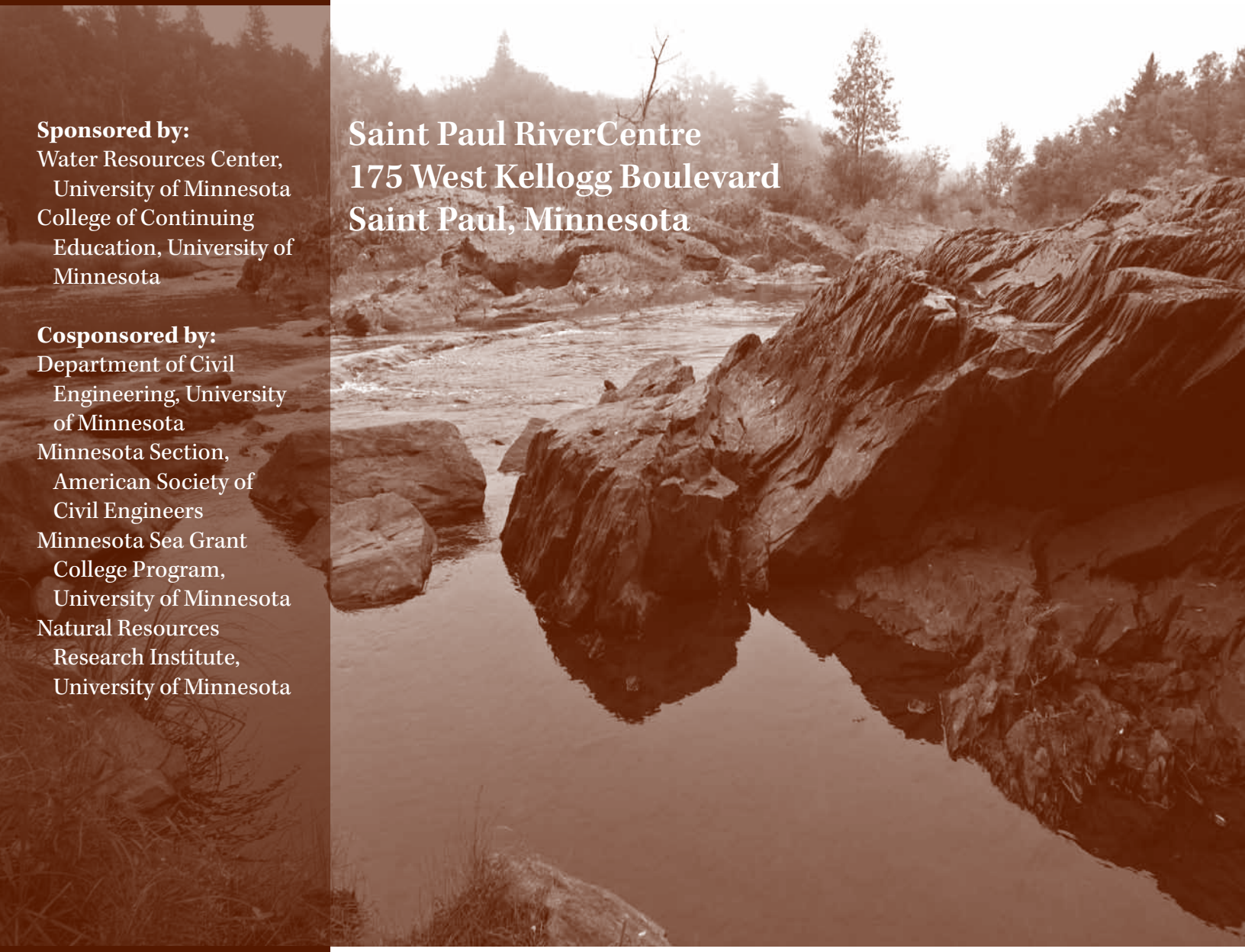
Water Resources Center
University of Minnesota

Final Program and Book of Abstracts

Minnesota Water Resources Conference

October 26–27, 2009



Saint Paul RiverCentre
175 West Kellogg Boulevard
Saint Paul, Minnesota

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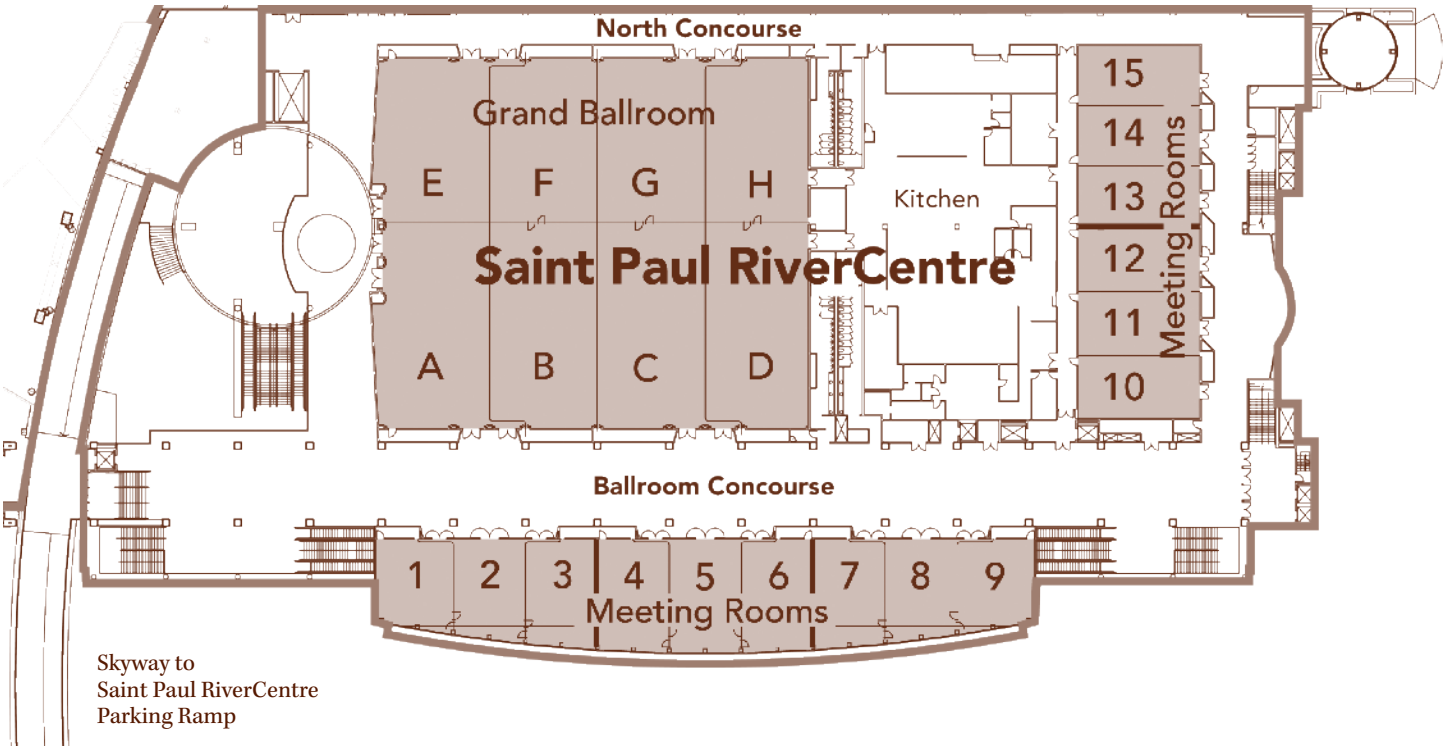
Minnesota Water Resources Conference

October 26-27, 2009

The **Minnesota Water Resources Conference** presents innovative and practical water resource management techniques and highlights research about Minnesota's water resources. The conference provides an opportunity to address: 1) **best practices** discovered in the **design and application** of water resource management techniques, 2) implications of **water policy** decisions, and 3) **research** into **current and emerging issues**. The conference facilitates interaction among water resources professionals including resource managers; researchers; local, state, and federal agency staff; consultants; practicing engineers; as well as students in the field.

Continuing Education Units (CEUs); Professional Development Hours (PDHs)

Conference attendees will receive .675 CEUs/PDHs for each day of the Minnesota Water Resources Conference. Participants who wish to receive full credit must attend all scheduled hours of the event.



2009 Water Resources Planning Committee

Bill Arnold	Department of Civil Engineering, University of Minnesota
John Baker	U.S. Department of Agriculture/Department of Soil, Water, and Climate, University of Minnesota
John Blackstone	Saint Paul Regional Water Services
Dan Breneman	Natural Resources Research Institute, University of Minnesota, Duluth
Tina Carstens	Ramsey-Washington Metro Watershed District
Heather Dorr	College of Continuing Education, University of Minnesota
Mark Edlund	Saint Croix Watershed Research Station
Lisa Goddard	SRF Consulting Group, Inc.
Lori Graven	College of Continuing Education, University of Minnesota
Lorin K. Hatch	HDR Engineering, Inc.
Andrea Hendrickson	Minnesota Department of Transportation
Jon Hendrickson	U.S. Army Corps of Engineers
Karen Jensen	Metropolitan Council
Suzanne A. Jiwani	Department of Natural Resources
Heather Johnson	Minnesota Department of Agriculture
Maria Juergens	Water Resources Center, University of Minnesota
Ron Leaf	Short Elliott Hendrickson, Inc.
Barb Liukkonen	University of Minnesota Extension
Randy Neprash	Bonestroo / Minnesota Cities Stormwater Coalition
**Jennifer L.Olson*	Emmons & Olivier Resources, Inc.
Wayne Sicora	Ryan Companies US, Inc.
Faye Sleeper	Water Resources Center, University of Minnesota
Gene Soderbeck	Minnesota Pollution Control Agency
James Stark	U.S. Geological Survey
**Deborah Swackhamer*	Water Resources Center, University of Minnesota
Stew Thornley	Minnesota Department of Health
Rick Voigt	Voigt Consultants, LLC
Greg Wilson	Barr Engineering Company
Brad Wozney	Board of Soil and Water Resources

* Committee Co-Chairs

Program at a Glance for Monday, October 26, 2009

7:00 a.m. **Registration and Continental Breakfast**

8:00 – 8:10 **Welcome,** *Ballrooms ABEF*
Deborah Swackhamer, Minnesota Water Resources Center, University of Minnesota

8:10 – 8:20 **Dave Ford Water Resources Award**
Presented by: *Ed Nater*, Department of Soil, Water, and Climate, University of Minnesota
Award Recipient: *James L. Anderson*, Department of Soil, Water, and Climate, University of Minnesota

8:20 – 9:30 **Water Sustainability**
Professor Jerald Schnoor, College of Engineering, University of Iowa

9:30 – 10:00 **Break,** *Ballroom Concourse*

10:00 – 11:30 **Concurrent Sessions I**			
A *Meeting Rooms 1–3*	B *Meeting Rooms 4–6*	C *Ballroom C*	D *Ballroom D*
Sustainability for Minnesota Waters	Lake Pepin TMDLs	Stormwater BMP Performance	Macrophytes: Management Tools and Assessment

11:30 – noon **Luncheon Presentation – Building Partnerships for Clean Water,** *Ballrooms ABEF*

Congresswoman Betty McCollum, Minnesota District 4
Moderator: *Deborah Swackhamer*, Water Resources Center, University of Minnesota

Noon – 1:00 p.m. **Lunch**

1:15 – 2:45 **Concurrent Sessions II**			
A *Meeting Rooms 1–3*	B *Meeting Rooms 4–6*	C *Ballroom C*	D *Ballroom D*
Best Management Practices I	Water Quality Standards and Assessment	Pesticides in Water	River Reach Restoration—Selective Stream Surgery

2:45 – 3:15 **Poster Session and Refreshment Break,** *Ballroom Concourse*

3:15 – 4:45 **Concurrent Sessions III**			
A *Meeting Rooms 1–3*	B *Meeting Rooms 4–6*	C *Ballroom C*	D *Ballroom D*
Engaging Citizens in Water Resources	Biota TMDLs	Best Management Pactices II	Lake Management

4:45 – 5:45 **Reception and Poster Session,** *Ballroom Concourse*

Dave Ford Water Resources Award

Past Award Winners

2009 – James L. Anderson
2008 – Steve Heiskary
2007 – Patrick Brezonik
2006 – Ron Harnack
2005 – Marcel Jouseau
2003 – Heinz G. Stefan

"Award for Outstanding Achievement"
1999 – Ron Nargang
1987 – Ed Bowers
1986 – Earl Kuehnast

Program at a Glance for Tuesday, October 27, 2009

7:00 a.m. **Registration and Continental Breakfast,** *Ballroom Concourse*

8:00 – 8:10 **Welcome,** *Ballrooms ABEF*
Jennifer Olson, Emmons & Olivier Resources, Inc.

8:10 – 9:30 **Land Use and Water Quality: Lessons from the First Two Decades of the USGS National Water-Quality Assessment (NAWQA) Studies**
Paul D. Capel, United States Geological Survey, and Department of Civil Engineering, University of Minnesota

9:30 – 10:00 **Poster Session and Refreshment Break,** *Ballroom Concourse*

10:00 – 11:30 **Concurrent Sessions IV**			
A *Meeting Rooms 1–3*	B *Meeting Rooms 4–6*	C *Ballroom C*	D *Ballroom D*
News from the MPCA: Stormwater, TMDLs, NPDES Permits, and a Watershed Approach	Erosion and Sediment Transport in the Minnesota River Basin	GIS Applications in Water Resource Management	Thermal/Cold Water Trout Streams

11:30 – 12:15 p.m. **Lunch,** *Ballrooms ABEF*

12:15 – 1:00 p.m. **Luncheon Presentation—Wetland Drainage and Its Impacts in Minnesota**
Rex Johnson, United States Fish and Wildlife Service
Moderator: *Jennifer Olson*, Emmons & Olivier Resources, Inc.

1:15 – 2:45 **Concurrent Sessions V**			
A *Meeting Rooms 1–3*	B *Meeting Rooms 4–6*	C *Ballroom C*	D *Ballroom D*
Water Resource Responses to Climate and Human Interaction	Turbidity TMDL	Best Management Practices III	Trends and Mapping of Minnesota Wetlands

2:45 – 3:00 **Break,** *Ballroom Concourse*

3:00 – 4:30 **Concurrent Sessions VI**			
A *Meeting Rooms 1–3*	B *Meeting Rooms 4–6*	C *Ballroom C*	D *Ballroom D*
Techniques for BMP Maintenance	Big River Trends and Forecasting	Agriculture and Water Quality	Geomorphologic Methods for Rivers and Streams

4:30 Adjourn

Program Schedule – Monday, October 26, 2009

8:00 – 8:10 **Welcome,** *Ballrooms ABEF*
Deborah Swackhamer, Minnesota Water Resources Center, University of Minnesota

8:10 – 8:20 **Dave Ford Water Resources Award**
Presented by: *Ed Nater*, Department of Soil, Water, and Climate, University of Minnesota
Award Recipient: *James L. Anderson*, Department of Soil, Water, and Climate, University of Minnesota

8:20 – 9:30 **Living With a Changing Water Environment**
Professor Jerald Schnoor, College of Engineering, University of Iowa

9:30 – 10:00 **Break,** *Ballroom Concourse*

10:00 – 11:30 Concurrent Sessions I

TRACK A *Meeting Rooms 1–3*

Sustainability for Minnesota Waters

Moderator: *Shannon J. Fisher*, Minnesota River Board and Water Resources Center, Minnesota State University, Mankato
Co-Moderator: *Ron Leaf*, Short Elliott Hendrickson, Inc.

Developing Minnesota's Framework for Water Sustainability
Princesa VanBuren Hansen and *John Wells*, Minnesota Environmental Quality Board; *Faye Sleeper* and *Deborah Swackhamer*, Water Resources Center, University of Minnesota

Water Resources Sustainability and Climate Change in the Twin Cities Metropolitan Area
Heidi Peterson, *John Nieber*, and *Roman Kanivetsky*, University of Minnesota; *Boris Shmagin*, South Dakota State University

Sustaining Energy and Water Resources of Minnesota—The Systematic Analysis Framework
Yi-Wen Chiu, and *Sangwon Suh,* University of Minnesota; *Laura Schmitt Olabisi*, Michigan State University

TRACK B *Meeting Rooms 4–6*

Lake Pepin TMDLs

Moderator: *John Blackstone*, Saint Paul Regional Water Services
Co-Moderator: *Jon Hendrickson*, U.S. Army Corps of Engineers

Lake Pepin TMDL Edging Toward Implementation
Norman Senjem, Minnesota Pollution Control Agency

Sediment and Nutrient Reduction Strategies for the Minnesota River and Lake Pepin
Larry Gunderson, Bill Kell, Hafiz Munir, and *Chuck Regan,* Minnesota Pollution Control Agency

Lake Pepin TMDL Nonpoint Source Implementation
Kris Sigford, Minnesota Center for Environmental Advocacy

TRACK C *Ballroom C*

Stormwater BMP Performance

Moderator: *Andrea Hendrickson*, Minnesota Department of Transportation
Co-Moderator: *Karen Jensen*, Metropolitan Council

Particle Settling Velocity and the Impact on Stormwater BMP Performance
Eric Hettler, *Andrew Erickson,* and *John Gulliver,* University of Minnesota; *Peter Weiss*, Valparaiso University

Standard Sumps as a Stormwater Best Management Practice
Adam Howard, *John Gulliver, Omid Mohseni,* and *Heinz Stefan*, University of Minnesota

Stormwater BMP Performance and Cost Effectiveness
Melissa Baker and *Mark Doneux*, Capitol Region Watershed District

TRACK D *Ballroom D*

Macrophytes: Management Tools and Assessment

Moderator: *Lorin K. Hatch*, HDR Engineering, Inc.
Co-Moderator: *Mark Edlund*, Saint Croix Watershed Research Station

Evaluation of a Submergent Macrophyte as a Tool for Nutrient Removal in a Southcentral Minnesota Hypereutrophic Lake
Matthew Ribikawskis, and *Shannon Fisher*, Minnesota State University, Mankato

Development of a Macrophyte-Based Index of Biotic Integrity for Minnesota Lakes
Marcus Beck and *Lorin K. Hatch*, University of Minnesota

Assessment of Lake-Wide Herbicide Treatment for Controlling Curlyleaf Pondweed in Minnesota Lakes
James Johnson and *Raymond Newman,* University of Minnesota

11:30 – Noon **Luncheon Presentation – Building Partnerships for Clean Water,** *Ballrooms ABEF*
Congresswoman Betty McCollum, Minnesota District 4
Moderator: *Deborah Swackhamer*, Water Resources Center, University of Minnesota

12:00 – 1:00 p.m. **Lunch**

1:15 – 2:45 Concurrent Sessions II

TRACK A *Meeting Rooms 1–3*

Best Management Practices I
Moderator: *Tina Carstens*, Ramsey-Washington Metro Watershed District
Co-Moderator: *Brad Wozney*, Board of Water and Soil Resources

Murphy Warehouse Company: Retrofit in a Highly Urbanized Area
Rebecca Kluckhohn, Wenck Associates, Inc. and *Richard Murphy*, Murphy Warehouse Company

Celebrating Water: Maplewood Nature Center's Sustainable Landscape Project
Jan Hayman, Maplewood Nature Center; *Ron Leaf* and *Veronica Anderson,* Short Elliot Hendrickson, Inc.; *Gina Gaynor*, City of Maplewood

LEEDing by Example
Mary Jo Roth, Great River Energy

TRACK B *Meeting Rooms 4–6*

Water Quality Standards and Assessment
Moderator: *Gene Soderbeck*, Minnesota Pollution Control Agency
Co-Moderator: *Randy Neprash*, Bonestroo/Minnesota Stormwater Coalition

Draft River Nutrient Water Quality Standards: A Regional Approach Using Biological Response Relationships and Quantile Regression
Steven Heiskary, Will Bouchard, and *Howard Markus*, Minnesota Pollution Control Agency

Muddy Waters Typically Run Deep (or Developing Practical Turbidity TMDLs)
Greg Wilson, Barr Engineering Company

Correlations and Spatial and Seasonal Variations Among Streamflow, Suspended-Sediment Concentration, and Turbidity in Minnesota's Wild Rice River
Christopher Ellison, James Fallon, and *Richard Kiesling,* U.S. Geological Survey

TRACK C *Ballroom C*

Pesticides in Water
Moderator: *Faye Sleeper*, Water Resources Center, University of Minnesota
Co-Moderator: *Heather Johnson*, Minnesota Department of Agriculture

Taking a Holistic Approach to Niche Monitoring: Pesticides in Minnesota Waters
David Tollefson and *Heather Johnson*, Minnesota Department of Agriculture

A Review of Atrazine Detections in Drinking Water and Groundwater in Support of a Special Registration Review of Atrazine in Minnesota
Nila Hines, Minnesota Department of Agriculture

Pesticide Breakdown Products in Minnesota Groundwater
John W. Hines,and *Heather Johnson*, Minnesota Department of Agriculture

TRACK D *Ballroom D*

River Reach Restoration —Selective Stream Surgery
Moderator: *Rick Voigt*, Voigt Consultants, LLC
Co-Moderator: *Andrea Hendrickson*, Minnesota Department of Transportation

Minnehaha Creek Restoration at Methodist Hospital; Integrating Healing Processes
Martin Melchior, Interfluve; *Jonathon Kusa*, HR Green

Current Research at the Saint Anthony Falls Laboratory Outdoor StreamLab
Anne Lightbody and *Jeffrey Marr,* Saint Anthony Falls Laboratory, University of Minnesota

North Creek Rehabilitation Design and Construction: Reconstructive Surgery for a Ditched Stream
Jesse Carlson, Bonestroo; *Corey Markfort*, Saint Anthony Falls Laboratory, University of Minnesota; *Jen Dullum*, City of Farmington

2:45 – 3:15 **Poster Session and Refreshment Break,** *Ballroom Concourse*

3:15 – 4:45 **Concurrent Sessions III**

TRACK A *Meeting Rooms 1–3*

Engaging Citizens in Water Resources

Moderator: *Barb Liukkonen*, University of Minnesota
Co-Moderator: *Stew Thornley*, Minnesota Department of Health

Connecting Environmental Policy with Citizen Engagement: A Comparative Study Between Minnesota's Lake Improvement Districts and Wisconsin's Lake Districts
Kaitlin Steiger-Meister, University of Minnesota

The Amity Creek Charrette: Engaging the Community, Protecting Resources
Jesse Schomberg, Minnesota Sea Grant, University of Minnesota

What Will it Take to Get You to Conserve? Lessons from the Native Shoreland Buffer Incentives Program Surveys
Karlyn Eckman, Water Resources Center, University of Minnesota; *Mary Blickenderfer*, University of Minnesota Extension; *Steve Henry,* East Otter Tail Soil & Water Conservation District; *Erika Rivers*, Minnesota Department of Natural Resources

TRACK B *Meeting Rooms 4–6*

Biota TMDLs

Moderator: *Greg Wilson*, Barr Engineering Company
Co-Moderator: *John Blackstone*, Saint Paul Regional Water Services

Linking Stressors to Aquatic Stream Health: A Protocol for Developing Impaired Biota TMDLs in Minnesota
Jeff Jasperson, *Kimberly Laing,* and *Joseph Magner,* Minnesota Pollution Control Agency

Stream Biological TMDLs – Overcoming the Challenges of the Stressor Identification Process
Annie Felix, Benton Soil and Water Conservation District; *Jeff Jasperson and Kimberly Laing*, Minnesota Pollution Control Agency

A Case Study Examining a Biotic Impairment in Western Minnesota: Dry Wood Creek
Kimberly Laing, Chandra Carter, Joel Chirhart, Kelli Daberkow, Jeffrey Jasperson, and *Joseph Magner,* Minnesota Pollution Control Agency; *Shaun McNally,* Stevens Soil and Water Conservation District

TRACK C *Ballroom C*

Best Management Practices II

Moderator: *Lisa Goddard*, SRF Consulting Group
Co-Moderator: *James Stark*, U.S. Geological Survey

Stormwater BMPs to Meet Pre-Settlement Volume and Nutrient Export Objectives—A Case Study
John Barten, Three Rivers Park District; *Walter Eshenauer*, SRF Consulting Group, Inc.

Blue Green Schools
Paul Chellsen, City of Minneapolis; *Kristina Robertson*, Burnsville Eagan Savage Public Schools

Argenta Hills: A True LID Development—Planning, Policy and Engineering
Brett Emmons and *Eli Rupnow*, Emmons & Olivier Resources; *Scott Thureen*, City of Inver Grove Heights; *Jim Dockstader*, Enebak Construction Company

TRACK D *Ballroom D*

Lake Management

Moderator: *Lorin K. Hatch*, HDR Engineering, Inc.
Co-Moderator: *Ron Leaf*, Short Elliot Hendrickson, Inc.

Bathymetric Analysis of Lake Minnetonka: Charting What Lies Beneath
Jason Carlson, Fillmore Soil & Water Conservation District; *Shahram Missaghi*, Saint Anthony Falls Laboratory, University of Minnesota; *Udai Singh*, Minnehaha Creek Watershed District

Three Dimensional Lake Modeling to Design and Test Lake Aeration Systems: Case Study of Ford Lake in Michigan
Kevin Menken and *Keith Pilgrim*, Barr Engineering Company, Inc.

Modern and Historical Water Quality Variability in the Lake Minnetonka Watershed: Using Sediment Core Analysis to Develop Nutrient Targets and Prioritize Lake Management Efforts
Mark Edlund, *Avery Cook Shinneman,* and *Joy Ramstack*, Saint Croix Watershed Research Station; *Udai Singh*, Minnehaha Creek Watershed District; *Jason Carlson*, Fillmore Soil & Water Conservation District

4:45 – 5:45 **Reception and Poster Session,** *Ballroom Concourse*

Program Schedule – Tuesday, October 27, 2009

8:00 – 8:10 **Welcome,** *Ballrooms ABEF*
Jennifer Olson, Emmons & Olivier Resources, Inc.

8:10 – 9:30 **Plenary Session – Land Use and Water Quality: Lessons from the First Two Decades of the USGS National Water-Quality Assessment (NAWQA) Studies**
Paul D. Capel, United States Geological Survey, and Department of Civil Engineering, University of Minnesota

9:30 – 10:00 **Poster Session and Refreshment Break,** *Ballroom Concourse*

10:00 – 11:30 Concurrent Sessions IV

TRACK A *Meeting Rooms 1–3*

News from the MPCA: Stormwater, TMDLs, NPDES Permits, and a Watershed Approach

Moderator: *Randy Neprash*, Bonestroo/Minnesota Stormwater Coalition
Co-Moderator: *Dan Breneman*, Natural Resources Research Institute

Addressing Regulated Stormwater in Large Watershed TMDLs
Anna Kerr and *Michael Trojan*, Minnesota Pollution Control Agency

Industrial Stormwater Regulations: Adding the Third Leg to the MPCA Stormwater Program Stool
Melissa Wenzel, Minnesota Pollution Control Agency

A Watershed Framework for Clean Water Legacy Act Implementation
Shannon Lotthammer, and *Glenn Skuta*, Minnesota Pollution Control Agency

TRACK B *Meeting Rooms 4–6*

Erosion and Sediment Transport in the Minnesota River Basin

Moderator: *Jon Hendrickson*, U.S. Army Corps of Engineers
Co-Moderator: *Heather Johnson*, Minnesota Department of Agriculture

Lake Pepin: Recent Accumulation Rates and Source Apportionment
Dylan Blumentritt, University of Minnesota; *Daniel Engstrom* and *Shawn Schottler,* Saint Croix Watershed Research Station

Sediment Sources in the Minnesota River Basin
Peter Wilcock, Johns Hopkins University; *Patrick Belmont*, National Center for Earth-surface Dynamics, Saint Anthony Falls Laboratory, University of Minnesota; *Karen Gran,* University of Minnesota Duluth; *Carrie Jennings,* Minnesota Geological Survey

Barr-NCED Mapper for Channel-Floodplain Sediment Exchange Modeling
Patrick Belmont, National Center for Earth-Surface Dynamics, Saint Anthony Falls Laboratory, University of Minnesota; *Tim Anderson, Christy Shostal,* and *Miguel Wong*, Barr Engineering Company, Inc.

TRACK C *Ballroom C*

GIS Applications in Water Resource Management

Moderator: *Suzanne Jiwani*, Minnesota Department of Natural Resources
Co-Moderator: *Rick Moore*, Water Resources Center, Minnesota State University, Mankato

Historic Waters of the MWMO
Anthony Randazzo, HDR Engineering, Inc.; *Dan Kalmon*, Mississippi River Watershed Management Organization

Minnesota DNR Watershed Delineation Project—The First Decade
Sean Vaughn, Minnesota Department of Natural Resources

Using Community Growth Scenarios to Evaluate Potential Water Quality Impacts
Valerie Brady and *Gerald Sjerven*, Natural Resources Research Institute, University of Minnesota; *Jesse Schomberg*, Minnesota Sea Grant, University of Minnesota

TRACK D *Ballroom D*

Thermal/Cold Water Trout Streams

Moderator: *Stew Thornley*, Minnesota Department of Health
Co-Moderator: *John Baker*, U.S. Department of Agriculture/Department of Soil, Water, and Climate, University of Minnesota

Groundwater Recharge in a Coldwater Stream During Urbanization
Timothy Erickson and *Heinz Stefan*, University of Minnesota

Estimating Groundwater Input to the Vermillion River from Measurements of Stream Temperature and Stream Flow
Ben Janke, *William Herb, Omid Mohseni,* and *Heinz Stefan*, University of Minnesota

Brown's Creek Biotic TMDL: An Alternative to Thermal Modeling for Quantifying Thermal Stresses on Brown Trout
Thomas Miller, Emmons & Olivier Resources, Inc.

11:30 – 12:15 p.m. **Lunch,** *Ballrooms ABEF*

12:15 – 1:00 **Luncheon Presentation – Wetland Drainage and Its Impacts in Minnesota**
Rex Johnson, United States Fish and Wildlife Service
Moderator: *Jennifer Olson*, Emmons & Olivier Resources, Inc.

1:15 – 2:45 Concurrent Sessions V

TRACK A *Meeting Rooms 1–3*

Water Resource Responses to Climate and Human Interaction
Moderator: *James Stark*, U.S. Geological Survey
Co-Moderator: *Faye Sleeper*, Water Resources Center, University of Minnesota

Changes in Groundwater Level and Potentiometric Surfaces in Selected Bedrock Aquifers in the Twin Cities Metropolitan Area, 2008
Christopher Sanocki, *Susan K. Langer* and *Jason C. Menard,* U.S. Geological Survey

Shallow Groundwater Temperature Response to Climate Change and Urbanization
Craig Taylor, Saint Anthony Falls Laboratory, University of Minnesota

Low-Flow Characteristics of the Mississippi River and Selected Tributaries
Dave Lorenz, and *Erich Kessler*, U.S. Geological Survey

TRACK B *Meeting Rooms 4–6*

Turbidity TMDL
Moderator: *Dan Breneman*, Natural Resources Research Institute
Co-Moderator: *Scott Bohling*, Water Resources Center, Mankato State University

The Relationship of Turbidity Surrogates to Physical Watershed Characteristics
Larry Gunderson and *David Mulla,* University of Minnesota

SWAT Modeling of a Rural Watershed for Turbidity TMDL
Joe Mulcahy, Metropolitan Council

TMDL Allocations for Non-Point Sources—A Turbidity TMDL Study Using SWAT for Carver Creek Watershed, MN
Hong Wang, *Karen Jensen, Judy Sventek,* and *Marcel Jouseau,* Metropolitan Council

TRACK C *Ballroom C*

Best Management Practices III
Moderator: *Jennifer L. Olson*, Emmons & Olivier Resources, Inc.
Co-Moderator: *Gene Soderbeck*, Minnesota Pollution Control Agency

Iron-Enhanced Sand Filtration for Stormwater Phosphorus Removal
Andy Erickson and *John Gulliver,* Saint Anthony Falls Laboratory, University of Minnesota; *Brian Huser*, Barr Engineering Company, Inc.

Pine City Storm Water Management Retrofits, a Cost Comparison of the Traditional Methods Verses New Methods
Sean R. Clark, Short Elliot Hendrickson, Inc.

Permeable Pavement: Bloomington Public Works Experience
Steven Segar and *Dave Gunderson*, City of Bloomington

TRACK D *Ballroom D*

Trends and Mapping of Minnesota Wetlands
Moderator: *Brad Wozney*, Board of Water and Soil Resources
Co-Moderator: *Lorin K. Hatch*, HDR Engineering, Inc.

Status and Trends of Wetlands in Minnesota: Wetland Quantity
Steve Kloiber and *Doug Norris*, Minnesota Department of Natural Resources; *Mark Gernes*, Minnesota Pollution Control Agency

Status and Trends of Wetlands in Minnesota: Wetland Quality
John Genet, Minnesota Pollution Control Agency

Evaluating the Potential of Using Topographic Data for Wetland Mapping in Minnesota
Lian Ortiz, *Joseph Knight,* and *Bryan Tolcser,* University of Minnesota; *Steve Kloiber*, Minnesota Deparment of Natural Resources

2:45 – 3:00 **Break,** *Ballroom Concourse*

3:00 – 4:30 **Concurrent Sessions VI**

TRACK A *Meeting Rooms 1–3*

Techniques for BMP Maintenance

Moderator: *Karen Jensen*, Metropolitan Council
Co-Moderator: *Tina Carstens*, Ramsey-Washington Metro Watershed District

2-D Modeling of Rice Creek: Alternatives for Reducing Channel Maintenance
Matt Redington and *Nick Fleming*, HDR Engineering, Inc.

Certifying Infiltration Practices: A Critical,but Often Overlooked Step
Patrick Conrad, Emmons & Olivier Resources, Inc.; *Dave Bauer,* Rice Creek Watershed District

BMPs: Now That You Have Them, How Do You Maintain Them?
Lisa Goddard, SRF Consulting Group, Inc.; *Mark Maloney*, City of Shoreview

TRACK B *Meeting Rooms 4–6*

Big River Trends and Forecasting

Moderator: *Suzanne Jiwani*, Minnesota Department of Natural Resources
Co-Moderator: *Rick Voigt*, Voigt Consultants, LLC

Long-Range Probabilistic Forecasts for the 2009 Red River Flood
Allen Bradley and *Mohamed Habib*, University of Iowa; *Steve Buan*, NWS North Central River Forecast Center

Forecasting the 2009 Record Floods on the Red River of the North
Andrea Holz, *Steve Buan*, and *Mike DeWeese*, NWS North Central River Forecast Center

Minnesota River Trends Report
Kimberly Musser, *Scott Kudelka,* and *Rick Moore*, Water Resources Center, Minnesota State University, Mankato; *Larry Gunderson*, Minnesota Pollution Control Agency; *Deepak Sanjel*, Mathematics Department, Minnesota State University, Mankato

TRACK C *Ballroom C*

Agriculture and Water Quality

Moderator: *Les Everett*, Water Resources Center, University of Minnesota
Co-Moderator: *John Blackstone*, Saint Paul Regional Water Services

Two-Stage Designs for Agricultural Drainage Ditches
Bruce Wilson, *Brad Hansen, Geoffrie Kramer, John Nieber, Gary Sands,* and *Jeff Strock*, University of Minnesota; *Joseph Magner*, Minnesota Pollution Control Agency

Crop Residue Management Trends in Minnesota
Shannon Fisher and *Richard Moore,* Water Resources Center, Minnesota State University, Mankato

Can Perennial Biofuel Cropping Systems Be Used to Remove Pharmaceuticals from the Environment?
Jared Trost, *Melinda Erickson,* and *Richard Kiesling*, U.S. Geological Survey; *Clarence Lehman* and *John Nieber*, University of Minnesota

TRACK D *Ballroom D*

Geomorphologic Methods for Rivers and Streams

Moderator: *Mark Edlund*, Saint Croix Watershed Research Station
Co-Moderator: *Greg Wilson*, Barr Engineering Company, Inc.

Rapid Channel Stability Assessments for Streams in Minnesota: Do We Need to Reinvent the Wheel? Or Just Redesign the Bicycle?
Brenda Asmus, *Joe Magner,* Minnesota Pollution Control Agency; *Britta Suppes*, University of Minnesota

Assessment of Geomorphic Methods for Application to Biota TMDLs in the Red River Basin
Chris Lenhart, Emmons & Olivier Resources, Inc., and University of Minnesota; *Kevin Biehn, Andrea Plevan, Toben LaFrancois,* and *Jason Naber*, Emmons & Olivier Resources, Inc.

Dobbins Creek Culvert Sizing
Greg Eggers, Minnesota Department of Natural Resources

4:30 **Adjourn**

Poster Display

The following posters will be displayed during the breaks and Monday reception.

1 **Urban Lake Management Action Plans: Getting ahead of TMDLs**
Carl Almer, Emmons & Olivier Resources, Inc.; *Matthew Kocian*, Rice Creek Watershed District

2 **Meta-Analysis as a Statistical Tool for Evaluating the Hydrologic Effects of Subsurface Drainage Design and Water Table Management**
Sheila Amenumey, *Gary Sands*, and *Bruce Wilson*, University of Minnesota

3 **Clean Water Act 316(a) Demonstrations on the Upper Mississippi River**
Jeff Berrington and *Brian Schmidt*, Xcel Energy

4 **An Assessment of Chloride Sources and Contamination in the Twin Cities Metropolitan Area**
Joe Bischoff and *Diane Spector*, Wenck, Inc.; *Brooke Asleson* and *Barb Peichel*, Minnesota Pollution Control Agency

5 **Modeling Road Salt and Total Dissolved Solids Transport in StormNET (Powered by EPA-SWMM)**
Kent Brander, *Nancy-Jeanne LeFevre*, and *Eli Rupnow*, Emmons & Olivier Resources, Inc.

6 **Making TMDLs Make Sense Through Simulations and Games**
Cynthia Hagley and *Jesse Schomberg* Minnesota Sea Grant; *John Bilotta*, University of Minnesota Extension; *Amy Elliot*, and *Susan O'Halloran,* University of Wisconsin Extension; *Barbara Liukkonen*, University of Minnesota Extension; and *Julie Westerlund*, Minnehaha Creek Watershed District

7 **Cost Analysis of Alternative Culvert Installation Practices in Minnesota**
Bradley Hansen; *Christian Lenhart*, and *John Nieber*, University of Minnesota

8 **Climate Change and Watershed Management Model Uncertainty**
Suresh Hettiarachchi, *Ted Shannon* and *Jeff Christopherson*, HDR Engineering, Inc.

9 **Mapping Stream and River Shoreland in Southeast Minnesota**
Ross Hoffmann, Cannon River Watershed Partnership

10 **Practical Floristic Quality Assessment of Wetlands in Minnesota**
Wayne Jacobson, Jacobson Environmental

11 **Field-Scale Evaluation of *Escherichia coli* and Nutrient Transport through Subsurface Tile Drainage**
Kyle Jarcho and *Shannon Fisher*, Minnesota State University, Mankato

12 **Shaping Our Future Water Policy: Water Recycle and Reuse**
Michael Jungbauer, Landform

13 **Implementation First: A Watershed-Wide Approach to TMDL Implementation**
Rebecca Kluckhohn, Wenck Associates, Inc.; *Merle Anderson* and *Dennis Loewen*, Clearwater River Watershed District; and *Margaret Leach*, Minnesota Pollution Control Agency

14 **Tipping Point: A Northern Lakes and Forests Nutrient TMDL for Jessie Lake**
Rebecca Kluckhohn, Wenck Associates, Inc.; *Noel Griese,* Itasca Soil & Water District; *Don Carlson*, Minnesota Pollution Control Agency

15 **Building Training Capacity to Meet Clean Water Goals**
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16 **Doing More with Less: Tools for Screening the Potential Health Risks of Emerging Contaminants with Limited Toxicological Information**
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Eric Sell, Kyle Beadle, and *Nancy Read,* Metro Mosquito Control District

20 **Reducing Spread of Invasive Species through In-Line Screening**
Lindsey Roberts McKenzie, *Emily Davis*, and *Donald Lutch*, Short Elliott Hendrickson Inc.; *William (Jay) Rendall*, Minnesota Department of Natural Resources; *Tom Wesolowski*, City of Shoreview

21 **Remote Sensing Approaches for Assessing Loss of Restored Wetlands**
Patrick Sherman and *Susan Galatowitsch*, University of Minnesota

22 **Metro Metals—Creative Stormwater Management Using Recycled Materials**
Todd Shoemaker, Wenck Associates, Inc.

23 **Minnesota's Statewide Citizen Stream Monitoring Program—Transparency Trend Analysis and Future Program Possibilities**
Bill Thompson, Minnesota Pollution Control Agency

24 **Minnesota Geochemical Database**
L. Harvey Thorleifson and *Richard S. Lively*, Minnesota Geological Survey

25 **Stormwater Mapping: Making Connections with the New Data Exchange Standard**
Mike Trojan, Minnesota Pollution Control Agency; *Nancy Read*, Metro Mosquito Control District

26 **Dynamics of Mercury Export from an Upland-Peatland Watershed in North-central Minnesota**
Martin Tsui, *Jacques Finlay,* and *Edward Nater,* University of Minnesota; *Stephen Sebestyen*, U.S. Department of Agriculture, Forest Service

27 **Influences of Land Cover on Methylmercury Concentrations in Water and Invertebrates in Minnesota Stream Ecosystems**
Martin Tsui and *Jacques Finlay*, University of Minnesota

28 **Sibley Parkway Redevelopment and Riverbank Restoration**
Chuck Vermeersch, I&S Group, Inc.

Minnesota Section, American Society of Civil Engineers (ASCE) Meeting

Monday, October 26, 2009
6:00 p.m. Social Hour, 7:00 p.m. Dinner, 8:00 p.m. Program
Location: Mancini's Char House and Lounge, 531 West Seventh Street, Saint Paul, Minnesota
Cost: $30
This meeting is open to anyone who is interested.

Saint Paul Regional Water Services and Vadnais Lake Area Water Management Organization Watershed Restoration Program (VLAWMO)

Speaker: *Dave Schuler*, Saint Paul Regional Water Services

The Saint Paul Regional Water Services (SPRWS) serves over 415,000 customers. The single treatment facility receives source water from a chain of reservoirs that are augmented with water from the Mississippi River and local watersheds. VLAWMO is a joint powers organization that governs the 24-square-mile watershed in the northeast twin city area that drains to Vadnais Lake, the final impoundment reservoir for the SPRWS.

In 1984 SPRWS initiated an intensive diagnostic study of the source water reservoir system and contributing watersheds. The results of the study indicated that phosphorus enrichment of the reservoirs caused water-treatment problems. Identified sources of phosphorus loads into the reservoir system included the Mississippi River, internal loads from lake sediments, and drainage from local watersheds – primarily Lambert Creek.

Phosphorus (P) loadings from the Mississippi River source and reservoir sediments were addressed by capital projects funded by SPRWS in the form of chemical feed applications and hypolimnetic aerators in two reservoirs. In 1989 the Vadnais Lake Area Watershed Management Organization initiated a Clean Water Partnership with funding from Minnesota Pollution Control Agency and later the Section 319 funding from the U.S. Environmental Protection Agency. The project resulted in stop-log weir construction that was completed on two of the wetlands along Lambert Creek in 1995 in an effort to restore them to their former hydrology.

Further reductions in P loading are desirable for improved water quality in Vadnais Lake. Lambert Lake, the final wetland in the Lambert Creek watershed, provides an opportunity, via ponding, flow dispersion, and infiltration to reduce the P loadings to Vadnais Lake.

SPRWS has benefited from the watershed restoration practices through reductions in frequency and magnitude of taste and odor compounds in the supply system. However, taste and odor incidences continue to occur. Granular activated carbon filters were installed at the McCarron's filtration plant and 2006 to provide a final control of taste and odor compounds.

For questions or additional registration information, contact Teresa Kes, Barr Engineering, tkes@barr.com, or John F. Blackstone, PE, jblackstone@comcast.net or 651-266-6324.

Reservations can be made online at www.ascemn.org or through voice mail at 952-832-2929.

Minnesota Water Resources Conference

October 26–27, 2009

Saint Paul RiverCentre

175 West Kellogg Boulevard
Saint Paul, Minnesota

Book of Abstracts

Arranged by session in order of presentation
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Plenary Session 1 8:20 a.m. – 9:30 a.m.

Living With a Changing Water Environment

Jerald L. Schnoor, Department of Civil and Environmental Engineering, IIHR – Hydroscience and Engineering & Center for Global and Regional Environmental Research, University of Iowa, Jerald-schnoor@uiowa.edu

Water is a vital resource for our society that is increasingly impacted by multiple demands of water supply, agriculture, industry, recreation, and ecosystem needs. Stressing our water resources are a changing climate, and shifting patterns of population and land use. Increasing rainfall, falling in more intense episodes, is a characteristic pattern for the Upper Midwest. The U.S. Climate Change Science Program reported in its Synthesis and Assessment Product 3.3, June 2008, "One of the clearest trends in the United States observational record is an increasing frequency and intensity of heavy precipitation events. Over the last century there was a 50% increase in the frequency of days with precipitation over 101.6 mm (four inches) in the upper midwestern U.S.; this trend is statistically significant". Such rainfall causes severe flooding and carries nutrients and pathogens down the Mississippi River on its way to the Gulf of Mexico, exacerbating Gulf Hypoxia. Furthermore, flood waters drain agricultural land that is changing due to the demand for biofuels and the Energy Independence and Security Act of 2007 (EISA).

Traditionally, water has been managed in a fragmented manner—for example, groundwater is treated separately from surface water, and standards for effluent discharge are often disconnected from quality required at downstream water intakes. Development of integrated research and management of water resources has been frequently stated as a goal, but knowledge gaps make this difficult to achieve. The WATer and Environmental Research Systems (WATERS) Network Project Office, which is funded by the National Science Foundation Engineering and Geosciences Directorates, will provide an opportunity to advance our understanding of water as an integrated resource. The WATERS Network will be an integrated real-time distributed observing system that will enable academic and government scientists, engineers, educators, and practitioners to advance effective analysis of our nation's water resources through the understanding of human interactions with water and the natural and built environment.

Monday, October 26

Concurrent Session I 10:00 a.m. – 11:30 a.m.

Track A: Sustainability for Minnesota Waters

Developing Minnesota's Framework for Water Sustainability

Princesa VanBuren Hansen, Minnesota Environmental Quality Board, princesa.vanburen@state.mn.us; Faye Sleeper, Water Resources Center, University of Minnesota; Deborah Swackhamer, Water Resources Center, University of Minnesota; John Wells, Minnesota Environmental Quality Board

The water appropriation permit and state environmental review programs systematically engage project proposers, decision makers and citizens in discussions about the environmental effects of projects involving water use. These groups want a better understanding of the long-term implications of individual project choices. Determining whether the state is on a sustainable course requires knowledge of what rates of water use can be sustained and assessment of the cumulative significance of future land use and climate changes on Minnesota's human and ecological communities.

The Environmental Quality Board, University of Minnesota, Department of Natural Resources and Freshwater Society have engaged a wide range of experts in coordinated efforts to consider Minnesota's water sustainability framework. The presentation will report on these efforts, including progress to understand framework elements, tools for assessing sustainability, strategic information needs and applications to Minnesota problem areas.

Water Resources Sustainability and Climate Change in the Twin Cities Metropolitan Area

Heidi Peterson, University of Minnesota, pete6495@umn.edu; John Nieber, University of Minnesota; Roman Kanivetsky, University of Minnesota; Boris Shmagin, South Dakota State University

Consistent monitoring within the Twin Cities metropolitan area (TCMA) can address the issue of water resources sustainability in a changing climate. Markers of unsustainable water use have historically been evident within the TCMA since the 1880s. The key indicator in freshwater sustainability is the ratio of renewable water supply to water use by humans and the environment. Water resources sustainability for the TCMA was estimated using an innovative paradigm which parameterized and quantified the relationships between landscape properties and water balance characteristics, by integrating components of the terrestrial hydrologic system with quantitative watershed characterization. This resulted in the development of hydrologic units within the TCMA, which were spatially depicted onto a map containing statistically estimated recharge rates. The creation of community accessibly multi-scale water resources maps promotes the study of interconnections of air temperature and precipitation regimes and provides quantitative criteria for better management of water resources sustainability.

Sustaining Energy and Water Resources of Minnesota—The Systematic Analysis Framework

Yi-Wen Chiu, University of Minnesota, chiux030@umn.edu; Laura Schmitt Olabisi, Michigan State University; Sangwon Suh, University of Minnesota

Minnesota's water resources are poised to undergo significant changes in the coming decades due to climate change, and to the anticipated increase in population and energy demand. To better understand the complexities of water and energy sustainability associated with climate and demographic trends, we propose a framework which incorporates system dynamic and geographic information system (GIS) models. The framework will analyze the future of MN's water budget with particular attention to changes in water demand under different scenarios. Key trends that will be incorporated into the scenarios include (1) biofuel development, (2) changes in the electricity grid mix and growth in demand for electricity, (3) demographic changes, and (4) climate change. Spatially and temporally explicit water budget projections for each scenario will be derived using the framework. The results will help to inform water policy and practice in Minnesota under rapidly changing future conditions.

Concurrent Session I 10:00 a.m. – 11:30 a.m.

Track B: Lake Pepin TMDLs

Lake Pepin TMDL Edging Toward Implementation

Norman Senjem, Minnesota Pollution Control Agency, norman.senjem@pca.state.mn.us

The Lake Pepin TMDL calls for substantial reductions in phosphorus and sediment from point and nonpoint sources of pollution. Almost 1,000 permitted point sources, and untold numbers of nonpoint sources, are affected. The urban, industrial and construction sectors bears the brunt of mandatory reductions through National Pollutant Discharge Elimination System (NPDES) permits for stormwater and wastewater. However, the vast majority of pollutant load reductions must come from nonpoint sources, especially in the Minnesota River. Waste Load Allocations for point sources and Load Allocations for nonpoint sources, along with potential implementation strategies, will be presented.

Sediment and Nutrient Reduction Strategies for the Minnesota River and Lake Pepin

Larry Gunderson, Minnesota Pollution Control Agency, larry.gunderson@state.mn.us; Bill Kell, Minnesota Pollution Control Agency; Hafiz Munir, Minnesota Pollution Control Agency; Chuck Regan, Minnesota Pollution Control Agency

The Minnesota River contributes 80 percent of the sediment and about half of the load of total phosphorus to the Mississippi River and Lake Pepin. It is also impaired on the main stem and most tributaries for excess turbidity. Watershed modeling has been used together with extensive stakeholder interaction to design and evaluate a series of implementation strategies, ranging from application of conventional best management practices to extensive land retirement and upland water storage.

Lake Pepin TMDL Nonpoint Source Implementation

Kris Sigford, Minnesota Center for Environmental Advocacy, ksigford@mncenter.org

The Clean Water Legacy Act calls for use of existing regulatory authorities together with education and economic incentives to achieve land-use changes needed to reach TMDL goals. Existing authorities include state rules regarding agricultural shoreland protection, soil loss limits, livestock feedlots, and others. How can existing regulations be used in conjunction with additional funding from the Clean Water Amendment to provide reasonable assurance that nonpoint source reductions specified in the Lake Pepin TMDL will be achieved?

Concurrent Session I 10:00 a.m. – 11:30 a.m.

Track C: Stormwater BMP Performance

Particle Settling Velocity and the Impact on Stormwater BMP Performance

Eric Hettler, University of Minnesota, hettl001@umn.edu; Andrew Erickson, University of Minnesota; John Gulliver, University of Minnesota; Peter Weiss, Valparaiso University

The performance of stormwater best management practices (BMPs) that rely on sedimentation to remove solids from runoff is heavily dependent on settling velocity. Settling velocity depends on particle properties such as shape, density, and particle size distribution (PSD) of the solids. Characteristics of particles in stormwater are not typically measured, and stormwater BMPs are often designed with inaccurate assumptions of particle shape, particle density, and PSD. By applying the fundamentals of particle settling to BMP design, this paper examines the effect an inaccurate assumption of particle properties has on the predicted performance of sedimentation ponds and commercially available hydrodynamic separators. To overcome the issues associated with mischaracterization of particles in stormwater, an elutriation device to directly measure particle settling velocity distribution in the field is being developed. This device can be used to collect data on particle settling velocity distribution throughout the State of Minnesota.

Standard Sumps as a Stormwater Best Management Practice

Adam Howard, University of Minnesota, howar298@umn.edu; John Gulliver, University of Minnesota; Omid Mohseni, University of Minnesota; Heinz Stefan, University of Minnesota

Sediment deposition has been witnessed in many stormwater sumps. However, there is no data on the effectiveness of sediment removal and proper operation of the sumps to retain sediment. The Minnesota DOT is interested in understanding whether standard sumps already installed in the stormwater collection systems can remove suspended sediment from stormwater runoff and meet stormwater quality goals.

To determine whether the standard sumps remove suspended sediment from stormwater runoff, two full scale standard sumps of different size (4- and 6-ft diameters) have been tested at the St. Anthony Falls Laboratory. Their removal efficiencies under low flow conditions as well as the effluent concentrations under high flow conditions (i.e., scour) have been determined.

Sump removal efficiency functions have been developed. The data collected were compared to proprietary devices that use settling to determine how well the standard sumps will function as stormwater treatment BMPs. The conclusions could result in decreased costs for some projects and stormwater credits for existing facilities.

Arlington Pascal Stormwater BMP Performance and Cost Effectiveness

Melissa Baker, Capitol Region Watershed District, melissa@capitolregionwd.org; Mark Doneux, Capitol Region Watershed District

During 2005 – 2007 the Capitol Region Watershed District (CRWD) constructed BMPs for the Arlington Pascal Stormwater Improvement Project to alleviate flooding and reduce nutrients and sediment reaching Como Lake, which is impaired. The BMPs included a 2 ac-ft underground infiltration facility, eight infiltration trenches constructed beneath city streets, seven raingardens within road right-of-way and a rain garden and regional pond within Como Park.

In 2007 and 2008, the CRWD monitored BMPs for pollutant removal effectiveness through empirical and measured data. In addition to documenting pollutant removal effectiveness, CRWD also documented all design and construction costs and full maintenance costs for each year(s) studied.

Results of the pollutant removal effectiveness will be presented. In addition, comprehensive construction costs as well maintenance practices and costs will also be discussed. Analyzing life cycle costs of Stormwater BMPs along with pollutant removal effectiveness has provided a good method to develop a cost per pound of pollutant removal comparison.

Concurrent Session I 10:00 a.m. – 11:30 a.m.

Track D: Macrophytes: Management Tools and Assessment

Evaluation of a Submergent Macrophyte as a Tool for Nutrient Removal in a Southcentral Minnesota Hypereutrophic Lake

Matthew Ribikawskis, Minnesota State University, Mankato, matthew.ribikawskis@mnsu.edu; Shannon Fisher, Water Resource Center, Minnesota State University, Mankato

Nutrient loading into lakes is a large problem that can have several negative impacts on a water body and the surrounding areas. Continual nutrient inputs into lakes can cause algae to grow uncontrollably, creating the potential for algal blooms. Algal blooms can reduce light and nutrient availability for other plants, create aesthetically displeasing sights and smells, and can become toxic to humans. In southern Minnesota, algal blooms have become a problem for some shallow lakes due to anthropogenic activities. Crystal Lake is considered a highly nutrient enriched lake and has algal problems almost every year. During the summer of 2008, sago pondweed (*Potomogeton pectinatus*) was transplanted to Crystal Lake (Lake Crystal, Minnesota) into four fencing enclosures across the lake. Goals included identifying the mechanism of sago pondweed nutrient uptake, quantifying the amount of phosphorus uptake, and modeling the number of sago pondweed plants needed to significantly reduce the phosphorus levels within Crystal Lake. Ultimately, our objective is to show how/if using sago pondweed is a viable resource to naturally remove nutrients from a lake.

Development of a Macrophyte-Based Index of Biotic Integrity for Minnesota Lakes

Marcus Beck, University of Minnesota, beckx266@umn.edu; Lorin K. Hatch, University of Minnesota

Current methods of ecological health assessment for Minnesota lakes are inadequate for meeting the requirements of the 1972 Clean Water Act (CWA) and assessing the condition of aquatic biota. An aquatic plant-based index of biotic integrity (IBI) was developed to assess the ability of lake macrophytes to provide water quality indications and to fulfill the biotic integrity requirement of the CWA. Index development followed methods used to develop the aquatic macrophyte community index (AMCI) in Wisconsin. In addition to a regional application of the AMCI, metrics and scoring methods were substantially modified to further refine the index. IBI scores showed significant relationships with trophic state, watershed land uses, and county population density. Results suggest that aquatic plant communities are effective indicators of environmental condition that show predictable responses across disturbance gradients. Eventual implementation of the Minnesota macrophyte IBI will enable managers to address increasing human impacts on lacustrine environments.

Concurrent Session I 10:00 a.m. – 11:30 a.m.

Track D: Macrophytes: Management Tools and Assessment, *continued*

Assessment of Lake-Wide Herbicide Treatment for Controlling Curlyleaf Pondweed in Minnesota Lakes

James Johnson, University of Minnesota, h2ojamesj@gmail.com; Raymond Newman, University of Minnesota

Curlyleaf pondweed (*Potamogeton crispus* L.) occurs in over 800 Minnesota lakes. Its early season growth, propensity to form dense surface matting, and ability to out-compete many native aquatic plants allow it to degrade the ecological and recreational quality of infested lakes. Management strategies such as harvesting and localized herbicide treatment can effectively reduce local nuisance growth, but do not generally provide effective long-term control of curlyleaf in heavily infested lakes.

To address the need for improved long-term control strategies, we collaborated with the Minnesota Department of Natural Resources in 2006, 2007, and 2008 to evaluate the use of whole-lake herbicide treatments as a new management strategy. Six infested lakes were treated annually with endothall (0.75-1.00 ppm) or fluridone (2-4 ppb). To assess the impacts of these treatments on curlyleaf and native plants, we conducted three comprehensive point-intercept aquatic vegetation surveys each year (May, June, August) to assess aquatic plant frequency and distribution in the six treated lakes and three additional untreated control lakes. Our monitoring also included plant biomass assessments to track growth density of individual plant taxa, and sediment sampling to track the distribution and density of curlyleaf turions (vegetative propagules) over the three years of the study.

We observed dramatically reduced curlyleaf abundance and reduced sediment turion density in treated lakes. We will present final results of the three-year study with an emphasis on the depletion of turions in treated lakes, the response of native plants, and management considerations for using large-scale herbicide treatments.

Luncheon Presentation 11:30 a.m. – noon

Building Partnerships for Clean Water

Congresswoman Betty McCollum, U.S. House of Representatives, Minnesota District 4

Congresswoman Betty McCollum (MN District 4), a strong advocate for protecting freshwater resources, will highlight the major national and international challenges facing freshwater systems and discuss the importance of a comprehensive, coordinated approach to water policy through local, state, and federal partnerships.

Concurrent Session II 1:15 p.m. – 2:45 p.m.

Track A: Best Management Practices I

Murphy Warehouse Company: Stormwater Retrofit in a Highly Urbanized Area

Rebecca Kluckhohn, Wenck Associates, Inc., rkluckhohn@wenck.com; Richard Murphy, Murphy Warehouse Company

Murphy Warehouse Company faced costly capital improvements and disruption of business at their 22-acre, 98% impervious facility in Minneapolis due to escalating storm water utility fees and a looming city deadline to disconnect 7 acres of storm drainage from the City's sanitary system. The age of the site, its location in a highly urbanized area, the limited adjacent storm water utilities, the unknown underground conditions, and the grade of the site added to the complexity and expense of the problem.

Following an initial evaluation and concept design for the project the site was re-designed to handle the 10-year storm event, exceeded water quality requirements and achieved the *first* major 100% storm water credit of this type in the City of Minneapolis.

The project redirected runoff via the installation of leading-edge storm water management features including a large vegetated infiltration/rate-control pond (slope stability provided through native vegetation), and three bio-retention cells, as well as pipes, catch basins, and sumps. Open-grate sanitary sewer castings were reconstructed with solid cover castings, fully eliminating storm water inflow. An innovative staged pond outlet was designed to maximize pond storage and infiltration in the summer, while assuring the system functions in the winter. The outlet also assures compatibility with a capacity-restricted city storm sewer system.

Visual aesthetic was also a major concern for the client. The President and CEO of Murphy Warehouse, Mr. Richard T. Murphy, R.L.A., is also a registered landscape architect, so maintaining the existing, highly-visible green spaces on site was a high priority in the design. The existing green spaces were improved with plantings and used for infiltration/rate-control. The storm water management features actually enhance the beauty of the site while effectively managing runoff from the rest of the mostly impervious site. Incorporating green space and the use of infiltration and evapotranspiration, the project represents a sustainable design which couples an existing highly impervious area with responsible storm water management at a reasonable return on investment.

The result is an innovative, beautiful storm water retrofit that exceeds city water quality and hydrologic requirements, provides a utility fee credit for an annual savings of $92,000, and disconnects 7 acres of impervious area from the sanitary sewer system, all in the tight confines of an urban facility where land is a premium and visual aesthetic was a key factor for the client. It serves as an example for business owners that stormwater management CAN be achieved in urban areas.

Celebrating Water: Maplewood Nature Center's Sustainable Landscape Project

Jan Hayman, Maplewood Nature Center, jan.hayman@ci.maplewood.mn.us; Gina Gaynor, City of Maplewood; Ron Leaf, Short Elliott Hendrickson, Inc.; Veronica Anderson, Short Elliott Hendrickson, Inc.

The Maplewood Nature Center's new landscape celebrates water from roof to rain gardens and all paths between. An infiltration planter, rain barrels, a meandering rain canal and several rain gardens are part of the first phase of work completed in 2008 to create a more sustainable site. Maplewood has a long history of promoting the use of innovative stormwater BMPs and sustainable landscaping on its projects. The Nature Center, with its educational mission, was presented with a unique opportunity to improve the site drainage conditions and also create a demonstration site for sustainable landscape practices. This presentation will include: a summary of the overall site plan and the process the City followed to realize these improvements; a closer look at the stormwater features; a discussion of the challenges presented with the limited budget; and a discussion of the lessons learned (what went well and what would be done differently).

Concurrent Session II 1:15 p.m. – 2:45 p.m.

Track A: Best Management Practices I, *continued*

LEEDing by Example

Mary Jo Roth, Great River Energy, mjroth@grenergy.com

Great River Energy is a not-for-profit cooperative which provides wholesale electricity to more than 1.7 million people through 28 member distribution cooperatives in Minnesota and Wisconsin. In April 2008 Great River dedicated its new headquarters building in Maple Grove. Designed to be the most efficient building possible, it was named the first Platinum certified LEED building in Minnesota by the U.S. Green Building Council. The 166,000-square-foot office building is designed to use 45 percent less energy than a comparable facility built to state code requirements and 90 percent less water than a similarly sized corporate campus. It features a geothermal HVAC system embedded in adjacent Arbor Lake, in-floor displacement ventilation, daylight harvesting, 72 kilowatts of on-site solar panels and a 200-kilowatt wind turbine. This presentation will describe the energy and environmental aspects of the building and campus with an emphasis on the water conservation and use attributes.

Concurrent Session II 1:15 p.m. – 2:45 p.m.

Track B: Water Quality Standards & Assessment

Draft River Nutrient Water Quality Standards: A Regional Approach Using Biological Response Relationships and Quantile Regression

Steven Heiskary, Minnesota Pollution Control Agency, steven.heiskary@pca.state.mn.us; Will Bouchard, Minnesota Pollution Control Agency; Howard Markus, Minnesota Pollution Control Agency

The Minnesota Pollution Control Agency has developed draft nutrient standards for rivers. Studies have demonstrated significant and predictable relationships among summer nutrients, chlorophyll *a*, and biochemical oxygen demand (BOD) in several medium to large Minnesota rivers. Diurnal dissolved oxygen (DO) flux (based on submersible data recorders) also was found to be strongly positively correlated to TP and chlorophyll-*a* concentrations. Our findings demonstrate significant relationships among several sensitive invertebrate and fish metrics and TP, TN, chlorophyll-a, and DO flux. Criteria were refined and supported by use of quantile regression using invertebrate and fish data. A regional approach to developing nutrient criteria was used and demonstrated that different criteria should be applied across regions and stream sizes. Draft river nutrient criteria based on these scientifically-developed lines of evidence will be presented.

Muddy Waters Typically Run Deep (or Developing Practical Turbidity TMDLs)

Greg Wilson, Barr Engineering Company, gwilson@barr.com

The water quality standard for turbidity in Minnesota presents several challenges for development of Total Maximum Daily Load studies (TMDLs) and the associated Implementation Plans. The current standard is based on a threshold exceedance percentage, which results in a wide range of impairment listings, depending on the monitoring methods employed. In addition, the turbidity standard is not a direct measure of pollutant mass and does not define the allowable magnitude or duration of exceedance, resulting in varying interpretations for setting the allowable pollutant load. Recent project experience will present methods for demonstrating compliance with the standard in Minnesota while enabling the development of turbidity TMDLs that address the physical, chemical and biological integrity of streams in a more meaningful way. Background loadings, surrogates and implications for monitoring programs and the listing/de-listing of impaired waters will also be discussed.

Correlations and Spatial and Seasonal Variations Among Streamflow, Suspended-Sediment Concentration, and Turbidity in Minnesota's Wild Rice River

Christopher Ellison, U. S. Geological Survey, cellison@usgs.gov; James Fallon, U. S. Geological Survey; Richard Kiesling, U. S. Geological Survey

The Wild Rice River is listed as impaired for turbidity by the U.S. Environmental Protection Agency. Understanding relations between suspended-sediment concentrations (SSC) and other measurements of water transparency is critical for addressing this impairment. Water-quality data were collected by U.S. Geological Survey staff during 2007 and 2008 to gain insight about these relations. This work was done as part of a project with the Wild Rice River Watershed District and their consultant, Houston Engineering.

Statistical techniques were used to assess variations and to evaluate relations among streamflow, temperature, SSC, specific conductivity, turbidity (nephalometric turbidity unit [NTU]), and (nephalometric turbidity ratio unit [NTRU]), percent fine-grained material and transparency tube readings. Pearson and Kendall's tau correlation tests detected strong positive relations between streamflow and NTU (r = 0.8578) and NTU and SSC (r = 0.8036) and a strong negative relation between transparency tube readings and NTU (r = -0.8615).

Concurrent Session II 1:15 p.m. – 2:45 p.m.

Track C: Pesticides in Water

Taking a Holistic Approach to Niche Monitoring: Pesticides in Minnesota Waters

David Tollefson, Minnesota Department of Agriculture, david.tollefson@state.mn.us; Heather Johnson, Minnesota Department of Agriculture

The Minnesota Department of Agriculture began to monitor for pesticides in groundwater in 1985; since then the monitoring approach, platform, and medium have evolved to target varying levels of risk across the distinct regions of Minnesota. Groundwater sampling in areas with sandy soil has dominated sampling; however, the program began to sample springs, domestic wells, and urban wells. Surface water sampling began in 1991. The surface water program approaches statewide stream sampling on a "tiered" approach focusing more resources to streams that have shown levels of concern in previous sampling, while maintaining a broad outlook. The surface water program has expanded from streams to include lakes, precipitation, and agricultural drainage tile demonstration sites to get a better understanding of pesticide occurrence in water in different mediums. Data will be presented from all networks, focusing in on trends over time and areas of concern around the state.

A Review of Atrazine Detections in Drinking Water and Groundwater in Support of a Special Registration Review of Atrazine in Minnesota

Nila Hines, Minnesota Department of Agriculture, nila.hines@state.mn.us

The Minnesota Department of Agriculture (MDA) together with partners at the Minnesota Department of Health (MDH) and the Minnesota Pollution Control Agency (MPCA) are conducting a special registration review of the herbicide atrazine. The goal of the review is to identify any unreasonable adverse effects on human health or the environment in Minnesota and consider appropriate additional state-specific restrictions, limitations on use as a condition of registration, or registration without state-specific restrictions. One component of this special review is an assessment of atrazine detections in drinking water and groundwater throughout Minnesota. Monitoring data was collected and analyzed from a wide range of sources including: community public water supply (PWS) sampling by local units of government, private well sampling conducted by MDA through special projects, private well sampling conducted by local units of government and water planners, MDH flood contamination assessments of public and private wells, and routine groundwater/spring monitoring conducted by MDA. This comprehensive data set will be helpful in understanding potential exposures and assessing health risks associated with drinking water consumption. Currently, atrazine contaminant levels from groundwater and drinking water surveys rarely exceed applicable Minnesota drinking water standards.

Pesticide Breakdown Products in Minnesota Groundwater

John Hines, Minnesota Department of Agriculture, John.W.Hines@state.mn.us; Heather Johnson, Minnesota Department of Agriculture

Pesticide occurrence in groundwater is no longer a new subject, having been detected as early as the 1970s. Historically most analyses of pesticides in groundwater have been for the parent compound, missing a relatively large part of the contamination picture. Analyzing water for the breakdown products of pesticides dates back to the early 1990s when methods for the analysis of two of the breakdown products of atrazine became readily available. In 2002 the Minnesota Department of Agriculture expanded its degradate analysis capability to include breakdown products of the most commonly found chloroacetanalide pesticides. This presentation discusses the results of MDA groundwater monitoring for pesticide breakdown products of the five compounds currently in common detection in the state of Minnesota. Data detailing how pesticide degradates exceed the detection frequency and concentration of their respective parent material will be presented. Implications of the frequencies of detection and the levels at which the breakdown products are occurring will be discussed as will data regarding trends over time and space.

Concurrent Session II 1:15 p.m. – 2:45 p.m.

Track D: River Reach Restoration—Selective Stream Surgery

Minnehaha Creek Restoration at Methodist Hospital; Integrating Healing Processes

Martin Melchior, Interfluve, mmelchior@interfluve.com; Jonathon Kusa, HR Green

Over the years, segments of Minnehaha Creek have been straightened or moved, with the earliest projects dating to the late 1800s. As part of the ongoing effort to reclaim stream habitat lost through channelization, the Minnehaha Creek Watershed District partnered with Park Nicollet Health Services to restore sinuosity and improve habitat on a portion of Minnehaha Creek. The project was designed in 2007 and constructed in January of 2008, restoring roughly 2000 feet of the creek running through the Methodist Hospital property wetlands in the City of St. Louis Park. The project also included design and construction of a boardwalk to promote the public's connection with the restored stream and wetland environment. This presentation outlines some of the key design parameters and discusses the approach taken to fulfill the project partners' desire to integrate ecological healing through restoration and medical healing through direct interaction with the natural environment.

Current Research at the Saint Anthony Falls Laboratory Outdoor StreamLab

Anne Lightbody, Saint Anthony Falls Laboratory, University of Minnesota, annel@umn.edu; Jeffrey Marr, Saint Anthony Falls Laboratory, University of Minnesota

The lack of engineering standards for stream restoration techniques is underscored in the design and installation of shallow, in-stream, low-flow structures. These structures are preferred by many federal, state, and local governmental agencies to assist in stabilizing beds and banks in stream restoration projects while enhancing aquatic habitat. We are using a comprehensive research strategy to develop comprehensive quantitative engineering guidelines, design methods, and recommended specifications for in-stream structure installation, monitoring, and maintenance. To accomplish this goal, we are coupling an in-depth review of the current use of in-stream structures to a comprehensive study using physical and numerical models to explore the most promising structures. A key component of this project is an examination of the performance and stability of in-stream structures within a sinuous channel within the St. Anthony Falls Laboratory (SAFL) Outdoor StreamLab (OSL) in order to assess the performance of various structures in a natural stream setting in order to quantify potential for failure as function of flow rate and stream geomorphology as well as the impact of the structures on erosion rates, stream stability, and lateral channel migration.

On July 31, 2009, a single rock vane was installed along the outer bank of the middle meander bend of the OSL Riparian Basin. A high-resolution data acquisition carriage (DAQ) designed for outdoor use in the OSL enables the precise positioning of instrumentation within a 3 m by 1.5 m area of the channel or floodplain. A total station is used to reference the local DAQ coordinate system to the OSL global coordinate system, enabling the positioning of instrumentation at millimeter-scale resolution in all three dimensions. By successively positioning the DAQ at various overlapping locations along the stream, the entire stream system can be accessed to provide high-resolution measurements of the stream bathymetry and flow field. Measurements under both base and bankfull flow have documented the effect of the addition of the structure on flow patterns, turbulence intensities, sediment transport, and bank stability. Results from these measurements will be extended to a wide range of other stream morphologies and types using SAFL's advanced numerical model, the Virtual StreamLab, which will provide the breadth of information necessary to develop guidelines for the successful construction of stable in-stream structures in a wide range of streams. Model predictions will be verified against measurements of changes in bed and bank topography obtained from several existing field installations of in-stream structures. These results will be combined into comprehensive quantitative engineering guidelines.

Complementary projects during 2009 included improving the prediction of meandering river migration rates by characterizing the effect of vegetated slump blocks; investigating the feedbacks between vegetation growth, flow hydraulics, sediment transport rates, and channel topography; determining the effect of engineered structures on residence times and nutrient transformations within benthic and hyporheic environments, and enhancing the quantitative prediction of fish habitat characteristics via simultaneous observations of fish position, simple kinematic parameters such as tail beat frequency, and flow characteristics.

Concurrent Session II 1:15 p.m. – 2:45 p.m.

Track D: River Reach Restoration—Selective Stream Surgery, *continued*

North Creek Rehabilitation Design and Construction: Reconstructive Surgery for a Ditched Stream

Jesse Carlson, Bonestroo, jesse.carlson@bonestroo.com; Corey Markfort, Saint Anthony Falls Laboratory, University of Minnesota; Jen Dullum, City of Farmington

Farmington's North creek is a principal connector and tributary to the Vermillion River, the Twin Cities' prized trout stream. It is within an aquatic corridor in which multiple streambank stabilization projects and stream meander projects are encouraged to protect water quality, provide flood control, assist with temperature control, create wildlife habitat, and improve aesthetic value.

To meet the objectives above, the City, in coordination with the Vermillion Joint Powers Organization, planned to remeander approximately 0.6 miles of the unmanaged ditch channel with the goal of enhancing ecological function and providing an amenity as part of the City's park system. The drainage ditch was within an existing wetland complex containing a mix of reed canary grass, peaty soils and a high water table, which proved to be challenging from the design and construction perspective.

Concurrent Session III 3:15 p.m. – 4:45 p.m.

Track A: Engaging Citizens in Water Resources

Connecting Environmental Policy with Citizen Engagement: A Comparative Study between Minnesota's Lake Improvement Districts and Wisconsin's Lake Districts

Kaitlin Steiger-Meister, University of Minnesota, stei0579@umn.edu

Similar to Minnesota's Lake Improvement District (LID) program, Wisconsin has a local unit of government known as a Lake District (LD). Though a preliminary review of the two programs' statutes has found them to be very similar, the actual impacts of the two statutes are notably different. Whereas it has taken Minnesota nearly four decades to create 24 LIDs, in a similar time period Wisconsin has created over 200 LDs. By undertaking a comparative content analysis of the two policies, research provides a platform to begin examining the institutional framework each statute exists in. Using Minnesota's LIDs and Wisconsin's LDs, research examines the potential of targeted policy to provide the resources and institutional support needed to coordinate local water quality improvement activities to achieve *regional* water quality goals. Concurrently, the project explores the dynamic role of citizens in policy creation and management plan implementation by employing in-depth semi-structured interviews with relevant stakeholders.

The Amity Creek Charrette: Engaging the Community, Protecting Resources

Jesse Schomberg, Minnesota Sea Grant, University of Minnesota, jschombe@umn.edu

Increased development is recognized as a driver of reduced water quality across Minnesota, yet community regulations often require development designs that result in greater impacts than necessary. Conflicts associated with development plans and impacts to natural resources are common, increasing costs to communities and developers, and often putting communities, developers, and residents in opposition. When citizens play a meaningful role in the development process up-front, the result is a plan that is responsive to resident, community, and developer concerns.

In 2007, the Northern Minnesota Chapter of the American Institute of Architects sponsored a charrette: a dynamic, multi-day planning exercise involving planners, developers, residents, fisheries experts, stormwater managers, and others. The charrette focused on 100 acres along an impaired trout stream in Duluth. Previous development proposals met with strong resistance from residents concerned about water quality, recreation, and congestion. The final design met the needs and concerns of all parties, with more homes, but half the impervious surface of existing zoning requirements.

What Will it Take to Get You to Conserve? Lessons from the Native Shoreland Buffer Incentives Program Surveys

Karlyn Eckman, Water Resources Center, University of Minnesota, eckma001@umn.edu; Mary Blickenderfer, University of Minnesota Extension; Steve Henry, East Otter Tail Soil & Water Conservation District; Erika Rivers, Minnesota Department of Natural Resources

The Native Shoreland Buffer Incentives Program conducted two separate social surveys in the spring of 2009 to determine what barriers prevent homeowners from maintaining or restoring native shoreland buffers, and what kinds of incentives might be offered to encourage this shoreland best management practice. The survey method measured the knowledge, attitudes and practices (KAP) of two target audiences in Otter Tail and Itasca counties. This presentation outlines how the KAP methodology provided local project managers with a cost-effective, rapid assessment tool for obtaining target audience information; compares the findings from each application of the tool; and discusses how findings from the research were used to select and design incentives for each target audience.

Concurrent Session III 3:15 p.m. – 4:45 p.m.

Track B: Biota TMDLs

A Case Study Examining a Biotic Impairment in Western Minnesota: Dry Wood Creek

Kimberly Laing, Minnesota Pollution Control Agency, kimberly.laing@pca.state.mn.us; Chandra Carter, Minnesota Pollution Control Agency; Joel Chirhart, Minnesota Pollution Control Agency; Kelli Daberkow, Minnesota Pollution Control Agency; Jeffrey Jasperson, Minnesota Pollution Control Agency; Joseph Magner, Minnesota Pollution Control Agency; Shaun McNally, Stevens Soil & Water Conservation District

In 2007, intensive watershed monitoring conducted by the MPCA in the Pomme de Terre watershed led to the preliminary fish index of biotic integrity of 16.8 out of 60 on Dry Wood Creek. An initiative to understand the stressors to the biological community began in 2008. The effort examined potential water quality, physical, and connectivity issues in the watershed.

Stressor identification field work included increased biological coverage of the watershed. Potential water quality issues were examined by monitoring diurnal dissolved oxygen, longitudinal dissolved oxygen, nutrients, anions/cations, pH, temperature, and turbidity. A quantitative physical habitat assessment and methods from Dr. Dave Rosgen's *Applied River Morphology* were utilized at biological stations to assess fluvial processes and habitat conditions.

The analysis of data collected led to a list of potential stressors including: low dissolved oxygen, sedimentation, lack of in-stream habitat, widening/lack of riparian area, and high pH, turbidity, phosphorus, and nitrate-nitrite levels.

Stream Biological TMDLs—Overcoming the Challenges of the Stressor Identification Process

Annie Felix, Benton Soil & Water Conservation District, annie@soilandwater.org; Jeff Jasperson, Minnesota Pollution Control Agency; Kim Laing, Minnesota Pollution Control Agency

One of the most challenging phases in TMDL biological impairment projects is identifying the dominant stressors causing the impairment. The EPA has developed the Stressor Identification (SI) process for identifying any type of stressor or combination of stressors that cause biological impairments.

Little Rock Creek, a coldwater stream located in central Minnesota, is listed as impaired for aquatic life. The Little Rock Creek Biota TMDL Project was one of the first projects to use the MPCA's biological TMDL protocol, which is based on the EPA Stressor Identification process. Fish, invertebrate, geomorphology, flow, and water chemistry data was collected. A watershed groundwater model was developed to allow further understanding of flow regimes. A Technical Subcommittee developed conceptual models, evaluated and scored evidence using the appropriate metrics and identified probable causes.

This presentation will focus on presenting results, discussing lessons learned and challenges, as well as, providing useful project insight, and recommendations for future biota TMDL projects.

Concurrent Session III 3:15 p.m. – 4:45 p.m.

Track B: Biota TMDLs, *continued*

Linking Stressors to Aquatic Stream Health: A Protocol for Developing Impaired Biota TMDLs in Minnesota

Jeff Jasperson, Minnesota Pollution Control Agency, jeffery.jasperson@mpca.state.mn.us; Kim Laing, Minnesota Pollution Control Agency; Joe Magner, Minnesota Pollution Control Agency

Minnesota is currently engaged in comprehensive stream water quality assessment using biological monitoring of fish and macroinvertebrates. Biological monitoring provides a direct measurement of aquatic stream health; however, drivers (landscape land-use, natural processes associated with climate & geology) of aquatic health are generally unknown. Linking potential physical, chemical & biological stressors to biological response metrics requires an environmental "CSI" approach. Once initial index of biotic integrity (IBI) scores are developed for a given region, a second phase of investigation examines watershed characteristics; upland through riparian hydrologic pathways and biogeochemical processes. Stream channel stability and habitat features are often stressed and directly related back to changes in the watershed. MPCA has developed a protocol that applies the USEPA Stressor Identification approach, yet offers users choice when selecting assessment tools to build a convincing argument for linking likely stressors to measured in-stream aquatic condition.

Concurrent Session III 3:15 p.m. – 4:45 p.m.

Track C: Best Management Practices II

Stormwater BMPs to Meet Pre-Settlement Volume and Nutrient Export Objectives - A Case Study

John Barten, Three Rivers Park District, jbarten@threeriversparkdistrict.org; Walter Eshenaur, SRF Consulting Group, Inc.

In 2004, Three Rivers Park District purchased the Salvation Army Camp in St. Anthony with the objective of developing it into a multi-use park. One objective during redevelopment was to incorporate stormwater treatment Best Management Practices that achieved pre-settlement volume and nutrient discharge rates.

The BMPs selected for the Silverwood Park redevelopment, included traditional practices such as rain gardens, ponds, and pervious pavers. However, to achieve the aggressive pre-settlement nutrient runoff goals, stormwater reuse, and large scale soil amendments were incorporated into the project design. Soil amendments included compost additions, sub-soil ripping, and tilling of fill areas in 8-inch lifts. These practices have not been very widely implemented or tested. This presentation will describe how the water reuse and soil amendment BMPs were designed and constructed. Specific attention will be given to source water considerations for reuse, construction of the amended soil system, and effectiveness of the practices during the 2009 growing season.

Blue Green Schools

Paul Chellsen, City of Minneapolis, paul.chellsen@ci.minneapolis.mn.us; Kristina Robertson, Burnsville Eagan Savage Public Schools

The *Blue Green Schools Initiative* is a partnership and program between the Minneapolis Public Schools and the City of Minneapolis to resolve a combined sewer issue. This partnership was formed to develop plans which would provide sustainable stormwater improvements to five schools. These plans also met the needs of the neighborhood, MPS and Public Works while addressing the required combined sewer separation orders from the City. Storm drains at the schools connected to the sanitary sewer contributed to Combined Sewer Overflows (CSOs), which allowed untreated sewage to flow directly into the Mississippi River. These CSOs are the largest source of pathogens in the Mississippi River and a major water pollution concern. Thanks to this unique partnership, over 25 acres of rainwater previously contributing to CSOs now flows through beautifully landscaped rain gardens which double as curriculum enhancements for the schools.

Fully developed urban areas with limited resources and aging infrastructure face special challenges in meeting today's storm water regulations. To be successful we need to think outside the box and work together as a community recognizing our common goals. By doing this we have not only succeeded in improving our water resources but created a more sustainable community. The *Blue Green Schools Initiative* truly proved that "We all do better when we all do better."

Concurrent Session III 3:15 p.m. – 4:45 p.m.

Track C: Best Management Practices II, *continued*

Argenta Hills: A True LID Development—Planning, Policy & Engineering

Brett Emmons, Emmons & Olivier Resources, Inc., bemmons@eorinc.com; Scott Thureen, City of Inver Grove Heights, Eli Rupnow, Emmons & Olivier Resources, Inc.; Jim Dockstader, Enebak Construction Company

This session will address the unique policies required, the design process, and the construction techniques used to construct Phase 1 of a Low Impact Development (LID) in Inver Grove Heights.

Many years of planning preceded the beginning of development in the Northwest Area (NWA) of Inver Grove Heights. This 3,400-acre portion of Inver Grove Heights had only undergone limited development despite its location as an inner-tier suburb. The primary hindrance to development had been the steep topography, resulting in high development costs. City planning efforts for the NWA created innovative development standards to preserve some of the unique landscape, manage stormwater in a landlocked system, and address the large infrastructure costs associated with this area's setting.

The entire NWA is landlocked and has no regional stormwater outlet channel or pipe. Instead, existing depressions and on-site BMPs are used to infiltrate runoff from development, mimicking the existing hydrology. An overflow policy and site infiltration standards were set to high standards to protect the capacity of the regional basins to retain the water.

One of the first developments in the NWA was a 135-acre Low Impact Development (LID) consisting of both commercial and residential land uses. The commercial, first phase was designed and has been partially constructed. Phase 1 included the most challenging part of the site with intensive commercial development and a new county road.

Stormwater on the site was designed to retain the 100-year rainfall event. Features used to satisfy this design in Phase 1 included:

- Raingardens (35)
- Infiltration Basins (5)
- Porous Pavers (2 road intersections = 10,000 SF)
- Porous Asphalt (274 stalls = approx. 25% of stalls = more than one acre)
- Infiltration Trenches (3,200 LF)
- Regional Basins (3)

Due to the extensive number of infiltration features on the site, it was not feasible to take soil borings at each infiltration feature prior to construction. Therefore, interpolation between soil borings was required to assume infiltration rates for each stormwater feature. Because this site was a former gravel pit, the soils were also highly variable, with well-draining sands located immediately adjacent to dense clays. The steep topography of the area, also dictated that some large cut (60-feet) and fill (25-feet) depths were required to create the commercial portion of the site. The large cuts and fills added to the difficulty of constructing intensive infiltration practices. Many field modifications, such as connecting infiltration features to overcorrected building pads were made to ensure the site would meet or exceed the design.

Concurrent Session III 3:15 p.m. - 4:45 p.m.

Track D: Lake Management

Bathymetric Analysis of Lake Minnetonka: Charting What Lies Beneath

Jason Carlson, Fillmore Soil & Water Conservation District, jason.carlson@fillmoreswcd.org; Shahram Missaghi, Saint Anthony Falls Laboratory, University of Minnesota; Udai Singh, Minnehaha Creek Watershed District

Hydrodynamics drive lake ecosystems and are defined by a lake's bathymetry. Manual surveying of lake terrain is both slow and prone to inaccuracies. The objective of this project was to create accurate and detailed spatial data for use in three-dimensional (3D) water quality modeling of Lake Minnetonka. Using a Biosonics DT-X single-beam transducer mounted on a pontoon coupled with real-time GPS we were able to collect over one million distinct points of data. Determinations in resolution requirements, data collection procedural establishment, as well as creating analysis methodologies for accuracy assessments and map creation have helped make this an exemplary project in water resource management. Utilizing ArcMap GIS software to analyze the data, create maps, and compare results with 1949 bathymetry, this project has provided essential data for 3D modeling that can be used to quantify spatially distributed nutrient fluxes from the lake sediment into the water column.

Three Dimensional Lake Modeling to Design and Test Lake Aeration Systems: Case Study of Ford Lake in Michigan

Kevin Menken, Barr Engineering Company, kdm@barr.com; Keith Pilgrim, Barr Engineering Company

A three dimensional lake and reservoir hydrodynamic and ecological model (ELCOM-CAEDYM) was developed to design and test a proposed aeration system for Ford Lake in Ypsilanti, Michigan. The primary purpose of constructing an aeration system is persistent low oxygen conditions in the reservoir and water quality violations at the dam outlet. The secondary purposed of lake aeration is improvement of the trophic condition of the lake by inhibit internal phosphorus release. A three dimensional lake model was chosen to assist in aeration design, that is, where should the aerators be placed, how much air should be delivered, and how often do they need to be operated. A three dimensional hydrodynamic and ecological model was chosen to assist in design because of the poor track record of aeration in improving water quality and the risk of under design. There are several complications with aeration that can not be modeled with simple mass balance or one-dimensional models, they are: special delivery of oxygen (hydrodynamics), the effect of greater oxygen availability on sediment oxygen demand, and the effect of higher benthic temperatures (due to greater mixing) on sediment oxygen demand. These factors have led to consistent under sizing of aeration systems. The chosen three dimension model has functionality to address each of these complications.

Modern and Historical Water Quality Variability In The Lake Minnetonka Watershed: Using Sediment Core Analysis To Develop Nutrient Targets and Prioritize Lake Management Efforts

Mark Edlund, Saint Croix Watershed Research Station, mbedlund@smm.org; Udai Singh, Minnehaha Creek Watershed District; Avery Cook Shinneman, Saint Croix Watershed Research Station; Joy Ramstack, Saint Croix Watershed Research Station; Jason Carlson, Fillmore Soil & Water Conservation District

Modern water quality (WQ) monitoring in the Lake Minnetonka watershed indicates current lake conditions vary widely, from mesotrophic to hypereutrophic. To prioritize management efforts and develop sound nutrient targets, modern and historical (pre-European) nutrient condition was estimated for eighteen lakes using a combination of WQ monitoring and sediment core analysis. Sediment cores (1-2 m long) were recovered from central lake basins, dated using magnetic and radioisotopic (210-Pb and 137-Cs) analyses, and analyzed for biogeochemical signals of change in sedimentation and WQ. Sediment diatom assemblages were used to reconstruct historical water column total phosphorus concentrations. Results indicate that pre-European water quality was also variable across lakes in the Minnetonka watershed. Bays with direct connection to the main body of Lake Minnetonka had mesotrophic water quality in historical and modern times, whereas upgradient bays and lakes tended to have eutrophic to hypereutrophic modern conditions and meso- to eutrophic historical water quality.

Poster Session: 4:45 – 5:45 p.m.

1. Urban Lake Management Action Plans: Getting ahead of TMDLs

Carl Almer, Emmons & Olivier Resources, Inc., calmer@eorinc.com; Matthew Kocian, Rice Creek Watershed District

RCWD initiated the Southwest Urban Lakes Study to assess 24 lakes that have been subjected to decades of concentrated urban runoff and are now showing the effects of that pollutant loading. This project developed Management Action Plans (MAPs) for each lake that summarize lake characteristics and existing lake data, provide a diagnostic assessment of the data, summarize public input, identify water quality issues, identify potential retrofit BMPs, and recommend remedial strategies on a lake-watershed basis. As such, each lake MAP provides a concise summary of the known issues and recommended management approaches. The MAPs were guided by watershed (P8) modeling, in-lake sediment collection to estimate internal phosphorus release rates, and in-lake modeling (Bathtub) used as a predictive tool to estimate the load reductions needed to achieve water quality goals. BMP locations were identified through an extensive field evaluation of each watershed.

The MAPs will be used to further define management strategies, prioritize activities and guide development of the RCWD 3rd Generation Plan, and serve as the basis for seeking project partners and grant funding for the retrofit water quality improvements identified.

2. Meta-Analysis as a Statistical Tool for Evaluating the Hydrologic Effects of Subsurface Drainage Design and Water Table Management

Sheila Amenumey, University of Minnesota, amenu001@umn.edu; Gary Sands, University of Minnesota; Bruce Wilson, University of Minnesota

Agricultural drainage remains vitally important in many parts of the USA and the world because it allows timely field operations and improves crop production. Meta-analysis was used to investigate the effect of drainage designs and water table management on drainage volume from different soils types and climatic regions. To investigate the potential causes of effectiveness of controlled drainage compared to conventional drainage, meta-analysis was performed to qualitatively and quantitatively aggregate the effect of controlled drainage. The results showed that given the same sample size, the power to detect an effect using meta-analysis is 10% to 40% greater when compared to the results obtained by the analysis of variance approach. A chronologic, cumulative meta-analysis of fifty-three controlled drainage studies demonstrated that controlled drainage is effective and with a mean effect of 47%. A categorical meta-analysis suggested that soil types, crop types, and differences in seasonality affect the effectiveness of controlled drainage to reduce drainage volumes.

3. Clean Water Act 316(a) Demonstrations on the Upper Mississippi River

Jeff Berrington, Xcel Energy, jeff.j.berrington@xcelenergy.com; Brian Schmidt, Xcel Energy

As a result of the recent repowering projects by Xcel Energy, the permitting authority, Minnesota Pollution Control Agency, has required, by permit, revisiting the Clean Water Act 316 a Demonstrations of these facilities. The thermal demonstration must show the cumulative impact of its thermal discharge together with all significant impacts on the species affected, will assure the protection and propagation of a balanced indigenous community of aquatic life in the Mississippi River. To complete this assessment, general fisheries (electro fishing), discharge effluent fisheries (Gill netting and Telemetry Surveys), macro invertebrate studies, temperature surveys and dissolved oxygen measurements were completed on Pool 2 of the Upper Mississippi River. Results from these studies have been completed for a number of river locations, species and scenarios as they were for initial Clean Water Assessments and found to have comparable results due to maintaining compliance with MPCA limits and operational requirements.

Poster Session: 4:45 – 5:45 p.m.

4. An Assessment of Chloride Sources and Contamination in the Twin Cities Metropolitan Area

Joe Bischoff, Wenck Associates, Inc., jbischoff@wenck.com; Diane Spector, Wenck Associates, Inc.; Brooke Asleson, Minnesota Pollution Control Agency; Barb Peichel, Minnesota Pollution Control Agency

The Minnesota Pollution Control Agency undertook the Metro Chloride Feasibility Study to develop a holistic understanding of the extent and magnitude of chloride contamination to surface waters in the Twin Cities Metro Area (TCMA) and the current practices and programs currently in place to address chloride reduction. The study will guide the State in determining the best route for addressing chloride impairments in the TCMA. The Twin Cities Metropolitan Area is defined as the seven counties in the Twin Cities and includes Carver, Hennepin, Scott, Anoka, Ramsey, Washington and Dakota Counties.

Numerous studies and TMDLs in Minnesota and around the country have identified road salt for snow and ice control as the primary source of chloride impacting surface waters. This Feasibility Study evaluated a predictive tool to identify where chloride exceedances are expected to occur and to estimate the magnitude of those exceedances. Road salt purchasing data and other data were collected to develop a chloride budget for each watershed in the TCMA. The budget was combined with spatial data on watersheds, land use, lane miles, and imperviousness to develop a GIS-based model that predicted road salt use by lane mile and by tons applied per square mile. Finally, these data were correlated with stream monitoring data to identify relationships between road salt use and observed chloride concentrations.

The Feasibility Study also included a survey of road maintenance practices across the TCMA to determine which Best Management Practices were being used or contemplated for use. Finally, the study included an identification of knowledge, practice, data, and research gaps for future consideration.

This presentation will provide an overview of the available data and the predictive tool and will include discussion on the options being considered by regulatory agencies to address current and future chloride impairments.

5. Modeling Road Salt and Total Dissolved Solids Transport in StormNET (Powered by EPA-SWMM)

Kent Brander, Emmons & Olivier Resources, Inc., kbrander@eorinc.com; Nancy-Jeanne LeFevre, Emmons & Olivier Resources, Inc.; Eli Rupnow, Emmons & Olivier Resources, Inc.

Computer modeling of pollutant transport in the environment is essential for establishing a scientific basis for policy and management decisions and predicting BMP performance. In particular, chloride TMDLs need effective modeling software, and facility operators need a platform upon which to evaluate road salt management strategies. This study uniquely applies the water quality component of StormNET (an new, integrated stormwater modeling software package which uses the EPA-SWMM engine) to create a model that simulates road salt application and washoff, industrial discharges of chloride and TDS, and the resultant pollutant transport through a network of pipes and ponds at a 550-acre corporate campus in the upper Midwest. Salt (NaCl) application was modeled as a buildup of chloride (Cl) and total dissolved solids (TDS) occurring on paved surfaces during snowfall. Cl and TDS transport from paved surfaces to water bodies was modeled as a wash-off of pollutants occurring during runoff events (including snowmelt). In StormNET, water quality calculations are driven by the hydrologic and hydraulic model components and additional parameters, including pollutant buildup and wash-off coefficients and snow pack parameters. The model was calibrated to eight continuous years of pollutant monitoring data, and then used to characterize the relationship between salt application practices and the frequency with which chloride and TDS discharge concentrations exceed regulatory limits. The model provides a framework for representing pollutant sources, a platform upon which facility operators can evaluate road salt management strategies for permit compliance, cost/benefit ratios, or other criteria and the ability to model chloride transport for development of and implementation of a chloride TMDL.

Poster Session: 4:45 – 5:45 p.m.

6. Making TMDLs Make Sense Through Simulations and Games

Cynthia Hagley, Minnesota Sea Grant, University of Minnesota, chagley@umn.edu; John Bilotta, University of Minnesota Extension; Amy Elliot, Lake Superior Research Institute, University of Wisconsin; Barbara Liukkonen, University of Minnesota Extension; Susan O'Halloran, University of Wisconsin Extension; Jesse Schomberg, Minnesota Sea Grant, University of Minnesota; Julie Westerlund, Minnehaha Creek Watershed District

A watershed management simulation, developed for small streams and modified for large rivers, provides an interactive, positive venue for reducing confusion and inviting critical thinking about the TMDL program—one of the least intuitive water quality program names in existence. It focuses on cumulative impacts from several land uses on downstream water quality—duplicating factors that trigger a TMDL. Participants become land use managers trying to reduce sediment loads to meet water quality goals. Each land-use team has several BMPs and a "budget" available. As the game progresses, teams use their BMPs to reduce impacts while cooperating to meet communal goals. The activity helps participants understand TMDLs, familiarizes them with potential BMPs, and stresses watershed-wide cooperation. It is under revision to make it widely applicable geographically, appropriate for several nonpoint pollutants, and available as three linkable gameboards—headwaters stream, lake, river—each with its own land uses and BMPs.

7. Cost Analysis of Alternative Culvert Installation Practices in Minnesota

Bradley Hansen, University of Minnesota, hanse038@umn.edu; Christian Lenhart, University of Minnesota; John Nieber, University of Minnesota

Various factors associated with conventional culvert design, including shallow water, perched inlets and high flow velocities, can cause difficulties for migrating fish and affect their genetic diversity and long-term survival. Conventional culvert design has traditionally been based on hydraulic conveyance, safety and cost. Recently, some alternative culvert designs have been developed to facilitate salmon migration on the west coat of the United States. These alternative designs focus on matching the natural dimensions and characteristics of the stream channel through the culvert. The intended purpose of these newer designs is to provide unimpeded passage of aquatic life, reduce maintenance costs and improve erosion control. Currently, some of these new designs are being implemented in Minnesota mostly when fish passage is a consideration. There are concerns about the additional costs associated with these alternative designs as well as whether they are really needed at some road crossings. The objectives of this research were to summarize state-wide fish passage concerns related to culvert road crossings on public waters and to perform a cost comparison between the conventional and the alternative culvert designs.

Eight of the fifteen conventional design culverts studied had potential issues related to sedimentation, high velocities and low flows that would make it difficult for fish passage. The remaining seven culverts, while not matching all of the alternative design parameters, matched the bankfull width within two feet. In these situations fish passage may or may not benefit from an alternative design. Alternative designs increased the cost of the culvert by 0-25%, which added an additional $2000 to $20,000 to the project costs. Baffles, roughened channels and weirs cost between $1,000 and $10,000 to install depending on the scope of the project. The additional cost of installing alternative designs may be offset by lower long term maintenances costs and the ecological benefits they provide not only fish but all aquatic organisms.

Poster Session: 4:45 – 5:45 p.m.

8. Climate Change and Watershed Management Model Uncertainty

Suresh Hettiarachchi, HDR Engineering, Inc., shettiar@hdrinc.com; Ted Shannon, HDR Engineering, Inc.; Jeff Christopherson, HDR Engineering, Inc.

Distribution of water resources is an important topic in the climate change discussion with a high degree of uncertainty. This study helps to deal with the degree of uncertainty that impacts surface water modeling and water management due to climate change, focusing on a detailed XP-SWMM model for a watershed draining to Wilmes Lake within the South Washington Watershed District. A Monte Carlo method is used to determine the variability the levels at Wilmes Lake. To reduce the model run-time, a simplified EPA-SWMM model is developed by calibrating the EPA model to the detailed model using the Width and Slope parameter. The impacts of climate change are then incorporated by adjusting the variability of input parameters such as depressional storage, soil moisture, and rainfall depths based on current prediction on variability for these parameters for future conditions. An MCS is re-run with the new distributions based on climate change for the input parameters.

9. Mapping Stream and River Shoreland in Southeast Minnesota

Ross Hoffmann, Cannon River Watershed Partnership, ross@crwp.net

In southeast Minnesota, one of the last lines of defense for protection of our surface waters are buffers of permanent vegetation along our stream and river shoreland that filters runoff before it reaches a waterway. Data from the Southeast Minnesota Shoreland Mapping Project will assist in identifying areas on many major streams and rivers where there are insufficient buffers to offer adequate surface water protection. Using Geographic Information Systems (GIS,) major streams and rivers will be digitally traced and their land use outlined based off of 2008 one-meter resolution aerial photos. Outlines are drawn by hand within 300 feet of the stream centerline and properly coded for each specific land use. The intended project result is a GIS database of shoreland land use provided to each county to make locating deficient shoreland buffers easier and therefore direct county assistance to those land owners that need it the most.

10. Practical Floristic Quality Assessment of Wetlands in Minnesota

Wayne Jacobson, Jacobson Environmental, jacobsonenv@msn.com

Floristic Quality Assessment is a technical activity which involves the sampling of vegetation to determine natural area quality of wetlands in Minnesota. Methodology from the May 2007 Minnesota Pollution Control Agency "Floristic Quality Assessment for Minnesota Wetlands" by S.A. Milburn, M. Bourdaghs, and J.J. Husveth was used to determine natural area quality for a large 11.07 acre wetland in Savage where development was proposed in the surrounding area. This presentation will involve a brief introduction to Floristic Quality Assessment and the use on the Savage site of over two hundred 40 foot x 40 foot sample plots to compute the FQA values for the wetland which led to a more accurate rating of the wetlands quality than MNRAM in the author's opinion. The author will show the methodology used to compute the FQA rating of the wetland which was a powerful comprehensive tool in rating the wetlands quality. The quality of the individual plots will also be presented visually using GIS showing the zonation of quality that was found in the basin. The quality of the wetland determines items such as buffer width in many areas, but due to other natural resource factors a wide buffer area was chosen in this case. Other special aspects of mitigation will also be presented briefly regarding this site and its unique natural resource features.

The oral presentation with photographs will be made on powerpoint will include handouts comprising powerpoint note sheets and a summary page of the publication "Floristic Quality Assessment for Minnesota Wetlands."

Poster Session: 4:45 – 5:45 p.m.

11. Field-Scale Evaluation of *Escherichia Coli* and Nutrient Transport through Subsurface Tile Drainage

Kyle Jarcho, Minnesota State University, Mankato, kyle.jarcho@mnsu.edu; Shannon Fisher, Water Resource Center, Minnesota State University, Mankato

The focus of this project was to analyze differences in *Escherichia coli* and nutrient movement in subsurface drainage water from manured and non-manured agricultural fields with and without surface tile intakes. This research project has 20 agricultural field-scale study sites located in several counties throughout south-central Minnesota. Samples were collected either by grab sampling or by an Isco 6712 auto-sampler that collected 24 samples over a 24-hour period when triggered by rain events. For each rain event sampled, 5–6 samples were taken from the sampler and analyzed for total and ortho-phosphorus, *E. coli,* nitrate plus nitrite (combined assessment), and total suspended solids. The purpose of this project was to use agriculture field-scale settings to gain insight about the movement of nutrients and *E. coli* into subsurface tile drainage systems; therefore giving us the knowledge and ability to improve best management practices in agricultural production. Results will be available by the conference.

12. Shaping Our Future Water Policy: Water Recycle and Reuse

Michael Jungbauer, Landform, mjungbauer@landform.net

This presentation will focus on how to enable policy changes related to sustainable water regulations in Minnesota. Topics discussed will include how to develop framework legislation and how to bring new technologies to the forefront by working with communities and agencies to adopt legislation.

Strategies on how to update water regulations and the process to adopt new laws will be discussed. These strategies include building coalitions with individuals in the private sector, local governments, state agencies, other legislators, and working with interest groups that support common goals such as water recycle and reuse.

Understanding the science and the protection of health and public welfare is the key to shaping our future water policy. Technology and long term solutions are available today that are economical and are being used on sites around the country with common goals to recycle, reuse, protect the environment, and save money. The goal of this presentation is to discuss methods for adopting appropriate legislation related to water resources.

Poster Session: 4:45 – 5:45 p.m.

13. Implementation First: A Watershed-Wide Approach to TMDL Implementation

Rebecca Kluckhohn, Wenck Associates, Inc., rkluckhohn@wenck.com; Merle Anderson, Clearwater River Watershed District; Dennis Loewen, Clearwater River Watershed District; Margaret Leach, Minnesota Pollution Control Agency

The riverine nature of the Clearwater River Watershed provided an opportunity to address the all of the Watershed District's fourteen Impaired Waters listings at once to control costs, increase efficiency, and reduce stakeholder "burnout". The impairments include 11 lake nutrient TMDLs, two dissolved oxygen TMDLs and one bacteria TMDL. From the beginning and throughout the TMDL process, the Technical Advisory committee (TAC) worked together to keep the Stakeholders focused on implementation and how the implementation process would impact each of them. The result is an ultra-motivated watershed board and a group of landowners and lake associations with a clear path forward to meet significant load reductions from urban, agricultural, and lake shore land uses as well as internal nutrient loading for lakes, and wetland sediment oxygen demand (SOD). The process, in fact, has already begun with some unique projects geared towards significant load reductions at minimal costs.

Because the watersheds of the impaired waters in many cases overlap, the District has an opportunity to address multiple impairments at once. For example, BMPs used to address the nutrient impairment to upstream lakes will improve not only water quality upstream, but downstream as well. To that end, implementation efforts will be sequenced to have the most immediate impact. Another benefit to addressing implementation on a watershed wide basis is cost savings realized through an integrated watershed management plan. This presentation will cover the basic plan, and how it will be implemented. It will provide a model for agricultural watersheds to achieve TMDL implementation efficiently and effectively.

14. Tipping Point: A Northern Lakes and Forests Nutrient TMDL for Jessie Lake

Rebecca Kluckhohn, Wenck Associates, Inc., rkluckhohn@wenck.com; Noel Griese, Itasca Soil & Water Conservation District; Don Carlson, Minnesota Pollution Control Agency

Jessie Lake was placed on the impaired waters list for nutrients as compared to current Northern Lakes and Forest Ecoregion Guidelines. However, recent data and several studies indicated that the lake may not be far from background conditions. Despite these findings and minimal anthropogenic impacts in the watershed currently, lake shore residents perceived a continuing degradation of lake water quality. The main challenge of the Jessie Lake TMDL was to set an achievable nutrient load reduction goal that that reflected both the lake's condition relative to native conditions, and allowed for the maximum flexibility in terms of lake management going forward. It was also critical not to set an ill-advised precedent for lake management in the area considering the 200 lakes currently being assessed in Itasca County for nutrient impairments. This presentation will focus on the load allocations with respect to policy and implementation with special attention to where they overlap.

15. Building Training Capacity to Meet Clean Water Goals

Ann M. Lewandowski, Water Resources Center, University of Minnesota, alewand@umn.edu; Leslie Everett, Water Resources Center, University of Minnesota

Over the next 25 years, the Legacy Amendment Clean Water Fund is estimated to generate $1.5 billion for water quality projects. Well-trained professionals are needed to carry out these projects, but how to meet increased training needs has not been adequately and systematically considered. Private sector ag professionals, who have regular contact with land owners and their land, are underutilized for implementing clean water projects. The objectives of the Technical Service Provider Training Initiative were to provide conservation skills training for crop consultants and to convene an interagency committee to create a plan for coordination of conservation professional training for the public and private sector. We present lessons learned about providing training for well-established content such as Nutrient Management Planning and RULSE2, and for content new to private sector professionals such as resource assessment. We also present current progress toward creating an interagency structure for conservation training.

Poster Session: 4:45 – 5:45 p.m.

16. Doing More with Less: Tools for Screening the Potential Health Risks of Emerging Contaminants with Limited Toxicological Information.

Paul Moyer, Minnesota Department of Health, paul.moyer@state.mn.us; Helen Goeden, Minnesota Department of Health

The detection of new chemical contaminants in the environment continues to be an important issue. The potential effect of these contaminants on human health is taking on increasing significance due to heightened public concern. Often there is little or no toxicological information available for an in depth evaluation of the potential human health risks from these exposures. Also, as more emerging contaminants are detected, there is an increased need to establish priorities in order to allocate the limited available resources. In recent years, various tools and techniques have been developed or adapted to address the need of screening newly identified chemical contaminants. An overview of two of these methods: 1) the toxicological threshold of concern, and 2) the margin of exposure, will be provided. This review will promote a better understanding of these options as initial steps in addressing the potential human health risks posed by emerging chemical contaminants.

17. Analysis of Uncertainty in Estimating Lateral Effects for Wetland Impacts

Joel Peterson, Board of Water & Soil Resources, joel.r.peterson@state.mn.us; John Nieber, University of Minnesota

Lateral effect (Le) equations are one method used in Minnesota to determine the impacts of drainage on wetlands. A commonly used equation is the van Schilfgaarde equation. Key inputs are the saturated hydraulic conductivity and drainable porosity, which are highly variable. The variability in these soil properties can be described by probability density functions (pdf). By extension, the variability in Le estimates using the Van Schilfgaarde equation can be described through a Monte Carlo simulation (MCS) to generate a pdf for Le. Performing Le calculations in the context of the error associated with input parameters is anticipated to help policy makers, wetland scientists and engineers determining impacts, and local governments by providing more information regarding the (un)certainty in Le estimates, providing an idea of the expected variability in the estimate and statistical confidence in those estimates. These results could also be used to design a wetland monitoring program.

18. Using Triple Bottom Line to Guide Citizen Involvement on a Water Resource Project in Minneapolis

Jodi Polzin, Camp Dresser McKee, Inc., polzinjm@cdm.com; H.R. (Bo) Spurrier, Minneapolis Public Works; Lisa Cerney, Minneapolis Public Works

A 90-acre residential area of Minneapolis has multiple water resource challenges: street flooding, sanitary sewer inflow from two alleys, and future Lake Hiawatha TMDL requirements—all within a neighborhood with active citizen involvement. To find a solution that was acceptable to both the City and the neighborhood, the City opted to organize a Citizen Advisory Committee, who were asked to recommend a construction project. A Triple Bottom Line (TBL) approach was used, one that parallels the framework for sustainability. Economic, environmental, and social costs/impacts of capital improvement projects were assessed. Five alternatives were developed, assessed, scored, and ranked according to weighting criteria established by the Citizens for each TBL category. Results were deliberated and the citizens recommended a solution that balanced their competing goals of preservation of open space and creation of raingardens.

Poster Session: 4:45 – 5:45 p.m.

19. Mosquitoes and Established Raingardens: An Update

Eric Sell, Metro Mosquito Control District, esell@mmcd.org; Kyle Beadle, Metro Mosquito Control District; Nancy Read, Metro Mosquito Control District

Rain gardens have become a part of many water quality projects in the Minneapolis-St. Paul metro area. Designed to hold water for less than 5 days, they would not be expected to provide sufficient habitat for larval mosquitoes to allow them to emerge as adults. However, if there are issues with construction or maintenance that cause these sites to hold water longer, they can produce mosquitoes. In this study, we selected a sample of rain gardens constructed at least 3 years ago and evaluated whether larval mosquitoes are found there and whether the observed hydroperiod in these sites is supporting mosquito development through adult emergence. We compare these results with what is known about design and construction of the sites and their maintenance plans. We also explore how agencies or the public could track who is responsible for sites after they are installed.

20. Reducing Spread of Invasive Species through In-Line Screening

Lindsey Roberts McKenzie, Short Elliott Hendrickson, Inc., lroberts@sehinc.com; Emily Davis, Short Elliott Hendrickson, Inc.; Donald Lutch, Short Elliott Hendrickson, Inc.; William (Jay) Rendall, Minnesota Department of Natural Resources; Tom Wesolowski, City of Shoreview

The Minnesota DNR recently forced a shutdown of the Snail Lake Augmentation System to prevent the spread of invasive Zebra Mussels from Sucker Lake source water, which has supplemented Snail Lake's water supply since the early 1990s via a 2,500-gallon-per-minute pumping intake. The City of Shoreview, Minnesota considered five alternatives for improved pumping processes that would prevent the transfer of Zebra Mussels into Snail Lake, ranging from chemical disinfection to filtration systems. The in-line screening facility option they selected will be implemented in summer 2009, allowing for pumping to resume in October 2009. The Minnesota DNR is planning to use similar solutions to reduce the spread of Zebra Mussels and other invasive species in Minnesota lakes.

21. Remote Sensing Approaches for Assessing Loss of Restored Wetlands

Patrick Sherman, University of Minnesota, psherman@umn.edu; Susan Galatowitsch, University of Minnesota

Evaluating the long-term fate of the hundreds of wetlands restored twenty years ago under the Conservation Reserve Program in Minnesota, Iowa, and South Dakota requires a remote sensing approach. We developed an iterative process and identified necessary attributes of imagery and ancillary data to assess restoration loss from 1988-2008. Critical components of this analysis include multiple images from different years, image resolution of 1-meter or better, and at least one color infrared image which provides the clearest indication of wetness. Rapid, centralized access to aerial imagery and secondary data sources, such as digital elevation models, was crucial for working with this large dataset. Analysis showed that 27% of these restored wetlands have been lost over twenty years and losses of small wetlands were disproportionately high. Estimating wetland restoration losses due to reconversion or failure through a remote sensing approach utilizes the increased availability and quality of remote sensing data.

Poster Session: 4:45 – 5:45 p.m.

22. Metro Metals—Creative Stormwater Management Using Recycled Materials

Todd Shoemaker, Wenck Associates, Inc., tshoemaker@wenck.com

Metro Metals Corporation, Inc. broke new ground in 2008 with its innovative approach to storm water management: keeping its storm water effluent clean through the creative use of recycled tire shreds in an underground storm water management system.

The system enables this salvage business to exceed current regulatory requirements for on-site storm water treatment while conserving valuable real estate for its business activities. The innovative design is the first of its kind in a fully-contained storm water management system. In addition, this environmentally conscious solution provides a tremendous savings over alternative designs as well as a cost-effective beneficial reuse of waste product that would have otherwise been burned as a fuel supplement.

A number of design challenges added to the complexity of the project. First, the state's industrial storm water general permit had expired, so effluent standards for this type of industrial facility had not yet been established. Therefore, the design would have to exceed current and likely future water quality standards, a moving target. Second, the client had little to no room on site for storm water management, and the site was almost completely impervious. Going underground for storm water treatment was the only way to implement a system without negatively impacting the client's business. Third, site soils contained hazardous compounds, so to keep costs under control, excavation had to be kept to a minimum, which meant the solution had to have a smaller footprint than traditional pipes, culverts and tanks.

Wenck proposed a lined system using a front-end storm water management system for sediment removal and collection of immiscible liquids, and a tire-shred "water safe." The innovative design is the first of its kind to use tire shreds as fill in a fully-contained storm water management system. Compared to traditional aggregate, tire shreds have 60% more void space and are 80% lighter; therefore, the size of the pond could be reduced through the use of tire shred as fill. In addition, the structural capacity of tire shreds is roughly equivalent to aggregate. Combined, these properties make tire shreds an innovative, cost-effective option not only for previous applications, such as road beds, but also for storm water systems. Metro Metals would have lost at least 1.4 acres of surface area critical to business operations with an aboveground system. In contrast, when paved, the aboveground area will be an improved site for heavy industrial activities.

The system is a model of innovation in storm water management. It demonstrates a cost-effective, proactive approach other businesses can use to mitigate storm water impacts of their operations without sacrificing valuable operating space. Potentially, the system is applicable anywhere an inexpensive, lightweight fill with high void space is required. In addition, the project enhances public perception of the client and the industry as environmentally responsible.

23. Minnesota's Statewide Citizen Stream Monitoring Program—Transparency Trend Analysis and Future Program Possibilities

Bill Thompson, Minnesota Pollution Control Agency, bill.thompson@pca.state.mn.us

Minnesota's statewide citizen stream monitoring program (CSMP) began in 1998 with a handful of volunteer observers. In 2008 there were over 500 volunteers at nearly 800 stream and river sites. Water column transparency, as measured in a 60cm or 100cm transparency tube, is an important parameter collected by the volunteers. Changes in transparency over time can be used to estimate improvements or degradation in stream water quality. A trend analysis of 1079 CSMP sites was recently conducted by a University of Minnesota advisor and student, in coordination with the MPCA staff. Selected examples of trend plots produced by this effort will be presented, with pertinent watershed and precipitation/runoff data. Statistical analyses show that 11% of sites have decreasing transparency (i.e. poorer water column clarity), 25% show a positive improvement, and 64% have no trend. As CSMP moves into its second decade, future aspects and possibilities will be presented. The significant work of many volunteers and local projects will be acknowledged.

Poster Session: 4:45 – 5:45 p.m.

24. Minnesota Geochemical Database

L. Harvey Thorleifson, Minnesota Geological Survey, thorleif@umn.edu; Richard S. Lively, Minnesota Geological Survey

The rocks and soils that are the foundation of our environment leave an imprint on the chemistry of our water and our lives. This chemical landscape reflects a combination of natural history and cumulative human impacts, and presumably has an influence on biodiversity and human health. Understanding that this landscape exists, geochemical mapping is a necessary part to knowing what are the natural geochemical variations and their origins. The Minnesota Geological Survey (MGS) and the Minnesota Pollution Control Agency (MPCA), in cooperation with the United States Geological Survey (USGS), have assembled three separate geochemical data sets into the Minnesota Geochemical Database and Atlas. Data contributed to the project by the partners were derived from soil, soil parent material, and well water samples analyzed following USGS, Geological Survey of Canada, and Environmental Protection Agency protocols respectively. The analyzed size fraction for soils was <150 microns; for soil parent materials it was <63 microns, and both employed a multi-acid near-total digestion of the sample.

Soil geochemistry provided by the USGS were derived from 1,352 samples. Maps were prepared by averaging the results from soil in the top 0.2 meter and at about 0.5 meter depth from the same sample site. The soil maps also include stream sediment data from west-central and western Minnesota and a few additional samples in other parts of the state. Soil and some stream sediments were collected in 2004 and 2005. Most stream sediments were collected in 1979, under the National Uranium Resource Evaluation program, and were reanalyzed by USGS in 2005. Results from soil parent material used data from 250 till samples collected at 1 to 2 meters depth and analyzed as part of a till indicator mineral project in 2004. The ground water data was provided by the MPCA from the Ground Water Monitoring and Assessment Program (GWMAP) which collected and analyzed 954 water well samples between 1993 and 1996. The well sampling protocol set up nine square mile grids on 11 mile centers. Within each grid, one sample was collected from each identified aquifer.

The results of this compilation are provided in multiple formats. Geochemical maps of each element, from each sample media, are combined on a single sheet along with a generalized explanation. Symbol categories were based on natural groupings in the data using the natural breaks method; values below detection were set to half the detection limit, or other value (GWMAP data). The data tables for each sample media are available as Excel tables and as an ESRI geodatabase. Selected element maps and generalized geologic information are presented on a separate plate to give a statewide view of the geochemical landscape and how that might be interpreted within the existing Minnesota geological environment. Together, the Database components provide a regional framework for environmental management and exploration. Construction of the database and an associated atlas maps was funded by the Minnesota Minerals Coordinating Committee. The data and maps are available from the Minnesota Geological Survey web site (Minnesota Geochemical Database), while additional information may be obtained from the MPCA (GWMAP) and the USGS (National Geochemical Survey).

25. Stormwater Mapping: Making Connections with the New Data Exchange Standard

Mike Trojan, Minnesota Pollution Control Agency, mike.trojan@pca.state.mn.us; Nancy Read, Metro Mosquito Control District

Stormwater system maps have many potential uses, including aiding in emergency response, water quality management, fulfilling permit requirements, flood preparedness, and vector control. Although stormwater systems behave as a single hydrologic system, maps created by different entities often do not link to each other, making the information difficult for planners, designers and managers to use. We present a standard that can be applied to stormwater mapping to create a common framework that allows linkage of maps developed by different entities. Any entity can use the standard to facilitate data exchange. It also includes recommendations for format and coding of additional information about these structures, if collected. The standard was developed by a multidisciplinary team and has been reviewed through the public notice process of the Governor's Council on Geographic Information. It is expected to exist as a provisional standard for a period of not less than one year, during which time the development team will determine if modifications are needed.

Poster Session: 4:45 – 5:45 p.m.

26. Dynamics of Mercury Export from an Upland-Peatland Watershed in North-Central Minnesota

Martin Tsui, University of Minnesota, tsuix010@umn.edu; Stephen Sebestyen, U.S. Department of Agriculture, Forest Service; Jacques Finlay, University of Minnesota; Edward Nater, University of Minnesota

Mercury (Hg) contamination in fish and resulting consumption advisories are widespread throughout the world. Wetlands, especially peatlands, are sources of toxic methylmercury (MeHg) to surface waters. MeHg is the dominant form that accumulates in fish tissue. Although the overall contribution of peatlands to MeHg in surface water is known, the temporal dynamics and environmental controls of such export are less clear. In this study, we examine a small watershed located at Marcell Experimental Forest in north-central Minnesota. We are collecting water samples from different hydrological settings in which MeHg may be produced or transported: surface and subsurface runoff from upland to peatland, surface water at the lagg zone interface between uplands and peatlands, and stream water at the watershed outlet. We are measuring concentrations of total-Hg, MeHg and a suite of other solutes (e.g. dissolved organic carbon, soluble reactive phosphorus, iron, manganese and sulfate) from the onset of snowmelt until the flow of surface waters along these intermittent flowpaths ceases. The results are expected to provide a better understanding on how and when inputs of water from upland source areas affects MeHg production in peatlands as well as the watershed export of MeHg. In addition, the analyses of soluble reactive phosphorus, iron and manganese may provide insight on the temporal dynamics of reducing conditions in the watershed and their potential relationships with MeHg production.

27. Influences of Land Cover on Methylmercury Concentrations in Water and Invertebrates in Minnesota Stream Ecosystems

Martin Tsui, University of Minnesota, tsuix010@umn.edu; Jacques Finlay, University of Minnesota

Mercury (Hg) is a highly toxic pollutant and causes many fish consumption advisories throughout the world. Methylmercury (MeHg) is the dominant form of Hg that accumulates in aquatic organisms. In this study, we examined how land cover patterns in the watershed mediate MeHg levels in water and invertebrates in stream ecosystems with gradients of land cover types in the eastern part of Minnesota that included agricultural watersheds in the south, mixed land uses in Twin Cities Metropolitan Area, and watersheds with forests and wetlands in the north. Our data on 31 streams from July to October, 2008 showed that aqueous total-Hg and MeHg concentrations changed temporally within individual sites but in general increased from agricultural and Twin Cities sites to sites with forests and wetlands. MeHg concentrations in a ubiquitous stream invertebrate (hydropsychid caddisflies) also showed a similar pattern although variability within zone of similar watershed types was relatively large. Overall our data confirm that wetlands, well known as a source of MeHg to lakes, are largely responsible for spatial patterns of MeHg distribution in water and organisms in streams. In summary, conversion of land use would lead to changes in water chemistry (e.g., suspended sediments, nutrients) but also mediate the levels of toxic MeHg in the surface waters and its subsequent accumulation in aquatic organisms.

Poster Session: 4:45 – 5:45 p.m.

28. Sibley Parkway Redevelopment and Riverbank Restoration

Chuck Vermeersch, I&S Group, Inc., chuck.vermeersch@is-grp.com

The Sibley Parkway Redevelopment Project Area covers approximately 70 acres in Mankato located along the Minnesota River. The improvements are intended to stimulate residential and commercial redevelopment of this underutilized industrial area along the river, while restoring the historic character, connecting with the environment, and providing public places.

The redevelopment of the area addressed numerous environmental issues that need to be addressed, including potential wetlands, possible contamination from previous industrial activity, floodway preservation, riverbank restoration, and the closure of the adjacent water treatment plant lime storage pond.

The project included coordination with many agencies, including the City of Mankato, Department of Natural Resources, several departments of the Minnesota Pollution Control Agency, and the US Army Corps of Engineers. The project was financed in part by a redevelopment grant from the Minnesota Department of Employment and Economic Development (MNDEED).

The capstone of the project was the reclamation of the existing lime sludge storage pond into a passive park, and the restoration of the adjacent bank of the Minnesota River. The restoration included the installation of bendway weirs in the river, temporary and permanent erosion control measures, and significant landscaping.

Plenary Session II 8:10 a.m. – 9:30 a.m.

Land Use and Water Quality: Lessons from the First Two Decades of the USGS National Water-Quality Assessment (NAWQA) Studies

Paul D. Capel, United States Geological Survey, and Deparment of Civil Engineering, University of Minnesota, capel@usgs.gov

The long-term sustainability of our communities and ecosystems is dependent on the integrity and availability of the Nation's water resources. Information on the quantity and quality of these water resources is critical to ensure an adequate supply of water needed for human consumption, industry, agriculture (irrigation, livestock), recreation and to support ecosystems. In 1991, the U.S. Geological Survey implemented the National Water-Quality Assessment (NAWQA) Program to support national, regional, state and local information needs for making well informed decisions related to water-quality management and policy. The NAWQA Program is designed to answer questions such as: What are the conditions of our Nation's streams and groundwater? How are conditions changing over time? How do natural features and human activities affect the quality and quality of the water resources, and where are those effects most pronounced? By combining information on water chemistry, environmental characteristics, land use, stream habitat, and aquatic life, the NAWQA Program aims to provide scientific insights to current and emerging water resources issues and priorities. The mainstay of the NAWQA Program has been a consistent focus on three goals: 1) Status – to assess the quality of the Nation's water resources, 2) Trends – to evaluate if and how water-quality conditions are changing over time, and 3) Understanding – to determine how natural and human factors, such as geology, climate, and land use, affect water quality. NAWQA employs a targeted study design, in which study areas and sampling locations are chosen because they represent important environmental settings across the country. Three of the NAWQA study areas are partially located in Minnesota (the Red River of the North Basin (Minnesota, North Dakota and South Dakota), the Upper Mississippi River Basin (Minnesota and Wisconsin) and the Wapsipinicon, Cedar, Iowa, and Skunk River Basins (Minnesota and Iowa)). This presentation will summarize the results from these three study areas for nutrients, pesticides, volatile organic chemicals and other constituents in streams and groundwater and frame these results within the context of other NAWQA results obtained in the Midwest and throughout the Nation.

Concurrent Session IV 10:00 a.m. – 11:30 a.m.

Track A: News from the MPCA: Stormwater, TMDLs, NPDES Permits, and a Watershed Approach

Addressing Regulated Stormwater in Large Watershed TMDLs

Anna Kerr, Minnesota Pollution Control Agency, anna.kerr@pca.state.mn.us; Michael Trojan, Minnesota Pollution Control Agency

Large watershed TMDLs, such as the Lake Pepin nutrient TMDL, present challenges for addressing stormwater that is regulated under a National Pollutant Discharge Elimination System (NPDES) permit. These challenges include the following.

Regulated stormwater typically accounts for less than 10 percent of the total pollutant load.

Models used to determine the TMDL are not well suited to address regulated stormwater.

There are typically many permitted entities representing a diversity of stormwater management challenges.

The stakeholder process is difficult because of the large number of stakeholders from other sectors and within the stormwater community.

Although we continue to learn as these TMDLs proceed through development, we now know enough to offer guidance for addressing regulated stormwater in these TMDLs. In our discussion we use several case studies to present this guidance.

Industrial Stormwater Regulations: Adding the Third Leg to the MPCA Stormwater Program Stool

Melissa Wenzel, Minnesota Pollution Control Agency, melissa.wenzel@pca.state.mn.us

Locally and nationally, the trend is shifting from Construction and MS4 Stormwater programs to Industrial Stormwater permit development and implementation. Why? The first two "legs" addressed more highly-ranked water-quality challenges; now, following USEPA's lead, Minnesota is re-invigorating the Industrial Stormwater Permit to add the third leg in a transparent, thoughtful and responsive process. Challenges included the intricacies of drafting a permit for hundreds of different types of businesses, organized by 29 unique industry sectors. Opportunities included new and traditional outreach methods to reach, and teach, more than 20,000 potential stakeholders. Benefits included forming partnerships with local government and watershed districts to help carry out the Industrial Stormwater Program goals; and development of state-of-the-art Web-based tools to help permittees with regulatory compliance. Anyone can recognize the challenges of reinvigorating a program-learn how the Industrial Stormwater Program accepted the challenges with humor and grace, giving tips and suggestions that could benefit any regulatory or water program.

Concurrent Session IV 10:00 a.m. – 11:30 a.m.

Track A: News from the MPCA: Stormwater, TMDLs, NPDES Permits, and a Watershed Approach, *continued*

A Watershed Framework for Clean Water Legacy Act Implementation

Shannon Lotthammer, Minnesota Pollution Control Agency, shannon.lotthammer@state.mn.us; Glenn Skuta, Minnesota Pollution Control Agency

As we all know, in recent years "impaired waters" and "TMDLs" have been the focus of much attention and concern. The passage of the Clean Water Legacy Act (CWLA) in 2006 provided a policy framework and resources to state and local governments to accelerate efforts to monitor, assess, and restore impaired waters, and protect unimpaired waters. Since then, the Minnesota Pollution Control Agency (MPCA) has been ramping up its efforts to monitor and assess Minnesota's waters on a 10-year cycle, and to develop and implement TMDLs for impaired waters. These increased efforts present an opportunity, and a need, to develop an approach for organizing our water resource management efforts to provide a richer understanding of water quality conditions; better engage local government and stakeholders; and allow for coordinated planning, TMDL development and implementation.

This presentation will describe how the MPCA and partners are moving towards organizing its monitoring, TMDL and restoration strategy development, and implementation work using a watershed framework to better meet the coordination and collaboration needs associated with the implementation of the CWLA. The overall goal of this effort is to move from an individual impairment-driven approach to a more integrated, watershed-based system.

Concurrent Session IV 10:00 a.m. - 11:30 a.m.

Track B: Erosion and Sediment Transport in the Minnesota River Basin

Lake Pepin: Recent Accumulation Rates and Source Apportionment

Dylan Blumentritt, University of Minnesota, blum0123@umn.edu; Daniel Engstrom, Saint Croix Watershed Research Station; Shawn Schottler, Saint Croix Watershed Research Station

Lake Pepin is a natural impoundment on the Mississippi River and is located downstream of the confluence with the Minnesota and St. Croix Rivers. The majority of sediment that reaches Lake Pepin (~80%) is sourced in the Minnesota River watershed. In 1996 a study of Lake Pepin focused on the accumulation rates of both sediment and phosphorus since the time of European settlement to the area. In 2008, cores were re-collected and analyzed to determine how accumulation rates have changed over the past decade. In addition, methods were used to fingerprint sediment source-types (field v. non-field) in Lake Pepin and how they too have changed over time. Results indicate a slight decrease in overall sedimentation rates, and sediment source types have remained predominantly non-field throughout the past decade. Historically sediment sources transitioned from dominance by field erosion during the mid-1900s to non-field sources today.

Sediment Sources in the Minnesota River Basin

Peter Wilcock, Johns Hopkins University, wilcock@jhu.edu; Patrick Belmont, National Center for Earth-Surface Dynamics, Saint Anthony Falls Laboratory, University of Minnesota; Karen Gran, University of Minnesota, Duluth; Carrie Jennings, Minnesota Geological Survey

To evaluate the effectiveness of management options for reducing sediment loading to the Minnesota River, we must determine the rate, location, and mechanism of sediment sources and assess the potential storage between source and outlet. Extensive stream gauging by MPCA has identified those subwatersheds that contribute much of the sediment to the Minnesota River. In seven subwatersheds, paired MPCA gages indicate that a large fraction of sediment derives from the incising portion of the watershed close to the mainstem Minnesota River. To identify rates and mechanisms of sediment supply, we assess five primary sources in the Le Sueur watershed: bluffs, ravines, streambanks, tributaries, and flat, agriculture-dominated uplands and use a sediment budget to evaluate the relative magnitude of different sources and assess uncertainties in these estimates. We combine these results with other studies to present a synthesis of current understanding of sediment sources in the Minnesota River Watershed.

Concurrent Session IV 10:00 a.m. - 11:30 a.m.

Track B: Erosion and Sediment Transport in the Minnesota River Basin, *continued*

Barr-NCED Mapper for Channel-Floodplain Sediment Exchange Modeling

Patrick Belmont, National Center for Earth-Surface Dynamics, Saint Anthony Falls Laboratory, University of Minnesota, belmont@umn.edu; Tim Anderson, Barr Engineering Company; Christy Shostal, Barr Engineering Company; Miguel Wong, Barr Engineering Company

Sediment pathways through drainage networks, including short- and long-term channel bank and floodplain erosion and deposition, are poorly understood. Lack of predictive models for channel-floodplain interaction limits the resolution of traditional sediment budgets and routing models and obscures the relationship between sediment source contributions and flux at a monitored location. One critical step toward prediction of floodplain sediment deposition involves accurate prediction of floodplain inundation. The National Center for Earth-surface Dynamics (NCED) and Barr Engineering Co. (Barr) have collaborated to develop an easily applied code and graphical user interface within ESRI ArcMap software, which will be made publicly available. This tool will be used to predict the duration of floodplain inundation using high resolution LiDAR topography and flow data. In addition, the GIS tool is a rigorous, yet simple approach for measuring valley-bottom hypsometry with fidelity to channel gradient for delineation of the geomorphic floodplain. Availability of high-resolution LiDAR topographic data for a portion of the Le Sueur River watershed, southern Minnesota provided the opportunity to apply the tool to predict the duration of floodplain inundation under several hydrologic conditions that are relevant to understand the morphodynamic evolution of the riverine system. Thus, the results from this tool are being used to directly inform the NCED integrated sediment budget and routing model currently under development for the Le Sueur River watershed and will prove valuable for development and implementation of TMDL management plans. Here we discuss the development of the tool and its application to the Le Sueur River watershed.

Concurrent Session IV 10:00 a.m. – 11:30 a.m.

Track C: GIS Applications in Water Resource Management

Historic Waters of the Mississippi Watershed Management Organization

Anthony Randazzo, HDR Engineering, Inc., Anthony.Randazzo@hdrinc.com; Dan Kalmon, Mississippi River Watershed Management Organization

The Twin Cities urban core developed so rapidly during the industrial age of the 19th Century that there was often little record of the character of the landscape and water resources at the time of settlement. Major objectives of the project include the delineation of pre-settlement sub-watersheds, geospatially locating historic waters, including wetlands, streams, springs and lakes within the MWMO area from a range of historic sources, and providing best estimates of the character of each of the water features within the larger pre-settlement ecological context. Results of the study are intended to be made available to policy makers, professionals and citizens to be applied in water resource modeling, ecological restoration, historical documentation and water issues identification.

Minnesota Department of Natural Resources Watershed Delineation Project—The First Decade

Sean Vaughn, Minnesota Department of Natural Resources Waters, sean.vaughn@dnr.state.mn.us

The DNR Watershed Delineation Project and methodology will be introduced. After nearly 11 years of work, this effort has mapped over 10,000 watershed delineations called DNR Catchments. DNR Catchments are scale independent delineations that function as the elementary drainage "building blocks" used to define watersheds within a hierarchal classification system. Discussion will focus on the new DNR Catchments. The derivation of DNR Basin Watersheds, DNR Minor Watersheds and DNR Major Watersheds from DNR Catchments and the application of these products for natural resource management will also be covered. Recently developed GIS tools relating to the application of the DNR Watershed Project products will be demonstrated.

Using Community Growth Scenarios to Evaluate Potential Water Quality Impacts

Valerie Brady, Natural Resources Research Institute, University of Minnesota, Duluth, vbrady@d.umn.edu; Jesse Schomberg, Minnesota Sea Grant, University of Minnesota; Gerald Sjerven, Natural Resources Research Institute, University of Minnesota, Duluth

Many communities have specific goals or objectives in local plans on protecting water resources, but find it difficult to change existing ordinances regulating development or evaluate the future impacts of today's decisions.

To help these communities better evaluate alternative development options, we used GIS and the Community Viz software to evaluate several scenarios of growth in a rural township, a small city, and a watershed spanning several communities. We used three scenarios: smart growth, conservation design, and existing zoning. For each scenario, we evaluated the potential effects on water resources by calculating estimates of impervious surface, forest cover loss, runoff volumes, and other indicators.

3-D flyovers and visuals were created to help communities understand what these different styles of development would look like "on the ground". Results indicate that by changing the style of development, communities could significantly reduce future impacts to water resources, with total runoff reductions of 25–66% over continuing existing zoning policies.

Concurrent Session IV 10:00 a.m. – 11:30 a.m.

Track D: Thermal/Cold Water Trout Streams

Groundwater Recharge in a Coldwater Stream during Urbanization

Timothy Erickson, University of Minnesota, eric1003@umn.edu; Heinz Stefan, Saint Anthony Falls Laboratory, University of Minnesota

The change to groundwater recharge resulting from the urban development in the Vermillion River watershed, south of the Twin cities, was investigated. The quantity and quality of surface runoff and groundwater recharge are changed by urbanization. If water recharge to aquifers is reduced, and surface runoff is increased by urban development in a watershed, fish habitat in cold-water streams can be adversely affected. The Vermillion River is a coldwater stream that provides habitat for brown trout and brook trout populations.

Three studies related to groundwater recharge were conducted: (1) a soil water budget study to estimate the influence of changed imperviousness and surface vegetation on natural recharge in a small tributary watershed of the Vermillion River, (2) a trend analysis of stream/base flow at the USGS stream gauging site on the Vermillion River near Empire, MN, and (3) a water use study to estimate the influence of imported water on artificial groundwater recharge from lawn watering, leaky water supplies, etc.

The results of the first study confirm that the increase in impervious surface area associated with urban development will decrease annual natural groundwater recharge. The trend analysis (second study) showed no statistically significant trend in the stream flow record during the period of 1982 to 2006 even though imperviousness in the watershed increased from 8% in 1984 to 13% in 2005. The third study revealed that groundwater recharge from urban water supply and drainage systems and from irrigation has more than doubled from 1982 to 2006; it accounts for nearly 10% of annual recharge in the watershed and matches the reduction in natural recharge predicted by the soil water budget models (first study). The net effect of urbanization on groundwater recharge, seen in the trend analysis of the Vermillion River base flow was close to zero.

Estimating Groundwater Input to the Vermillion River from Measurements of Stream Temperature and Stream Flow

Ben Janke, University of Minnesota, janke024@umn.edu; William Herb, University of Minnesota; Omid Mohseni, University of Minnesota; Heinz Stefan, University of Minnesota

The Vermillion River is a trout stream south of the Twin Cities, and portions of its watershed have experienced intense urban development. There is growing concern about the possible increase in stream temperatures associated with urbanization due to the negative impact this would have on the trout fishery of the stream. A stream temperature model for the river capable of predicting the impact of current and proposed land use scenarios on stream temperature has been created. A significant input to this model is the estimated groundwater inflow rate, which is known to maintain low stream temperatures in summer. A technique had to be developed to estimate groundwater inflow to a stream reach. If all major heat transfer processes in a stream reach can be modeled accurately, the groundwater inflow rate can be extracted by solving the governing equations. This approach requires measured stream flow rates, measured stream temperatures at the upstream and downstream ends of the stream reach, an estimate of the temperature of the groundwater, weather data, and stream morphology. These data have been collected over the past three years at a number of sites in the main stem and major tributaries of the Vermillion River. The heat budget technique was applied to several reaches, and the results suggest that groundwater input to the system is both spatially and seasonally variable. Stream reaches for which groundwater inflow is significant were identified, and have been compared to reaches that were identified as crucial trout habitat by the DNR.

Concurrent Session IV 10:00 a.m. – 11:30 a.m.

Track D: Thermal/Cold Water Trout Streams, *continued*

Brown's Creek Biotic TMDL: An Alternative to Thermal Modeling for Quantifying Thermal Stresses on Brown Trout

Thomas Miller, Emmons & Olivier Resources, Inc., tmiller@eorinc.com

Brown's Creek in Washington County has been listed on the EPA's 303(d) list of impaired waters for biotic impairment, specifically *lack of coldwater assemblage* (in this case brown trout). Temperature was indicated as one of the stressors through the Brown's Creek stressor identification process. In this TMDL study, allocations were assigned without resource intensive thermal modeling. Load and wasteload allocations were determined using heat load as a surrogate for temperature, and in-stream temperature monitoring was analyzed along with climatic factors to characterize trout threat temperature exceedences. Daily heat loads were calculated under all flow conditions and baseflow separation was conducted using HYSEP software to further distinguish between the load and wasteload in the stream. In addition to calculating the TMDL, this method assisted with the implementation process by providing insight into the timing, duration and climatic conditions that threaten trout in Brown's Creek.

Luncheon Presentation 12:15 p.m. – 1:00 p.m.

Wetland Drainage and Its Impacts in Minnesota

Rex Johnson, United States Fish and Wildlife Service, rex_johnson@fws.gov

While Minnesota is estimated to have lost approximately 40% of its presettlement wetlands statewide, in the intensively farmed prairie pothole region of the state we have conducted an inventory of drained wetlands and found that drainage rates for counties and watersheds routinely exceed 85%. Generally drainage has been greatest in the southern and southwestern most counties. The conversion of a wetland-rich landscape to a landscape characterized by an integrated network of ditches and tile lines has profoundly altered the state's wildlife, flood patterns and water quality. These impacts will be discussed, as will the development of a strategic approach to the restoration of historic environmental functions.

Concurrent Session V 1:15 p.m. – 2:45 p.m.

Track A: Water Resource Responses to Climate and Human Interaction

Changes in Groundwater Level and Potentiometric Surfaces in Selected Bedrock Aquifers in the Twin Cities Metropolitan Area, 2008

Christopher Sanocki, U.S. Geological Survey, sanocki@usgs.gov; Susan K. Langer, U.S. Geological Survey; Jason C. Menard, U.S. Geological Survey

Water-level measurements from more than 300 wells in three major aquifers serving the Twin City Metropolitan Area (TCMA) show little change in 19 years. The USGS in cooperation with the Minnesota Pollution Control Agency, Minnesota Department of Natural Resources and the Metropolitan Council conducted a synoptic water-level study for the Prairie du Chien-Jordan (PDCJ), Franconia-Ironton-Galesville (FIG) and Mt. Simon-Hinckley (MSH) aquifers in March and August of 2008. Maps were created to show: (1) potentiometric surfaces for March and August, 2008, (2) potentiometric surface change from March to August, (3) updated potentiometric contour maps for the PDCJ and the MSH aquifers during the winter of 1988/89, (4) and estimates of long term potentiometric surface change for the PDCJ and the MSH aquifers. The comprehensive GIS database of study results can assist resource managers in water supply planning, calibration of water supply models, and understanding seasonal change and future water-level synoptics.

Shallow Groundwater Temperature Response to Climate Change and Urbanization

Craig Taylor, Saint Anthony Falls Laboratory, University of Minnesota, tayl0423@umn.edu

Groundwater temperatures, especially in shallow aquifers depend on ground surface temperatures which in turn depend on climate and land use. Seasonal surface temperature cycles penetrate the ground to depths on the order of 10 to 15m. Basic heat transfer relationships (conduction/dispersion) are applied in order to estimate how changes in land use (urban development) and climate change may affect shallow groundwater temperatures.

This analysis indicates that a fully urbanized downtown area near Minneapolis/St. Paul is likely to have a groundwater temperature that is nearly 3°C warmer than an undeveloped/agricultural area. Data collected by the MPCA in the St. Cloud, MN area confirm that land use influences groundwater temperatures.

Groundwater temperatures are also projected to rise in response to global warming and associated ground surface temperature increases. In the extreme case of a 2xCO2 climate scenario, groundwater temperatures in the Minneapolis St. Paul metropolitan area could rise by up to 4°C.

Compounding urbanization and climate change, by applying the extreme 2xCO2 climate scenario to a land use change from "undeveloped" to "fully urbanized," is expected to raise groundwater temperatures by about 5°C.

Low-Flow Characteristics of the Mississippi River and Selected Tributaries

Dave Lorenz, U.S. Geological Survey, lorenz@usgs.gov; Erich Kessler, U.S. Geological Survey

Planning for sustainable water supplies for the growing Twin Cities metropolitan area in Minnesota is an ongoing issue. One key in assessing water sustainability is understanding streamflow in the Mississippi River and its tributaries during drought conditions. This study, done in cooperation with the Metropolitan Council, characterized regional low flows in the Mississippi River Basin above Anoka, Minn., and estimated the likelihood of extremely low flows in the Mississippi River near Anoka.

Based on the methods used in this study, the probability that the flow in the Mississippi River at Anoka will be less than 660 cubic feet per second (ft^3/s) in any 1 year is 1 percent, and the probability that the flow will be less than 510 ft^3/s is 0.1 percent.

Concurrent Session V 1:15 p.m. - 2:45 p.m.

Track B: Turbidity TMDL

The Relationship of Turbidity Surrogates to Physical Watershed Characteristics

Larry Gunderson, Minnesota Pollution Control Agency, larry.gunderson@state.mn.us; David Mulla, University of Minnesota

Setting sediment reduction targets in Minnesota watersheds depends on the relationship between total suspended solids (TSS) and turbidity. Minnesota has a 25 NTU turbidity standard but no standard for TSS. TMDLs are established based on TSS loads intended to achieve the turbidity standard. This study used paired turbidity and TSS data to establish turbidity surrogates for 42 stations in southern Minnesota. Turbidity surrogates ranged from 46.3 to 488.1 mg/L TSS.

The relationship of the turbidity surrogate to watershed characteristics was investigated. The surrogate was strongly correlated to mean watershed slope (r = -0.593), percent of land in the Alluvium and Outwash (r = -.527) and Steep Wetter Moraine (r = -0.55) Agroecoregions, and percent of land in agriculture (r = 0.672). Watershed area, stream slope, and percentages of land in watershed storage, water, urban, and perennial uses predicted the turbidity surrogate using linear regression with an R^2 value of 0.725.

SWAT Modeling of a Rural Watershed for Turbidity TMDL

Joe Mulcahy, Metropolitan Council, joe.mulcahy@metc.state.mn.us

The Bevens Creek watershed is located in the western part of the Twin Cities Metropolitan Area, and is tributary to the Minnesota River. The watershed is largely in agricultural and rural land use. The creek was listed as impaired for excessive turbidity under Section 303(d) of the Clean Water Act.

The watershed was modeled using the Soil and Water Assessment Tool (SWAT). The SWAT model was used to determine the feasibility of reducing turbidity and to determine general best management scenarios for reducing the suspended solids (the surrogate chosen for turbidity) in the watershed.

The SWAT model was successfully constructed and calibrated for flow and total suspended solids using 14 years of observed data. Several best management practices scenarios were evaluated for suspended solids reduction.

TMDL Allocations for Non-Point Sources - A Turbidity TMDL Study Using SWAT for Carver Creek Watershed, MN

Hong Wang, Metropolitan Council, hong.wang@metc.state.mn.us; Karen Jensen, Metropolitan Council; Judy Sventek, Metropolitan Council; Marcel Jouseau, Metropolitan Council

Carver Creek, a Minnesota River tributary located in Carver County, MN, was listed on the 2002 Minnesota 303(d) Impaired Waters List due to high turbidity caused by suspended sediments. To assign TMDL (Total Maximum Daily Load) allocations for the creek, the SWAT model (Soil and Water Assessment Tool) was calibrated and validated for hydrology and TSS based on 17 years of monitoring data and a radioisotope sediment fingerprint study for field and non-field erosion.

General allocations of TMDL are made to the waste load allocation (WLA), load allocation (LA), and a margin of safety (MOS) using the duration curve method. The calibrated SWAT model was used to refine the LA to individual non-point sources and sub-basins in the watershed, which will provide with detailed information on field and bank erosion sites where pollution mitigation is of priority, and greatly benefit TMDL implementation.

Results indicate that 50.7% of the non-point source load capacity should be allocated to soybean fields, 31.6% to corn fields and 15.9% to bank and other non-field erosion. The study recommends that in order to meet the turbidity standard, BMP efforts should focus on non-point source control including erosion from soybean, corn fields, stream bank and other non-field erosions.

Concurrent Session V 1:15 p.m. – 2:45 p.m.

Track C: Innovative Stormwater BMPs

Iron-Enhanced Sand Filtration for Stormwater Phosphorus Removal

Andy Erickson, Saint Anthony Falls Laboratory, University of Minnesota, eric0706@umn.edu; John Gulliver, Saint Anthony Falls Laboratory, University of Minnesota; Brian Huser, Barr Engineering Company

Most treatment practices for urban runoff utilize either the settling of particles or the filtering of particles to remove the compounds associated with these particles. Dissolved substances are not treated. Dissolved phosphorus, for example, composes an average of 35-45% of total phosphorus, and can be as high as 95%. Research at the University of Minnesota studied dissolved phosphorus removal by ASTM C-33 sand, calcareous sand, limestone, three blast oxygen furnace (BOF) by-products, aluminum oxide, chopped granular steel wool, and steel wool mesh. On average, between 34 and 81% of the dissolved phosphorus was retained with 0.3 and 5% steel wool by weight, respectively, in the six steel-enhanced sand filtration columns. As a result, a field application of an iron-enhanced sand filter has been installed in Maplewood, Minnesota using approximately 5% iron filings by weight with the purpose of removing dissolved phosphorus from stormwater runoff. The basin surface area is approximately 0.27 acres (3.4% of the contributing watershed). The basin is designed to treat approximately 0.65 acre-feet of stormwater without overflow and the average annual hydraulic loading rate for the filter is estimated to be 5.6 meters (18.4 feet) per year. A model developed from the column studies is used to predict the phosphorus removal for the basin.

Pine City Storm Water Management Retrofits, a Cost Comparison of the Traditional Methods Verses New Methods

Sean Clark, Short Elliott Hendrickson, Inc., sclark@sehinc.com

Pine City has taken a non-traditional approach in dealing with storm water conveyance and treatment with their street reconstruction projects. The City is located adjacent to Cross Lake and Snake River. To protect these resources the City and its citizens have implemented multiple non-traditional methods for their storm water conveyance and treatment methods. Unexpectedly, the costs of these methods were considerably less, as compared to the more traditional method of catch basins, piping, and treatment ponds.

The presentation will focus on the costs of the non-traditional methods in comparison to traditional methods, and will highlight the City's 2007, 2008 and its upcoming 2009 street reconstruction projects. These projects feature overland drainage, small infiltrating depressions, gradual swales, rainwater gardens, underground infiltration chambers, and infiltrating perforated storm sewer/catch basin drainage systems. The presentation will also include design challenges, an overview of how the systems are performing and how they have been received by the community and surrounding area.

Concurrent Session V 1:15 p.m. – 2:45 p.m.

Track C: Innovative Stormwater BMPs, *continued*

Permeable Pavement: Bloomington Public Works Experience

Steven Segar, City of Bloomington, ssegar@ci.bloomington.mn.us; Dave Gunderson, City of Bloomington

The City of Bloomington constructed an Infiltration Demonstration Project at Harrison Park in the fall of 2008. The Project consists of a permeable asphalt parking lot and two rain gardens.

Project Design Objectives:

- Improve water quality
- Reduce quantity of storm water runoff
- Reduce flash flows during intense rain events
- Reduce impervious land coverage
- Provide retention, infiltration and cooling of storm water
- Minimize erosion
- Increase Creek base flows during low flow periods
- Bind heavy metals and toxins coming off parking lot

Lessons were learned during construction, construction logistic difficulties encountered, design changes were made in the field, and documented for future projects. Bloomington Engineering and Maintenance Divisions worked together both in the design of the parking lot and adjacent rain gardens and also to develop maintenance best management practices and train staff to preserve the infiltration performance of the facility.

Concurrent Session V 1:15 p.m. – 2:45 p.m.

Track D: Trends and Mapping of Minnesota Wetlands

Status and Trends of Wetlands in Minnesota: Wetland Quantity

Steve Kloiber, Minnesota Department of Natural Resources, steve.kloiber@dnr.state.mn.us; Mark Gernes, Minnesota Pollution Control Agency; Doug Norris, Minnesota Deparment of Natural Resources

In 2006, Minnesota instituted a random sample wetland survey as part of a comprehensive wetland strategy. This monitoring survey involves repeatedly mapping wetlands in 4,990 randomly selected 1-square mile plots over a three year cycle. The data from this survey are intended to answer questions regarding the status and trends of wetland quantity and quality in Minnesota.

The data indicate that wetlands comprise 21.3% of the sampled area. Extrapolating these results to the entire state, there are 11,500,000 acres of wetland in Minnesota, not counting deepwater habitats. Forested wetlands were the most common wetland class and covered 9.1% of the state. Emergent wetlands and scrub-shrub wetlands occupy 5.8% and 4.7% of the state, respectively. Data also indicate a strong geographic gradient of wetland occurrence. Comparison between the survey results and the National Wetland Inventory found a strong relationship ($r^2 = 0.94$) for total wetland area. The relationship between NWI and survey results for forested wetlands was similarly strong ($r^2 = 0.82$). However, there was more variability in the results for emergent wetlands ($r^2 = 0.59$). Differences between the NWI and the wetland survey will be discussed along with information about trends.

Status and Trends of Wetlands in Minnesota: Wetland Quality

John Genet, Minnesota Pollution Control Agency, john.genet@pca.state.mn.us

In 2006 Minnesota initiated a random survey designed to assess status and trends of wetland quality (function and condition) throughout the state. This effort compliments the random wetland quantity survey currently being conducted in Minnesota. The quality survey follows a rotating ecoregion schedule to obtain statewide estimates every three years and utilizes wetland quantity 1 mi^2 survey plots as the sample frame. The first 3-year iteration of the survey focuses exclusively on depressional wetlands with emergent vegetation and ponds. The condition of each sample site is assessed using regionally calibrated plant and macroinvertebrate indices of biological integrity (IBIs). Sample sites are also evaluated for their ability to provide several wetland functions using the Minnesota Routine Assessment Method. Water chemistry parameters are measured to provide an indication of environmental stress.

Results from the first year of the survey indicate that an estimated 82,000 depressional wetlands and ponds occur in the central hardwood forest ecoregion. According to the plant IBI an estimated 18% of these wetlands and ponds are in good condition, 21% are fair, and 61% are poor. The macroinvertebrate IBI resulted in estimates of 43% good, 41% fair, and 15% poor. Potential reasons for the differences in these two assessments will be discussed as well as results from functional and stressor indicators.

Evaluating the Potential of Using Topographic Data for Wetland Mapping in Minnesota

Lian Ortiz, University of Minnesota, ortiz073@umn.edu; Joseph Knight, University of Minnesota; Bryan Tolcser, University of Minnesota; Steve Kloiber, Minnesota Department of Natural Resources

Topographic information can assist in mapping depressional areas that may contain wetlands. Terrain indices are indicators of the expected "wetness" of an area based on the amount and direction of surface water flow. Resolution sensitivity of the Compound Topographic Index (CTI) and a Slope Cost-Distance Index (SCDI) was examined. LiDAR-based elevation data (3m) was used to create degraded DEMs of 9, 12, 24 and 33 meters. Results of this sensitivity analysis indicate that acceptable wetland mapping accuracies can be achieved with relatively coarse resolution DEMs. Further statistical analyses of terrain indices, in conjunction with optical data, stream networks, and soil type data, will be used to evaluate their predictive value for identifying wetlands. Results of this analysis are expected to assist with wetland mapping in Minnesota by increasing overall accuracy and cost-effectiveness of mapping efforts.

Concurrent Session VI 3:00 p.m. – 4:30 p.m.

Track A: Techniques for BMP Maintenance

2-D Modeling of Rice Creek: Alternatives for Reducing Channel Maintenance

Matt Redington, HDR Engineering, Inc., matthew.redington@hdrinc.com; Nick Flemming, HDR Engineering, Inc.

There is a history of sedimentation problems within Rice Creek and in Long Lake. A sedimentation basin that was built upstream of Long Lake is effective at removing some sediment from Rice Creek flows, however, the channel between the sedimentation basin and Long Lake and a cove adjacent to the channel still periodically fill with sediment.

A 2-dimensional (2-D) model (FESWMS) was created of this section of Rice Creek to allow examination of flow paths, depths, and velocities throughout the reach and the cove. Bend-way weirs and channel bank realignment alternatives were modeled to evaluate their effectiveness for minimizing channel and cove maintenance costs. The conclusion of the study was that sedimentation will always occur, but construction of a bend-way weir at the entrance to the cove could be used to minimize maintenance costs for the cove.

Certifying Infiltration Practices: A Critical but Often Overlooked Step

Patrick Conrad, Emmons & Olivier Resources, Inc., pconrad@eorinc.com; Dave Bauer, Rice Creek Watershed District

In 2003 the RCWD conducted a three year BMP monitoring report and developed several recommendations for improving the application of infiltration practices through its permitting process. One of the significant recommendations for improving the District's regulatory program was to develop guidance documents on the design and construction of infiltration BMPs. The guidance documents, available on the District's website since 2004 for use by permit applicants and engineers, provide specific information on how to promote infiltration within stormwater BMPs including recommendations for soil amendments, vegetative establishment and basin configuration. Many of the recommendations have been followed by permit applicants since their development. Since then, the RCWD has shifted regulatory focus from design to construction and implementation guidance with a follow-up assessment to determine whether the permit program improvements have had an impact on the effectiveness of infiltration BMPs. In the summer of 2007 an updated methodology was developed to assess numerous infiltration BMP sites across the District. The assessment methodology includes actual field measurements of infiltration capacity along with additional specific assessment points. A secondary purpose of this project was to develop a stormwater BMP certification process to determine compliance to District standard at permit close-out. During the 2009 field season, Inspectors from Rice Creek will incorporate the BMP certification for both closeout inspections as well as maintenance inspections.

BMPs: Now That You Have Them, How Do You Maintain Them?

Lisa Goddard, SRF Consulting Group, Inc., lgoddard@srfconsulting.com; Mark Maloney, City of Shoreview

The use of stormwater treatment strategies has increased significantly due to new stormwater regulations. These regulations also require governmental units to develop a systematic approach for the documentation of BMP inspection and maintenance. While numerous manuals address BMP design, a comprehensive resource guide that addresses detailed inspection and maintenance activities for various categories of BMP devices did not exist. As a result, cities participating on the Local Road Research Board requested that a maintenance resource guide be created to supplement the Minnesota Stormwater Manual.

The resource guide provides detailed guidance on five BMPs heavily used in Minnesota. Maintenance procedures in technical manuals was supplemented with the Technical Advisory Panel's working knowledge of what is typically needed to maintain BMP facilities, based on previous experience and engineering judgment. The resource guide concludes with an introduction to newer BMPs that are not widely used, but are gaining in popularity and interest. This session will focus on presenting the organization and content of the resource guide and how it can be customized for specific city needs.

Concurrent Session VI 3:00 p.m. – 4:30 p.m.

Track B: Big River Trends and Forecasting

Long-Range Probabilistic Forecasts for the 2009 Red River Flood

Allen Bradley, University of Iowa, allen-bradley@uiowa.edu; Steve Buan, NWS North Central River Forecast Center; Mohamed Habib, University of Iowa

Record floods devastated parts of the Red River of the North in the Spring of 2009. Yet as early as December 2008, there were forecasts issued indicating a significantly increased springtime flood risk. A few years after the 1997 Red River flood, Advanced Hydrologic Prediction Services (AHPS) were developed and implemented for seasonal streamflow forecasting at the National Weather Service (NWS) North Central River Forecast Center (NCRFC). AHPS uses ensemble streamflow prediction (ESP) techniques to make forecasts of the probability of the occurrence of flood levels (and other flow variables) out to 90 days in the future.

How good are these probability forecasts? This presentation examines the long-range forecasts issued in the months and weeks preceding the floods. In some locations, forecast probability for major flooding was close to 100%. To provide some historical context, we compare these with past forecasts for the Red River. The past forecasts were generated retrospectively, using the operational models in use today, for a period from 1950 to 1999. The comparison shows what would have been forecast historically had AHPS been available then, what happened when forecast probabilities were unusually high (or low), and how extreme the forecast probabilities were in 2009. The comparison shows the confidence and associated uncertainty with long-range flood forecast probabilities, and their significant potential value for flood planning and advance preparation.

Forecasting the 2009 Record Floods on the Red River of the North

Andrea Holz, NWS North Central River Forecast Center, andrea.holz@noaa.gov; Steve Buan, NWS North Central River Forecast Center; Mike DeWeese, NWS North Central River Forecast Center

During the 2009 record floods on the Red River of the North, the National Weather Service (NWS) North Central River Forecast Center (NCRFC) issued river forecasts throughout the region. Long before the event, NWS was issuing probability forecasts for the occurrence of flooding at locations within the Red River basin. In late February and early March, the Spring Hydrologic Outlook was issued. But with the start of warming in late March, the NWS began shifting from long-range probabilistic forecasts (for events out to 90 days) to short-range deterministic forecasts (out to seven days or more), which continued throughout the flood event.

This presentation describes the forecasting process for the 2009 Red River floods, along with the hydrologic and hydraulic conditions that were factors in the event. Significant precursors to the event were the wet Fall, the soaking rains that froze in place late in the season, and the snowy winter. As the event unfolded, NWS assembled real-time information on current hydrologic conditions and weather forecasts to make river forecasts. The flat terrain posed significant challenges, as flows can breakout from rivers and be stored in fields, or travel overland to adjacent rivers, effectively bypassing the river gauges where flows are measured. Close cooperation with people in the field, from the US Geological Survey crews making direct discharge measurements, to other federal and local agency personnel carrying out management activities, provided valuable information in making the forecasts.

Concurrent Session VI 3:00 p.m. – 4:30 p.m.

Track B: Big River Trends and Forecasting, *continued*

Minnesota River Trends Report

Kimberly Musser, Water Resource Center, Minnesota State University, kimberly.musser@mnsu.edu; Larry Gunderson, Minnesota Pollution Control Agency; Scott Kudelka, Water Resource Center, Minnesota State University; Rick Moore, Water Resource Center, Minnesota State University; Deepak Sanjel, Mathematics Department, Minnesota State University

The Minnesota Trends Report broadly characterizes trends in water quality and key biological indicators across the Minnesota River Basin. The Trends Report is an outgrowth of the State of the Minnesota River Reports that have consolidated surface water quality monitoring information collected from diverse agencies across the Minnesota River Basin since 2000. The Trends Report expands the scope beyond water quality provide a broader perspective of ecosystem health. Researchers collected and analyzed water quality, biological, demographic, and spatial data from a wide variety of sources. The report is designed for a non-technical audience and is rich in summary maps and graphics.

The contents of the Trends Report include: water quality trends based on statistical trend analyses performed on mainstem and major tributary sites, a brief overview of land use and demographics trends, and a summary of trends for key biological indicators (e.g. mussels, fish, and macroinvertebrates). Presenters will provide an overview of major conclusions drawn during the study and discuss factors influencing those trends.

Concurrent Session VI 3:00 p.m. – 4:30 p.m.

Track C: Agriculture and Water Quality

Two-Stage Designs for Agricultural Drainage Ditches

Bruce Wilson, University of Minnesota, wilson@umn.edu; Brad Hansen, University of Minnesota; Geoffrie Kramer, University of Minnesota; Joseph Magner, Minnesota Pollution Control Agency; John Nieber, University of Minnesota; Gary Sands, University of Minnesota; Jeff Strock, University of Minnesota

Agricultural drainage ditches are often inadequate from both production agriculture and environmental perspectives. For agricultural communities, the maintenance of drainage channels is expensive, requiring a substantial financial commitment from counties and watershed districts. Unstable ditches also have direct negative impact on the environment with increased sediment loading. In addition, because drainage ditches are relatively straight channels that are periodically dug out for maintenance, they have limited ability to develop a sufficient biological community to effectively mediate high nutrient loads. An alternative design that mimics the main and flood-plain channels of natural streams is being evaluated in Mower County. Relationships for the design of these two-stage channels are developed and applied to private drainage ditch located in Mower County. The construction of the two-stage drainage ditch is also described.

Crop Residue Management Trends in Minnesota

Shannon Fisher, Water Resource Center, Minnesota State University, Mankato, shannon.fisher@mnsu.edu; Richard Moore, Water Resource Center, Minnesota State University, Mankato

Conservationists and agricultural economists agree that crop residue management is a critical aspect of land management. We coordinated a 2007 residue management survey in the 67 Minnesota counties where crop production exceeded 30% of the land use. Using Conservation Technology Information Center protocol, local viewers completed the 2007 survey. We assessed historical residue data and identified trends and concerns. From 1989 to 2007, the statewide application of conservation tillage (>30% residue) increased from 18.1% to 35.1%, reduced tillage (15-30% residue) increased from 27.0% to 33.0%, and conventional tillage (<15% residue) dropped from 54.9% to 31.9%. Although trends were present, residue management was driven by various factors, generating watershed, cropping, and regional differences in tillage status across the state. Various trends and observations will be discussed, including a roll out of the 2010 residue survey plan.

Can Perennial Biofuel Cropping Systems Be Used to Remove Pharmaceuticals from the Environment?

Jared Trost, U.S. Geological Survey and University of Minnesota, jtrost@usgs.gov; Melinda Erickson, U.S. Geological Survey; Richard Kiesling, U.S. Geological Survey; Clarence Lehman, University of Minnesota; John Nieber, University of Minnesota

Preliminary results from a 3-year plot-scale study indicate that antibiotic compounds are taken up by plants, and some compounds reach groundwater from land application, typically following major recharge events (e.g. spring 2009 recharge).

Study goals are to observe and simulate the fate and transport of selected antibiotics, endocrine disrupting compounds, and inorganic nitrogen from land surface to groundwater. The study is assessing chemical movement through the unsaturated zone beneath three different biofuel cropping systems: corn, prairie, and hay. There are five replicates for each biofuel crop/chemical addition combination on 121 square meter experimental plots located at the Cedar Creek Ecosystem Science Reserve, on the Anoka Sand Plain. Plant biomass, root biomass, soil, soil water, and groundwater were sampled and analyzed for antibiotics, endocrine disrupting compounds, and inorganic nitrogen concentrations.

The study is being conducted by the U.S. Geological Survey, the University of Minnesota, and the Legislative-Citizen Commission on Minnesota Resources.

Concurrent Session VI 3:00 p.m. – 4:30 p.m.

Track D: Geomorphologic Methods for Rivers and Streambeds

Rapid Channel Stability Assessments for Streams in Minnesota: Do We Need to Reinvent the Wheel? Or Just Redesign the Bicycle?

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Rapid Channel Stability Assessments have been developed for many regions in the United States; however, these assessment tools often do not adequately characterize and assess indicators of steam instability for low-gradient, alluvial streams found in Minnesota. We applied existing channel stability assessments to streams in the Minnesota River Basin and Cedar River Basin in order to determine which set of metrics best characterized indicators of channel stability observed. We present a modified Rapid Channel Stability Assessment designed for low-gradient alluvial streams that could be used during biological collection in tandem with habitat assessments, for stressor identification and causal analysis of biological impairments, and for determining where quantitative geomorphic surveys should be targeted for Total Maximum Daily Load investigations of excess sediment.

Assessment of Geomorphic Methods for Application to Biota TMDLs in the Red River Basin

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Biotic impairment of streams is widespread throughout the Red River basin (RRB). There is a need to correlate stream geomorphic characteristics with index of biotic integrity (IBI) scores, yet it is unclear which geomorphic tools are most relevant to biotic assessment. A guidance document was prepared for the MPCA to address this need, given the unique characteristics of the RRB. Numerous geomorphic techniques were assessed including tools to measure channel stability, channel form and sediment load. Geomorphic methods alone are insufficient for diagnosing causes of low IBI scores. Methods need to be tailored by geologic setting, land-use and watershed size. In the RRB the characteristics of intensively drained agricultural watersheds require special consideration. Headwaters streams, (< 200 mi^2) had the lowest IBI scores, having undergone the greatest geomorphic and hydrologic alteration. Therefore small-medium sized streams are targeted for assessment and implementation actions. Implementation steps are recommended with stratification by channel materials, watershed size and geographic location.

Concurrent Session VI 3:00 p.m. – 4:30 p.m.

Track D: Geomorphologic Methods for Rivers and Streambeds, *continued*

Dobbins Creek Culvert Sizing

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Due to chronic flooding in the Upper Cedar River Watershed (UCRW), representatives of local government units and organizations have formed an Ad-Hoc Committee to develop a Stormwater Management Plan (SWMP) with a primary goal of providing flood protection throughout UCRW. The desire is also to reduce the 1 percent flood discharge in the City of Austin, MN. by 20 percent. Land use in the UCRW is predominantly agriculture and extensive drainage to remove excess water through the years has left little natural depression storage in the watershed. The Gridded Surface Subsurface Hydrologic Analysis (GSSHA) model was used to assess the benefits and impacts of culvert sizing in the Dobbins Creek watershed just east of Austin. GSSHA is a spatially explicit physically based, process driven hydrologic model that tracks watershed response to precipitation inputs using a high resolution grid and short time scales that facilitates assessment of water balance and other processes throughout the entire watershed. Culvert sizing offers the potential to delay runoff at road crossings and reduce downstream flood peaks. However, the downstream benefits must be weighed against the cost of culvert replacements, required road raises and the impacts on agriculture. Flood peak reductions, acres flooded and duration of inundation were analyzed throughout watershed for a range of hypothetical rainfall events. This data will be useful to the Ad-Hoc Committee in the development of the SWMP and in determining if culvert sizing should be considered as a best management plan (BMP) throughout the UCRW.

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