, waterfowl, freshwater and anadromous fishes, and wildlife, including threatened and endangered species. In addition to providing critical habitat for wildlife, the lower Roanoke River corridor is used for a variety of purposes, including water supply, hydropower production, wastewater assimilation, and recreation. The timing, duration, and extent of floodplain inundation can have either positive or negative effects on vegetation, wildlife, and fisheries in the region. The relation between river flow and floodplain water level is important but poorly understood for the lower Roanoke River corridor. Flooding and floodplain inundation no longer follow a natural seasonal pattern of large floods in the late winter, occasional floods in the fall, and lower flows throughout the remainder of the year, but are primarily governed by upstream reservoir releases.

Under Section 216 of Public Law 91-611, the U.S. Army Corps of Engineers (USACE) is conducting a study of John H. Kerr Dam and Reservoir, which is located on the Roanoke River in Virginia and North Carolina. The purpose of the study is to identify whether there is a Federal interest in modifying the structures or operation of the Dam and Reservoir to improve the quality of the environment affected by the Dam. Effects of Kerr Dam operations on downstream flooding in the lower Roanoke River corridor was identified by the USACE as one of the major problems to be addressed in the Section 216 study. Any proposed changes in Kerr Dam operation could potentially affect the Roanoke River from the headwaters of Kerr Reservoir downstream to Albemarle Sound. As part of this study, a numerical hydrodynamic model was set up by the U.S. Geological Survey (USGS) for continuous simulation of streamflow and floodplain inundation for the 118-mile reach of the lower Roanoke River from Roanoke Rapids, NC to Jamesville, NC for the period 1997-2007. The USACE one-dimensional hydraulic model, Hydrologic Engineering Center – River Analysis System (HEC-RAS) was used for the model simulations. The 18-mile reach extending from Jamesville, NC to the Albemarle Sound was modeled by the USGS over the same period using the two-dimensional, laterally averaged, finite difference hydrodynamic and water quality model CE-QUAL-W2. A two-dimensional model was used for the downstream-most reach because of saltwater intrusion into the river from Albemarle Sound and the associated effects on dissolved oxygen, which will be considered in future water quality modeling efforts.

The models were tested to ensure mass conservation, particularly for out-of-bank flows, and calibrated to measurements at twelve gages over a wide range of flows including sustained high and low flows. In the upper 118-mile reach, the mean in-stream water level errors for the 11-year continuous simulation were less than 0.07 feet at five gages, and +0.25, -0.66, -0.88 and -1.21 feet at the remaining four gages. Standard deviations of these errors ranged from 0.13 to 1.20 feet. The lower 18-mile reach had one calibration point with a mean water level error of 0.10 feet and a standard deviation of 0.23 feet. Further testing included the comparison of modeled versus measured floodplain water levels and the comparison of modeled floodplain inundation area with remotely sensed images of inundated areas. Data from water-level gages located in the Big Swash, Broadneck and Devil's Gut floodplains were compared to simulated floodplain depths for three unique periods of sustained high flows in 1998. The average water level errors were -0.16, -0.35 and -1.39 feet with respective standard deviations of 1.82, 1.55 and 2.58 feet. Future integration of the current model setup with the Water Quality Analysis Simulation Program (WASP) from Roanoke Rapids, NC to Jamesville, NC will enable the simulation of temperature, salinity, five day biochemical oxygen demand and dissolved oxygen in the lower Roanoke River corridor from Roanoke Rapids, NC to Albemarle Sound.

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FLOODPLAIN MANAGEMENT IN URBAN DISTRICTS

A CASE STUDY OF ROCKETTS LANDING, RICHMOND VA

Laura Mwirigi¹, CFM, Timmons Group

The definition of urbanization is often held synonymous with high densities reflective of population, industry, infrastructure and most of all economic opportunity. The need to condense economic growth and populations into relatively smaller real estate creates challenges for responsible developers seeking to provide and implement stormwater management plans. These plans are designed to meet the stormwater and floodplain management objectives defined by pertinent jurisdictions.

The need to address this issue is increasingly important because urbanization has historically been drawn and continues to develop adjacent to critical areas prone to flooding namely; rivers, lakes and coastal regions.

Rocketts Landing is a 45 acre urban mixed used community development located along 1 ½ miles of the historic James Riverfront. This is a phased development estimated for completion in 2015. Timmons Group was contracted in to prepare civil design plans for units of Phase 2 and Phase 3 of the development which include detailed stormwater management plans.

The project is located within the City of Richmond and Henrico County limits and is subject to design regulations from both jurisdictions. Sections of the project are within the Chesapeake Bay Preservation Area. Sections of the Site are located within FEMA high risk flood zone AE that is prone to flooding from the 100 year storm event and zone X which is an area of moderate flood hazard, usually an area between the 100 year and 500 year floods. This is as shown on City of Richmond FEMA Map Community Panel Number 5101290010C dated July 20, 1998 and Henrico County FEMA Map Community Panel Number 51087C0145C, dated December 18, 2007.

This paper discusses the project's approach to meeting its floodplain and stormwater management objectives as outlined below:

- Mapping and delineation of the floodplain and other resource management areas within the project limits.
- Flood Proofing
- Overlay districts including IDA (Intensely Developed Area) and the RMA (Resource Management Area) and underlying Zoning districts are mapped on the site layout plan to determine applicable Best Management Practices (BMP's).
- Floodplain impact mitigation and site selection.
- Detailed stormwater management and erosion control plans which include an erosion control flood plan are specified on the plans.
- Improvement of the Floodplain area for continued use and appreciation by the community.

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AUTOMATED, ITERATIVE HEC-RAS FLOODWAY MODELING USING GIS

Siva Selvanathan¹, Dr. Randy Dymond², PE, CFM, Virginia Tech

Floodplain management studies involve hydrologic and hydraulic modeling of flooding streams to estimate the amount of flooding that may occur in the event of a rainfall. As part of the National Flood Insurance Program (NFIP), the Federal Emergency Management Agency (FEMA) supervises floodplain delineation and management studies in the United States. Floodway modeling is a key component in a detailed hydraulic study. Currently, the Hydraulic Engineering Center's River Analysis System (HEC-RAS) is the most common modeling software used for modeling.

Floodway modeling in HEC-RAS is an iterative trial and error procedure where an engineer models flows according to stipulated FEMA guidelines. This research has automated this process by developing an algorithm using Visual Basic and HEC-RAS class libraries. The program currently functions as a standalone executable program and is being ported to perform within the GIS environment. In this automated approach, a floodway is developed by running HEC-RAS in an iterative fashion with minimal user intervention. Some amount of manual fine-tuning is required to modify the floodway to be consistent with the development agenda of the local community.

This floodway modeling tool increases the productivity of an engineer by saving an appreciable amount of modeling time. It also facilitates easy transfer of the modeling output for GIS spatial analysis. Future work will incorporate land use and urbanization factors into a geospatial decision support system for developing and visualizing hydraulic modeling scenarios.

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RISK COMMUNICATION IN THE DIGITAL AGE - VISUALIZATION TOOLS FOR COMMUNITIES

Matthew Breen¹, PE, CFM, Taylor Smith², CFM, AMEC Earth and Environmental, Inc.

FEMA's Map Modernization process, from scoping through DFIRM issuance and beyond, provides several opportunities for collaboration between the community and FEMA as well as opportunities to supply the community with tools to help them more effectively manage floodplains and visualize potential impacts of their decision making. In addition, these tools can be utilized to better communicate flood risks to citizens and to encourage stakeholders to partner with FEMA in responsible floodplain management.

Geared toward community officials, this presentation will evaluate the scoping process, data availability, the engineering analyses supporting floodplain creation, and the sometimes overlooked byproducts of their development. Automated mapping techniques rely on georeferenced HEC-RAS model components, GIS-based water-surface tins and water-surface depth grids which can be used to evaluate existing floodplain issues as well as prevent future ones. Freeboard mapping, HAZUS evaluation, and 'build out' scenario floodplain generation are a few of the options available to communities once an accurate baseline is established. This living floodplain is more powerful than its static, plan-view predecessor, allowing communities to analyze several scenarios in great detail to help make difficult floodplain management and permitting decisions more straightforward and defensible. Public outreach efforts can be enhanced through advanced risk communication techniques, using many of these same digital evaluation and visualization techniques. Examples of effective and well-received visualizations utilized at DFIRM final meetings (consisting of community officials and business/home owners) will be presented.

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SESSION 3C

DAM SAFETY 3

Lake Townsend Dam Replacement Project, Greensboro, NC

Tillman Marshall, Schnabel Engineering

Changing Hazard Classification of Todd Lake Using Computational Tools

Kelly Ramsey, NRCS

Dam Safety-Sources of Free, Public Domain, & Pertinent Information on Current Practices for Dam
Design Criteria, Rehabilitation, Maintenance, and Inspection

Thomas Roberts, VA DCR

Greene Acres Dam POA Develops Novel Approach to Finance Repair of Dam

Robert VanLier, VA DCR

LAKE TOWNSEND DAM REPLACEMENT PROJECT, GREENSBORO, NC

Tillman Marshall¹, P.E., Schnabel Engineering

Lake Townsend Dam impounds the primary water supply for the City of Greensboro, North Carolina. The concrete gated spillway is suffering from severe deterioration due to alkali silica reactivity (ASR) and has inadequate hydraulic capacity to meet spillway design flood (SDF) requirements of North Carolina Dam Safety. A major challenge related to the rehabilitation or replacement of the dam is the need to maintain a full pool and uninterrupted water supply throughout construction.

A phased approach was applied to the evaluation and design for this project. Phase 1 of the project included a review of the available data, visual inspection of the structure, development of the spillway design flood, a preliminary geotechnical assessment, a stability analyses of the existing spillway, an emergency spillway integrity (SITES) analyses, and preliminary evaluation of alternatives for rehabilitation or replacement. Based on the Phase 1 evaluation, rehabilitation of the existing structure was not considered feasible due to the severity of the ASR, the complexity and cost of maintaining a full reservoir during rehabilitation, and the cumulative effects of the other deficiencies including providing sufficient spillway capacity and meeting recommended stability criteria.

The selected alternative consists of a replacement spillway designed to have similar hydraulic capacity to the existing gated spillway. The embankment will be armored to allow overtopping for storms up to the SDF. The focus of Phase 2 of the project was to evaluate options within the framework of this alternative. Phase 2 included a subsurface investigation program, hydraulic modeling and analyses, and an evaluation of outlet works. The subsurface investigations revealed soft and loose alluvial clays and sands in the original stream and floodplain. Excavation and replacement of these soft loose soils will be necessary for support of the new spillway and earth embankments.

Modeling of the downstream channel revealed that tailwater depths will submerge the spillway for extreme flood events. The submergence effects suggested that a fixed crest labyrinth weir is more appropriate than a gated structure. In addition, the City of Greensboro prefers a fixed crest to a gated spillway to limit operation and maintenance. The selected replacement spillway will consist of a seven cycle, 300 ft wide labyrinth with a weir height of 20 feet. Articulating concrete blocks (ACB) will be used to armor the earthen embankments for overtopping flows.

Phase 3, Final Design, resulted in a set of plans and specifications for the selected alternative, and included hydraulic modeling using computational fluid dynamics (CFD) and a physical model study of the labyrinth and energy dissipater. The structural design included finite element modeling of the labyrinth weir.

The project is scheduled for construction to commence in the spring of 2009. Interested Contractors were requested to submit qualifications in the fall of 2008. Seven Contractors were selected to submit bids for the project construction by January 15, 2009. The successful responsive bidder will be awarded a construction contract in April of 2009.

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CHANGING HAZARD CLASSIFICATION OF TODD LAKE USING COMPUTATIONAL TOOLS

Kelly Ramsey¹, PE, Natural Resources Conservation Service

NRCS evaluated the current Hazard Classification for Upper North River 10 dam, Todd Lake. The Upper North River 10 dam is located in Augusta County on Skidmore Fork, a tributary to North River, approximately 4 miles upstream of the town of Stokesville. In 1963, when Upper North River 10 dam was built, it was rated as a low hazard structure since it primarily protected agricultural lands and there was little threat to life or property.

To evaluate the current hazard classification, NRCS performed a sunny day breach analysis with the water level at the crest of the auxiliary spillway. When conducting a breach analysis, two of the more time consuming processes are setting up the hydraulic model and delineating the breach zone. The integration of computational tools into hydraulic modeling and breach inundation zone mapping improves accuracy, effectiveness, and quality. By using GIS data sets, HEC-GeoRAS automates the pre-processing of input data and the post-processing of results from HEC-RAS. These tools expedite the production of breach inundation zone mapping and ensure accurate hydraulic results.

In this presentation, Todd Lake is employed to demonstrate the uses, capabilities, and challenges faced when using these tools to evaluate hazard classification of watershed dams.

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DAM SAFETY - SOURCES OF FREE, PUBLIC DOMAIN, & PERTINENT INFORMATION ON CURRENT PRACTICES FOR DAM DESIGN CRITERIA, REHABILITATION, MAINTENANCE, AND INSPECTION

Thomas I. Roberts¹, PE, VA DCR

The new dam owner, new dam safety regulator, new dam design engineer, and new dam contractors are often faced on the one hand with seemingly impenetrable and indiscernible wealth of available information and on the other hand no clear direction on where to find the specific pertinent information needed. This presentation is intended to be resource to those who are interested in obtaining information on the current practices for dam design criteria, rehabilitation, maintenance, and inspection. Where possible, sources of free and public domain information are cited.

Topics such as Freeboard, Slopes, Top Width, prohibition on Anti-Seep Collar use, Conduits, Vegetative Restrictions, Animal Impacts, Energy Dissipaters, Roller Compacted Concrete Use and Criteria, Hazard Classification and other topics will be covered. Each of the topics will be briefly addressed for applicability, which authoritative agency or group advocates the topics use, and where to find or obtain the information needed.

Input from Dam Owners, Contractors, Engineers and others prior to the date of the presentation and after the presentation are welcome on the types of information that would be useful for this and future presentations.

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GREENE ACRES DAM POA DEVELOPS NOVEL APPROACH TO FINANCE REPAIR OF DAM.

Robert J. VanLier¹, PE, VA DCR

Greene Acres Dam in Greene County Virginia is a High Hazard recreational dam owned by Greene Acres POA. The earthfill dam built in 1970, is 37 feet high and 900 feet long with a maximum capacity of 341 acre-feet. On March 23, 2008 the HOA discovered a serious leak on the face of the dam near the valve of the drain pipe on the downstream face of the dam. The dam was drained over the next few weeks to alleviate any hazards and to ultimately evaluate the source of the leak. It was discovered that the leak was in the drain pipe itself in the middle of the dam. An alteration permit was submitted and approved to slip-line the pipe and to move the drain valve from the downstream side of the dam to the upstream side of the dam within the lake. The final bid for the work was \$60,000. In order to finance the project (after failure to obtain a loan through conventional financial institutions) 12 of the property owners formed an investment partnership. Each investor invested \$5,000 apiece to finance the project. All property owners within the subdivision will pay an annual dam repair fee along with their annual dues until the investment group loan is paid off. The project overview and details of the development of the investment group will be presented.

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SESSION 3D

WATER QUALITY 3

Pollutant Target Load Study: Lake Simcoe & Nottawasaga River Watersheds, Canada
Dr. Raed El-Farhan, Louis Berger Group

Total Maximum Daily Load Implementation Strategies: Are They Working?
Lisa Bass/Martin Malone/Katherine Perkins, Old Dominion University

Identification of Sources of Fecal Coliform Contamination
Cheryl Wapnick, PBS&J

POLLUTANT TARGET LOAD STUDY: LAKE SIMCOE & NOTTAWASAGA RIVER WATERSHEDS, CANADA

Raed El-Farhan¹, The Louis Berger Group

This paper describes the process, methodology, analysis, and results of the study conducted to develop pollutant load targets for the Lake Simcoe and Nottawasaga River Watersheds in Canada. The study takes the results and conclusions of previous assimilative capacity studies to create a framework within which land management and land use decisions can be readily evaluated for their potential impact on water quality conditions and the health of resident aquatic communities. Specifically, this paper describes a general framework for setting load based water quality thresholds, or 'load targets', designed to ensure the preservation of aquatic communities and recreational uses in the Lake Simcoe and Nottawasaga River Watersheds. It presents a characterization of the current and potential future physical, biological, and anthropomorphic conditions found in each of subwatersheds and presents preliminary load targets for a primary pollutant of concern based on current and potential future conditions within each subwatershed. This presentation will also address the use of watershed model and water quality targets for the restoration of hypertrophic lakes.

KEYWORDS

Phosphorus Target Load, Nutrients, TMDL, TMML, Eutrophication in lakes, GWLF (*CANWET™*), *PRedICT*, *BMPs*,

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TOTAL MAXIMUM DAILY LOAD IMPLEMENTATION STRATEGIES: ARE THEY WORKING?

Lisa Bass¹, Martin Malone², Katherine Perkins³ and Jaewan Yoon⁴

Although states comply generally with documenting the total maximum daily load (TMDL) process, including submitting an implementation plan, there are few TMDLs that are regularly monitored after being put into place. Therefore, the effectiveness of a TMDL IP, specifically whether it's a worthwhile effort and how state resources are being utilized for these efforts is largely unknown. The main objective of this research was to study and quantify the effectiveness of implementation practices put into place in rural and urban settings following a bacterial TMDL study. TMDL reduction practices that have been initiated were identified and before-and-after bacteria levels were used to determine the effectiveness of such practices. A secondary objective of this project was to gain a better understanding of various practices being used to achieve bacteria reduction; additionally, the evaluation of a rural and urban IP as well as one from another state provide a better understanding of overall TMDL reduction effectiveness. The impaired portion of Deep Creek in Amelia County, Virginia was selected as the site of the rural investigation; the urban setting is at the Lynnhaven, Broad, and Linkhorn Bays, in Virginia Beach. Finally, Breton Bay in St. Mary's County, Maryland was selected to gain a better understanding of the TMDL implementation guidance across different states.

The research at Deep Creek in Amelia County found that five stream exclusions have been installed since January 2008, excluding 387 cattle from Deep Creek and its tributaries. However, the research examined only two adjacent BMP locations (excluding 245 cattle) to analyze the before-and after bacteria concentrations. Due to being in the very early stages of implementation, the water quality results are not sufficient to conclude the ability of the installed BMPs to reduce bacteria levels. Furthermore, the results indicated that bacteria concentrations were higher at the downstream monitoring location than the upstream location for both monitoring periods (before and after BMP implementation). Several factors may contribute to this result such as unaccounted sources of pollution and insufficient monitoring data due to the recent BMP installations.

Lynnhaven Bay was a success story with several acres opened for shell fishing in 2008. This was due to the enormous focus and effort of several government organizations including the City of Virginia Beach, the Hampton Roads Planning District Commission, and the Department of Health. Because the TMDL was primarily for shell fishing, ongoing monitoring by the Department of Health is assured. In addition other non-government organizations such as Lynnhaven Now continue to monitor the progress of the health of the bay. Results of the TMDL and Implementation Plan for Breton Bay have thus far decreased the bacterial loading in the bay by 14 percent, but a more stringent monitoring plan will begin in the spring of 2009.

One challenge for the Lynnhaven River approach is raising public awareness on the effects of individual actions having on the water quality of nearby waters. The City of Virginia Beach, for example, has taken the approach of educating local citizens with pet waste, boater education, and wildlife feeding programs. Alternatively, implementation in the Deep Creek watershed is a much more individual-based approach.

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Currently, agricultural BMPs are entirely voluntary for producers. Paula Totten of the PSWCD, works with farmers to convince them to take advantage of state-funded cost-sharing while it is available. She adds that as farmers start seeing the benefits and returns on investing in fencing and pasture management, nearby farmers will be more likely to follow suit.

Another interesting point noted was that tracking the source of pollution continues to be a major challenge for government officials. Bacteria source tracking in the Lynnhaven River and Breton Bay proved to very unreliable. For example, BST revealed 83% source of bacteria from livestock sources in the Lynnhaven River when in reality there are no livestock in the area. One reason for the unreliable source tracking in the urban settings is due to the high percentage of non-point source pollution. In Maryland, the majority of fecal coliform came from wildlife. In the conclusion of the TMDL report, it was decided that wildlife pollution could not be addressed.

A point of concern identified in this project was that stream exclusion design standards may be excessive, contributing to unnecessary costs. Requirements are for four strands barbed (or high-tensile) wire, with at least two strands “hot,” or electric. Totten indicated that one farmer kept his cattle inside the pasture and off the roads with a single strand of electric wire. Therefore, the fencing requirements for the stream exclusion may be excessive, contributing to the cost of installation, and possibly hindering the producer’s ability to install such fencing.

It must be pointed out that the TMDLs in this study are for bacteria only, and that two of them are for shell fishing closures. Thus there is not only more of a drive for improvement for these waters, but post implementation monitoring is assured. Nonetheless, the findings of this project do help answer some of the questions posed when considering if the TMDL implementation process is working in Virginia.

Keywords: Bacteria Source Tracing (BST); Implementation plan (IP); Total Maximum Daily Load (TMDL)

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IDENTIFICATION OF SOURCES OF FECAL COLIFORM CONTAMINATION

Cheryl M. Wapnick¹, PBS&J

PBS&J, as a prime contractor for the Florida Department of Environmental Protection (FDEP), has developed a unique and comprehensive methodology for identifying bacteria sources. These methods are at the cutting edge of bacteria source detection and re-mediation. Although the methodologies were developed and tested throughout Florida, they can be applied anywhere in the country. The methodologies consist of three main parts:

1. Bacteria decision-support tool. PBS&J, as part of a collaborative effort, has developed a bacteria decision-support tool to guide the identification of bacteria sources and the implementation of bacteria TMDLs. The tool is based on the “Annapolis protocol” recommended by the WHO (2003) and the “phased monitoring approach” recommended by the NRC (2004) to address bacteriological impairments in recreational waters. The WHO (2003) and NRC (2004) methodologies acknowledge the limitations that affect the use of existing bacterial water quality indicators, such as fecal coliforms, *E. coli*, and enterococci, and use a weight-of-evidence approach to help compensate for those limitations. The methodologies use two independent categories of information—bacterial indicator data to identify locations with potential fecal contamination, combined with site-specific surveys to identify and classify indicator sources on the basis of their potential human health risks—to help prioritize and guide management actions to address bacteriological water quality impairments.

The decision-support tool is used at the start of the investigation to prioritize bacteria impairments at the water quality basin or sampling station level. This helps to focus the investigation, resulting in a significant saving of time and money. Upon completion of the contaminant source surveys and water quality sampling (the second and third parts of the methodology), the tool is used to classify the level of impairment and to track the success of management actions in improving water quality over time.

2. Contaminant source surveys. Using data analysis, field surveys, intensive one-on-one interviews with local stakeholders, public workshops, field reconnaissance, and, if necessary, microbial source tracking, PBS&J compiles a comprehensive contaminant source survey (CSS) of all potential bacteria sources within an impaired watershed. Since local stakeholders participate in all aspects of the survey, the results truly represent a consensus as to the most probable sources. Once the sources are identified, management actions for removing the sources are initiated.

3. Water quality sampling, including advance Microbial Source Tracking techniques. PBS&J uses a decision tree-based approach to water quality sampling that is designed to build on the results of the contaminant source survey. To minimize cost and time, this approach uses lower-cost, more basic analytic methods first, followed by higher-cost, more sophisticated methods. The approach follows the EPA (2005) recommendation of using some combination of MST methods coupled with chemical tracers, where appropriate. Use of multiple MST methods increases the confidence in source identification, because the error rates of individual procedures are affected by complex factors that are not fully explored due to the recent deployment of these methods (Stoeckel & Harwood 2007). The weight-of-evidence approach used by PBS&J places more weight on the positive or negative result of multiple methods.

The MST methods currently used by PBS&J include non-library-based PCR tests using *Bacteroides*, an anaerobic fecal bacterium (3 separate tests for human, ruminant, and horse); *Enterococcus faecium* esp gene, a gene for virulence factor of bacterium found in humans, and; human polyomavirus, a nonpathogenic virus shed in urine (high carrier rate in human populations and ubiquitous in sewage). Microbial source tracking assays are continually being developed. PBS&J works with local laboratories, including the University of South Florida, to utilize the most current and cost-effective methods available, including the use of quantitative PCR.

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SESSION 3E

STORMWATER INFRASTRUCTURE

Assessing the Condition, Need, and Funding Requirements for Virginia's Infrastructure
Glenn Bottomley, PB America's, Inc.

Urban Areas Face Stormwater Infrastructure Challenges – City of Richmond Perspective
Berry White, City of Richmond

NRCS Assisted Flood Control Infrastructure in VA – Issues, Opportunities and Action
Mathew Lyons, NRCS

Grading Dams and Stormwater Management and Conveyance Systems for the ASCE
Infrastructure Report Card
Ingrid Stenbjorn, ASCE Infrastructure Report Card Committee

How You Can Make a Difference
Glenn Bottomley, PB America's, Inc.

ASSESSING THE CONDITION, NEED, AND FUNDING REQUIREMENTS OF VIRGINIA'S INFRASTRUCTURE

Glenn Bottomley¹, PE, PB America's, Inc.

As stewards of the natural and built environment - it is paramount that civil engineers effectively inform the public of the importance of infrastructure and promote the need to protect our natural resources. As caretakers of the built infrastructure environment - we must emphasize and convey infrastructure's impact on everyone's quality of life and economic prosperity. Engineers must advocate to the public and elected officials that infrastructure needs are real and a critical investment that requires new, adequate, and sustained funding.

ASCE's Virginia Infrastructure Report Card is an important step towards making all this happen. The objectives of the Report Card are to:

- Reinforce that civil engineers are the experts for infrastructure matters (much like doctors are experts for health issues)
- Influence action from the public, engineering community and elected officials to provide adequate funding
- Reinforce that engineers hold paramount the safety, health and welfare of the public

The Report Card will:

- Inventory infrastructure assets
- Assesses condition and needs
- Evaluate funding requirements
- Evaluate dedicated funding provide
- Assign a grade
- Establish baseline to measure future progress
- Advocate for new, adequate and sustained funding

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URBAN AREAS FACE STORMWATER INFRASTRUCTURE CHALLENGES - CITY OF RICHMOND PERSPECTIVE

Berry Wright¹, City of Richmond

Stormwater collection and treatment infrastructure are among those being evaluated in ASCE's Infrastructure Report Card. Older urban areas, such as the City of Richmond, have particular challenges with the conveyance, collection and treatment of stormwater. Portions of the stormwater conveyance system in Richmond are more than a century old. Parts of the City are still served by combined sewer. The City has made some considerable strides in managing the combined sewer systems by constructing retention facilities for combined flows to be treated after rain event. Other challenges the City faces are older facilities that have been over loaded during large storm events. The speaker for this session will present the City of Richmond's progressive solutions to these and other challenges it is presented regarding stormwater

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NRCS ASSISTED FLOOD CONTROL INFRASTRUCTURE IN VA ISSUES, OPPORTUNITIES AND ACTION

Mathew Lyons¹, USDA, NRCS

Since 1954, the United States Department of Agriculture, Natural Resources Conservation Service (NRCS) has assisted Soil and Water Conservation Districts (SWCD) and other local units of government to construct 150 flood control dams under the PL-534, Flood Control Act and PL-566, Watershed Protection and Flood Prevention Act. Most of the dams were originally built to provide flood protection to agricultural lands and a rural infrastructure. The majority of the dams were designed for a 50-year life span and many are now at or near the end of their designed life. Major issues impacting NRCS assisted flood control structures include aging components, hazard classification increases due to changing downstream conditions, deteriorating concrete and metal components, sedimentation, loss of institutional knowledge of why the dams were originally built, lack of public awareness of benefits and funding to cover normal operation and maintenance as well as significant upgrades.

The Watershed Rehabilitation Amendments of 2000 (PL 106-472) authorizes NRCS to provide technical and financial assistance to watershed project sponsors in rehabilitating their aging dams that NRCS originally helped them to construct. The purpose of rehabilitation is to extend the service life of the dams and bring them into compliance with applicable safety and performance standards or to decommission the dams so they no longer pose a threat to life and property.

NRCS has received applications for Federal assistance to rehabilitate 18 dams in Virginia. To date, NRCS has provided technical and financial assistance to Sponsors in completing rehabilitation of three structures. There is currently one rehabilitation project under construction, one starting the bid process, one in final design and two in the planning phase.

According to the Virginia Department of Conservation and Recreation, Division of Dam Safety and Floodplain Management, there are several other NRCS assisted flood control structures that have received "Conditional" permits and are in need of rehabilitation. The Virginia Department of Conservation and Recreation (DCR) has begun to utilize \$20 million appropriated by the General Assembly to upgrade several SWCD owned structures to meet current state Dam Safety criteria.

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GRADING DAMS AND STORMWATER MANAGEMENT AND CONVEYANCE SYSTEMS FOR THE ASCE INFRASTRUCTURE REPORT CARD

Ingrid Stenbjorn¹, Town of Ashland

The American Society of Civil Engineers (ASCE) is developing the *2009 Virginia Infrastructure Report Card* including a category for Dams and Stormwater Infrastructure by enlisting a team of engineers, analyzing studies, reports and other sources to provide a grade for the dams and stormwater systems in Virginia. We are reviewing municipal stormwater systems in urban areas to evaluate age, condition, maintenance requirements and required repairs. For dams, we are reviewing DCR records, dam classifications, previous evaluations, and maintenance requirements. Grades are assigned on the basis of condition and capacity, and funding versus need, generally following a traditional grading scale (e.g., if 77% are in good condition, that would earn a grade of C).

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HOW WE CAN MAKE A DIFFERENCE

Glenn Bottomley¹, PE, PB Americas, Inc.

Making a difference involves much more than providing a technical solution to a problem. For the most part, the solutions are out there for most infrastructure problems – they just are not acted on due to a lack of priority and lack of available funding.

While engineers are respected for their professional evaluations and resourceful solutions – they need to strive to be more effective in influencing the public and elected officials to prioritize infrastructure needs and provide adequate funding in a timely manner. Political interests or special interest groups often times prevail with their influence. Engineers must develop relationships with their elected officials and be recognized as trusted infrastructure experts. ASCE provides the necessary advocacy tools and a wealth of information on issues that affect the profession to allow busy professionals to communicate with their elected officials.

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SESSION 4A

STORMWATER MANAGEMENT 4

Stormwater Retrofit: Lessons Learned

Seth Brown, RKK Engineers, Matt Meyers, Fairfax County

61st Street Stormwater Pump Station and Ocean Outfall

Michael Mundy, City of Virginia Beach Dept. of Public Works

The Integrated Stormwater System of an Urban Project

Tracy Ruff, Timmons Group

Partnering with Private Organizations for Better Public Education

Bill Johnston, City of Virginia Beach

STORMWATER RETROFIT: LESSONS LEARNED

Seth Brown¹, RKK Engineers, Matt Meyers, Fairfax County

The first generation of stormwater facilities focused primarily on water quantity control by attenuating peak discharges for the 10- and 100-year storms. Hundreds/thousands of such facilities were designed and constructed in the Northern Virginia area in the 1970's and 80's. Since this time, research and study has shown that the design philosophy associated with these stormwater BMPs was effective at reducing downstream flooding; however, the majority of pollutants associated with stormwater runoff bypass these facilities and remain untreated. Also, high-frequency events, such as the 1-year storm, are not greatly attenuated by these facilities, which allows for continued stream degradation below facilities. This damage to streams is exacerbated due to elongated shaved peaks for events such as the 2-year storm. Current water quality standards require treatment of the water quality volume and extended detention of the 1-year storm.

A significant portion of these facilities now require maintenance in order to operate effectively. Many municipalities are taking this opportunity to not only repair these facilities, but also retrofit them to bring them up as close to current water quality standards as possible. Factors that must be taken into account during a maintenance/retrofitting effort includes available site access, right-of-way availability, utility impacts, environmental impacts, and stakeholder buy-in. Planning for a large-scale maintenance and retrofit effort may not account for all the challenges that may arise during the implementation phase.

Fairfax County has embarked on a stormwater maintenance/retrofit effort, and some lessons have been learned along the way. One of the challenges is in the selection/prioritization of projects. A number of parameters must be accounted for in the screening process, such as available existing stormwater easements, site conditions that limit adequate water quality retrofit opportunities, and reasonable access options. Another challenge is prioritization of goals. Ideally, retrofitting efforts would address all current water quality requirements as well as repair facilities; however, the reality is that site constraints often limit the water quality treatment capacity of facilities. In these situations, a clear understanding of the project priority is required between repairing/maintenance efforts versus water quality/extended detention capacity. When additional capacity is available, prioritization of water quality versus stream protection capacity must be determined. Many options are available to enhance water quality treatment, such as micropools, sediment forebays, and no-mow policies. Knowing when these options should be applied is another challenge that must be met. Along with clear design goals, a set of clear design standards must be developed in order to more cost-effectively implement the retrofit activities. Most municipal design standards were developed without considering the possibility of retrofitting opportunities. The creation of retrofit-specific design standards will greatly increase implementation efficiency. Lastly, retrofitting/maintenance activities often impact several governmental departments, such as construction, maintenance and design divisions. Unity of goals and requirements across all affected municipal departments provides for more consistent and efficient design efforts and cost-effective implementation of construction of retrofits.

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61ST STREET STORMWATER PUMP STATION AND OCEAN OUTFALL

Michael Mundy¹, City of Virginia Beach Dept. of Public Works

This presentation will review the City efforts to design a stormwater pump station and ocean outfall including an improved stormwater collection system within a beach front neighborhood of Virginia Beach. The focus will include design considerations, impacts to the existing neighborhood and individual residents, obstacles in obtaining environmental permits, and coordinating the relocation of multiple utilities. The proposed pump station will provide a maximum discharge rate of 100 cfs and its receiving watershed is approximately 140 acres. The presentation will also briefly discuss how this pump station works in conjunction with the other three existing pump stations and ocean outfalls located along the Virginia Beach resort area (Rudee Inlet to 89th Street.)

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THE INTEGRATED STORMWATER SYSTEM OF AN URBAN PROJECT

Tracy Ruff¹, PE, Timmons Group

The presentation will explore the integral relationship between various stormwater aspects of urban redevelopment and sustainable design for a mixed use project in Richmond, Va. The phased project is the redevelopment of two warehouse/industrial buildings in the Manchester area. The proposed uses include residential and commercial with areas of common use and a potentially restaurant. The designed stormwater system that will be examined implements several low impact development practices including building disconnection, several rain gardens, infiltration trenches, and impervious surface materials. The project's stormwater runoff that will enter the public system will be reduced by more than 50% compared to the predevelopment conditions.

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PARTNERING WITH PRIVATE ORGANIZATIONS FOR BETTER PUBLIC EDUCATION

Bill Johnston¹, PE, City of Virginia Beach

A significant portion of improving stormwater Quality is pollution Prevention. Unfortunately, the primary polluter in a non-industrial city is its own citizens. Traditionally Public Education Workshops or Conferences are poorly attended and viewed with significant skepticism.

The City of Virginia Beach has achieved rapid and measurable water quality improvement in the Lynnhaven River through partnering with a local grass roots citizen environmental organization, Lynnhaven River Now (2007). In just 6 years, the river has gone from almost 100% condemnation to over 30% being released for shellfish harvesting by the Virginia Health Department.

Public education and improved public awareness has played a significant role in this success. Partnership between Lynnhaven River Now and the City of Virginia Beach has resulted in great dividends for both organizations.

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SESSION 4B

FLOODPLAIN MANAGEMENT 3

Beyond Map-MOD and 2-D Floodplains: Developing Flood Depth Maps

James Mawby, Dewberry

GeoTerrain: Supportint Sealess Floodplain Modeling and Mapping

Srikanth Koka/Milver Valenzuela, Dewberry

Unsteady State Flow Analysis for Dam Break and Incremental Damage Assessments

Kaveh Zomorodi, Dewberry

Reviewing Your Community's DFIRM Mapping, Bedford County's Experience
Through the Map Modernization Initiative

Kevin Leamy, Bedford County

BEYOND MAP-MOD AND 2-D FLOODPLAINS: DEVELOPING FLOOD DEPTH MAPS

James R. Mawby¹, Dewberry

FEMA's Mapping Modernization or "Map MOD" program has focused on moving legacy National Flood Insurance Rate Mapping (FIRM) products into a modern digital format. Now a new age is upon the NFIP program as the Map MOD initiative is coming to a close in many communities and is raising the question: what can be done with or more importantly, what should be done with the Map MOD data. Floodplain Managers throughout the Commonwealth can obtain greater benefit from the Map MOD data, otherwise known as DFIRM data, by using engineering cross sections to produce 3-D enabled digital products. 3-D enabled DFIRM byproducts offer the Floodplain Manager new opportunities for prudent community floodplain management. Notably, the use of such 3-D data will provide the pathway for developing inputs to damage estimation software such as FEMA's Hazard US (HAZUS).

The presentation will summarize our experience with the depth maps generated for Pittsylvania County, Virginia. Issues related to the migration of DFIRM data from 2-D to 3-D will be highlighted in the presentation. The presentation will provide a new perspective and insight into how to work with DFIRM data in order to fuel new flood mitigation initiatives.

¹ Lead Geographer

GEOTERRAIN: SUPPORTING SEAMLESS FLOODPLAIN MODELING AND MAPPING

Srikanth Koka¹, EIT/Milver Valenzuela², CFM, GISP, Dewberry

Advances in remote sensing technology have made the acquisition of high-quality elevation data, such as LiDAR, more commonplace in flood hazard risk assessment and mapping projects. While the amount of additional data has helped increase the overall accuracy and knowledge for a study area, it has become increasingly difficult to manage and use the data with existing software. The Terrain data type was introduced in ArcGIS 9.2 to more efficiently store large topographic data, and provide on-screen visualization in dynamic TIN format.

Dewberry's GeoTerrain initiative evaluated the benefits and challenges to implementing this datatype for floodplain modeling and mapping as compared to traditional DEMs or TINs. Metrics were collected and best-practices derived while preparing Terrain for FEMA DFIRM studies with datasets of varying sizes. GeoTerrain increased modeling and mapping efficiency and quality by supporting the interaction between a seamless topographic model and processes such as field survey incorporation, hydrologic and hydraulic data handling and modeling, and terrain based floodplain delineation. A case study is presented.

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UNSTEADY STATE FLOW ANALYSIS FOR DAM BREAK AND INCREMENTAL DAMAGE ASSESSMENTS

Kaveh Zomorodi¹, PhD, PE, CFM, Dewberry

With the need to better define hazard conditions among the hundreds of existing or newly regulated state dams, detailed analyses regarding the potential failure of dams and the corresponding incremental damage assessments has become much more critical. Utilizing updated engineering and software techniques, this presentation focuses on the unsteady flow approach used to help develop a more reliable estimate of potential damages due to dam failures, and helps to regulate the requirements and conditions that may affect dam safety regulatory determinations and requirements. Dewberry will present data and case studies that summarize the unsteady and steady analysis approach and how these approaches can be applied. The presentation will also discuss how these updated analysis techniques can be used to support incremental damage assessments.

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REVIEWING YOUR COMMUNITY'S DFIRM MAPPING BEDFORD COUNTY'S EXPERIENCE THROUGH THE MAP MODERNIZATION INITIATIVE

Kevin Leamy¹, Bedford County Dept. of Community Planning

Created and managed by FEMA in the U.S. Department of Homeland Security, the map modernization initiative is designed to create accurate, reliable, and easier to use flood maps. Bedford County hosted the Map Modernization Final Meeting with FEMA (Federal Emergency Management Agency) on 12 March 2008. An overview of the process was discussed as well as the release of the Preliminary Map Set. FEMA placed the two required notices in the Bedford Bulletin on 16 & 23 April 2008. The 90-day appeal period commenced on 23 April 2008 with the second newspaper notice and was to conclude on 22 July 2008. Bedford County also sent letters to affected property owners informing them that the maps were at the Department of Community Development in the Bedford County Administration Building for view and comment. On 23 June 2008, Bedford County received a letter from FEMA indicating that they had been sent revised Digital Flood Insurance Rate Map (DFIRM) panels. The maps were for the redelineation of the 100-year and the 500-year floodplain for Smith Mountain Lake based on the newly available topographic data (March 2008) provided by the Virginia Geographic Information Network (VGIN).

Based on citizen comment and information, as well as on information provided through the County's consulting engineering firm (Anderson & Associates), on 17 July 2008 the County sent an appeal and protest letter signed by the County Administrator to FEMA Region III. One of the major identified areas of concern, the Smith Mountain Lake area, had already been addressed by the 23 June 2008 revision. By using the VGIN topographic information, more accurate delineation of the Lake floodplain was obtained.

The Appeal portion consisted of four of the Lake communities in the Forest area that requested the following:

- Lake Vista: utilize a report provided by Wiley & Wilson to Bedford County for the modeling of the Lake which is believed to be more accurate than the original hydraulic analysis.
- Ivy Lake, Swan Lake and Spring Lake: utilize future as-built elevations for the dams and remodel the Lakes.

The Protest portion consisted of the following:

- Through Bedford County's contract with Anderson & Associates, Inc. (A&A) consulting engineers to review the preliminary DFIRM panels and associated Flood Insurance Study (FIS) report, the following major comments related to the floodplain boundaries were identified:
- Floodplain elevations not equal on left/right sides of stream. Floodplain crosses contours.
- Floodplain does not match water surface elevation. This is particularly evident around the Lake communities.

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- Floodplain does not appear to follow stream at lowest elevation.
- No apparent water surface elevation.
- Stream centerline is outside of floodplain.
- Spillway elevation/floodplain cuts across contours.
- Some ponds show a delineated floodplain and others do not. Why?

Additional information was acquired after the Appeal and Protest letter was sent to FEMA. Bedford County received as-built drawings for the Spring Lake Dam and obtained a copy of a detailed study done by the Corps of Engineers for a stretch of Lick Run on the south side of Route 460. This information was sent to AMEC (FEMA's engineer) and FEMA Region III.

A representative from FEMA Region III and AMEC met with Bedford County on 29 September 2008. The results of the meeting are found below:

- AMEC will revise the HEC-RAS modeling to reflect the as-built data submitted by the County.
- VGIN data will be used to delineate the flood hazards at the static water surfaces (lakes).
- VGIN data cannot be used for detailed riverine flood studies since it is not National Map Accuracy Standard Compliant.
- Bedford County will provide AMEC with critical areas as well as information pertaining to the Levkoff property.
- A floodplain error on Buffalo Creek will be corrected at the Campbell / Bedford County line.
- The information gathered by Bedford County will be used in Phase II of the Map Modernization effort, to identify areas where additional detailed studies may be necessary to fully address map inaccuracies.

The following information was sent to AMEC and FEMA Region III by early November 2008:

- Swan Lake Elevations
- Ivy Lake Elevations
- Buffalo Creek conflict information
- Critical Area information
- Levkoff Property information

Revised Preliminary DFIRM should be delivered to Bedford County the last week of January 2009.

SESSION 4C

DAM SAFETY 4

Corrugated Metal Pipes: Inspection Repair, Abandonment, and Replacement

Lisa Cabill, Watershed Services, Inc.

The Team Approach to Dam Repair Projects: With and Without

Scott Cabill, Watershed Services, Inc.

Hogan Dam Inspection: Solving a Historic Riddle

Cameron Smith, Watershed Services, Inc.

Corrugated Metal Pipe Failure at Johnsons Dam

Austen Bander, Watershed Services, Inc.

CORRUGATED METAL PIPES: INSPECTION, REPAIR, ABANDONMENT, AND REPLACEMENT

Lisa A. Cahill¹, Watershed Services, Inc.

For dams that have a primary spillway made of corrugated metal pipe, time is limited and their options are numbered. If the corrugated metal pipe (CMP) is allowed to deteriorate to the point that it experiences some type of failure, options for repair are reduced even further.

Inspection: This presentation will explore how and when to inspect CMP and what to look for to attempt to determine the proper timeframe for replacement. Brief video clips of CMP inspections will be shown and the problems discussed. Financial preparations for obsolescence of the CMP will also be discussed.

Slip-lining with a smaller diameter, smooth walled pipe is the only repair that addresses the entire problem of an aging CMP, and it does not require draining the lake. We will discuss when it is feasible, what materials and techniques can be used, and go through the process step-by-step. Minor repairs to the CMP primary spillway pipe can make fiscal sense if the pipe is basically in good condition, but has developed a localized problem, or if a problem dating from installation, such as a pinched gasket or bad joint, has just been discovered by inspection.

If the pipe has failed, become too deteriorated, or is too undersized to slip-line, it has to be properly abandoned when past its useful life, or it will continue to pose a risk of failure and unexpected loss of pool for the dam. The materials and methods used in proper abandonment, and the reasons for each, will be discussed.

Sometimes, the best option for a failed corrugated metal pipe is to replace it. Unfortunately, it does require that the lake be drained in most cases. But it also provides the opportunity to increase the diameter to pass greater storms, and to use the most up-to-date products and practices during the construction project.

We will also discuss the ultimate outcome of letting the corrugated metal pipe deteriorate beyond the point of failure, how that failure might occur, and what the ramifications could be.

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THE TEAM APPROACH TO DAM REPAIR PROJECTS: WITH AND WITHOUT

Scott Cahill¹, Watershed Services, Inc.

The engineer, dam owner, and contractor can approach a dam repair project as a cohesive team, all working together toward the goal of a safe dam. Extended members of that team can include Dam Safety, consultants, lakefront property owners, and others who share the goal of making the dam safe. With a team approach, the talents of all parties are leveraged. Communication is effective and plentiful. When unexpected obstacles arise during the construction project, addressing them as a team with the goal in mind facilitates reaching the best possible solution for the project. With this approach, the project can proceed quite smoothly, the work can get done efficiently, and the process can even be relatively pleasant.

Alternately, the engineer, dam owner, and contractor can approach the project as three disconnected entities with separate interests. Each can fiercely represent his own interests without regard for the needs or interests of others. Communication can become a challenge. Reaching solutions to unexpected problems can be difficult, even contentious. Although the project goal is still to produce a safe dam, and that goal may ultimately be reached, the project's progress will be fraught with difficulty.

This presentation will compare two projects that were approached very differently. One is a valve replacement and leak-stopping project at a state natural area that used a team approach. The team included the engineer, contractor, Director of State Parks, Director of Dam Safety, the park manager, and a citizens group formed to protect the lake and park. Working together as a team, a very difficult project was completed successfully, and all parties were pleased with the outcome. The second project was also a state dam with a leak located in a wildlife refuge, but that is where the similarities ended. Involved parties included the engineer, the dam owner's representative, and the contractor. No efforts were made to work as a team toward the goal of making the dam safe. Problem solving was difficult. When problems arose, one party chose a solution without seeking input from anyone else, and then told the other parties how they were to proceed. Communication was poor. Benefits that might be gained from the knowledge and talent of the other parties were instead lost. Project progress was hampered, and efficiency sacrificed. Even the ultimate goal of achieving a safe dam was in jeopardy.

If a spirit of teamwork is fostered and encouraged, not only is the project more pleasant and more efficient, but a better outcome is achieved for the project and funds are used more effectively.

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HOGAN DAM INSPECTION: SOLVING A HISTORIC RIDDLE

Cameron Smith¹, Watershed Services, Inc.

We were hired to do a complete inspection of this historic structure, built in 1909, however, very few facts were readily available about the dam. Our initial survey of the dam showed a number of pipes and valves, with little information about where each one went or what it did. Several pipes of different sizes left the dam in different directions. We had some oral history, both fact and fiction, about the dam, but little in the way of true documentation. Using various inspection techniques, we examined every aspect of the dam and solved a number of mysteries about its configuration. Through research at area libraries, historic societies, etc., we pieced together a great deal of its history. The final result was a comprehensive report incorporating our findings from the inspection and reconciling the dam that exists in the present day with the structure that was built 100 years ago, including several major modifications along the way. This presentation will explore our process of discovering and reconciling the features of the dam with the historical documents and oral history surrounding the structure.

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CORRUGATED METAL PIPE FAILURE AT JOHNSONS DAM

Austen Bander¹, Watershed Services, Inc.

Near Warrenton there was a beautiful 17-acre lake surrounded by rolling hills and a lovely neighborhood. The lake, created by Johnsons Dam, was a great place to fish and has been an important fixture of the community for a long time. The dam, an earthen impoundment 28 feet tall and 500 feet long, is the quintessential medium size earthen dam found all over the state of Virginia. It has a corrugated metal riser and outfall pipe, and a grass lined emergency spillway on one abutment. One morning, Watershed Services received a call from the residents that their lake had drastically lowered overnight and water was moving around the corrugated metal riser pipe, not through it. Later that morning, a crew member from Watershed Services was on site to evaluate the situation. After identifying the situation as a dam failure in progress, Watershed Services mobilized all crews to the site to assist the community any way possible. The presentation describes the events that took place that day and into the night to handle the dam failure, and it also goes into some detail on the forensic dam inspection that followed. At the end of the day, the residents simply wanted to return the 17-acre lake back to the condition it was when they went to sleep just the night before, but there were complications.

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SESSION 4D

WATERSHED MANAGEMENT

Value and Benefits of a Centralized Watershed Planning System in Fairfax County, VA
Fred Rose, Kate Bennett, LeAnne Astin, Matthew Meyers, Fairfax County Dept. of Public Works and Environmental Services, John Zastron, Clint Boschen, Tetra Tech,

Hydrologic and Water Quality Modeling for Watershed Management Planning in Fairfax County, VA
Kate Bennett, Fred Rose, Fairfax County Dept. of Public Works and Environmental Services, Clint Boschen, Tetra Tech, Inc.

Development of a Subwatershed Ranking Approach for Watershed Management in Fairfax County, VA
LeAnne Astin, Fred Rose, Kate Bennett, Fairfax County Dept. of Public Works and Environmental Services, Clint Boschen, Tetra Tech,

Difficult Run Watershed Management Plan
William Frost, KCI Technologies, Inc.

VALUE AND BENEFITS OF A CENTRALIZED WATERSHED PLANNING SYSTEM IN FAIRFAX COUNTY, VIRGINIA

Fred Rose¹, Kate Bennett², LeAnne Astin³, Matthew Meyers⁴, Fairfax County Dept. of Public Works and Environmental Services, John Zastrow⁵; Clint Boschen⁶

Watershed planning typically involves the development of watershed management plans for each managed watershed. Often these plans are developed sequentially and sometimes by different parties. However, static plans become outdated and new ones are costly and time-consuming to develop. Furthermore, plans developed by different parties at different times are often inconsistent and difficult to compare. To address these issues, Fairfax County commissioned the development of a centralized Watershed Management System (WMS) to manage relevant watershed planning data and to rapidly synthesize information that would previously only be brought together through manual processes in the watershed plans.

Through the WMS, Fairfax County stormwater planners expect to improve their responsiveness, reduce costs for producing consistent on-demand information, and increase access to information. WMS is an online system with an intuitive map-based interface that can quickly provide users a targeted dashboard view of the status of County subwatersheds, without needing specialized data processing skills. Data that support WMS are managed in the County's existing enterprise data infrastructure and will be actively updated by watershed planning staff. Finally, analytical tools built into the system will quickly prioritize planned watershed projects based on configurable business intelligence routines to reduce effort in short-listing projects for implementation. These aspects will allow WMS to reduce the cost of conducting watershed management activities and improve the efficiency of making decisions and accessing information. This presentation will highlight the features and benefits of such a system, and will offer many of the lessons learned during its development and implementation.

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HYDROLOGIC AND WATER QUALITY MODELING FOR WATERSHED MANAGEMENT PLANNING IN FAIRFAX COUNTY, VIRGINIA

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Appropriate management of urban stormwater runoff is becoming increasingly critical for sustainable growth. Fairfax County has adopted a proactive approach in the mission of environmentally friendly stormwater management. To support the County's watershed protections efforts and help meet Virginia's commitment under the Chesapeake Bay 2000 Agreement, watershed management plans are currently being developed throughout the County. This paper focuses on the application of hydrologic and water quality models to facilitate the development of comprehensive and effective watershed management plans.

Hydrologic simulations of watershed runoff were complete using the USEPA-SWMM5 model. SWMM model setup included separate representations for onsite (i.e. dry pond, bio-retention area, sand filter, etc.) and regional stormwater facilities. TIN data were used to derive channel cross-section information, which was used for channel routing in SWMM. The developed SWMM model allows for checking of flow conditions at any location within the watershed. The model also has a flexible setup for both design storm and long-term simulations. With a convenient pre-processing tool, the user can easily evaluate possible development scenarios, and evaluate potential flooding impacts.

Water quality simulation was accomplished using a customized version of the EPA Spreadsheet Tool for Estimating Pollutant Load (STEPL) model. Existing and possible BMPs in a watershed can be conveniently implemented through a drop-down list. For each BMP implementation scenario, the customized STEPL model can quickly calculate the overall water quality benefits throughout the watershed.

Overall, the SWMM and STEPL models help characterize runoff conditions. This provides the basis for developing stormwater management plans. These watershed models will be used to evaluate hydrologic and water quality conditions for both existing and ultimate development scenarios, to assess the benefits of proposed stormwater management facilities, and to identify candidate sites for implementing structural and non-structural projects. The hydrologic simulation results from SWMM will also be used for floodplain analysis and channel stability assessments using HEC-RAS.

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DEVELOPMENT OF A SUBWATERSHED RANKING APPROACH FOR WATERSHED MANAGEMENT IN FAIRFAX COUNTY, VIRGINIA

LeAnne Astin¹, Fred Rose², Kate Bennett³, Fairfax County Dept. of Public Works and Environmental Services, Clint Boschen⁴, Tetra Tech, Inc.

Various quantitative and qualitative approaches have been used by local governments to assess watershed conditions and identify priority areas that require stormwater controls. These approaches typically rely on a few key data sources, such as the location of existing infrastructure, impervious estimates, and historical information on known problem areas. For watershed planning purposes, a comprehensive approach that integrates various indicators of watershed condition and pollutant sources is often required to effectively identify and target problem areas and their individual needs.

The Fairfax County Department of Public Works and Environmental Services (DPWES), Stormwater Planning Division, is currently developing watershed management plans countywide. Various approaches have been used in the past to identify watershed goals and objectives, conduct watershed assessments, identify problem areas, and rank potential projects within a watershed. The County recently developed a subwatershed ranking approach to help establish a consistent framework for evaluating watershed conditions and stormwater management needs. This approach ensures that watershed plans are developed with appropriate attention to watershed-specific conditions.

A diverse suite of indicators was used to provide information on different components of the watersheds (e.g. land use patterns, habitat quality, water quality, existing stormwater infrastructure). Indicators included monitoring parameters and predictive measures (i.e. watershed model outputs, such as pollutant loads) for the evaluation of existing and future development scenarios. These indicators were linked to the Countywide goals and objectives and a subwatershed scoring methodology was developed. Subwatershed scores are currently being evaluated to classify and prioritize areas based on their individual requirements. This approach will be further expanded to provide County management with the ability to easily and efficiently prioritize stormwater projects and track implementation progress in the future.

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DIFFICULT RUN WATERSHED MANAGEMENT PLAN

William Frost¹, PE, KCI Technologies, Inc.

The Stormwater Planning Division of the Fairfax County Department of Public Works and Environmental Services (DPWES) is in the process of developing watershed management plans for the 30 watersheds within the county. Watershed plan development is anticipated to be completed over a 5-year period. The watershed plans will provide an assessment of management needs and will prioritize solutions within each watershed. The overall goal for the development of watershed management plans is to provide a consistent basis for the evaluation and implementation of solutions for protecting and restoring the receiving water systems and other natural resources of the County

KCI was selected for a \$1.8 million project to prepare a master plan for the Difficult Run watershed. At 58 square miles Difficult Run is the largest watershed in Fairfax County. The scope of this project encompassed compilation of existing studies, reports, monitoring data, and stream assessments to develop a summary of the current condition; modeling of existing and future conditions using SWMM and HEC-RAS; quantification of flooding, water quality, and habitat problems; analysis of alternative management strategies; development of concept plans; and public involvement.

Public Involvement. The County has emphasized the need for stakeholder and public involvement during the two-year study of Difficult Run, to ensure that the recommendations are acceptable and can be implemented once the study is complete. Monthly stakeholder advisory group meetings were held, and four major public watershed forums gave watershed residents a chance to review the progress of the study and the draft master plan.

Data Compilation. KCI reviewed and summarized earlier studies of the watershed done in 1978 and 1988 in order to assess conditions and problem areas noted as the watershed was being developed. Monitoring and stream assessment data were used to pinpoint current conditions and problems.

Watershed Modeling. SWMM models were developed as part of the project. SWMM was used to develop hydrology for streamflow modeling, and for estimating pollutant loading, and reductions from SWM facilities. The results of the modeling were used to estimate pollutant reductions from the proposed management alternatives. HEC-RAS was used to evaluate the flooding potential at road crossings.

Watershed Characterization. The eighteen subwatersheds and 201 catchments in the watershed were ranked for restoration and preservation using indicators based on GIS analysis, modeling, and stream assessment data. Candidate sites were selected for stormwater management retrofits, stream restoration, flooding mitigation, and watershed protection.

Watershed Restoration Strategies. Field surveys were conducted to identify the most suitable retrofits projects for each of the candidate sites. Potential facilities included new ponds and wetlands, pond retrofits, culvert retrofits, outfall protection, and LID retrofits. Riparian projects included stream and buffer restoration projects. For each project, a summary sheet was prepared with a site map, photo, descriptions of the project, location, benefits, and constraints. Cost estimates were prepared and projects were prioritized with schedule for implementation.

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SESSION 5A

STORMWATER MANAGEMENT 5

The Nuts and Bolts of Manufactured Treatment Systems:
An In-Depth Look at Critical Design Variables
Jennifer Steffens, CONTECH Stormwater Solutions, Inc.

Advanced Bioretention Media for Enhanced Bacteria Removal from Stormwater Runoff. A
Discussion of the Benefits, Mechanisms and Efficiencies for Bacteria Removal
Mindy Ruby, Filterra Bioretention Systems

Phosphorous – Advanced Removal Mechanisms and Amended Design for Stormwater BMPs
Scott Perry, Imbrium Systems Corp

Virginia Beach Trial Use of a Bacterra™ BMP
Steve McLaughlin, City of Virginia Beach Dept. of Public Works

THE NUTS AND BOLTS OF MANUFACTURED TREATMENT SYSTEMS: AN IN-DEPTH LOOK AT CRITICAL DESIGN VARIABLES

Jennifer Steffens¹, CONTECH Stormwater Solutions, Inc

The use of manufactured stormwater treatment systems to mitigate the adverse impacts of urban runoff has become commonplace. Not surprisingly, as the demand for manufactured treatment systems has grown the number of available options has followed suit. The typical stormwater professional could make deciphering the various performance claims, sizing methodologies and other supposed benefits marketed with each device a fulltime job, but most have little time for such endeavors. The majority of state and local agencies have not established sizing criteria for manufactured treatment systems, so agencies often rely on the manufacturers' sizing recommendations. However, manufacturers' sizing methods tend to be unique to each device making it virtually impossible to directly compare competing technologies to one another. Unfortunately, limited knowledge of critical sizing assumptions on the part of engineers and reviewers as well as fierce competition among vendors is resulting in the installation of undersized and poorly sited systems. Establishing uniform sizing criteria creates a level playing field from which to compare manufactured systems to one another and to other types of treatment systems, and ensures that devices are sized to meet applicable standards.

This paper explores the fundamental unit processes that govern the performance of manufactured devices and the sizing variables often manipulated by vendors to make their units seem superior or more financially attractive to the end user. Examples of common sizing methodologies and associated assumptions are presented in a manner that allows the reader to make informed decisions regarding device selection and sizing. Standardized sizing methodologies that are already in use by a number of state and local agencies are also discussed.

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PHOSPHOROUS – ADVANCED REMOVAL MECHANISMS AND AMENDED DESIGN FOR STORMWATER BMPS

Scott Perry¹, CPSWQ, Imbrium Systems Corporation

It is well documented that continued land development through urbanization is deteriorating surface water quality. One significant concern with our limited global fresh water resources is the on-set of algae blooms and reduced dissolved oxygen due to continued, uncontrolled phosphorous loading. This is leading to negative ecologic, economical and possibly even human health impacts. As a result we are beginning to acknowledge the impairment of fresh water bodies, and have begun trending toward an increase in implementation of TMDLs. However, applying TMDLs specifically to stormwater runoff (i.e. Total Phosphorous effluents of < 0.1 mg/L) may not be achievable without understanding limitations and available mechanisms to effectively address phosphorous capture in stormwater runoff.

To understand how to achieve continued, high levels of phosphorous removal without leaching, this paper reviews the fate and transport of Total Phosphorous, including both particulate-bound and dissolved phosphorous in urban stormwater runoff. Common mechanism, capability and longevity for phosphorus removal employed in both conventional BMPs and newer LID applications are discussed.

New advancements in technology have recently become available, providing the ability to not only remove particulate-bound phosphorous, but by capturing high levels of dissolved phosphorus for extended periods of time. Understanding and comparing functional mechanisms, overall ability to remove Total Phosphorous and how to ensure high removals remain long-lasting is critical to protecting our water bodies. Amended BMP design concepts with the inclusion of these technologies within both conventional BMPs and LID applications may provide solutions and tools to achieve existing and future TMDLs. These concepts are discussed as a potential means to raise the performance bar for capturing phosphorus and implementing practices that protect our fresh water resources.

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VIRGINIA BEACH TRIAL USE OF A BACTERRA™ BMP

Steve McLaughlin¹, PE, City of Virginia Beach Public Works

This presentation will discuss one of the most current urban BMP's installed in the City of Virginia Beach. In November 2008, a patented stormwater treatment device, trade named Bacterra™, was installed in a City park as a trial use of the device. The City is testing stormwater runoff, when it occurs, for bacteria, nutrients, and sediment removal. A design and construction summary will be given as well as the results of any analyses to date. This device is a part of a Water Quality Improvement Grant with 50% funding from the Virginia Department of Conservation and Recreation; the views expressed in this presentation are not necessarily the views of the Virginia Department of Conservation and Recreation.

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SESSION 5B

FLOODPLAIN MANAGEMENT 4

GIS Hydrology for Northern Virginia

Joni Calmbacher, Michael Baker Jr., Inc., Dr. Michael Casey, George Mason University

Cameron Run: Unintended Consequences of In-Stream Flood Mitigation in Urban Watersheds

Hunt Loftin, Tom Heil, RKK Engineers, Elsie Parrilla-Castellar, Michael Baker Jr., Inc.

Cost Effective Stormwater Model Calibration

Sean Bradberry, URS, Sam Sawan, City of Chesapeake, John Paine, URS

Conducting a Stormwater Study in a Watershed with Aging and Deteriorating Infrastructure

Stephanie Hood, URS

GIS HYDROLOGY FOR NORTHERN VIRGINIA

*Joni Calmbacher¹, PE, CFM, Michael Baker Jr., Inc., Dr. Michael Casey²,
George Mason University*

Ms. Calmbacher will discuss creating a GIS based program to calculate peak discharges in the Northern Virginia region. The purpose of this program is to generate input data for the Virginia regression equations and then compute the resultant peak discharge values. The program was developed using the same general premise as GISHydro2000 (an existing GIS based hydrologic model created by the University of Maryland and Maryland State Highway Administration). Supporting data was built into the program so that the user does not have to locate and add this information. The data includes the Virginia hydrologic regions, the Virginia regression equations, county boundaries, and digital elevation models for the applicable areas. Programming was done inside the ArcMap environment, which utilizes the Visual Basic language.

The program requires the user to choose an outlet point of the watershed that they want to analyze. Using this point, the program will generate the watershed for the outlet point and other applicable characteristics. Depending on the location of the watershed, different variables are required to use the regression equations. These variables include drainage area, watershed slope, mean basin elevation, and length of the main channel.

The presentation will discuss the process of program creation and the advantages of using GIS to aid in the application. An overview of the code and a short example will be given. A brief description of the limitations of the program will also be presented.

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CAMERON RUN: UNINTENDED CONSEQUENCES OF IN-STREAM FLOOD MITIGATION IN URBAN WATERSHEDS

*Hunt Loftin¹, Michael Baker, Jr., Inc, Tom Heil², RKK Engineers,
Elsie Parrilla-Castellar³, Michael Baker, Jr., Inc.*

Much of Cameron Run is located in Fairfax County, Virginia and the southern boundary of the City of Alexandria along the Capital Beltway (I-95). This places Cameron Run in an ultra urban environment that causes it to be traversed by major infrastructure and bounded by residential and commercial development. The infrastructure includes wastewater sewer pipes, water pipes, stormwater and drainage pipes, and major highways such as the Capital Beltway, Telegraph Road and Route 1. Before the 1930s, Cameron Run had few vertical or horizontal constraints, which allowed it to adjust naturally to extreme precipitation events and fluvial geomorphic stresses. To reduce flood risks to the Capital Beltway and surrounding development, Cameron Run was straightened between Route 1 and the Telegraph Road Bridge in 1961 and between the Capital Beltway and Eisenhower Avenue Bridge in 1978. The straightened channels were designed to a width of 200 feet to accommodate at least the 100-year discharge. Straightening the gentler slope of a meandering Cameron Run to create the flood channels resulted in steeper channels with increased erosive forces on the channel sides and bed. To mitigate the increased erosive forces, seven weirs were installed to step the steep channel down between the upper and lower ends of the trapezoidal flood channel.

The City of Alexandria and Fairfax County are near to their ultimate development plans and this development has resulted in excessive stormwater runoff that has increased the size and frequency of peak discharges in the Cameron Run tributaries, such as Holmes Run and Backlick Run. These increases have resulted in increased erosion that generates large sediment loads that are carried downstream during storm events. As the flow passes through the widened flood channels, discharge velocities decrease and sediments drop out. Sediments drop out at other locations along the channel also, and their deposition in the flood channels and elsewhere reduces the capacity of Cameron Run to contain flood flows. For this reason, the entire Cameron Run channel, including the trapezoidal flood channel, are frequently dredged to address health and safety concerns of the community by reducing the risk from floods and other hazards.

This paper will describe how the application of channel straightening and widening have created unanticipated consequences to human and environmental communities and the plans to minimize future impacts and consequences. This paper will also illustrate how similar streams in nearby areas with similar development patterns, but less urban encroachment on the floodway, are managing the consequences. While the human modifications to Cameron Run are typical of the time, and did not have the hind sight of today's stormwater and floodplain management lessons learned over the past half century, some communities were more successful in coexisting with river channel impacts, as much through luck as through foresight. Still, the observations provided by several examples, such as Four Mile Run, which flows in the north of the City of Alexandria, and the streams in Reston, Virginia, which preserved broad riparian buffers, provide insight on how urban streams can fit in the fabric of urban environments and retain some or all of their natural processes without undue threat to human health and safety.

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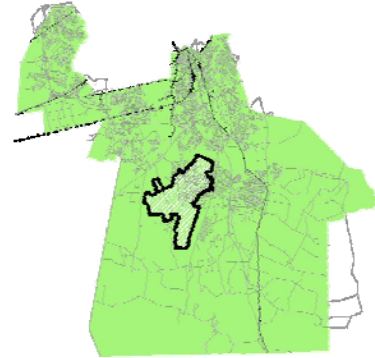
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COST-EFFECTIVE STORMWATER MODEL CALIBRATION

*Sean Bradberry¹, John Paine², URS Corporation, Sam Sawan³,
City of Chesapeake Department of Public Works*

The City of Chesapeake, Virginia has prepared master drainage plans for over 100 square miles of its developed land area, using detailed EPA Storm Water Management Model (SWMM) studies that have been completed over the past five years using a design storm approach. SWMM modeling involves the determination or estimation of thousands of parameters for each of these models, including soil moisture and subcatchment characteristics that are difficult to verify. Engineering judgment is often the only 'validation' these types of models receive, as calibration data (detailed rainfall and corresponding water surface elevation records) either does not exist or cannot be economically and expediently obtained. There are many new electronic monitoring options for rainfall and water surface elevation data, but implementing and maintaining much of what is commercially available can be very expensive. This presentation describes efforts to simply and economically obtain rainfall and high water mark data, and to use this data to calibrate a large SWMM model in the City of Chesapeake. The outcome will be used to establish modeling parameters for many new studies in southeastern Virginia.



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CONDUCTING A STORMWATER STUDY IN A WATERSHED WITH AGING & DETERIORATING INFRASTRUCTURE

Stephanie Hood¹, PE, URS Corporation

South Norfolk Watershed Phase I covers approximately 2,080 acres in Chesapeake Virginia, is tidal influenced and has low-lying elevations. Recently, the City has, in an effort to coordinate several drainage and stormwater management projects, utilized the Storm Water Management Model (SWMM) to conduct a study of this watershed. In addition to the SWMM study, the City wanted the drainage system to be cleaned and inspected with closed-circuit television (CCTV) equipment following Pipeline Assessment Certification Program (PACP) protocol. The inspected pipes will be evaluated for maintenance and condition issues, and the connectivity and structure data will be used to complete the SWMM modeling.

Phase I of the South Norfolk Watershed is substantially developed. Due to the age of the South Norfolk drainage system, accurate data on the existing drainage infrastructure is largely unavailable; therefore the collection of field information to develop an inventory of the drainage infrastructure is necessary. Several methods of data collection were used including land surveying and field inspections to gather structure elevations and pipe information in the field, as well as the utilization of existing plan sets and City GIS to record structure and pipe data. Prior to the start of the inventory process it was believed that South Norfolk contained approximately 31,000 linear feet of pipe. Once the inventory was completed, over 100,000 linear feet of pipe were found to exist within the South Norfolk Watershed Phase I boundaries. During the inventory process, much of the infrastructure was found to be heavily filled with sediment and debris. Due to the budget constraints and the much larger-than-expected increase in actual stormwater infrastructure, the City re-evaluated the system and prioritized only the major outfalls to be cleaned and CCTV'd.

This case study focuses on the challenging tasks that were undertaken in order to complete a database of stormwater pipe and structures currently existing in the South Norfolk Watershed Phase I. This database serves as a foundation for subsequent SWMM modeling that will ultimately be used to identify cost-effective Capital Improvement Projects to relieve street flooding within the South Norfolk Watershed Phase I.

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SESSION 5C

HYDROLOGY AND DAM SAFETY

Hydrologic Model Calibration Using Field Measured Bankfull Discharge
Troy Biggs, AMEC Earth & Environmental, Randy Sewell, Vanasse Hangen Brustlin, Inc.

Characterizing the Magnitude and Frequency of Peak Flows and Magnitude, Frequency, and
Duration of Low Flows in Virginia Streams: An Overview of Ongoing Work
Samuel Austin, Ute Wiegand, USGS

Lake Barcroft Probable Maximum Flood Inundation Mapping
Aaron George, Brett Martin, GKY & Associates, Inc.

Comparison of PMP Storm Distributions for Spillway Design Flood Development in Virginia
Geoffrey Cowan, Kaveh Zomorodi, Dewberry

HYDROLOGIC MODEL CALIBRATION USING FIELD MEASURED BANKFULL DISCHARGE:

*Troy Biggs¹, PE, PH, CFM AMEC Earth & Environmental,
Randy Sewell², Vanasse Hangen Brustlin, Inc.*

When tasked to perform a hydrologic study, typically designers and modelers are working in unengaged watersheds and have little or no information to calibrate their models. However, performing a geomorphic field assessment provides the information necessary to obtain the bankfull discharge which is the surrogate for the range of flows which maintain and shape the stream channel. The bankfull discharge typically occurs between the 1- and 2-yr return intervals. Hydrologic simulation can be run for the 1.5-yr return interval and input parameters for the SCS unit hydrograph, Clark unit hydrograph, and Snyder unit hydrograph can be calibrated to produce results which represent field identified bankfull discharge. This method provides a resource for engineers to check computed discharges against regression equations and effective discharges from previous FIS studies. Additionally, information collected in the field such as channel bed material can be used to calibrate hydraulic models. A case study will be provided which involves a stream that drains 17.25 mi² in semi-rural watershed (9% impervious) in the Virginia Piedmont Region.

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CHARACTERIZING THE MAGNITUDE AND FREQUENCY OF PEAK FLOWS AND MAGNITUDE, FREQUENCY, AND DURATION OF LOW FLOWS IN VIRGINIA STREAMS: AN OVERVIEW OF ONGOING WORK.

Samuel H. Austin¹, Ute Wiegand², USGS

Characterizing the magnitude and frequency of peak flows and the magnitude, frequency, and duration of low flows is essential to water supply planning and sound management of our water resources and associated riparian and watershed ecosystems. Accurate prediction of peak flows is needed to properly locate highways, railroads, industries, farms, and residences, safely construct highway bridges and culverts, and design reservoirs, levees, and floodwalls. Characterization and prediction of the magnitude, frequency, and duration of low flows is essential to assessment of ground-water recharge and the reliability of a stream to provide sufficient flow for municipal and industrial water supplies, irrigation, and maintenance of flow regimes needed to sustain aquatic habitat and ecology.

The U.S. Geological Survey (USGS), in cooperation with the Virginia Department of Environmental Quality (DEQ) and the Virginia Department of Transportation (VDOT), is conducting two studies of Virginia's streams and watersheds that characterize (1) the magnitude and frequency of peak flows and (2) the magnitude, frequency, and duration of low flows. The studies will provide detailed analysis of regional and basin characteristics associated with watersheds across Virginia. Methods are being developed for estimating peak flow and low flow probabilities at gaging stations. Equations are being developed for predicting peak flows and low flows based on regional and basin characteristics.

An overview of this ongoing work is provided. Available summaries of annual maximum stages and discharges will be highlighted. Methods for estimating the magnitude and frequency of peak flows and the magnitude, frequency, and duration of low flows will be discussed. Future products, significant benefits, and potential future needs of each study will be identified.

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LAKE BARCROFT PROBABLE MAXIMUM FLOOD INUNDATION MAPPING

Aaron George¹, Brett Martin², PE, GKY & Associates, Inc.

GKY and Associates, Inc. (GKY) assisted the Lake Barcroft Watershed and Improvement District (LBWID) in performing a dam break probable maximum flood (PMF) inundation study. The 135 acre lake's dam regulates flow to a series of runs which confluence with the Potomac River approximately seven miles downstream. Newly revised (2008) regulations by the Virginia Soil and Water Conservation Board for Impounding Structures provided guidelines for GKY to follow in performing the study. GKY utilized and modified existing hydrologic and hydraulic models produced by the United States Army Corps of Engineers (USACE) created for a 2007 FEMA Study. GKY and the LBWID collaborated to develop several model scenarios that would satisfy the new regulation code. The project required deriving rating curves for dam operation, investigation of appropriate rainfall distribution, analyzing model dam break parameters, altering existing models, and mapping the resulting inundation over portions of several highly developed Virginia counties and municipalities.

This session will visit the challenges GKY faced in altering USACE models to handle the magnitude of a PMF event during a dam break scenario. The sessions other topics will include hydrologic considerations that were taken to appropriately model a PMP event; dam break parameters chosen for a non-uniform dam structure; interpretation of requirements found in new impounding structure regulation; and modeling techniques used in the study.

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COMPARISON OF PMP STORM DISTRIBUTIONS FOR SPILLWAY DESIGN FLOOD DEVELOPMENT IN VIRGINIA

Geoffrey L. Cowan¹, P.E, Kaveh Zomorodi², Ph.D., P.E., CFM, Dewberry,

Spillway design floods (SDF) for dams have traditionally been selected as various ratios of the Probable Maximum Flood (PMF) depending on a dam's size and hazard classification. Development of the PMF hydrograph is typically based on rainfall-runoff modeling of a Probable Maximum Precipitation (PMP) storm event. For areas of Virginia outside of the Tennessee River basin the total PMP rainfall amount is generally taken from the National Weather Service publication HMR-51. The temporal distribution of the total PMP rainfall is generally developed using procedures outlined in either the NWS publication HMR-52 or the Natural Resources Conservation Service (NRCS) publication TR-60. The various temporal distributions that can be derived from these publications (e.g. HMR-52, ESFB, 5-point, etc.) coupled with various PMP storm durations (6 - 72 hour) that may be used often results in significant variations in the PMF inflow hydrograph to an impoundment which in turn can drastically affect required spillway capacity.

This paper evaluates various alternative PMP storm durations/distributions that can be derived using the procedures outlined in HMR-52 and NRCS TR-60 and compares the resulting PMF inflow and outflow hydrographs for three "hypothetical" impoundments having various drainage areas and flood storage volumes. It is shown that certain PMP storm distributions are more critical than others depending on the ratio of flood storage to drainage area. Because the various PMP storm distributions yield disparate results, these findings may assist engineers in determining the storm distribution that is most likely to yield the critical SDF without having to evaluate each distribution individually.

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SESSION 5D

WATERSHED MANAGEMENT 2

Residential RainScapes: Helping Homeowners Go Green in Montgomery County, MD
Melissa Bernardo Hess, Erin Morsheimer, URS Corp

Regional Watershed Improvements Through Coordinated Restoration Efforts
Town of Warrenton, VA
Jason Murnock, Angler Environmental

Total Water Management: Sustainability of Existing Water Resources
Thomas Singleton, PBS&J

Virginia Watershed Management in an International Context
Dr. Steve Gorzula, Harmony Ponds, Inc.

RESIDENTIAL RAINSCAPES: HELPING HOMEOWNERS GO GREEN IN MONTGOMERY COUNTY, MARYLAND

Melissa Bernardo Hess¹, PE, CFM, Erin Morsheimer², URS Corporation

Green infrastructure is at the forefront of innovative stormwater management solutions that focus on volume reduction. RainScapes, or Low Impact Development (LID) stormwater management techniques, a subset of green infrastructure, are used to reduce the impacts of stormwater runoff by providing storage and promoting infiltration for stormwater runoff, thereby mimicking pre-development hydrologic conditions. These techniques are typically small-scale measures that can be implemented on commercial, industrial, and private properties to manage stormwater onsite instead of using larger offsite facilities.

The Montgomery County Department of Environmental Protection's (MCDEPs) RainScapes Rewards Rebate Program offers financial incentives to residents and businesses for implementing a variety of LID applications. URS is developing a technical design and installation guidance manual for the LID stormwater practices highlighted in Montgomery County's RainScapes Program. The manuals will provide technical guidance to the County's property owners on LID stormwater management practices.

The Montgomery County, Maryland RainScapes Techniques Design and Installation Manual will be developed as a series of modules that can be distributed separately or collectively as hardcopies or for electronic download via the MCDEP website. The modules will provide an overview of on-lot LID stormwater management concepts, a description of the RainScapes Program, and technical guidance on the following specific RainScapes practices:

- Rain gardens
- Rain barrels and cisterns
- Dry wells
- Conservation landscaping
- Driveway retrofits (permeable pavers/porous concrete)
- Tree canopies
- Green roofs

The RainScapes techniques modules will provide design and installation guidelines that are user-friendly, accessible, and effective. The overall goal is to develop a standard that will allow a property owner to be able to design, construct, and maintain a RainScapes practice with ease. The modules will be developed from existing industry standards, but will be customized for the climate, soil types, and land use of Montgomery County, Maryland. This project will support the County's efforts to engage the public in the RainScapes program and to encourage the voluntary installation of LID techniques on residential, commercial, multi-family, and institutional properties.

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REGIONAL WATERSHED IMPROVEMENTS THROUGH COORDINATED RESTORATION EFFORTS

TOWN OF WARRENTON, VIRGINIA

Jason Murnock¹, Angler Environmental

Angler Environmental (Angler) is happy to submit this abstract for consideration of Dave Pearson's Watershed Excellence Award. Our project involves regional watershed improvements through coordinated restoration efforts in the Town of Warrenton, Virginia. The concept behind this project is that the collective total of these watershed improvements is greater than the simple sum of its parts, i.e. each individual restoration site on its own.

Angler has worked with the Town of Warrenton to strategically identify wetland and stream restoration sites that will improve downstream water quality for those watersheds within which the Town is situated. As Warrenton lies on the drainage divide between the Potomac and Rappahannock Rivers, the restoration projects include sites in both of these watersheds. The restoration projects are being completed as mitigation for impacts from various projects in the vicinity, and demonstrate the benefits of a strategic, coordinated approach to restoration site selection. Angler is striving to coordinate our restoration efforts both in geographic proximity to, and with needs of, the Town as we believe more than one restoration project in close proximity to another within the same watershed (especially an urbanizing watershed) helps to realize greater benefits to the ecosystem and water quality than any single restoration project on its own. Three examples of these overall watershed benefits include:

- Maintaining the positive overall water quality and health of the local aquatic ecosystem by balancing the urban growth and development of the Town with the creation of new high-value natural aquatic resource areas
- Increasing collective natural habitat nearer to the areas that are directly displacing native plants and animals via increased urbanization or other land use changes
- Providing a greater awareness of ecology and stewardship within the Town, not only through simply establishing restored wetlands and streams so close in proximity to urban residents, but also through collaboration with Town and County administration to maximize the educational and recreational aspects of the restoration sites

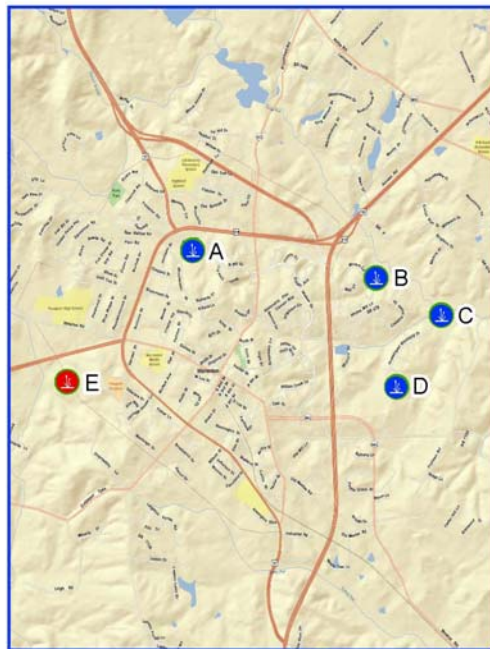


Figure 1: Angler Restoration Sites

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Figure 1 illustrates the locations of the four completed restoration projects and the fifth, pending project (E).

Within each wetland restoration area, several types of activities were conducted, and several types of wetlands were restored. Activities typically included creating or restoring wetlands in previously upland areas, primarily by restoring the hydrology of those areas, or simply preserving existing wetlands. The types of wetlands enhanced, restored or preserved include Palustrine Emergent Wetlands (PEM), Palustrine Scrub-Shrub Wetlands (PSS), and Palustrine Forested Wetlands (PFO). Table 1 illustrates the acreages and types of each wetland restoration area.

Table 1: Sizes and Types of Wetland Restoration Areas

Project Name	Figure 1	PEM (AC)	PEM/PSS (AC)	PSS (AC)	PFO (AC)	Floating Aquatic (AC)
Warrenton Chase	D	0.52	0.00	0.26	0.22	0.00
White's Mill	B	1.57	0.70	0.33	8.77	0.00
Woods at Warrenton	C	0.00	3.32	0.00	18.45	0.33
Sub-Totals		2.09	4.02	0.59	27.44	0.33

The grand total of created or restored wetlands is 34.47 acres. An additional 0.65 acre of existing wetlands was preserved as part of these restoration efforts.

Within each stream restoration area, several varying types of activities were also conducted, and included different combinations of stream channel restoration, channel relocation, bank stabilization, stream buffer reforestation, buffer enhancement, and channel or buffer preservation. Table 2 illustrates the lengths, acreages, and types of each stream restoration area for the four (4) completed project sites.

Table 2: Lengths, Acreages and Types of Stream Restoration Areas

Project Name	Figure 1	Restored or Enhanced (LF)	Restored or Enhanced (AC)	Preserved (LF)	Preserved (AC)
Warrenton Chase	D	490	1.12	0	0.00
Warrenton Crossroads	A	671	1.10	0	0.00
Whites Mill	B	3504	8.04	1521	3.46
Woods at Warrenton	C	3184	7.31	1227	2.82
Sub-Totals		7849	17.58	2748	2.82

In total, approximately 7,849 linear feet of stream channel and associated buffer areas (17.58 acres) were restored or enhanced, and another 2,748 linear feet of stream channel and associated buffer areas (2.82 acres) were preserved as part of these restoration efforts.

Several of these restoration areas were completed in 2004 and 2005. Upon completion, all restoration and preservation areas are professionally surveyed, platted and recorded at the governing locality. These areas are then protected in perpetuity by specific deed restrictions, which is in keeping with the first benefit described above.

In keeping with the third benefit described above, the Woods at Warrenton stream and wetland restoration area, upon completion, was deeded to the Fauquier County Parks and Recreation Department. Mr. Larry Miller, department Director, has explained that this restoration area is already planned as a component of an overall loop trail around Warrenton, serving for both recreation and transportation, and will also be used for environmental interpretation.

In closing, while mitigation for impacts to jurisdictional areas are typically permitted to occur in any number of places within a watershed, we believe these efforts should be coordinated and

collaborated upon to maximize the ecological benefits of improved water quality, created natural habitat, and environmental stewardship. Angler looks forward to continuing our collaboration with the Town of Warrenton and other jurisdictions as they, too, look to preserve and protect their natural resources!

Attachment 1 of 2: Explanation of Watershed Benefits

The overall purpose of these restoration areas is to compensate for authorized losses to streams, wetlands, and other aquatic resource functions within the same watershed. Each has been designed to complete this purpose in a manner that best contributes to the long-term ecological health of the watershed. Essentially, each site has accomplished this by restoring degraded stream channels and pre-existing agricultural fields to higher value, natural aquatic resource areas. These areas have demonstrated a replacement of the chemical, physical, and biological functions of the wetlands, stream channels, and open water areas that were lost, as shown in the annual monitoring and reporting submitted to the Virginia Department of Environmental Quality and Army Corps of Engineers. This monitoring is required for a period of 5 or 10 years following completion of each restoration area. Full documentation of monitoring results is available. Watershed benefits are summarized below:

Woods at Warrenton

Pre-existing conditions were open fields, grazed by cattle and/or used for hay production, with minimal forest areas near the perimeter of the site. Fields were historically modified with drainage ditches, minor fill areas and other drainage features (e.g. drain tiles) to drain the land. Restoration featured:

- A large plunge pool/forebay area at the main inflowing stream to trap incoming sediments and facilitate cleanout of these sediments prior to their import to any of the created wetlands
- Created, micro-topography features such as shallow pools, deep pools and open water habitat, as well as strategically placed, downed trees, all of which have encouraged habitat and faunal diversity at the site
- Stream restoration consisting of channel restoration, bank stabilization and buffer reforestation and enhancement
- The incoming stream can easily be diverted through or around the wetland area, as needed to ensure appropriate hydrology. Internally, a series of hydrologic berms and weirs distributes this water as required.
- Wetland areas have demonstrated significant removal of sediment and nutrients prior to discharge from the site.

White's Mill

Pre-existing conditions were cleared pasture with scrub-shrub vegetation and forested areas concentrated along drainageways, fencelines and property boundaries/ corners. Several wetland areas, associated with seeps and/ or contributing intermittent drainage features, were present within the floodplain, but while a few of these areas were forested, the majority were degraded emergent wetlands historically manipulated by farming practices. Restoration featured:

- Created and enhanced wetland areas
- Stream restoration consisting of channel restoration and bank stabilization
- Riparian buffer enhancement and buffer reforestation

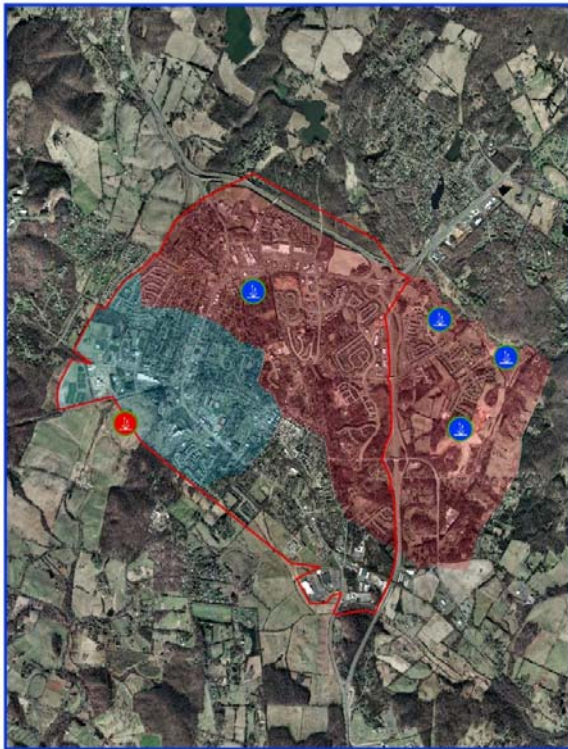
Warrenton Crossroads

This project consisted of stream and floodplain improvements at a commercial and retail center. The stream restoration consisted of channel relocation, modifications to its pattern and profile, stabilization with cross vanes, and the addition of flood conveyance practices, including a wetland enhanced floodplain bench. The floodplain bench was constructed to provide nutrient removal for the first one-half inch of stormwater runoff and flood storage during the 100-year storm return period. The relocation and new floodplain bench greatly improved conveyance of flood waters throughout the property, such that they eliminated the flooding that historically affected the property and neighboring sites downstream.

Warrenton Chase

Reforestation and invasive plant removal in a 50-foot buffer along each bank of 583 linear feet of R3 stream, and over one (1) acre of wetland restoration.

Attachment 2 of 2: Town of Warrenton & Restoration Project Watershed Areas



Legend:

- Red Boundary - Town of Warrenton Limits
- Red Shaded Area - Watershed Area Draining to Restoration Projects (Potomac)
- Blue Shaded Area - Watershed Area Draining to Restoration Projects (Rappahannock)
- Blue Symbols - Restoration Sites (Potomac)
- Red Symbols - Restoration Sites (Rappahannock)

TOTAL WATER MANAGEMENT: SUSTAINABILITY OF EXISTING WATER RESOURCES

Thomas L. Singleton¹, PBS&J

Water supports life. It connects and sustains both human and natural environments. Human activities, directly or indirectly impact water resources. These basic truths are central to understanding how to protect and preserve water as a valuable and essential resource.

Water resources in the United States, and for that matter throughout the world, have been greatly altered for human uses. They are becoming increasingly polluted and depleted, and as the country's population increases, these resources will be ever more vulnerable to over use.

Protecting water resources is critical to the current and future well-being of the country. It is the single greatest challenge that the states face and an issue that threatens the economic viability of every community.

Managing the impacts of human activities on water resources requires a new approach that recognizes that land and water need to be managed as finite resources—for there are limits to what the landscape can support. To identify these critical thresholds and live within these limits requires a deep understanding of the highly complex relationships between communities and the land and water resources that sustain them.

Water management must be implemented in a way that recognizes that each of its different aspects (such as water supply, water quality, flooding, natural system management, and land use) influences and is influenced by the built environment and the other aspects of water management. This approach, known as *total water management*, integrates all aspects of managing water resources. For example, management decisions related to water supply issues affect and are affected by decisions related to water quality, flooding, natural systems, and land use.

This presentation will provide a snapshot of the water resource challenges facing the states. Preserving the native functions of land to store and cleanse water to meet the long-term water and energy needs of the state will be discussed. In addition, a working thesis for investing in *natural* infrastructure (as opposed to *engineered* infrastructure) to meet these needs will be presented. Total water management will be shown to provide an essential framework for protecting and preserving valuable land and water resources.

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VIRGINIA WATERSHED MANAGEMENT IN AN INTERNATIONAL CONTEXT

Dr. Steve Gorzula¹, Harmony Ponds, Inc.

Whether you are managing the Chesapeake Bay watershed or the catchment area of a large hydropower project in the Tropics, the basic principles are the same. What has to be done to protect a natural (Chesapeake Bay) or man-made (hydropower project) resource?

Storm water management for urban communities in the USA is relatively new, and has not yet spread to the developing world. However, it could provide cost effective solutions in developing countries, thus opening business opportunities for members of the VLWA with international agencies such as the US Agency for International Development <http://indonesia.usaid.gov/en/Article.227.aspx>, the World Bank <http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTWAT/0,,contentMDK:21630583~menuPK:4602445~pagePK:148956~piPK:216618~theSitePK:4602123,00.html>, the Asian Development Bank <http://www.adbi.org/cdrom-review/2005/09/30/1386.urban.watershed.management./>, The Inter-American Development Bank <http://www.iadb.org/projects/project.cfm?id=HA-L1041%20&lang=en>, and UNEP http://www.unep.org/publications/search/pub_details_s.asp?ID=3597.

This presentation looks at watershed management problems with selected projects in Honduras, Nepal, Nigeria, Venezuela, and Vietnam on which the author has worked.

All large scale hydropower projects are planned using environmental parameters, which become "historical" once the final design has been decided upon and construction begins. The operational phase of large storage projects is expected to last several decades just to pay off the initial investment. For example, the 8,600 MW Guri project in Venezuela was a 6.3 billion dollar investment which will only break even after being on-stream for 50 years.

There are three important environmental parameters of a catchment area where changes in land-use upstream can have negative impacts on the efficiency, useful life, and maintenance costs of hydropower storage projects downstream. These are the hydrological regime, sedimentation rate, and water quality.

Hydrological Regime

- Forests play an important role in the maintenance of the water balance of a region by introducing into the atmosphere a considerable quantity of water vapor, which in turn is recycled to the region as rainfall. Massive deforestation can result in a net reduction in rainfall due to increased convection, decreased evapotranspiration and decreased water retention.
- Natural vegetation regulates run-off. Deforestation will increase the frequency and amplitude of floods, resulting in less efficient generation of electricity.
- Significant changes in run-off and flow rates will generally result in less efficient power generation.

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Sedimentation Rates

- Sediments reduce the storage capacity of a reservoir, making them less efficient and lose money.
- Once sediments begin to pass through the turbines, scouring and damage will occur. The useful life of the project ends when the production of electricity no longer covers the cost of maintenance and repair and the generating losses caused by shutdowns.
- Sediments are difficult to monitor. In a small basin, a single storm event may contribute in a few hours most of the entire sediment discharge for a whole year or even several years. In one Indian dam the estimated rate of siltation (during the planning stage) was only 6.1% of the real value.

Water Quality

- Direct corrosion of both concrete and steel structures of hydroelectric dams can be produced by water.
- Turbine generator parts may be corroded by H₂S if made of materials that can form metallic sulfides.
- Increased nutrient input can cause excessive eutrophication, resulting in the proliferation of aquatic weeds. In the worst case scenario, the water loss through evapotranspiration is equivalent to having a large leak in the dam.

Thus, the long-term management and protection of the watershed is fundamental for the economic viability of hydropower projects.

Storm water management ponds in the USA are designed to address the above by regulating flow, trapping sediments, and improving water quality. In addition, they provide habitat for terrestrial and aquatic wildlife. In many, if not all, developing countries storm water management dams could be built manually as community owned projects. In addition to their primary function of protecting water resources development projects downstream, in developing countries they would provide:

- a. fodder for livestock such as water buffalos;
- b. plant material for roofs and baskets;
- c. the opportunity for fish and turtle farming;
- d. less polluted drinking water for the communities downstream; and,
- e. new farmland once the pond has silted up.

Such initiatives could be financed by existing programs, such as the World Bank's "Payments for Environmental Services (PES)":

<http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/ENVIRONMENT/EXTEEI/0,,contentMDK:20487926~menuPK:1187844~pagePK:210058~piPK:210062~theSitePK:408050,00.html>

In conclusion, there are plenty of watershed management problems in the developing world, lending agencies have budgets to address these problems, and VLWA has the expertise to solve these problems.

SESSION 6A

STORMWATER MANAGEMENT 6

Is Street Sweeping an Effective Best Management Practice (BMP)

Lamont "Bud" Curtis, John Whitelan, Parsons Brinckerhoff

Storm Water Pollutant Removal Using Lightweight Aggregates

Peter W. Schmidt, Southern Aggregates, LLC

Bacteria Concentrations in Stormwater and Current BMP Design Methods

Lewis White, KCI

Summary of Historical Dry Weather Field Screening Results

Seshadri Iyer, URS Corp, Steve McLaughlin, City of Virginia Beach Public Works Engineering

IS STREET SWEEPING AN EFFECTIVE BEST MANAGEMENT PRACTICE (BMP)

Lamont "Bud" Curtis¹, PE., BCEE, John Whitelaw²

The City of Norfolk has a City wide street sweeping program with areas being swept on a daily to three month basis. The City Council wants the minimum cycle to be monthly. The City is also under storm water Phase I NPDES permit which is being re-authorized. The State Department of Conservation and Recreation has added a condition in the draft permit that the city track and report the total lane miles and tonnage of street sweepings and further that the city sample material to determine the composition to estimate the pollutant load reduction attributable to the street sweeping operations. With the permit conditions and being within the Chesapeake Bay and being subject to the Chesapeake Bay initiative, it was desirable to also compute the pollutant load potentially removed by the current and increased sweeping quantities of the most frequent operations desired by the City Council. A Protocol for sample collection and testing was first established. Sampling was done to compare the street sweeping with the literature.

In order to measure the routed miles per day and insure coverage, the equipment was outfitted with passive GPS units. The downloaded data was overlain on the GIS mapping. This provided real time data for sweeping times and coverage. Data acquired by GPS devices on the vehicles was used to adjust the areas and daily lane miles of sweeping, to increase the frequency of sweeping to meet the Council's criteria. The total number of lane miles was computed and a tonnage of material collected was computed. The results are compared to other City's data and the overall effectiveness is discussed. The controversy over effectiveness of street sweeping will also be discussed.

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STORM WATER POLLUTANT REMOVAL USING LIGHTWEIGHT AGGREGATES

Peter W. Schmidt¹, Southern Aggregates, LLC

Removal of pollutants from storm water using BMP's dates back to the early 1990's with the advent of regulatory initiatives such as the Chesapeake Bay Preservation Act and municipal storm water ordinances. These legislative requirements mandated treatment of storm water to remove pollutants before discharge to receiving streams.

Despite the proliferation of BMP's since that time, required with virtually every new construction activity, the majority of storm water still flows untreated from city streets through storm water conveyances into rivers, bays, and ultimately our oceans, contributing significantly to water quality degradation through the addition to our water bodies of sediments, nutrients, fecal coliform, metals, hydrocarbons, and trash. This untreated flow stems from the fact that most cities already had constructed the majority of their infrastructure before the advent of storm water ordinances, and there have been no regulatory requirements to retrofit the "built environment" to treat this storm water flow.

As an example, in Virginia Beach, Virginia, despite roughly 20 years of BMP implementation, 83% of all storm water that falls in the Lynnhaven River Basin flows untreated into the Lynnhaven River, which has a TMDL for fecal coliform. This disproportionate amount of untreated flow from lawns, streets and the city's storm system undoubtedly contributes significantly to the problem. As well, Virginia Beach has almost a thousand outfalls discharging into the Lynnhaven River, and the cost of retrofitting these outfalls at hundreds of millions of dollars is prohibitive.

There is, however, a new approach to treating storm water that does not flow through traditional BMP's. Using lightweight aggregates (LWA) to filter pollutants from storm water in the "built environment" is an effective, low cost way to improve water quality and a necessary alternative to capital projects to retrofit existing facilities. LWA include pumice, naturally occurring through volcanic eruptions, or shales, clays and slates that are expanded in a rotary kiln at 2000 degrees F., allowing escaping gases to create a bloated, popcorn-like material which doubles its size and forms a porous capillary structure in the aggregate. The finished product then is cooled and crushed to size depending on its application. When used to filter storm water, the absorbent nature of LWA traps pollutants in interstitial spaces, allowing high removal percentages of suspended solids, undissolved nutrients, fecal coliform, metals, and oil and grease. Indeed, absorptive products for pollutant removal routinely are used in conventional BMP's. This new approach focuses on the "built environment" that is virtually disregarded with regard to storm water treatment.

Once the LWA have reached a state where they are full can absorb no more pollutants, known as breakthrough, the LWA are removed, replaced with fresh LWA and then recycled to be used yet again. A corollary benefit to recycling LWA at breakthrough is the removal and disposal or recycling of any trash, grass clippings, general debris, etc. that collects at the curb inlet where LWA filters have been placed. As we know, trash contributes significantly to impaired water quality as it is washed into receiving streams during storm events.

Southern Aggregates, LLC, located in Chesapeake, Virginia, has been testing LWA for storm water pollutant removal at selected municipal sites in Virginia Beach over the past year. LWA filters provide a flexible, low cost method for a municipality to improve water quality by reducing pollutant load and debris removal at selected sites of concern without the appropriation of new capital or adding new staff.

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BACTERIA CONCENTRATIONS IN STORMWATER AND CURRENT BMP DESIGN METHODS

Lewis White¹, KCI

Current BMP design requirements provide for treating the “first flush” of rainfall for the impervious area of the basin to be treated. The “first flush” theory is that most pollutants runoff in the initial half inch to one inch of the rainfall. This may be true for nitrogen and phosphorus but at what part of the storm runoff does the higher concentration of fecal bacteria happen? And what is the impact of BMPs meeting current design standards have on the bacteria levels in the stormwater? Over the past three year, sampling and testing of fecal indicator bacteria levels have been conducted at several locations in the City of Virginia Beach. These locations include among others:

The piped drainage in the vicinity of the 79th Street Stormwater Pump Station.

The culverts at First Colonial Road and Mill Dam Road on Mill Dam Creek.

The piped drainage systems upstream of the 72” and 36” stormwater outfalls located east of Marshview Drive.

Bacteria levels were compared to rainfall data to determine when the samples were collected in relation to the amount of rainfall prior to the sample collection. In mostly impervious areas, bacterial levels tended to remain fairly constant or showed some decline as the rainfall progressed. However, in areas that contain significant areas of pervious surfaces such as subdivisions, bacteria levels were substantially higher well after the first inch of runoff had passed through the storm drainage system. Levels were even greater hours after the rain has ceased. This paper discusses the relationship between fecal indicator bacteria levels and the various stages of rainfalls of greater than one inch. Backup for research done in areas other than Virginia will be presented to support this presentation. The paper also discusses the bacteria levels from runoff from BMPs as compared to direct runoff.

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SUMMARY OF HISTORICAL DRY WEATHER FIELD SCREENING RESULTS

*Seshadri S. Iyer¹, URS Corp., Stephen G. McLaughlin², City of Virginia Beach
Public Works Engineering*

Since the Virginia Pollutant Discharge Elimination System (VPDES) permit became effective in 1994, the City of Virginia Beach has performed dry weather field screening of twenty-five (25) storm water outfall sites each year to meet permit requirement. Four samples are collected at each site. Each sample is analyzed for stormwater characteristics and pollutants. Analytical testing of each grab sample is conducted in the field for chlorine, copper, phenol, pH, ammonia and detergents.

The main objective of this study is to collect, review, and analyze the quantitative analytical parameters for chlorine, copper, phenol, pH, ammonia and detergents of the historical dry weather field screening efforts and to produce a summary map showing which pollutants exceeded action limits for each site monitored during the period of interest.

As part of this project, a geographical information system (GIS) database of historical dry weather field screening results was created. Historical data was collected for the years 1997-1998 and 2000-2008. Eleven (11) years of historical dry weather field screening results were collected and analyzed. Historical data for the years 1994-1996 and 1999 were not readily available.

For the 11 years of historical data, a total of 1120 samples were collected. Roughly half of the samples (584 samples) had no flow. Analytical field testing results of the remaining 536 dry weather flow samples were analyzed. The results indicate a strong correlation between the presence of ammonia and detergents. This paper discusses the summary of the results for quantitative analytical parameters: chlorine, copper, phenol, pH, ammonia and detergents and establishes a correlation between field results.

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SESSION 6B

FLOODPLAIN MANAGEMENT 5

Flooding: Tools for Maintaining Situational Awareness

Mark Slauter, VA Dept. of Emergency Management

FEMA's Map Modernization Status

David Gunn, VA DCR, Rich Sobota, FEMA

FEMA's New Elevation Certificate

Charley Banks, VA DCR

The NFIP in Virginia, Status and Trends

Alison Mitchell, VA DCR

FLOODING: TOOLS FOR MAINTAINING SITUATIONAL AWARENESS

Mark Slauter¹, Virginia Department of Emergency Management

Whether preparing for a storm event or responding to one the ability to acquire and maintain awareness can be a difficult task. How entities prepare and respond to a flood event can also impact how resources are assigned. There are a few key websites that can be indispensable for floodplain managers, emergency management staff and other agencies. This session will discuss how these sites can be useful and what their limitations are.

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FEDERAL/STATE PARTNERSHIP IN ADMINISTERING THE NATIONAL FLOOD INSURANCE PROGRAM

This presentation will include a brief outline of the Federal and State roles and responsibilities as set forth in the Code of Federal Regulations 44 Emergency Management and Assistance Subchapter B- Insurance and Hazard Mitigation, with emphasis on programs and activities related to the three main components of the NFIP: Hazard Identification, Floodplain Management and Hazard Mitigation, and Federal Flood Insurance.

Presenters from the Federal Emergency Management Agency and the Virginia Department of Conservation and Recreation will provide specific examples of the mutual goals, and some inherent conflicts, which are part of the day-to-day implementation of map modernization, floodplain ordinance review and updates, compliance and enforcement activities, local community assistance, planning, disaster response, education and outreach, and other activities. Anyone involved with “water subjects” will be able to obtain valuable insights and practical knowledge by attending and participating.

This is intended to be an interactive session, with suggested questions/topics solicited and encouraged from the audience. The format will include presentation, panel discussion and Q&A. Presenters will include:

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SESSION 6C

LAKE AND DAM MAINTENANCE

The Rehabilitation of the Cow Creek Mill Dam, Gloucester County, VA
Robert Cooper, Williamsburg Environmental Group, Inc.

Monitoring Invasive Aquatic Plants in Smith Mountain Lake, VA
Dr. Delia Heck/Dr. Bob Poblán, Ferrum College

Reserve Hydrographic Surveys Using a Linked Differentially Corrected GPS and Acoustic Depth
Sounding System
Harold Post, Virginia Tech Occoquan Watershed Monitoring Lab

Managing a Cyclical Lake Dredging Program in an Urban Setting: Lake Barcroft's Experience
Davis Grant, Lake Barcroft WID

THE REHABILITATION OF THE COW CREEK MILL DAM GLOUCESTER COUNTY, VIRGINIA

Robert E. Cooper¹, P.E., Williamsburg Environmental Group, Inc. (WEG)

The Cow Creek Mill Pond Dam is located in Gloucester County, Virginia just upstream from Route 14. The dam has been in existence since the 1700's and was originally used to power a grist mill. At one time, the fill causeway for Route 14 served as the dam embankment, but Route 14 was later re-located approximately 300 feet downstream of the embankment. Presently, the embankment is about 600 feet long, 11 feet in height, and impounds approximately 623 acre-feet of water. The outlet structures consist of an uncontrolled concrete spillway and a corrugated metal riser/pipe system.

In 1999, Hurricane Floyd dumped more than a foot of rain in Gloucester which caused the Cow Creek Mill Pond Dam to breach. This event also damaged the westbound Route 14 Bridge to the point of necessitating closure. At the time of failure, the homeowners that lived adjacent to the lake were not organized as an Association; therefore, there was no mechanism in place to collect funding to have collateral for the repair of the dam and spillway. This problem was solved by the formation of the Cow Creek Mill Pond Association (Association). This opened the way for the Association to receive a Federal Emergency Management Agency low interest loan to design and construct a new spillway, which occurred in 2000.

The formation of the Association was a mechanism that was available for this particular case to raise the capital needed to repair the dam. This is a common problem for older dams that were built and dedicated to civic associations or other entities without the power to levee mandatory fees. In our experience, creative solutions for dam funding are quite often needed in similar instances, including formation of associations, creation of special assessments or fees to establish dedicated lake management funding sources or even more innovative solutions such as selling of community out-parcels to raise capital and/or the formation of a lake management or dam maintenance fund. Many HOAs and community groups do not consider dam maintenance or possible dam failure when individual fees are assessed per household, until an unfortunate event occurs.

Unfortunately, for Cow Creek Mill Pond Dam a second spillway failure occurred after Tropical Depression Ernesto brought approximately 10 inches of rainfall to Gloucester. The Association was still paying on the first loan when this happen. This event caused soils from under the spillway to erode, thus undermining the spillway to the point of failure and limited dam breach. This caused the water level in the lake to drop about 8 feet below normal pool, dramatically impacting the view-shed of surrounding property owners and reducing property values accordingly. This failure was extremely frustrating to the Association which generated the desire for an extremely secure repair to the dam and spillway.

To meet the needs of the Association, Williamsburg Environmental Group (WEG) assembled a team of professionals including our Water Resource Engineering staff, a local land surveyor, geotechnical engineers, and a local contractor. Collaboratively, a creative solution was developed that provided increased spillway capacity and protection, met current Dam Safety

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requirements, and provided additional protection to the entire dam embankment. In order to meet Dam Safety requirements and determine the length of spillway an Incremental Damage Assessment was performed. Based on the analyses, the spillway length was increased by 22 feet which increased the spillway capacity to equal the capacity of the bridge opening under Route 14.

Additionally, because this was the second time that failure had occurred, and there was a strong concern of the materials located within the embankment, WEG worked with the contractor and the Association to develop a remediation option which included the installation of a PVC sheet piling cutoff wall on the upstream side of the embankment and in front of the spillway. The sheet pilings were driven into a clay layer and extend two feet above normal pool. The security that this solution brings is if the dam is overtopped and scour occurs on the downstream side that the pilings will serve to prevent total embankment failure and help to prevent the normal pool of water from being drained.

Other design solutions were explored. Initially, a labyrinth weir was considered. This design was not selected because of the cost associated with its construction and no additional protection was provided to the embankment. The solution that was chosen provided the Association with confidence that they would not lose the lake again. The estimated cost for the selected design which included engineering and construction was \$304,000. The Association, once again, secured a loan a 30 year loan at 4% through the Small Business Association.

In conclusion, the Association is repairing and reinforcing the existing dam embankment and spillway to standards that will greatly reduce the risk of failure from re-occurring and meet the current Dam Safety regulatory requirements. WEG assembled a team which worked cooperatively to develop an innovative and cost-effective design that better ensures the longevity of the spillway and embankment, improves hydraulic efficiency of spillway, protects the embankment, and increases overall public safety.

MONITORING INVASIVE AQUATIC PLANTS IN SMITH MOUNTAIN LAKE, VIRGINIA

Dr. Delia R. Heck¹, Dr. Bob Pohlman², Ferrum College

Smith Mountain Lake is a pumped storage reservoir in Virginia that is beginning to develop problems with aquatic invasive plants. The local lake resident association and the power company have noticed an increase in the presence of non-native invasive species in the last few years and are concerned about the invasive plants causing problems with recreational activities and power generation. Scientists at Ferrum College and lake residents began a monitoring program this summer to assess the extent of the invasive plant problem. Volunteer monitors are assisting a team of scientists to identify plant species and to measure the extent of the growth of each plant species. Instances of Hydrilla, Curly Leaf Pondweed, and Brazilian Elodea are of particular interest. Geographic Positioning System (GPS) units are being used to map the location and area of growth and then the data is plotted on Geographic Information System (GIS) maps of Smith Mountain Lake to present a visual understanding in order to decide the next courses of action. A lake commission will use data collected from this study to employ companies to treat some of the aquatic plants with herbicide. Other areas will continue to be monitored. Methods of identification and mapping will be presented along with the GIS maps.

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RESERVOIR HYDROGRAPHIC SURVEYS USING A LINKED DIFFERENTIALLY CORRECTED GPS AND ACOUSTIC DEPTH SOUNDING SYSTEM

Harold E. Post¹, Virginia Tech Department of Civil and Environmental Engineering

The Occoquan Watershed Monitoring Laboratory (OWML) has conducted a series of bathymetric surveys of the Occoquan Reservoir and other water bodies using a combination GPS and Depth Sounding system. Integrating real-time differential GPS with depth sounding equipment and a portable field computer provides a system for rapid collection of data for reservoir volume estimation and bottom mapping.

Differentially corrected GPS systems use receivers at known locations to acquire GPS satellite signals and calculate correction factors for application to field-collected positioning data. The correction data are broadcast to a mobile GPS unit, which calculates and stores the corrected positioning information on a real-time basis. Differentially corrected data can provide horizontal positioning accuracy in the submeter range. Real-time GPS correction subscriptions, broadcast by satellite or other communications systems, are also now available in the private sector.

Boat-mounted acoustic depth-sounding equipment operating at a frequency of 208 KHz is capable of providing vertical positioning accuracy to 0.1 meter. A laptop computer on-board the survey boat communicates with both the GPS and depth sounding instruments, and stores three dimensional coordinates of the output data. The corrected horizontal positioning data is merged in real time with the corresponding depth data to produce a single x,y,z coordinate data file. In addition, guidance software integrated with the GPS system can provide navigation cues to the boat operator so that a pre-planned survey pattern can be used to ensure adequate and even coverage of the water body. The boat operator also has the option of steering a random course through smaller inlets.

Compared to traditional methods, the GPS-acoustic sounding system can provide a much more robust hydrographic survey dataset that can be used to provide enhanced estimates of area-capacity-pool elevation relationships in lakes and reservoirs. In surveys of the Occoquan Reservoir, using a single survey boat, it has been possible to establish the x,y,z coordinates of over 85,000 individually positioned points in a lake of approximately 1500 acres in less than a week.

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MANAGING A CYCLICAL LAKE DREDGING PROGRAM IN AN URBAN SETTING: LAKE BARCROFT'S EXPERIENCE

Davis Grant¹, Lake Barcroft WID

Operation Director

To share information on the following topics:

1. The fundamentals of a cyclical dredging program.
 - a. Long term disposal strategy
 - b. Establishing a desired base line water depth
 - c. Lake bathymetry monitoring program
 - d. Understanding the dynamics of your watershed
2. The challenges that an urban setting presents.
 - a. Disposal options
 - b. Sediment transport
3. Benefits of a well planned cyclical dredging program
 - a. Budget development
 - b. Disposal opportunities

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SESSION 6D

STREAM RESTORATION

Dynamics of Dragonfly Colonization of New Lentic Habitats

Richard Groover, J. Sargeant Reynolds Community College

Nuttree Branch Stream Restoratio and Channel Improvements

David Wilmouth/Michael Claud, Timmons Group

Environmental Permit Compliance Through the Use of an
Independent Environmental Monitor

Gerry Hammel, McCormick Taylor, Inc.

DYNAMICS OF DRAGONFLY COLONIZATION OF NEW LENTIC HABITATS

Richard S. Groover¹, 2009 Recipient of VLWA Leo Bourassa Scholarship

The colonization of lentic habitats by dragonflies increases the richness of resident species in positive ways. The role of this aquatic predator is significant in the vitality of a pond ecosystem. The importance of dragonfly colonization and the manner it occurs is discussed in this presentation. The design and maintenance of lentic habitats to effectively attract colonizing species impacts the selection of these habitats by dragonflies and may affect their success of colonization. This presentation will provide recommendations for habitat improvements and characteristics that will increase success of dragonflies and other lentic species. The succession of these habitats is also covered relative to those species.

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NUTTREE BRANCH STREAM RESTORATION AND CHANNEL IMPROVEMENTS

David P. Wilmoth, EIT, Michael L. Claud, PE, Timmons Group

The County of Chesterfield identified a need for various channel improvements along a section of Nuttree Branch in the Brandermill Community in the northwest section of Chesterfield County. The particular section of Nuttree Branch in question falls below Old Hundred Road towards the West under Quail Hill Road into the Brandermill County Club's Golf Course. The existing stream is highly eroded with various slope failures and flow has been impeded by large amounts of sediment in the stream. The stream has an approximate 10-year storm event capacity and inundates structures during the 100-year storm event.

Timmons Group was challenged by the County to redevelop the existing stream section along Nuttree Branch using stream restoration practices to alleviate the 100-year flooding of the existing structures. Utilizing Chesterfield County GIS information and field survey, Timmons Group prepared design plans for approximately 1200 ft. of stream to be restored to natural conditions using various pools, bends, and environmental restoration techniques. In order to alleviate the 100 year flooding along the stream area in question, the existing flow path of the stream was relocated in various locations to provide more stream capacity and relocate the stream away from the houses along its current banks.

As part of the project, the existing four CMP pipes under Quail Hill Drive were evaluated for capacity to help alleviate flooding of Quail Hill Drive and the low lying area between Old Hundred Road and Quail Hill Drive. In order to alleviate the flooding and pass the 100 year storm under Quail Hill Drive, two countersunk 6'x5' concrete box culverts and two 6'x4' flanker concrete box culverts were required. This project is scheduled to begin construction in the fall of 2009.

ENVIRONMENTAL PERMIT COMPLIANCE THROUGH THE USE OF AN INDEPENDENT ENVIRONMENTAL MONITOR

Gerry Hammel¹, McCormick Taylor, Inc.

The role of the **Independent Environmental Monitor** (IEM) on construction projects in Maryland has gained recognition as a vital component to satisfying project compliance with environmental permits. Those managing construction projects often struggle to meet the challenges posed by environmental compliance. The use of an IEM provides the project owner and permitting agencies with additional oversight for identifying potentially non-compliant issues. The use of an IEM is a fairly new practice and can be seen by permitting agencies as a proactive measure to ensure permit compliance.

The IEM provides support to the permitting agencies in reviewing project designs and tracking environmental compliance on a daily basis. The IEM serves as the 'eyes & ears' of the permitting agencies in the field as the agencies typically have limited staffing available for routine site visits. Critical issues are brought to the attention of the Contractor, any Erosion & Sediment Control staff and the permitting agencies via the online EM Toolkit.

The EM Toolkit is a web based application designed for use by the IEM. The application serves as a tool to store and relay important information such as daily monitoring reports, issue tracking and resolution, compliance updates, photographic documentation, permits and permit documentation and plans. The information on the EM Toolkit can be accessed by stakeholders such as monitors, permitting agencies, project managers and any individuals given access to the project site. The site can also be used by the IEM to notify stakeholders via e-mail to simultaneously distribute real time information to all interested parties, in the event of a non-compliance.

Qualified monitoring staff range from professional engineers to environmental scientists to experienced construction personnel. The presentation offers an overview of the role of the IEM, the benefits allotted to project owners when utilizing an IEM, the keys to successful integration of the IEM into the scope of a project and examples of projects currently utilizing IEMs.

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PRE-REGISTERED AS OF FEBRUARY 18, 2009

<i>First</i>	<i>Last</i>	<i>Organization</i>	<i>City</i>	<i>State</i>
Sam	Amos	Henrico County Public Works	Henrico	VA
LeAnne	Astin	Fairfax County DPWES	Fairfax	VA
Samuel	Austin	USGS	Richmond	VA
Charley	Banks	VA DCR	Richmond	VA
John	Barnes	City of Virginia Beach	Virginia Beach	VA
Laura	Barry	Chesterfield County	Chesterfield	VA
Lisa	Bass	Old Dominion University	Norfolk	VA
Joseph	Battiata	Williamsburg Environmental Group, Inc.	Richmond	VA
David	Beasley	Virginia Lake Management Company	Virginia Beach	VA
Doug	Beisch	Williamsburg Environmental Group	Williamsburg	VA
Connie	Bennett	York County	Yorktown	VA
Kate	Bennett	Watershed Planning & Assessment Branch	Fairfax	VA
M	Biggs	AMEC Earth & Environmental	Chantilly	VA
Deva	Borah	Woolpert, Inc.	Portsmouth	VA
Glenn	Bottomley	Parsons Brinckerhoff	Norfolk	VA
Richard	Brawley	GKY & Associates, Inc.	Chantilly	VA
Matt	Breen	AMEC	Chantilly	VA
Bill	Browning	Virginia DCR	Richmond	VA
David	Bulova	AMEC	Chantilly	VA
Mike	Bumbaco	Kerr Environmental Services	Virginia Beach	VA
Joni	Calmbacher	Michael Baker Jr., Inc.	Alexandria	VA
Beth	Carpenter	Triad Engineering, Inc.	Winchester	VA
Robert	Cernuda	Professional Lake Management	Georgetown	SC
Boyd	Church	Loudoun County	Leesburg	VA
Mike	Claud	Timmons Group	Richmond	VA
Tucker	Clevenger	AMEC Earth & Environmental, Inc.	Chantilly	VA
Weedon	Cloe	Chesterfield County	Chesterfield	VA
Brian	Connoley	EcoDepot, LLC	Arbutus	MD

<i>First</i>	<i>Last</i>	<i>Organization</i>	<i>City</i>	<i>State</i>
Darryl	Cook	James City County	Williamsburg	VA
Robert	Cooper	Williamsburg Environmental Group, Inc.	Richmond	VA
Geoffrey	Cowan	Dewberry	Fairfax	VA
Adam	Crary	Golder Associates, Inc.	Richmond	VA
Aislinn	Creel	Timmons Group	Richmond	VA
Lori	Crossland	Schnabel Engineering	Greensboro	NC
Francisco	Cubas	Virginia Tech Occoquan Watershed Laboratory	Manassas	VA
Lamont	Curtis	Parsons Brinckerhoff	Norfolk	VA
John	Denniston	McCormick Taylor	Baltimore	MD
Ron	DiFrancesco	Golder Associates, Inc.	Richmond	VA
Pam	Dinkle	Tri-County Lake Administrative Commission	Moneta	VA
Bill	Dowling	EQRI, LLC	Arbutus	MD
Marissa	Duff	Virginia Water Resources and Research Ctr	Blacksburg	VA
Karen	Duhring	Virginia Institute of Marine Science	Gloucester Point	VA
Jason	Evans	In-Situ Inc.	Fort Collins	CO
Martin	Firth	Lake Services of Virginia, Inc.	Stafford	VA
Tom	Fitzgerald	Wiley/Wilson	Lynchburg	VA
Nicki	Foremsky	Reston Association	Reston	VA
Shelly	Frie	CH2M Hill	Virginia Beach	VA
Bill	Frost	KCI Technologies	Sparks	MD
Francis	Geissler	James City County	Williamsburg	VA
Aaron	George	GKY & Associates, Inc.	Chantilly	VA
Adil	Godrej	Occoquan Monitoring Lab	Manassas	VA
Eric	Goodrich Resources, LLC	Environmental Quality	Arbutus	MD
Steve	Gorzula	Harmony Ponds, Inc.	Fairfax	VA
Andrew	Gould	Timmons Group	Richmond	VA
Davis	Grant	Lake Barcroft WID	Falls Church	VA
Richard	Groover	George Mason University	Mechanicsville	VA
David	Gunn	VA DCR	Richmond	VA

<i>First</i>	<i>Last</i>	<i>Organization</i>	<i>City</i>	<i>State</i>
Gerry	Hammel	McCormick Taylor, Inc.	Baltimore	MD
Daniel	Hamric	Triad Engineering, Inc.	Winchester	VA
Delia	Heck	Ferrum College	Ferrum	VA
Trish	Hennessy-Webb	PBS&J	Chantilly	VA
Kelly	Henshaw	City of Winchester	Winchester	VA
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Margaret-Anne	Hilliard	Henrico County	Henrico	VA
Stephanie	Hood	URS Corporation	Newport News	VA
Carolyn	Howard	Draper Aden Associates	Blacksburg	VA
Joe	Humbertson	EQR LLC	Arbutus	MD
Seshadri	Iyer	URS Corporation	Virginia Beach	VA
Francis	Janes, Jr.	City of Virginia Beach	Virginia Beach	VA
Kenny	Johnson	Elkhorn Lake & Campground	Java	VA
Shelton	Jones	Brunswick County	Lawrenceville	VA
Shannon	Junior	Virginia Lake Management Co.	Virginia Beach	VA
Carolyn	Keeler	McCormick Taylor	Glen Allen	VA
Robert	Kerr	Kerr Environmental Services	Virginia Beach	VA
Don	Knezick	Pinelands Nursery and Supply	Columbus	NJ
David	Krisnitski	Virginia Dept. of Game and Inland Fisheries	Richmond	VA
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Jay	Lewis	Wiley/Wilson	Lynchburg	VA
Hunter	Loftin	Michael Baker Jr., Inc.	Alexandria	VA
Mathew	Lyons	USDA, NRCS	Richmond	VA
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Brett	Martin	GKY & Associates, Inc	Chantilly	VA
John	Matusik	The Engineering Groupe, Inc.	Woodbridge	VA

<i>First</i>	<i>Last</i>	<i>Organization</i>	<i>City</i>	<i>State</i>
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Art	Miller	Watershed Concepts/AECOM	State College	PA
Mary	Miller	Watershed Concepts/AECOM	State College	PA
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Lynne	Mowery	AMEC Earth and Environmental	Chantilly	VA
Susan	Mulholland	Timmons Group	Richmond	VA
Jason	Murnock	Angler Environmental	Manassas	VA
Jim	Nadeau	CONTECH	Bangor	ME
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John	Paine	URS Corporation	Newport News	VA
Elsie	Parrilla-Castellar	Michael Baker Jr., Inc.	Alexandria	VA
Shane	Parson	URS Corporation	Salem	VA
Fernando	Pasquel	Michael Baker Jr., Inc.	Alexandria	VA
Jim	Payne	Zigler & Payne	Manassas	VA
Glen	Payton	Filterra	Ashland	VA
Katie	Perkins	Old Dominion University	Norfolk	VA
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Jonathan	Pittman	Schnabel Engineering, LLC	Richmond	VA
Harold	Post	OWML	Manassas	VA
David	Powell	Woolpert	Portsmouth	VA
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Kurt	Powers	Dewberry	Fairfax	VA
David	Preusch	Michael Baker Jr., Inc.	Alexandria	VA

<i>First</i>	<i>Last</i>	<i>Organization</i>	<i>City</i>	<i>State</i>
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Don	Rissmeyer	A Morton Thomas and Associates, Inc.	Richmond	VA
Thomas	Roberts	VA DCR	Christiansburg	VA
James	Robinson	Virginia DCR	Richmond	VA
Fred	Rose	Fairfax County	Fairfax	VA
Mindy	Ruby	Filterra	Ashland	VA
Tracy	Ruff	Timmons Group	Richmond	VA
Niffy	Saji	Fairfax Water	Fairfax	VA
David	Sample	Virginia Tech-OWML	Manassas	VA
Elizabeth	Scheessele	URS Corporation	Virginia Beach	VA
Peter	Schmidt	Southern Aggregates, LLC	Chesapeake	VA
Perry	Scott	Imbrium Systems	Rockville	MD
Silvasankkar	Selvanathan	Center for Geospatial Information Technology, Virginia Tech	Blacksburg	VA
Albert	Short	Harmony Ponds, Inc.	Fairfax	VA
Brent	Silk	PLM Lake and Land Management Corp	Littleton	NC
Amy	Simons	City of Norfolk-Stormwater	Norfolk	VA
James	Smith	EcoDepot, LLC	Arbutus	MD
Steve	Snell	VA DCR	Richmond	VA
Marissa	Soule	Woolpert, Inc.	Arlington	VA
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Jennifer	Steffens	CONTECH Stormwater Solutions, Inc.	Linthicum	MD
Stuart	Stein	GKY & Associates, Inc.	Chantilly	VA
Brian	Stokes	Campbell Co. Government	Rustburg	BA
Carolyn	Thomas	Ferrum College	Ferrum	VA
Byron	Tracy	Old Dominion University	Norfolk	VA
Phil	Tucker	Sutron Corp	Sterling	VA
Ken	Turner	VA DCR	Richmond	VA

<i>First</i>	<i>Last</i>	<i>Organization</i>	<i>City</i>	<i>State</i>
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Robert	VanLier	VA DCR	Warrenton	VA
Michelle	Virts	Timmons Group	Richmond	VA
Will	Vonohlen	URS Corporation	Virginia Beach	VA
Jack	Wall	Woolpert LLP	Portsmouth	VA
Loren	Wehmeyer	USGS	Raleigh	NC
Donald	Wells	Hanover-Caroline Soil & Water Conservation District	Mechanicsville	VA
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David	Wilmoth	Timmons Group	Richmond	VA
Adam	Wolovick	CONTECH Construction Products	Richmond	VA
Christine	Worley	URS Corporation	Gaithersburg	MD
Berry	Wright	City of Richmond - DPU	Richmond	VA
Gerald	Wright	USDA, NRCD	Verona	VA
Jaewon	Yoon	Old Dominion University	Norfolk	VA
Kevin	Young	Virginia Tech	Blacksburg	VA
Kaveh	Zomorodi	Dewberry	Fairfax	VA