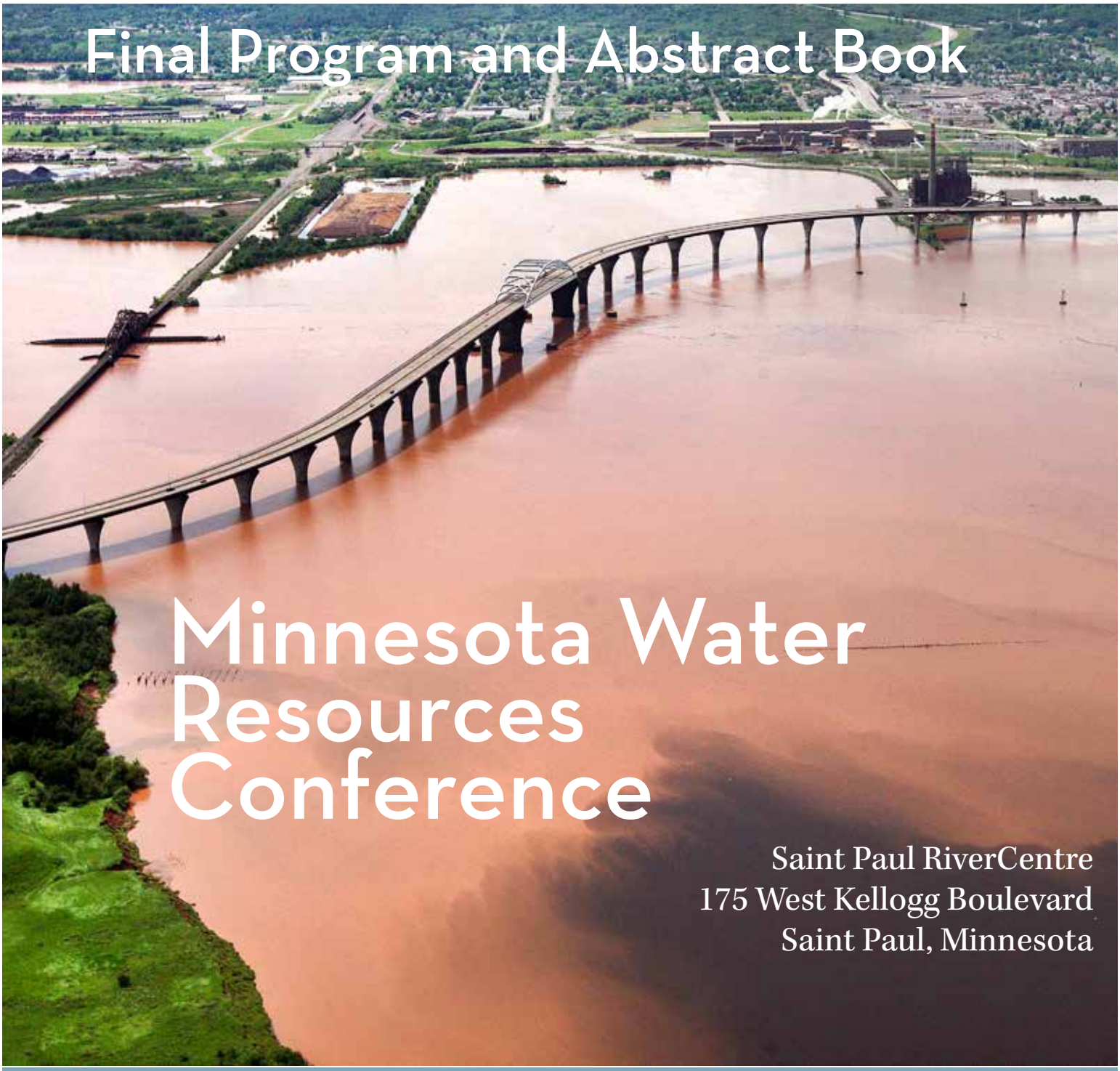
Final Program and Abstract Book



Minnesota Water Resources Conference

Saint Paul RiverCentre
175 West Kellogg Boulevard
Saint Paul, Minnesota

Sponsored by:

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Minnesota Water Resources Conference

October 15-16, 2013

The ***Minnesota Water Resources Conference*** presents **innovative and practical water resource engineering solutions, management techniques, and current research about Minnesota's water resources**. The conference provides an opportunity to address lessons learned from the implementation of engineering projects; best practices discovered in the design and application of water resource management techniques; implications of water policy decisions; and research into current and emerging issues. The conference facilitates interaction among engineers; water resources managers; researchers; and local, state, and federal agency staff.

Abstracts Booklet Available Only Electronically

The conference abstract booklet will not be printed this year, but will be available electronically one week prior to the conference. Conference participants will receive a printed copy of the final program schedule on site at the registration desk.

The cover photo shows red clay turbidity in the St. Louis River below the Bong Bridge following the 2012 500-year Solstice flood in Duluth, Minnesota. **Photo credit:** Bob King, *Duluth Tribune*

2013 Water Resources Planning Committee

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Gene Soderbeck, Minnesota Pollution Control Agency

James Stark, U.S. Geological Survey

**Deborah Swackhamer,* Water Resources Center, University of Minnesota

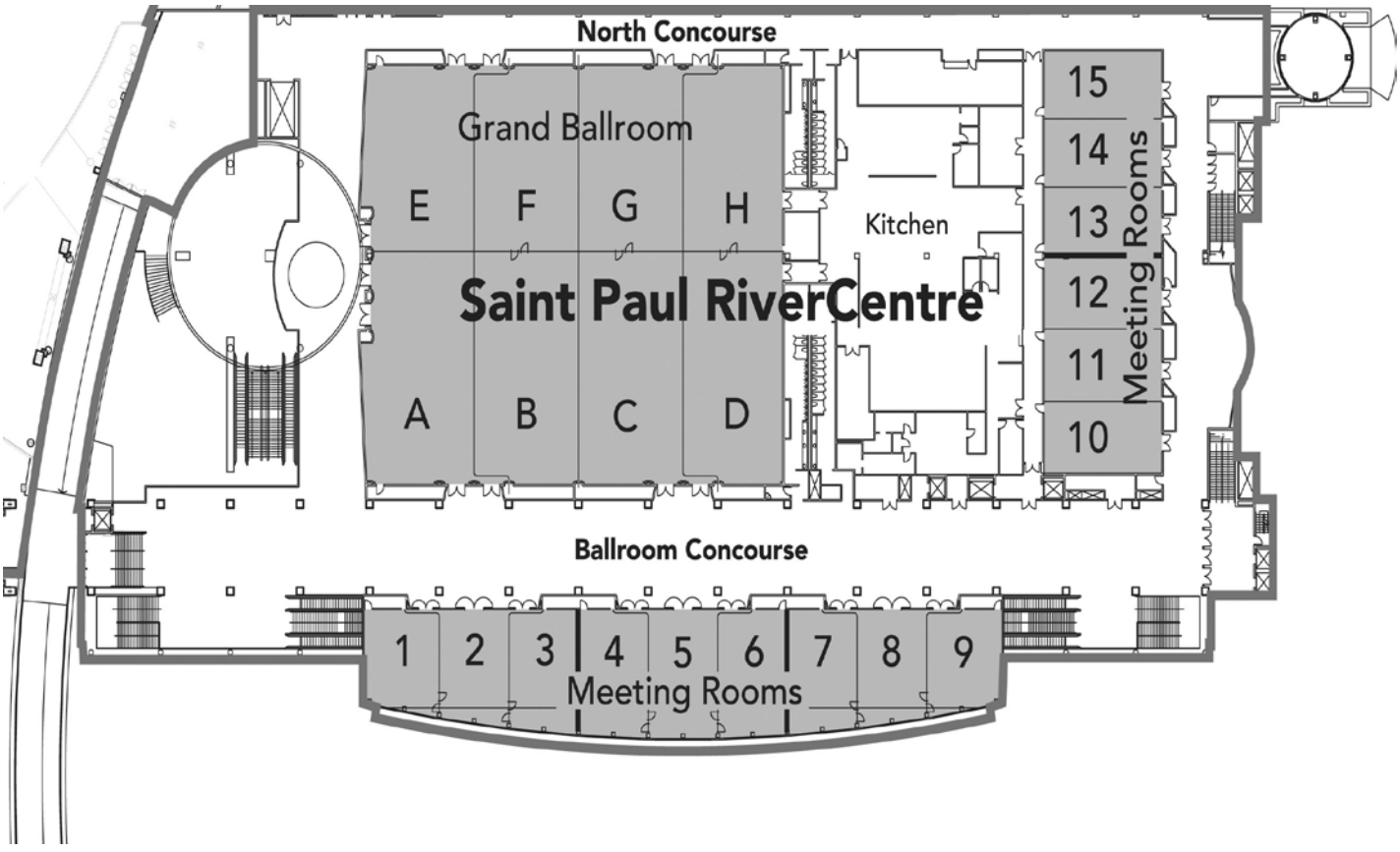
Stew Thornley, Minnesota Department of Health

Rick Voigt, Voigt Consultants, LLC

Greg Wilson, Barr Engineering Company

Brad Wozney, Minnesota Board of Soil and Water Resources

* Committee Co-Chairs



Program Schedule – Tuesday, October 15, 2013

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

8:10 – 8:20 **Dave Ford Water Resources Award**

8:20 – 9:30 **Plenary Session: Water Sustainability in Minnesota: Today's Decisions Affect Your Grandchildren**
James Stark, U.S. Geological Survey

9:30 – 10:00 **Break**

10:00 – 11:30 Concurrent Sessions I

TRACK A *ROOMS 1–3*

Redevelopment/BMP Planning

Moderator: *Tina Carstens,* Ramsey-Washington Metro Watershed District

Co-Moderator: *Ron Leaf,* SEH, Inc.

Catalyzing Green Infrastructure and Redevelopment in an Ultra-Urban TOD Corridor

Wes Saunders-Pearce, City of Saint Paul; *Joni Giese* and *David Filipiak*, SRF Consulting Group, Inc.

The Challenges and Successes in Planning, Designing, and Constructing a LID Industrial Park

Chantill Kahler-Royer and *Timothy Olson,* Bolton & Menk, Inc.; *Michael McCarthy,* City of Mankato

Permeable Alley Pilot Project in Saint Paul, Minnesota

Dan Edgerton, Stantec, Inc.; *Wes Saunders-Pearce,* City of Saint Paul

TRACK B *ROOMS 4–6*

Groundwater/Surface Water

Moderator: *Stew Thornley,* Minnesota Department of Health

Co-Moderator: *Jodi Polzin,* CDM Smith, Inc.

Restoring Wild Rice Through Hydrologic Assessment of Ditching, Stoney Brook Watershed, Fond du Lac Reservation, Minnesota

Nancy Schuldt, Fond du Lac Reservation Environmental Program; *Perry Jones*, U.S. Geological Survey; *Peter Cooper,* U.S. Department of Agriculture

Groundwater and Surface-Water Interactions Down-Gradient From a Decades-Old Crude Oil Spill

Brent Mason and *Jared Trost,* U.S. Geological Survey

Evaluating Watershed Recharge and Implications for Supporting Surface-Water Uses

Greg Wilson and *Evan Christianson,* Barr Engineering Company

TRACK C *BALLROOM C*

Fate of Contaminants in Surface Waters

Moderator: *Lisa Goddard*, SRF Consulting Group, Inc.

Co-Moderator: *Kimberly Hill,* St. Anthony Falls Laboratory, University of Minnesota

Production and Transport of Methylmercury in High-Sulfate Surface Waters Resulting From Mining Activity

Logan Bailey and *Nathan Johnson,* University of Minnesota; *Daniel Engstrom* and *Jill Coleman-Wasik,* St. Croix Watershed Research Station; *Carl Mitchell,* University of Toronto – Physical and Environmental Science; *Michael Berndt,* Minnesota Department of Natural Resources

Presence of Pharmaceuticals in Select St. Croix River Tributaries

Sarah Elliot, Kathy Lee, and *Edward Furlong*, U.S. Geological Survey; *Byron Karns,* National Park Service

Fine Dredged Material and Biosolids for Wetland Creation: Water Quality Implications

Aaron Mika, Nathan Johnson, and *Xianben Zhu,* University of Minnesota

TRACK D *BALLROOM D*

Flood Preparedness and Planning

Moderator: *Rick Voigt,* Voigt Consultants, LLC

Co-Moderator: *Judy Boudreau,* Minnesota Department of Natural Resources

Flood-Inundation Warning System for the Mississippi River in Saint Paul, Minnesota

Jennifer Nelson, Minnesota Homeland Security and Emergency Management; *Christiana Czuba,* Minnesota Water Science Center

Minnesota's Flood Hazard Mitigation Grant Assistance Program: Increasing Community Resiliency Through Flood Risk Reduction

Patrick Lynch, Minnesota Department of Natural Resources

Impact of Climate Change on Red River of the North Flood Frequency Curve

Patrick Foley and *Brian Alberto,* U.S. Army Corps of Engineers

Program Schedule – Tuesday, October 15, 2013 (continued)

11:30 – 12:15 p.m. **Lunch**

12:15 – 1:00 **Luncheon Presentation: Minnesota's Draft Nutrient Reduction Strategy**
Rebecca Flood, Minnesota Pollution Control Agency

1:15 – 2:45 Concurrent Sessions II

TRACK A *ROOMS 1–3*

Linear BMP

Moderator: Ron Leaf, SEH, Inc.

Co-Moderator: *Gene Soderbeck,* Minnesota Pollution Control Agency

How to Deliver a Low-Impact County Highway

William Klingbeil and *Jonathan Kusa,* HR Green, Inc.

The Lowry Sand Filter

Lisa Goddard, SRF Consulting Group, Inc.

Fast-Track Project Relies on Detailed Planning and Extensive Coordination with Numerous Entities to Install Box Culvert Beneath BNSF Tracks within 30 Hours

Jim Herbert and *Nathan Campeau,* Barr Engineering Company; *Anna Eleria,* Capitol Region Watershed District

TRACK B *ROOMS 4–6*

Interpreting Hydrologic Data

Moderator: *Dave Lorenz,* U.S. Geological Survey

Co-Moderator: *Faye Sleeper,* Water Resources Center, University of Minnesota

Use of the Soil-Water Balance (SWB) Model to Estimate Recharge to the Glacial Aquifers of the United States

Jared Trost, U.S. Geological Survey

Long-Term Lake-Water Quality Data: What Can It Tell Us?

Lorin Hatch, HDR Engineering, Inc.; *Kelly Dooley* and *Yvette Christianson,* Minnehaha Creek Watershed District

Characterizing Groundwater Flow in the Twin Cities Metropolitan Area, Minnesota; A Chemical and Hydrostratigraphic Approach

Robert Tipping, Minnesota Geological Survey

TRACK C *BALLROOM C*

Quantifying Low Spots in the Landscape

Moderator: *Shawn Schottler,* St. Croix Watershed Research Station

Co-Moderator: *Stephanie Johnson,* Houston Engineering, Inc.

Assessing Wetland Quantity Changes for Minnesota From 2006 to 2011

Steve Kloiber and *Doug Norris,* Minnesota Department of Natural Resources

Historic Water Retention Capacity of the Greater Blue Earth River Basin

Andrew Kessler and *Satish Gupta,* University of Minnesota

Contributing Drainage Area Analysis for Hydrologic Modeling

Brandon Barnes, Mike Strong, Scott Sobiech, Katie Wenigmann, Leslie Dellangelo, and *Omid Mosheni,* Barr Engineering Company

TRACK D *BALLROOM D*

Climate and Rainfall

Moderator: *William Douglass,* Bolton & Menk, Inc.

Co-Moderator: *Andrea Hendrickson,* Minnesota Department of Transportation

Rainfall Atlas 14; Replacement of Technical Paper 40: Part 1: Background, Technical Details, Results, and Implications

Steve Buan, National Oceanic and Atmospheric Administration; *Karen Chandler,* Barr Engineering Company

Rainfall Atlas 14; Replacement of Technical Paper 40: Part 2: Implications and Case Studies

Karen Chandler and *Nathan Campeau,* Barr Engineering Company

Community Stormwater Response to a Changing Landscape and Climate: A Framework for Adaptation Planning and Implementation

Leslie Yetka, Minnehaha Creek Watershed District; *James Gruber,* Antioch University of New England; *Trisha Moore,* University of Minnesota

2:45 – 3:15 **Break**

Program Schedule – Tuesday, October 15, 2013 (continued)

3:15 – 4:45 Concurrent Sessions III

TRACK A *ROOMS 1–3*

Stormwater BMPs

Moderator: *John Bilotta,* University of Minnesota Extension and Minnesota Sea Grant

Co-Moderator: *Jodi Polzin,* CDM Smith, Inc.

The First Steps to Tackling Water Quality in Existing Highly Developed Areas

April Ryan, SEH, Inc.; *Lisa Vollbrecht,* City of St. Cloud

Protecting Schwanz Lake Through Reductions of Neighborhood Phosphorus Loads in Eagan, Minnesota

Eric Macbeth and *Gregg Thompson,* City of Eagan

Innovative Stormwater Treatment Train Systems in Rural Communities Through Unique Funding Opportunities

William Douglass and *Timothy Olson,* Bolton & Menk, Inc.

TRACK B *ROOMS 4–6*

Managing Water Resources

Moderator: D*ave Lorenz,* U.S. Geological Survey

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

Learning and Adapting: Using a Community Capacity Model for Watershed Program Assessment

Paul Nelson, Scott County; *Mae Davenport,* University of Minnesota

A Social Science Assessment of Conservation Practices in the Red River Basin

Vanessa Perry, Mae Davenport, and *Linda Kingery,* University of Minnesota

Identifying Mechanisms Controlling Nutrient Cycling and Ecological Function in Lake St. Croix

Suzanne Magdalene, Science Museum of Minnesota; *Jeffrey Ziegeweid* and *Richard Kiesling,* U.S. Geological Survey; *Kent Johnson,* Metropolitan Council

TRACK C *BALLROOM C*

LiDAR and Remote Sensing Applications

Moderator: *Brad Wozney,* Minnesota Board of Water and Soil Resources

Co-Moderator: *Greg Wilson,* Barr Engineering Company

LiDAR and Terrain Analysis in Minnesota's Driftless Area

Thomas Miller and *Pat Conrad,* Emmons & Olivier Resources, Inc.

Determining the Amount of Altered Stream Channels in Minnesota

Benjamin Lundeen and *Scott Niemela*, Minnesota Pollution Control Agency; *Jim Krumrie,* Minnesota Geospatial Information Office

Regional Water Quality Measurements by Satellite Remote Sensing: Recent Trends, Current Status, and Future Prospects

Leif Olmanson, Marvin Bauer, and *Patrick Brezonik,* University of Minnesota

TRACK D *BALLROOM D*

Design Considerations for Stream Crossings

Moderator: *Judy Boudreau,* Minnesota Department of Natural Resources

Co-Moderator: *Rick Voigt,* Voigt Consultants, Inc.

Methods and Results of Peak-Flow Frequency Analyses for Streamgages in and Bordering Minnesota, Through Water Year 2011

Erich Kessler and *David Lorenz,* U.S. Geological Survey

Identify and Validate Alternate Designs for Road/River Intersections Using the Lower Whitewater Morphology and HEC-RAS

Kevin Zytkovicz and *Salam Murtada*, Minnesota Department of Natural Resources

Rationale for Alternative Stream Crossing Design Approach

Marty Rye, Superior National Forest

4:45 – 5:45 **Reception and Poster Session**

Program Schedule – Wednesday, October 16, 2013

8:00 – 8:10 **Welcome**
Lorin Hatch, HDR Engineering, Inc.

8:10 – 9:30 **Plenary Session: Agricultural Conservation Practices and Gulf of Mexico Hypoxia: A Model to Assess Costs and Trade-offs**
Cathy Kling, Professor, Iowa State University

9:30 – 10:00 **Break**

10:00 – 11:30 Concurrent Sessions IV

TRACK A *ROOMS 1–3*

Erosion/Sediment – Muddy Waters

Moderator: *Wayne Sicora,* Natural Resource Group

Co-Moderator: *Lisa Goddard,* SRF Consulting Group, Inc.

Statewide Evaluation of Soils for Improving Construction Site Discharge Through Site-Specific Chemical Treatment

Stephen Druschel, Chase Rasue, Jerry Schimmel, and *Isabelle Race*, Minnesota State University, Mankato

Refining BMP Implementation Choices in the Maple Creek Watershed Using ArcGIS and GSSHA

Jason Tidwell, Minnesota Department of Natural Resources

Stormwater Pond Dredging Using Hydraulic Dredging and Geotextile Tubes

Ted Shannon and *Peter Berrini,* HDR Engineering, Inc.; *Anna Eleria* and *Bob Fossum,* Capitol Region Watershed District

TRACK B *ROOMS 4–6*

Nitrogen Impacts on Minnesota's Waters

Moderator: *Faye Sleeper,* Water Resources Center, University of Minnesota

Co-Moderator: *Shawn Schottler,* St. Croix Watershed Research Station

Nitrate in Minnesota Rivers: Conditions, Trends, Sources, and Reductions

Dave Wall, Steve Weiss, Thomas Pearson, and *David Christopherson,* Minnesota Pollution Control Agency; *David Mulla,* University of Minnesota

Overview of the Revised Minnesota Nitrogen Fertilizer Management Plan

Bruce Montgomery, Minnesota Department of Agriculture

Quantifying In-Stream Biological Nitrogen Uptake

Amy Hanson, St. Anthony Falls Laboratory, University of Minnesota

TRACK C *BALLROOM C*

Lakes – Billy's Live Bait

Moderator: *Greg Wilson,* Barr Engineering Company

Co-Moderator: *Tina Carstens,* Ramsey-Washington Metro Watershed District

The Ecological History of a Fluvial Lake Chain in Northern Minnesota

Euan Reavie and *Amy Kireta,* University of Minnesota Duluth; *Andrea Nurse,* University of Maine

Arctic Lake Subwatershed Analysis

Shawn Tracy, HDR Engineering, Inc.; *Scott Walz,* Shakopee Mdewakanton Sioux Community; *Nat Kale,* Prior Lake-Spring Lake Watershed District; *Pete Young,* City of Prior Lake

Improving the Water Quality of Lake Nokomis Through Biomanipulation: A Lake Management Technique

Kelly Dooley, Minnehaha Creek Watershed District; *Steve McComas,* Blue Water Science

TRACK D *BALLROOM D*

Hydrologic Modeling

Moderator: *Andrea Hendrickson,* Minnesota Department of Transportation

Co-Moderator: *William Douglass,* Bolton & Menk, Inc.

Perfect* Calibration, Imperfect Solution (*or a Good, Acceptable Calibration)

Rita Weaver and *Omid Mosheni,* Barr Engineering Company

Watershed Models in Karst: HSPF/SWAT Models of the Root River Watershed, Minnesota

Saumya Sarkar and *Jon Butcher,* Tetra Tech, Inc.

11:30 – 12:15 **Lunch**

12:15 – 1:00 **Luncheon Presentation: America's Science Problem**
Shawn Otto, Author

1:15 – 2:45 **Concurrent Sessions V**

TRACK A *ROOMS 1–3*

Planning Tools

Moderator: *Tina Carstens,* Ramsey-Washington Metro Watershed District

Co-Moderator: *Randy Neprash,* Minnesota Cities Stormwater Coalition and Stantec, Inc.

Stormwater Reuse Design Calculator

Meghan Jacobson and *Brett Emmons,* Emmons & Olivier Resources, Inc.

Minnesota's Nutrient Reduction Strategy: A Path to Progress in Achieving Healthy Waters

Jennifer Olson and *Kellie DuBay*, Tetra Tech, Inc.; *Dave Wall* and *Wayne Anderson,* Minnesota Pollution Control Agency

Restoring the Balance: Water Supply Planning in the Twin Cities Metropolitan Area

Ali Elhassan, Brian Davis, and *Lanya Ross,* Metropolitan Council

TRACK B *ROOMS 4–6*

Historical and Recent Effects of Wastewater Effluent on River Water Quality

Moderator: *Gene Soderbeck,* Minnesota Pollution Control Agency

Co-Moderator: *Karen Jensen,* Metropolitan Council

The Mississippi River and Wastewater Treatment: A History of Water Quality Improvements

Kent Johnson, Metropolitan Council

The Mississippi River and Wastewater Treatment: Recent Treatment Technology Improvements and Water Quality Impacts

Larry Rogacki, Metropolitan Council

Antibiotic Resistance Determinants in Treated Wastewater and in the Upper Mississippi River

Timothy Lapara and *Matthew Madson,* University of Minnesota

TRACK C *BALLROOM C*

Rivers/Bio

Moderator: *Kimberly Hill,* St. Anthony Falls Laboratory, University of Minnesota

Co-Moderator: *Wayne Sicora,* Natural Resource Group

Investigating River Conditions in Minnesota: What Those Conditions May Mean for the Aquatic Fauna that Call These Rivers Home

April Lueck, Minnesota Pollution Control Agency

Effects of In-Stream Fine Sediments on Benthic Macroinvertebrates

Valerie Brady, Natural Resources Research Institute, University of Minnesota; *Larissa Herrera,* Water Resources Science, University of Minnesota

Two-Stage Ditch Fish IBI Scores: Implications

Brenda (Asmus) DeZiel, Minnesota Pollution Control Agency; *Joe Magner*, University of Minnesota

TRACK D *BALLROOM D*

Wetlands

Moderator: *Ann Banitt,* U.S. Army Corps of Engineers

Co-Moderator: *William Douglass,* Bolton & Menk, Inc.

Brown's Preserve Wetland Restoration: Innovation in the Hydrologic and Ecologic Restoration of a Wet Meadow Wetland Complex

Mark Deutschman, Chris Otterness, and *Emmy Baskerville*, Houston Engineering, Inc.; *Phil Belfiori,* Rice Creek Watershed District; *Jason Husveth*, Critical Connections Ecological Services, Inc.

Identifying Wetlands Using Vegetation: Variability and Bias

Ken Powell, Minnesota Board of Water and Soil Resources; *Jason Naber,* Emmons & Olivier Resources, Inc.

Developing a Geographic-Information-System-Based (GIS) Wetland Restoration Prioritization Tool for Minnesota

Jeremy Erickson, Terry Brown, Lucinda Johnson, and *Valerie Brady,* Natural Resources Research Institute, University of Minnesota; *Mark Gernes,* Minnesota Pollution Control Agency

2:45 – 3:00 **Break**

Program Schedule – Wednesday, October 16, 2013 (continued)

3:00 – 4:30 Concurrent Sessions VI

TRACK A *ROOMS 1–3*

Policy/Education

Moderator: *Randy Neprash*, Minnesota Cities Stormwater Coalition and Stantec, Inc.

Co-Moderator: *John Bilotta,* University of Minnesota Extension and Minnesota Sea Grant

Designing and Demonstrating the Minnesota Water Research Digital Library

Christine Yaeger, Minnesota Department of Agriculture

Minimal Impact Design Standards (MIDS): A New Paradigm for Stormwater Management in Minnesota

Jay Riggs, Washington Conservation District; *John Bilotta,* University of Minnesota Extension and Minnesota Sea Grant; *Anne Gelbmann,* Minnesota Pollution Control Agency; *Jim Hafner,* City of Blaine; *Mike Isensee,* Middle St. Croix Watershed Management Organization; *Jay Michels,* Emmons & Oliver Resources, Inc.

Updates to the Minnesota Stormwater Manual

Michael Trojan, Anne Gelbmann, and *Paul Leegard,* Minnesota Pollution Control Agency

TRACK B *ROOMS 4–6*

Water Quality and Agricultural Practices

Moderator: *John Baker,* U.S. Department of Agriculture/ Department of Soil, Water, and Climate, University of Minnesota

Co-Moderator: *Ann Banitt*, U.S. Army Corps of Engineers

Targeted Variable Rate Fertilizer Application: A Rare Win for Water Quality and Farmers

Rebecca Kluckhohn and *Wes Boll,* Wenck Associates, Inc.; *Dennis Loewen,* Clearwater River Watershed District

Response to Minnesota's First Pesticide Impairments

Ron Struss, Minnesota Department of Agriculture

Case Studies – Drainage Water Management

Timothy Gillete and *Al Kean,* Minnesota Board of Water and Soil Resources

TRACK C *BALLROOM C*

Regional and Statewide Stream and River Assessment

Moderator: *Karen Jensen,* Metropolitan Council

Co-Moderator: *James Stark*, U.S. Geological Survey

Metropolitan Council Long-Term Stream Monitoring Program: Results of a Comprehensive Water Quality Assessment of Metropolitan Area Streams

Emily Resseger, Jennifer Kostrzewski, Karen Jensen, and *Joe Mulcahy,* Metropolitan Council

Watershed Pollutant Load Monitoring Network: Program Overview and Statewide River Water Quality Results

Patrick Baskfield, Minnesota Pollution Control Agency

The State of the River Report

Trevor Russell, Friends of the Mississippi River; *Lark Weller,* Mississippi National River & Recreation Area

TRACK D *BALLROOM D*

Unique Stream Restoration Techniques and Assessment

Moderator: *Brad Wozney,* Minnesota Board of Water and Soil Resources

Co-Moderator: *Ron Leaf,* SEH, Inc.

Golf, Trains, and Highways: Addressing Three Unique Impairments to Brown's Creek

Kevin Biehn, Emmons & Olivier Resources, Inc.; *Karen Kill*, Brown's Creek Watershed District

Restoring a Native Creek Buffer Through a Residential Neighborhood: Approach, Challenges, and Lessons Learned

Becky Houdek, Minnehaha Creek Watershed District; *Lucius Jonett,* Wenck Associates, Inc.

Basin-Scale Geomorphology and Sediment Transport for Preliminary Impact Analysis

Peter Hinck, Benjamin Sheets, Miguel Wong, and *Amy Mikus,* Barr Engineering Company

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4:30 **Adjourn**

Poster Display

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

1. Swale Infiltration and Swale Runoff

Farzana Ahmed, John Gulliver, and *John Nieber*, University of Minnesota

2. Ecological Risk Screening Methods for Pesticide Ranking and Prioritization

Dan Balluff, Minnesota Department of Health

3. Assessing the Bioavailability of PAHs after Remediation and Restoration

Amanda Brennan and *Nathan Johnson,* University of Minnesota Duluth

4. Mercury Trends in Four Lakes in Voyageurs National Park, Northern Minnesota, 2000-2012

Mark Brigham and *David Krabbenhoft,* U.S. Geological Survey; *Mark Sandheinrich,* University of Wisconsin-La Crosse

5. Predicted Risk of Brook Trout to Climate Change in Lake Superior's North Shore Streams

Meijun Cai, National Resources Research Institute, University of Minnesota Duluth; *William Herb*, University of Minnesota; *Lucinda Johnson,* University of Minnesota Duluth

6. GIS as a Decision Support System

Erik Cedarleaf Dahl, Minnehaha Creek Watershed District; *Nat Kale,* Prior Lake Watershed District

7. Dedroecological Study on the Effects of Chlorides on Trees within a Wetland Wastewater Outflow in Onamia, Minnesota

Alan Cibuzar, A.W. Research Laboratories, Inc.

8. Manure Application Guided by Grid Soil Sampling: Minnesota Case Studies

Leslie Everett, Water Resources Center, University of Minnesota; *Jose Hernandez* and *Randy Pepin,* University of Minnesota Extension

9. Impacts of Climate Change on Lake Superior's North Shore Trout Habitat

William Herb, University of Minnesota; *Meijun Cai* and *Lucinda Johnson,* University of Minnesota Duluth

10. Reflections on 10 Years of West Nile Virus Vector Mosquitoes in Stormwater Structures

Kirk Johnson, and *Sandy Brogren,* Metro Mosquito Control District

11. Kingston Wetland: Nutrient Trap or Oxygen Demand Source?

Rebecca Kluckhohn, Wenck Associates, Inc.; *Dennis Loewen,* Clearwater River Watershed District

12. A SWAT Model for Farmers in the Whitewater River Watershed: The Importance of Local Input in Model Creation

Thomas Miller, Emmons & Olivier Resources, Inc.; *Jim Almendinger*, Science Museum of Minnesota – St. Croix Research Station; *Brian Green*, Minnesota Pollution Control Agency

13. Citizen-Based Water Quality Solutions: The Le Sueur River Watershed Civic Engagement Project

Kimberly Musser, Minnesota State University, Mankato; *Patrick Moore,* Riverartisan

14. City of Burnsville Stormwater Asset Management Program

Jacob Newhall, WSB & Associates, Inc.; *Ryan Peterson,* City of Burnsville

15. Minnesota Well Owners Organization (MNWOO) - A New Non-Profit for Private Well Owners

Karuna Ojanen, Ojanen Law Offices; *Paul Wotzka,* Land and Water Consulting

16. Stormwater Solutions for Cancer Cardio Research Building, Biomedical Discovery District, University of Minnesota

Rhonda Pierce and *Kevin Gardner,* Pierce Pini & Associates

17. Discovery Farms Minnesota - Field Scale Monitoring in Real World Conditions

Tim Radatz and *George Rehm,* Discovery Farms Minnesota

18. Using Value-Based Models Along with and Analytic Hierarchy Process to Prioritize Areas for Watershed Management

Paul Radomski and *Kristin Carlson,* Minnesota Department of Natural Resources

19. Side-By-Side Comparison of Denitrification Performance between a Woodchip Bioreactor and a Wetland System

Andry Ranaivoson, University of Minnesota; *Gary Feyereisen,* Soil & Water Management Research Unit, U.S. Department of Agriculture

20. What's in Your EAW? Incorporating Health and Climate Change into Environmental Review

Michele Ross, Kelly Muellman, Kristin Raab, and *Ginny Yingling,* Minnesota Department of Health

21. Stormwater Management on Minneapolis Northeast Green Campus

John Slack and *Dan Edgerton,* Stantec, Inc.

22. Hydrological Modeling of a Catchment Using SWAT-CN and SWAT-WB Approach in the Upper Blue Nile Basin of Ethiopia

Tewodros Taffese, Bahir Dar University; *Birhanu Zamadim,* International Water Management Institute

23. Buoyant Flow Devices for Pond Outlet Control: Full-Scale Testing & Evaluation

Craig Taylor and *Jon Hilsendager,* St. Anthony Falls Laboratory, University of Minnesota

Poster Display–Continued

24. Permanent Groundwater Interception System in Bovey, Minnesota

Brent Theroux and *Justin Klabo,* SEH, Inc.

25. Engineering Outside Our Comfort Zone

Amanda Weber, KLJ Inc.

26. **Exploring Constraints to Community Engagement in an Urban Watershed Restoration Project**

Leslie Yetka, Minnehaha Creek Watershed District; *Amit Pradhananga* and *Mae Davenport,* Department of Forest Resources, University of Minnesota

Minnesota Water Resources Conference

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175 West Kellogg Boulevard
Saint Paul, Minnesota

Book of Abstracts

Arranged by session in order of presentation
Index of first authors on page 61

Plenary Session 1 8:20 a.m. – 9:30 a.m.

Water Sustainability in Minnesota: Today's Decisions Affect Your Grandchildren

James Stark (stark@usgs.gov), U.S. Geological Survey

In 2008, the citizens of Minnesota passed the Clean Water, Land and Legacy Amendment to the State Constitution. The amendment added three-eighths percent to the State's sales tax and dedicated a portion of the increase to a Clean Water Fund to protect and enhance waters of the State. This created a unique opportunity for Minnesotans to do what few other states have done; to take action for a sustainable water future. After the amendment passed, the State Legislature directed the University of Minnesota's Water Resources Center to construct a framework describing what needed to be accomplished—based on the legislature's definition of sustainable—to do no harm to ecosystems, to prevent water-quality degradation, and to avoid compromising water needs for future generations. Over an 18- month period, experts synthesized the knowledge, insights, and perspectives of hundreds of the State's scientists and water-management professionals as well as taking input from citizens and interest groups. The resulting framework provides a roadmap toward water sustainability that identifies problems, offers solutions, and recommends actions based on current best practices and science.

The top priority of the framework is to preserve a sustainable and clean-water supply. The strategy includes a process to determine the State's water budget, and using that budget, to improve the State's water-appropriation permitting process. The framework also calls for protecting and restoring water quantity and quality through comprehensive, integrated policy and management that recognizes the interconnected nature of surface and groundwater as well as ecological needs during times on minimal streamflow. Most of the tools needed for sustainable water management exist. The County Geological Atlas Program, coordinated by Minnesota Geological Survey and Minnesota Department of Natural Resources (MDNR), provide the geological and hydrological framework to understand aquifers for much of the State. MDNR and Minnesota Pollution Control Agency (MPCA) programs have collected, or are collecting, necessary information to assess ecological-flow conditions in streams. The U.S. Geological Survey (USGS) and MNDR programs provide real-time stream flow information for many watersheds throughout the State, and techniques are being developed to estimate stream flow in ungaged watersheds. Estimates of groundwater recharge are being updated through an effort by the USGS and MPCA. Another major step involves synthesizing and modeling these data to provide information for the State's water-appropriation permit program. Additional cooperation among State, local and Federal partners will be needed to complete the process to manage water to ensure sustainable water resources for future residents of Minnesota.

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

Minnesota's Draft Nutrient Reduction Strategy

Rebecca Flood, Minnesota Pollution Control Agency

Abstract not received

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

Agricultural Conservation Practices and Gulf of Mexico Hypoxia: A Model to Assess Costs and Trade-offs

Cathy Kling (ckling@iastate.edu), Iowa State University

A large and persistent hypoxic zone in the Northern Gulf of Mexico has been well documented since 1985. A significant source of the nutrients contributing to this condition comes from the intensively managed agricultural land in the Upper Mississippi and Ohio-Tennessee River Basins. Policy interventions designed to change management of this land to reduce nutrient loading in rivers and streams is likely to impose additional costs of production. Policy makers designing conservation programs, regulatory actions, or other interventions to address the environmental externalities in this region would benefit from understanding the magnitude of the tradeoffs between costs of conservation and environmental improvement.

In this paper, we apply an evolutionary algorithm to an integrated land use, water quality, and hypoxic zone model to generate a simple, yet powerful modeling system that identifies tradeoffs in land use decisions with respect to costs and water quality. We integrate the Conservation Effects Assessment Project (CEAP) national SWAT modeling project results with a model of the hypoxic zone in the Northern Gulf of Mexico econometrically estimated by Rabotyagov to create the underlying modeling system. Using an evolutionary algorithm, we develop empirical frontiers that identify cost-effective placement of conservation practices. We demonstrate the value of this system by assessing the set of conservation actions evaluated by the USDA in the National CEAP Assessment to construct the tradeoffs between the cost of conservation actions and the resulting size and variability of the hypoxic zone.

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

America's Science Problem

Shawn Otto, Author

We live in a time of a growing science gap - the gap between the power we are able to wield with science and technology, and the global policymaking apparatus's ability to formulate successful policies to address the costs and benefits such power offers. The problem is magnified by the fact that the vast majority of policymakers come from the humanities and have little or no training in science. This talk will explore this issue of growing importance, and propose some solutions.

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

Track A: Redevelopment/BMP Planning

Catalyzing Green Infrastructure and Redevelopment in an Ultra-Urban TOD Corridor

Wes Saunders-Pearce (wes.saunders-pearce@ci.stpaul.mn.us), City of Saint Paul; Joni Giese (jgiese@srfconsulting.com) and David Filipiak (dfilipiak@srfconsulting.com), SRF Consulting Group, Inc.

The new Light Rail Transit Green Line (Central Corridor LRT) will run from downtown Minneapolis to downtown Saint Paul beginning in 2014. Primary redevelopment goals along the urban corridor include implementing transit-oriented development (TOD). This project investigates how stormwater management practices can help advance corridor TOD goals while complying with current stormwater regulations.

The Central Corridor Stormwater and Green Infrastructure Plan, facilitated by the City of Saint Paul, specifically addresses the feasibility of implementing shared, stacked-function green infrastructure (SSGI) in ultra-urban locales. SSGI is a shared system in which stormwater runoff generated from multiple parcels is jointly treated. In addition to treating stormwater, this system also incorporates "stacked" community amenities that provide additional social, economic, and environmental benefits.

This presentation identifies how ultra-urban stormwater design can advance TOD goals such as new open space, increased density, and livability; examines the cost-benefits of shared stormwater management approaches; and discusses how to implement green infrastructure policies.

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

Track A: Redevelopment/BMP Planning *(continued)*

The Challenges and Successes in Planning, Designing and Constructing a LID Industrial Park

Chantill Kahler-Royer (chantillka@bolton-menk.com) and Timothy Olson (timol@bolton-menk.com), Bolton & Menk, Inc.; Michael McCarthy (mmccarty@city.mankato.mn.us), City of Mankato

Industrial parks are often thought of as anything but "green." but the City of Mankato, Minnesota sought to change this perception by designing a Low Impact Industrial Park. The general concept included carefully chosen layout, access and design elements that ensure that the new industrial park had a minimal impact on the delicate Minnesota environment. The result proves that industrial parks can be "green" - both environmentally and financially! Bolton & Menk, Inc. was selected by the City of Mankato, Minnesota to provide a cost effective, low impact design for a new "Green by Design" 40-acre industrial park that would enhance this Midwestern regional business center.

The City adopted a Strategic Plan for Sustainability in May 2008. Included in this plan are design elements and policy initiatives to promote carbon reduction and reduce reliance on nonrenewable energy sources. Key low impact designs include decreasing pavement widths, tree planting, multi-modal transportation, and encouraging and promoting sustainable and efficient design practices when working with private developers.

The objective was to provide a needed industrial business development area that implements numerous innovative ideas to ultimately reduce the impact of development on the surrounding environment and waterways.

Stormwater was a major focus of this project, including bioretention basins, bioswales and native prairie seedings. Streets and trails in the industrial park are designed with a rural section so that runoff is immediately directed into roadside bioswales. The highly impervious clay soils in the area meant that underdrains needed to be designed into the bioretention basins and bioswales. The effective stormwater treatment train includes flow through bioswales and bioretention basins before ultimately entering a regional stormwater pond. The prairie plants not only provide aesthetic beauty and habitat and food for wildlife; their deep roots help prevent erosion and create channels to promote infiltration through the underlying clay soil. These plantings also provide nutrient uptake and transpiration.

The City's Strategic Plan heavily emphasizes bus transit which has a route that currently serves the nearby office park. Upon development of the industrial park, the City will complete a transit study to determine the greatest needs in the community and will adjust the bus routes based on the findings of the study. Additionally, Bolton & Menk's industrial park design was with trails and walkways throughout the park to provide transportation choices for the businesses' employees. The designs of these alternative transportation routes were completed with narrower widths to reduce pavement throughout the park. Also, informational kiosks along the trail are intended to help educate trail users about the significance of the design and its effort to enhance water quality.

The City will encourage private developers of the lots within the industrial park to incorporate green practices such as green roofs, permeable pavement and pavers, bioswales, filtration and infiltration, tree boxes, etc. into their building and site designs.

Cost savings were achieved by opting for a rural section as opposed to curb and gutter, and a narrower width of pavement. Eliminating storm sewer manholes and reducing pipe resulted in cost savings. The chosen native prairie plantings require much less fertilizer, pesticides, water and mowing than conventional lawn grass, resulting in maintenance cost savings.

The project was initiated in April of 2008. It is slated to be finished in 3 phases with an estimated comprehensive completion date of November, 2013. The project was designed for 25 acres of industrial lots. As of October 2012, the streets and the stormwater systems have been constructed with 8 acres of completed development and 6.25 acres that are currently under development.

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

Track A: Redevelopment/BMP Planning *(continued)*

Permeable Alley Pilot Project in Saint Paul, Minnesota

Dan Edgerton (dan.edgerton@stantec.com), Stantec Consulting Services Inc.; Wes Saunders-Pearce (wes.saunders-pearce@ci.stpaul.mn.us), City of Saint Paul

The City of Saint Paul reconstructed alleys around the Hamline Library with permeable asphalt as part of a pilot project. Soil borings indicated native sandy soils located approximately five feet down. A rock trench subgrade was designed with the goal of tying into these native sands, so as to maximize infiltration. Two storm sewer manholes were provided with open bottoms, to encourage additional infiltration.

Storm sewer was provided to capture any surface runoff leaving the site, to allow for stormwater monitoring. Stormwater monitoring will be used to quantify the volume of runoff potentially not captured by the permeable pavement as well as to determine if infiltration capacity is reduced over time.

Outreach was performed through meetings with the local Neighborhood District Council as well as educational materials provided at the Hamline Library.

The presentation will summarize design considerations, illustrate construction activities including construction challenges and lessons learned, and discuss monitoring results.

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

Track B: Groundwater/Surface Water

Restoring Wild Rice Through Hydrologic Assessment of Ditching, Stoney Brook Watershed, Fond du Lac Reservation, Minnesota

Nancy Schuldt, (nancyschuldt@fdlrez.com) Fond du Lac Reservation; Perry Jones (pmjones@usgs.gov), U.S. Geological Survey; Peter Cooper (peter.cooper@mn.usda.gov), U.S. Department of Agriculture

To restore wild rice in reservation lakes, the Fond du Lac Resource Management Division, Natural Resources Conservation Service, and U.S. Geological Survey assessed surface-water and groundwater resources in the Stoney Brook watershed and the effects of ditching on these resources. Hydrologic models were used to assess the watershed's hydrology and help evaluate and refine lake-level management options. A network of monitoring wells, a continuous stream gage, and precipitation gages were used to determine the relation between groundwater and surface drainage. Groundwater-level and stream-discharge analyses indicated that ditching only created localized changes to groundwater flow. Annual recharge estimates for 2007-2009 from wells more than 1,000 feet from ditches ranged from 4.5 to 18.6 inches when wells were open to outwash sands, and 0.43 to 2.9 inches when wells were open to sandy clay or till. Daily evapotranspiration estimated from groundwater levels from 2006-2009 produced a seasonal evapotranspiration estimate of 16.5 in.

Groundwater and Surface-Water Interactions Down-Gradient From a Decades-Old Crude Oil Spill

Brent Mason (bmason@usgs.gov) and Jared Trost (jtrost@usgs.gov), U.S. Geological Survey

In 1979 a crude oil pipeline near Bemidji, MN, burst and released 10,700 barrels of oil into sandy, surficial glacial deposits. After initial clean-up efforts, approximately 2,500 barrels of oil remained in the subsurface. The U.S. Geological Survey conducted a groundwater and surface-water interaction study in 2012 to determine if low dissolved oxygen (DO, less than 1 mg/L) groundwater from microbial degradation of crude oil, is discharging into Unnamed Lake 380 m down-gradient from the spill site. Dissolved-phase hydrocarbons have been detected only 160 meters down-gradient. Interactions between Unnamed Lake and the aquifer were quantified through measurements of hydrologic gradients, seepage rates, temperature differences, oxygen-16/oxygen-18 and hydrogen/deuterium isotope ratios, and water quality characteristics in the lake and lake sediments. These data indicate that low DO groundwater discharges into the lake from the aquifer, and that a zone of low DO water extends from the spill site to the lake.

Evaluating Watershed Recharge and Implications for Supporting Surface-Water Uses

Greg Wilson (gwilson@barr.com) and Evan Christianson, Barr Engineering Company

Managing groundwater resources has become significantly more challenging given the need to balance an increasing trend in appropriations with more frequent drought conditions while properly accounting for groundwater-surface water interactions and the associated effects on water quality, biology and recreational use. Within a watershed, groundwater is recharged primarily by precipitation that infiltrates through the soil and reaches the water table. This recharged groundwater, in turn, supplies an important component to the base flow of streams and groundwater-dependent wetlands. Alterations to topography, land use, and climate will affect groundwater recharge and change the amount of water flowing into streams or available for pumping by wells. New methods have been developed that couple models of surface hydrology with groundwater models, allowing managers to make decisions on how best to protect both surface water and groundwater in a holistic manner. We present an example from the Little Rock Creek watershed (a protected trout stream in Benton County) in Minnesota that applied coupled models to the problem of recharge and changes to surface water runoff resulting from increasing demand for cropland irrigation. This project resulted in Total Maximum Daily Loads (TMDLs) for dissolved oxygen, nitrate and temperature, as well as a Stressor Identification analysis for bedded sediment. The implications of competing groundwater demands will be discussed in the context of developing TMDLs and supporting surface water uses.

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

Track C: Fate of Contaminants in Surface Waters

Production and Transport of Methylmercury in High-Sulfate Surface Waters Resulting From Mining Activity

Logan Bailey (baile324@umn.edu), University of Minnesota, Water Resource Science; Nathan Johnson (nwjohnso@d.umn.edu), University of Minnesota Duluth, Civil Engineering; Daniel Engstrom (dre@smm.org) and Jill Coleman-Wasik (jcoleman@smm.org), St. Croix Watershed Research Station; Carl Mitchell (carl.mitchell@utoronto.ca), University of Toronto-Scarborough, Physical and Environmental Science; Michael Berndt (mike.berndt@state.mn.us), Minnesota Department of Natural Resources

Sulfate-impacted waters resulting from mining activity in Northeastern Minnesota are being studied to determine the effect of high sulfate concentrations on the production and transport of methylmercury (MeHg). The study encompasses lake and wetland sites subjected to various sulfate loads, ranging as high as 600-700 mg/L. Spatial and temporal analysis of the field sites was accomplished through intensive field sampling, which characterized sediment, pore-water, and open-water chemistries and sediment mercury methylation and demethylation rates. Solid-phase percent MeHg, a proxy for net MeHg production, was limited by high pore-water sulfide concentrations, likely due to the predominance of mercury species less bioavailable to methylating bacteria. In some sites, pore-water MeHg levels appear more closely tied to MeHg solubility from the solid-phase than production. Despite the presence of MeHg in anoxic lake bottom waters, inlet and outlet measurements show no net MeHg export, suggesting demethylation occurs prior to discharge from the lake epilimnion.

Presence of Pharmaceuticals in Select St. Croix River Tributaries

Sarah Elliott (selliott@usgs.gov), Kathy Lee (klee@usgs.gov), and Edward T. Furlong (efurlong@usgs.gov), U.S. Geological Survey; Byron Karns (byronkarns@nps.gov), National Park Service

In 2011, the U.S. Geological Survey, in cooperation with the National Park Service, collected wastewater effluent and surface-water samples upstream and downstream from effluent discharge at five locations in the St. Croix River basin to characterize the occurrence of pharmaceuticals. Filtered water samples were analyzed for 110 pharmaceuticals. Among all samples, 67 pharmaceuticals were detected at concentrations up to 5,110 nanograms per liter. Antidepressants, anticonvulsants, and analgesics were some of the most commonly detected pharmaceutical types. Concentrations and numbers of pharmaceuticals detected were greatest in effluent and greater downstream compared to upstream. Fish and crayfish tissues from select sites also were analyzed for 55 pharmaceuticals (35 of which were common to those analyzed in water). Diphenhydramine, diltiazem, and sertraline were detected in both tissue and water. Results indicate that wastewater effluent is a source of pharmaceuticals to St. Croix River tributaries and that some pharmaceuticals accumulate in aquatic organism tissue.

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

Track C: Fate of Contaminants in Surface Waters *(continued)*

Fine Dredged Material and Biosolids for Wetland Creation: Water Quality Implications

Aaron Mika (mikax011@d.umn.edu), Nathan Johnson (nwjohnso@d.umn.edu), and Xianben Zhu (zxbenz@gmail.com), University of Minnesota Duluth

A combination of fine dredged material from the Duluth harbor and biosolids from Duluth's waste water plant has the potential for use in mineland reclamation projects. This study investigates whether the use of this combined material in wetland reclamation could have a negative effect on water quality. In laboratory columns, water was flushed through material mixtures once a week and analyzed for ammonia, nitrate, and metals. Half of the columns were incubated under saturated conditions and half under dry conditions. The permeability of the material was also found weekly using a falling head test. Nitrogen quantity and composition of leachate was related to both the ratio of materials and the condition under which it was held. Some metals were related to the amount of biosolids in the blend but also the saturation conditions. Permeability decreased by increasing the ratio of dredged material and time of saturated exposure.

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

Track D: Flood Preparedness and Planning

Flood-Inundation Warning System for the Mississippi River in Saint Paul, Minnesota

Jennifer E. Nelson (jennifer.e.nelson@state.mn.us), Minnesota Homeland Security and Emergency Management; Christiana Czuba (cczuba@usgs.gov), Minnesota Water Science Center

A flood-inundation warning system for the City of Saint Paul, Minnesota, is being developed as a pilot project by the interagency Minnesota Silver Jackets hazard mitigation team. This warning system will include an electronic library of static maps showing predicted flood inundation areas for selected river stages from the U.S. Geological Survey streamflow-gaging station on the Mississippi River at Saint Paul. A one-dimensional hydraulic model was built in HEC-RAS from previously existing models, new structure details, and Light Detection and Ranging (LiDAR) topographic data. Simulated water-surface elevations were spatially mapped in a Geographic Information System (GIS) for a range of flood discharges. The resulting flood-inundation maps will be available online as part of the National Weather Service Advanced Hydrologic Prediction Service (AHPS) river forecasts. This pilot project demonstrates successes and challenges of flood-inundation mapping for Saint Paul and develops capabilities for applications to other river systems.

Minnesota's Flood Hazard Mitigation Grant Assistance Program: Increasing Community Resiliency Through Flood Risk Reduction

Patrick Lynch (pat.lynch@state.mn.us), Minnesota Department of Natural Resources

In Minnesota**,** there have been 40 flood-related federal disaster declarations between 1957 & 2012.

Since 1987, Minnesota's Flood Hazard Mitigation (FHM) Grant Assistance Program has cost-shared with local units of government on flood risk reduction projects large and small, with the objective of increasing community resiliency to flooding. These projects include acquisition and removal of flood-prone structures, as well as construction of levees, floodwalls, diversions, pumping stations, impoundments and other structural improvements. Over 3,500 structures have been removed from the floodplain and many thousands more protected by public improvements.

These cooperative efforts have significantly reduced the risk of public and private property damage and loss of life associated with flooding in these communities, and further result in improved quality of life and economic viability.

This presentation will provide an overview and history of the Minnesota FHM program, and some of the successes and challenges experienced since its inception in 1987.

Impact of Climate Change on Red River of the North Flood Frequency Curve

Patrick M Foley (patrick.m.foley@usace.army.mil) and Brian Alberto (brian.t.alberto@usace.army.mil), U.S. Army Corps of Engineers

This study used available down-scaled climate projections through year 2100 as input to hydrologic models of the Red River above Fargo-Moorhead. From the available 112 projections, 9 were selected to represent the range of results. The projections are for monthly precipitation and temperatures. For each of the 9 selected projects, 10 weather generations with daily values were developed. Using these as input the hydrologic models were run for time periods 1950-1999, 2011-2040, 2041-2070, and 2071-2100. The results indicate there is a wide range of possible changes, but on the average, floods would be expected to increase until about 2040 and then return to the existing flood probabilities.

1. Corps of Engineers, Saint Paul District

2. Corps of Engineers, Hydrologic Engineering Center

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

Track A: Linear BMP

How to Deliver a Low Impact County Highway

William Klingbeil (bklingbeil@hgreen.com) and Jonathon Kusa (jkusa@hgreen.com), HR Green, Inc.

HR Green has completed final plans for a 3-mile segment of County Highway 19 for Washington County, Minnesota. The design was initially based on a nearby 4-lane project designed by HR Green and constructed in 2005. The Highway 19 project posed several additional challenges due to the lack of available right-of-way along the corridor. The team worked closely with County and City staff to engage the public and local watershed to create a plan that met a diverse range of goals. Those goals included off-road bike paths, stormwater treatment, as well as safe and efficient roadway designs that included two new roundabouts. The street design included narrow lanes and shoulders as well as detailed vegetation planning to achieve the safety and aesthetic goals set by the community. The stormwater solution included two stormwater re-use systems that pump water from adjacent stormwater ponds to nearby golf courses for irrigation – exceeding the water quality goals for runoff from the watershed. The project has received over $550,000 in State funding to implement the stormwater solutions. This paper will present the challenges, rewards, and project delivery tips associated with delivering an urban low impact roadway for a County Highway Department.

The Lowry Sand Filter

Lisa Goddard (lgoddard@srfconsulting.com), SRF Consulting Group, Inc.

The new Lowry Avenue Bridge is an iconic crossing of the Mississippi River. Reconstruction of the bridge provided Hennepin County with the opportunity to install an innovative, state-of-the-art stormwater treatment system, which recently won the FHWA Environmental Excellence Award for Wetlands, Watersheds, and Water Quality for the underground sand filter that treats runoff from 137.5 acres of residential, commercial, industrial, and transportation land uses. The project has also won several other engineering awards since its grand opening in October 2012. The filter is the largest of its kind in the Upper Midwest.

This presentation will discuss the following: development of the stormwater management plan given the site constraints and challenges; the methodology for the design of the filter; and special coordination and provisions made in order to facilitate the maintenance requirements of such a large structure.

Fast-Track Project Relies on Detailed Planning and Extensive Coordination with Numerous Entities to Install Box Culvert Beneath BNSF Tracks within 30 Hours

Jim Herbert (jherbert@barr.com) and Nathan Campeau (ncampeau@barr.com), Barr Engineering Company; Anna Eleria (anna@capitolregionwd.org), Capitol Region Watershed District

The Capitol Region Watershed District executed a fast-track project to realign its 100-year-old Trout Brook interceptor to make way for new highway interchange bridges near downtown Saint Paul. BNSF Railway agreed to a rare 30-hour shutdown of two mainline railroad tracks to allow removal and replacement of 120 feet of track, installation of 162 feet of box culvert, open-cut excavation, and backfilling.

Months of planning preceded the effort and involved government agencies, consultants, and investigative contractors. The excavation needed to be completely dewatered prior to construction which required permits for disposing of contaminated groundwater and impacted soils, and the design of a sophisticated track-monitoring system to verify that dewatering didn't affect the surrounding railway.

Construction was completed successfully and rail service restored on time, minimizing disruptions and enabling MnDOT's highway project to move forward. Site history, design challenges and a time-lapse video of the 30-hour BNSF crossing will be presented.

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

Track B: Interpreting Hydrologic Data

Use of the Soil-Water Balance (SWB) Model to Estimate Recharge to the Glacial Aquifers of the United States

Jared Trost (jtrost@usgs.gov), U.S. Geological Survey

As part of the Glacial Aquifer System Groundwater Availability Study, the U.S. Geological Survey is using the Soil-Water Balance (SWB) model to estimate groundwater recharge across the glacial aquifer system of the continental United States. Recharge is calculated in SWB on a daily timestep by applying a modified Thornthwaite-Mather approach to publicly-available gridded soils, geologic, land-cover, and meteorological data. To test the broad applicability of a single set of calibrated variables for the entire glacial aquifer system, SWB model runs were completed for several watersheds under a range of climatic conditions, from semi-arid to humid. SWB recharge estimates were compared to other recharge-estimation methods including baseflow, water-table fluctuations, and chloride mass balances. SWB tended to underestimate recharge in areas of relatively low precipitation (Minnesota) and overestimate recharge in areas with higher precipitation (New England). Annual differences between SWB and other recharge methods were significantly, positively correlated with annual watershed precipitation.

Long-Term Lake-Water Quality Data: What Can It Tell Us?

Lorin K. Hatch (lorin.hatch@hdrinc.com), HDR Engineering, Inc.; Kelly Dooley (kdooley@minnehahacreek.org) and Yvette Christianson (ychristianson@minnehahacreek.org), Minnehaha Creek Watershed District

Lake monitoring has occurred in the MCWD since 1968, with increased monitoring intensity occurring since 1997. Lake surface parameters of interest include Secchi transparency, chlorophyll a, and total phosphorus. Statistical analysis was undertaken to better understand the health of MCWD lakes and to more effectively use monitoring resources. The specific objectives included 1) assessment of the optimal number of monitoring locations on Lake Minnetonka, 2) determination of the required sampling frequency to determine the health of Lake Minnetonka and of the lakes in the upper watershed, and 3) trend analysis to determine statistically significant improvement or degradation of water quality at the sampling sites. Results suggest that there are some adjacent monitoring locations on Lake Minnetonka that have highly-similar water quality results, there may be some benefit for altering the sampling frequency at certain monitoring stations, and short- and long-term trends may be associated with natural and human causes.

Characterizing Groundwater Flow in the Twin Cities Metropolitan Area, Minnesota: A Chemical and Hydrostratigraphic Approach

Robert G. Tipping (tippi001@umn.edu), Minnesota Geological Survey

Historic chemical and isotopic data for groundwater within the extended 11 county Twin Cities Metropolitan Area (TCMAx) were used to distinguish three regional hydrochemical types: 1.) recent waters, characterized by detectable tritium, elevated chloride, and/or the presence of anthropogenic compounds; 2.) waters with elevated strontium to calcium plus magnesium ratios; and 3.) naturally elevated chloride-distinct from recent waters. The three-dimensional distribution of these hydrochemical facies were compared to permeability of unconsolidated sediment, bedrock hydrostratigraphy, and the regional distribution of vertical hydraulic head gradient. This evaluation demonstrated that groundwaters within the TCMAx can be broadly categorized by chemical composition, and that their distribution is controlled both by regional differences in subsurface permeability and natural hydraulic head gradients, and by changes in vertical hydraulic gradient due to high-capacity pumping. Results are currently being used by the Metropolitan Council to guide conceptual models of recharge to bedrock aquifers in their regional groundwater model.

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

Track C: Quantifying Low Spots in the Landscape

Assessing Wetland Quantity Changes for Minnesota from 2006 to 2011

Steve Kloiber (steve.kloiber@state.mn.us) and Doug Norris (doug.norris@state.mn.us), Minnesota Department of Natural Resources

The State of Minnesota has developed a monitoring program to provide scientifically-sound data regarding long-term changes in wetland quantity and quality. Modeled after the national status and trends program, the Minnesota program assesses changes in wetland acreage and type over time using repeat assessment of permanent, random plots using remote sensing and photo-interpretation. This program tracks land cover change for 4,990 plots over repeating 3-year sampling cycles. The analysis presented here includes the results from the first two complete sampling cycles, 2006–2008 and 2009–2011. A small, but statistically significant net gain in wetland acreage was identified for this period. Extrapolating these results statewide indicates that Minnesota had a net gain of 2,080 acres of wetland during the study period, or about 0.02% of Minnesota's total wetland area of 10.62 million acres. In spite of this gain, the results of the data raise questions regarding both the change in wetland quality as well as the relative permanence of these changes in wetland quantity.

Historic Water Retention Capacity of the Greater Blue Earth River Basin

Andrew C. Kessler (kessl127@umn.edu) and Satish C. Gupta (gupta002@umn.edu), University of Minnesota

It is often implied that restoration of wetlands will mitigate excessive runoff from drained agricultural landscapes yet, the historic water retention capacity of these landscapes is not known. Using airborne light detection and ranging (lidar), we calculated the historic water holding capacity of wetlands across the Greater Blue Earth River Basin (GBERB). The historic water retention capacity of wetlands was 152 mm for the entire GBERB with the Le Sueur, Blue Earth, and Watonwan River Watersheds having retention capacities of 193 mm, 143 mm, and 114 mm, respectively. The average retention capacity for HUC 12 watersheds within the GBERBE was 156 mm and ranged from 23 mm to 915 mm. Results indicate that the restoration of most drained wetlands in the GBERB would have a small impact on reducing annual flows under present climatic conditions where we are receiving 50-100 mm of additional precipitation.

Contributing Drainage Area Analysis for Hydrologic Modeling

Brandon Barnes (bbarnes@barr.Com), Mike Strong, Scott Sobiech, Katie Wenigmann, Leslie Dellangelo, and Omid Mohseni, Barr Engineering Company

For a given depth of rainfall excess (surface runoff), a certain portion of a watershed may not contribute any surface runoff to the drainage basin outlet. This is due to topographic characteristics such as depressions, low areas, and landlocked lakes or wetlands. These areas are referred to as non-contributing areas for a given amount of rainfall excess. For some watersheds, accounting for non-contributing areas is crucial in simulating historical flood events or predicting future events.

Two different methods were developed to identify non-contributing areas for the Mouse River watershed in North Dakota with 7,700 square mile drainage area for different rainfall excess depths. One is a GIS based method and the other is a spreadsheet method consisting of preprocessing in ArcGIS and a spreadsheet to track depression storage. We will present both methods as part of the hydrologic model developed for the Mouse River Enhanced Flood Protection Plan.

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

Track D: Climate and Rainfall

Rainfall Atlas 14: Replacement of Technical Paper 40 Part 1: Background, Technical Details, Results, and Implications

Steve Buan (steve.buan@noaa.gov), National Oceanic and Atmospheric Administration; Karen Chandler (kchandler@barr.com), Barr Engineering Company

Hydrologists and engineers use precipitation frequency estimates to design stormwater conveyance systems, flood protection, and water quality treatment infrastructure and make recommendations to policy decision makers. Design storms, such as the 10-year or 100-year frequency events, have typically been defined using rainfall estimates from Technical Paper 40 (TP-40), published by the U.S. Weather Bureau in 1961, and supplemental revisions. NOAA re-evaluated these rainfall estimates to reflect an additional 50 years of rainfall data, and in April 2013 released final precipitation frequency estimates for the Midwestern states (NOAA Atlas 14, Volume 8). NOAA will release the documentation describing the station metadata, data, and project methodology in June 2013.

Part 1 will provide background and technical details about NOAA's analytical approach for Atlas 14 (e.g., longer data records, more stations, better data), and showing how to navigate the website to get the new numbers.

Rainfall Atlas 14: Replacement of Technical Paper 40 Part 2: Implications and Case Studies

Karen Chandler (kchandler@barr.com) and Nathan Campeau (ncampeau@barr.com), Barr Engineering Company

Hydrologists and engineers use precipitation frequency estimates to design stormwater conveyance systems, flood protection, and water quality treatment infrastructure and make recommendations to policy decision makers. Design storms, such as the 10-year or 100-year frequency events, have typically been defined using rainfall estimates from Technical Paper 40 (TP-40), published by the U.S. Weather Bureau in 1961, and supplemental revisions. NOAA re-evaluated these rainfall estimates to reflect an additional 50 years of rainfall data, and in April 2013 released final precipitation frequency estimates for the Midwestern states (NOAA Atlas 14, Volume 8).

The presentation will:

- provide comparisons of Atlas 14 results with TP-40 values,
- present different methods of modeling rainfall distributions for different duration storm events,
- provide case studies comparing hydrologic and hydraulic model results for different rainfall distributions for Atlas 14 and TP-40, using current Minnesota watershed organizations models,
- discuss the implications of Atlas 14 for designers, planners and regulators.

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

Track D: Climate and Rainfall *(continued)*

Community Stormwater Response to a Changing Landscape and Climate: A Framework for Adaptation Planning and Implementation

Leslie Yetka (lyetka@minnehahacreek.org), Minnehaha Creek Watershed District; James Gruber (jgruber@antioch.edu), Antioch University New England; Trisha L. Moore (tlmoore@umn.edu), St. Anthony Falls Laboratory, University of Minnesota

The frequency of intense storms in our region has increased, and climate projections indicate that trend will continue. The capacity of existing stormwater infrastructure may be inadequate in our communities, resulting in more frequent flooding and impacts to infrastructure, public safety, and the quality of downstream water bodies. Development and redevelopment can exacerbate the problem, but also provide an opportunity for communities to make sound planning decisions that reflect adaptation to our new environment. A two-year study within the Minnehaha Creek watershed focused on community stormwater adaptation in two cities, the urban City of Minneapolis and the suburban community of Victoria. Results of this study provide a framework for community adaptation planning, including risk and vulnerability assessments, planning and implementation strategies, and a stakeholder engagement process that increases the capacity of a community to respond to a changing environment.

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

Track A: Stormwater BMPs

The First Steps to Tackling Water Quality in Existing Highly Developed Areas

April A. Ryan (aryan@sehinc.com), SEH Inc.; Lisa Vollbrecht (Lisa.Vollbrecht@ci.stcloud.mn.us), City of St. Cloud

A significant sediment plume was observed discharging into the Mississippi River from a 96-inch outfall. The 367 acre watershed consists primarily of industrial and commercial land uses, with no storm water treatment. The City of St. Cloud decided it was time to take a critical first step towards improving water quality by initiating a detailed analysis of the drainage system. The presentation will summarize the analysis approach which included modeling 47 minor catchments using WinSLAMM software. WinSLAMM modeling results included runoff volumes, TSS, and TP loads for existing conditions and seven potential BMPs, including 19 different scenarios. Efforts also included site investigations, review of current policies and goals, and comprehensive costs analysis. Results include a prioritized plan of action for BMPs and improvements based on treatment results, maintenance efforts, City goals, and overall cost. The City is currently working towards implementing BMPs with help from the SWCD and BWSR.

Protecting Schwanz Lake Through Reductions of Neighborhood Phosphorus Loads in Eagan, Minnesota

Eric Macbeth (emacbeth@cityofeagan.com) and Gregg Thompson (gthompson@cityofeagan.com), City of Eagan

The City of Eagan retrofitted a 28-acre neighborhood with 25 bioretention basins in 2009-2011, totaling 5,588 ft2 of surface infiltration. Comprising only 4% of the watershed, the neighborhood contributes 24% of the phosphorus to 11.5-acre Schwanz Lake. Data suggest the neighborhood originally discharged about 133,000 gallons (gal) of untreated runoff to the lake from an average one-inch rainstorm. Post-construction results suggest runoff volumes from a similar rainstorm were annually reduced (i.e., 76,600 gal in 2010, 54,600 gal in 2011, and 43,400 gal in 2012). Calculated phosphorus reductions through 2013 and overall project costs will be summarized. Project funding was from city stormwater utility fees and grants to the Gun Club Lake Watershed Management Organization from the Minnesota Clean Water Fund and Dakota County. This is a follow-up to Punching Holes in a Targeted Neighborhood: Reducing Phosphorus Load to Schwanz Lake, Eagan, Minnesota, presented at the 2011 Minnesota Water Resources Conference.

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

Track A: Stormwater BMPs *(continued)*

Innovative Stormwater Treatment Train Systems in Rural Communities Through Unique Funding Opportunities

William Douglass (billdo@bolton-menk.com) and Timothy Olson (timol@bolton-menk.com), Bolton & Menk, Inc.

Promoting innovative, often more expensive, stormwater quality best management practices in rural areas presents several challenges including limited funding sources, reduced maintenance budgets, and inadequate infrastructure to support additional drainage improvements. To circumvent these issues in Storm Lake, Iowa, a balance was obtained to improve water quality of impaired receiving waters while utilizing the existing terrain to provide multiple linear treatment opportunities along with limiting the economic burden through the use of creative funding sources. A Community Development Block Grant (CDBG) was obtained to mitigate the frequent flooding of a low to moderate income neighborhood. The grant approval was based on the design that included improving water quality by providing a treatment train of multiple and varying treatment cells along the primary downstream drainage route. Water quality improvements included linear bioretention facilities along an abandoned rail road bed, regional stormwater wetlands, infiltration swales, and iron enhanced sand filters constructed alongside of golf course ponds. The sand filters were disguised as sand traps on the golf course.

The final comprehensive design allowed the low, "first flush" flows to utilize the treatment train while diverting the larger flows through bioswale treatment. This design not only provided low flow treatment, but also provided cost effective conveyance for more significant runoff. The project cost is approximately $1,050,000 shared by City and CDBG dollars.

Once the design was completed and construction contracts were finalized, the late spring created construction timing challenges associated with the City's desire to provide full access to the golf course while construction continued. In addition to the golf course constraints, there was also concern that late spring might delay the upstream extensions and the timely construction of the needed outfall before the June severe rainfall season. This could mean that the target neighborhood not be relived of flooding in 2013.

A full description of the design constraints and considerations associated with the terrain and multiple treatment train BMP opportunities along with the construction challenges associated with groundwater and the late spring will be presented.

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

Track B: Managing Water Resources

Learning and Adapting: Using a Community Capacity Model for Watershed Program Assessment

Paul Nelson (pnelson@co.scott.mn.us), Scott County; Mae Davenport (mdaven@umn.edu), University of Minnesota

It is frequently difficult to make decisions in watershed management given a number of sources of uncertainty. Uncertainty arises from natural resource and climate variability and from limited understanding of human, social and administrative factors affecting water resources and watershed management programs. Uncertainty and its precipitating factors require learning and adapting, or in the context of natural resource decision-making, require adaptive management. Until recently, however, there has been a lack of a sound structure for examining the human, social and administrative factors that may enhance or hinder the adaptive management of water resources. This presentation will introduce the Multilevel Community Capacity Model for sustainable watershed management and discuss how the Scott Watershed Management Organization is using the model, and other measures, to assess its program, to learn from its successes and limitations, and to adapt.

A Social Science Assessment of Conservation Practices in the Red River Basin

Vanessa Perry (perry497.@umn.edu) and Mae Davenport (mdaven@umn.edu), University of Minnesota; Linda Kingery (kinge002@umn.edu), Northwest Regional Sustainable Development Partnership, University of Minnesota

This study examines farmer decision-making in the Red River Basin (RRB), Minnesota, where water resource professionals fear high commodity prices will result in the conversion of thousands of acres of conservation lands back to cropland. Using participatory, social science research methods, University of Minnesota researchers collaborated with local partners to investigate farmers' values, beliefs and decision-making processes associated with water resource conservation. Twenty-four key informant interviews were conducted with farmers in December 2012 through April 2013. Data were analyzed for predominating themes and relationships between themes. The complex role of personal and social norms as drivers of and constraints to conservation behavior was explored. Data suggest that norm dissonance may constrain conservation decision-making. A more holistic and science-based understanding of the determinants of conservation behavior will enhance existing programs, inform future interventions, and provide policy direction for watershed planning in the RRB. This study will be completed in August 2013.

Identifying Mechanisms Controlling Nutrient Cycling and Ecological Function in Lake St. Croix

Suzanne Magdalene (smagdalene@smm.org), Science Museum of Minnesota; Jeffrey Ziegeweid (jrziege@usgs.gov) and Richard Kiesling (kiesling@usgs.gov), U.S. Geological Survey; Kent Johnson (kent.johnson@metc.state.mn.us), Metropolitan Council Environmental Services

The lower 25 miles of the St. Croix River comprise Lake St. Croix, a riverine lake that integrates the water quality of the entire St. Croix River basin. Despite reductions in point-source phosphorus loads, Lake St. Croix phosphorus and chlorophyll concentrations still exceed water-quality standards. The objective of this study was to identify mechanisms that control nutrient cycling and ecological function in Lake St. Croix. A flow gage was installed at Stillwater, Minnesota to improve lake inflow nutrient-load calculations. Bed-sediment incubations, monthly dissolved oxygen profiles, and hypsographic curves were used to estimate internal phosphorus loads from anoxic sediments in deep pools. Phytoplankton bioassays were used to assess phosphorus and nitrogen limitation, and grazing experiments were used to assess rates of zooplankton predation on phytoplankton. The results of this study will be incorporated into follow-up studies that will improve historical flow and nutrient-loading estimates and produce a CE-QUAL-W2 dynamic lake model.

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

Track C: LiDAR and Remote Sensing Applications

LiDAR and Terrain Analysis in Minnesota's Driftless Area

Thomas Miller (tmiller@eorinc.com) and Pat Conrad (pconrad@eorinc.com), Emmons & Olivier Resources, Inc.

A terrain analysis utilizing LiDAR was conducted to identify highly erodible areas in the Whitewater River and Garvin Brook Watersheds. These watersheds are characterized by steep wooded slopes with farmed bluff tops and river bottoms. Several post-processing operations were performed to improve the results of the terrain analysis. Based on a field survey, a systematic list of areas was buffered and raster tools were used to remove false positives from the final maps.

The results of this analysis provide insights into many aspects of erosion risk including the role of landcover, grassed waterways, grade control structures, WASCOBs and karst features. The analysis indicates that much of the visible (field) erosion within the watersheds is being effectively controlled with 92 miles of grassed waterways but that wooded pastureland is a larger contributor of sediment than previously thought

Determining the Amount of Altered Stream Channels in Minnesota

Benjamin Lundeen (benjamin.lundeen@state.mn.us) and Scott Niemela (scott.niemela@state.mn.us), Minnesota Pollution Control Agency; Jim Krumrie (jim.krumrie@state.mn.us), Minnesota Geospatial Information Office

The Minnesota Pollution Control Agency (MPCA) conducts yearly water quality assessments on streams throughout the State, and will complete watershed assessments on all 80 watersheds by 2017. Because altered stream channels (i.e. ditching and straightening of stream channels) influence habitat for aquatic life it is important to understand the magnitude of stream channel alteration when assessing the states waters. The historic and current extent of stream channel modification in Minnesota is largely unknown; because available geographic information system (GIS) layers (e.g. national hydrography dataset (NHD), public waters inventory (PWI) and Minnesota Department of Transportation (MNDOT)) are outdated or incomplete. The MPCA and Minnesota Geospatial Information Office (MNGeo) have developed a GIS based methodology for determining stream channel modification focused on visual interpretation of contemporary and historic aerial imagery (including LiDAR), and several reference layers. This study provides the first comprehensive effort to distinguish altered stream miles on a statewide scale.

Regional Water Quality Measurements by Satellite Remote Sensing: Recent Trends, Current Status and Future Prospects

Leif Olmanson (olman002@umn.edu), Marvin Bauer (mbauer@umn.edu), and Patrick Brezonik (brezonik@umn.edu), University of Minnesota

Remote sensing of surface water bodies, a cost-effective way to gather information for water resources management, has been embraced by several states including Minnesota. Historic and recent state-wide water clarity assessments conducted on many thousands of lakes have been used to investigate spatial and temporal patterns and explore factors that affect water quality. This presentation will review advances over the past decade in using satellite imagery for regional scale-measurement of lake water quality characteristics, such as water clarity and chlorophyll, and describe improvements of the recently launched Landsat-8 and impending European Space Agency Sentinel-2 and -3 satellites. The addition of these new satellite systems with improved spectral, radiometric, spatial and temporal characteristics will significantly increase the capabilities for optical characterization and regional water quality assessment of lakes.

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

Track D: Design Considerations for Stream Crossings

Methods and Results of Peak-Flow Frequency Analyses for Streamgages in and Bordering Minnesota, Through Water Year 2011

Erich Kessler (ekessler@usgs.gov) and David Lorenz (lorenz@usgs.gov), U.S. Geological Survey

Peak-flow frequency analyses were completed for 409 streamgages in and bordering Minnesota having at least 10 systematic peak flows through water year 2011. Selected annual exceedance probabilities were determined by fitting a log-Pearson type III probability distribution to the recorded annual peak flows. A detailed explanation of the methods that were used to determine the annual exceedance probabilities, the historical period, acceptable low outliers, and analysis method for each streamgage are presented. The final results of the analyses are presented.

Identify and Validate Alternate Designs for Road/River Intersections Using the Lower Whitewater Morphology and HEC-RAS

Kevin Zytkovicz (kevin.zytkovicz@state.mn.us) and Salam Murtada (salam.murtada@dnr.state.mn.us), Minnesota Department of Natural Resources

Inadequate design of road stream channel intersections can cause significant and long term impacts to both stream channel and road infrastructure. As a result of these inadequate designs, the cumulative impacts can propagate throughout the river system. This study examines these present day design approaches by quantifying their impacts. It then proposes an alternative approach to better mitigate impacts to these intersection. This approach improves channel efficiency and stability, biological function, lateral and longitudinal connectivity, and can drastically reduce road "maintenance" (i.e, culvert cleanouts, etc.) overtime.

Rationale for Alternative Stream Crossing Design Approach

Marty Rye (mrye@fs.fed.us), Superior National Forest

Our infrastructure is aging and many crossings are nearing their design life. In addition, as our transportation system expands new crossings are being installed. Historic and existing design methodologies for stream crossing design have relied upon clear flood water hydraulic analysis. This does not take into account other environmental services at low flow, sediment transport, and debris flow. In many cases the reliance on clear flood water hydraulic analysis does not adequately protect the public or meet ecological needs. The result is an unfulfilled social contract, increased risk to the public, and increased liability to the design engineer. This presentation reviews historic crossing design methodologies, the importance of considering crossings as riverine structures instead of roadway structures, and affirms the need to adopt a new standard of practice.

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

Track A: Erosion/Sediment – Muddy Waters

Statewide Evaluation of Soils for Improving Construction Site Discharge Through Site-Specific Chemical Treatment

Stephen Druschel (stephen.druschel@mnsu.edu), Chase Radue, Jerry Schimmel and Isabelle Race, Minnesota State University, Mankato

In many Minnesota locations with fine-grained soils, traditional stormwater best management practices (silt fences, diversion ditches, temporary seeding, check dams and sediment ponds) have been observed to be ineffective in removing many fine particles, frustrating construction personnel and leaving construction sites unable to meet stormwater regulations. Flocculation, a chemical treatment to enhance fine particle sedimentation and filtration, is a common technique in the controlled world of water treatment.

Results are presented of a statewide pre-treatment evaluation done on fifty-seven soils selected by soil morphology and geographic characteristics with twenty-one different flocculants. Design recommendations for construction site sediment control systems are provided that anticipate site-specific soil conditions for improved surface water protection related to construction water discharges.

Refining BMP Implementation Choices in the Maple Creek Watershed Using ArcGIS and GSSHA

Jason Tidwell (jason.tidwell@state.mn.us), Minnesota Department of Natural Resources

Advanced methods in watershed modeling using GSSHA (Gridded Surface Sub-surface Hydrologic Assessment) and ESRI's ArcGIS 10.1 geographic information system software were applied to develop and evaluate a range of Best Management Practice (BMP) strategies for the Maple Creek watershed in Steele County, MN. The objective was to develop a watershed pollutant management strategy for areas upstream of Owatonna. The analysis was developed in successive phases; a coarse analysis of BMP scenarios, and a refined scenario. The Coarse Analysis Scenario evaluated the effectiveness of BMPs applied at large throughout the watershed. The final Refined Scenario integrated the most effective BMP combinations for the Maple Creek watershed based on model results and realistic expectations of landowner adoption. Results of the final Refined Scenario model show estimated reductions in TSS loadings range from 1% to 40%, and peak flow reductions range from 2% to 6% as compared to the base condition for a series of standard storm events.

Stormwater Pond Dredging Using Hydraulic Dredging and Geotextile Tubes

Ted Shannon (tshannon@hdrinc.com) and Peter Berrini, HDR Engineering, Inc.; Anna Eleria (anna@capitolregionwd.org) and Bob Fossum (bob@capitolregionwd.org), Capitol Region Watershed District

For years the Minneapolis-Saint Paul metro area has relied on storm water ponds to detain and treat runoff. A recognized issue has been sediment retention in these ponds, much of which is heavily contaminated with polycyclic aromatic hydrocarbons (PAHs). A Star Tribune article tallied potential cleanup costs in the hundreds of millions of dollars for the area's 20,000 ponds ("Storm-water pond cleanup costs to soar, maybe to $1 billion", Star Tribune, November 9, 2012). The Capitol Region Watershed District and City of Roseville Villa Park Wetland System (VPWS) is a set of six ponds providing habitat and a front line of water quality protection for McCarrons Lake. Constructed in the 1980s, the VPWS has largely filled with sediment and is now a net contributor of phosphorus to McCarrons. A dredging and sediment removal project was conducted in 2013 to restore the VPWS functions. As VPWS is located in a park in close vicinity to homes, hydraulic dredging was used to minimize disturbances to residents and impacts to wetland and shorelines. Sediment was mixed with a chemical flocculent and stacked in engineered geotextile tubes. Sediment consolidated in these tubes, producing clear effluent which returned to the VPWS and solids which were hauled off-site.

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

Track B: Nitrogen Impacts on Minnesota's Waters

Nitrate in Minnesota Rivers: Conditions, Trends, Sources, and Reductions

Dave Wall (david.wall@state.mn.us), Steve Weiss (steven.weiss@state.mn.us), Thomas Pearson (thomas.pearson@state.mn.us), and David Christopherson (david.christopherson@state.mn.us), Minnesota Pollution Control Agency; David Mulla (mulla003@umn.edu), University of Minnesota

The MPCA, working in collaboration with other organizations, completed a comprehensive report on Minnesota's river nitrogen conditions, trends, sources, and options for reducing loads. Results from over 700 monitoring sites show that nitrate-N concentrations and loads are high throughout most of southern Minnesota (exceeding 5 mg/l) and are low in northern Minnesota. Fifteen southern Minnesota watersheds contribute 74% of the load to the Mississippi River, with the highest loads coming from south-central Minnesota. Mississippi River nitrate concentrations have more than doubled since the mid-1970's and are still increasing. The Minnesota River nitrate levels remain very high, but show some recent signs of stability or improvement.

Nitrate reaches rivers from a variety of sources. The largest source is cropland, contributing an estimated 72% of the statewide load and 78% of the load to the Mississippi River, during an average precipitation year. The largest pathway to surface waters is row-crop tile drainage, followed by groundwater baseflow that originates under cropland. Cropland runoff contributes much less nitrate to surface waters compared to the subsurface pathways. Wastewater point sources, dominated by municipal wastewater, contribute an estimated 9% of the nitrogen load.

Progress can be made to reduce nitrate through widespread adoption of a series of cropland best management practices, including optimal fertilizer rates and timing, tile drainage management and treatment, and strategic use of perennial vegetation. Municipal wastewater can also be further treated to remove one-third to two-thirds of the nitrate from that source. Costs to achieve statewide river nitrate improvements increase substantially after the first 13 to 18% reductions are accomplished.

Overview of the Revised Minnesota Nitrogen Fertilizer Management Plan

Bruce Montgomery (bruce.montgomery@state.mn.us), Minnesota Department of Agriculture

The Nitrogen Fertilizer Management Plan (NFMP) is Minnesota's prevention and response strategy for dealing with nitrates in groundwater resulting from agricultural inputs. Originally developed in 1990, the NFMP has recently gone through an extensive two-year review process with the assistance of a diverse committee representing agricultural commodities, environmental organizations, the University of Minnesota, and multiple state agencies. The revised NFMP has significant improvements for addressing nitrate contamination of both public water suppliers and private wells in agricultural regions. The public comment period for the revised NFMP is August 2 – November 1, 2013.

This presentation will highlight the plan's elements with emphasis on the strategy for identifying and aggressively conducting nitrate assessments in targeted areas on a township scale. Currently 230-280 townships, based on groundwater sensitivity and agricultural intensity, have been identified for future assessment.

Also highlighted will be the four distinct phases to categorize township conditions based on nitrate severity in tandem with the adoption rate and effectiveness of voluntary nitrogen fertilizer Best Management Practices.

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

Track B: Nitrogen Impacts on Minnesota's Waters *(continued)*

Quantifying In-Stream Biological Nitrogen Uptake

Amy Hansen (hanse782@umn.edu), St. Anthony Falls Laboratory, University of Minnesota

Excessive landscape derived nitrogen, which can cause local and downstream algal blooms and dead zones, can be mediated by in-stream biological processes. In-stream biological uptake processes which temporarily store or permanently remove nitrogen vary at stream reach and riverine network scales. The research presented here explores the extent and variability of in-stream nitrogen uptake in selected Minnesota streams and rivers. On a river network scale, we analyzed long term monitoring data to quantify the magnitude of in-stream nitrogen uptake in the Minnesota River and its larger tributaries. On a stream reach scale, we modeled velocity and nitrogen uptake, and validated results with experimental measurements, in Eagle Creek (Savage, MN). Together, these two points of research help quantify the spatial and temporal variability of in-stream nitrogen uptake and the physical conditions which promote it in a Minnesota river network.

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

Track C: Lakes – Billy's Live Bait

The Ecological History of a Fluvial Lake Chain in Northern Minnesota

Euan Reavie (ereavie@d.umn.edu) and Amy Kireta (akireta@d.umn.edu), University of Minnesota Duluth; Andrea Nurse (andrea_nurse@umit.maine.edu), University of Maine

The White Iron Chain of Lakes (WICOL) drains an area of 1,200 square miles of northern Minnesota. Since human settlement the WICOL has been affected by damming, catchment development, nutrient enrichment, species invasions and erosion. Watershed development is likely to continue in the forms of housing, resorts and mining. By describing in detail impacts caused by past environmental insults, we may be able to predict the impacts of future development scenarios. A time-integrated assessment of the environmental status of the WICOL was undertaken using paleolimnology, to provide pre-settlement baselines, environmental trends, and the timing and magnitude of changes related to human activities. This presentation will summarize results for sedimentary indicators analyzed from five cores in the WICOL. Four indicators were investigated: (1) diatoms, to evaluate water quality, particularly past nutrient concentrations; (2) geochemistry, to determine past inputs of metals and other trace materials; (3) pollen, to track historical terrestrial activities such as logging; and (4) overall organic and inorganic sediment content, to evaluate changes in accumulation rates.

Arctic Lake Subwatershed Analysis

Shawn Tracy (shawn.tracy@hdrinc.com), HDR Engineering; Scott Walz (scott.walz@shakopeedakota.org), Shakopee Mdewakanton Sioux Community; Nat Kale (nkale@plslwd.org), Prior Lake-Spring Lake Watershed District; Pete Young (pyoung@cityofpriorlake.com), City of Prior Lake

The SMSC, the PLSLWD, the City of Prior Lake and HDR investigated potential restoration strategies for Arctic Lake. SMSC data results (1999-2012) show average epilimnion values of 0.128 µm-TP (0.045-.0320 µm), 20.331 µm-TSS (5.500-51.000 µm) and 1.01-ft Secchi Depth (0.04-2.97 ft). A rural watershed model was developed using PLSLWD's GIS tool while urban portions used WinSLAMM. A BATHTUB model was also developed for the lake. Early-season 2013 inflow data from the main inlet to the lake was used with in-lake and outflow data to assist in model calibration. A review of the modeling results, historic aerial photos, estimated Secchi depths (UMN) from 1975-2008 and a 2012 plant and fish survey for the lake suggest two principal driving factors of poor water quality for the lake: likely historic loading from a predominantly agricultural landscape from circa 1850-1990 and the cumulative effects of high populations of carp, bullhead and bluegill species.

Improving the Water Quality of Lake Nokomis Through Biomanipulation: A Lake Management Technique

Kelly Dooley (kdooley@minnehahacreek.org), Minnehaha Creek Watershed District; Steve McComas (mccomas@pclink.com), Blue Water Science

A biomanipulation project was initiated in 2010 to improve water quality in Lake Nokomis. The objectives were to increase walleyes to reduce the black bullheads and increase native aquatic plant coverage to meet MPCA's nutrient criteria standards.Lake Nokomis was exceeding the nutrient standard with a total phosphorus concentration of 56 ppb in 2010. Black bullheads were removed in 2010 and 2011, while 4 pounds/littoral acre of walleye yearlings were stocked in 2011, 2012, and 2013. Fish surveys showed black bullheads decreased to less than 0.1 fish/net and walleyes increased to 3.3 fish/net. However aquatic plant growth has remained sparse due to the lake's peculiar bathymetry and clarity limitations. Lake Nokomis met the nutrient standards in 2011, but not in 2012. Biomanipulation can be a practical management tool, but developing a robust aquatic plant community is a requirement and water quality improvement responses can take longer than planned.

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

Track D: Hydrologic Modeling

Perfect* Calibration, Imperfect Solution (*or a Good, Acceptable Calibration)

Rita Weaver (rweaver@barr.com) and Omid Mosheni (omosheni@barr.com), Barr Engineering Company

Barr Engineering Company was tasked with computing the Probable Maximum Flood (PMF) for the Au Sable River Basin, MI, with a drainage area of 1700 square miles. The drainage area is a forested watershed with highly permeable soils, which exhibits steady base flow conditions and moderate changes in discharge during storm events. An HEC-HMS model of the watershed was developed for the PMF analysis. During model calibration, it was determined that the hydrologic model of the river could be calibrated in a number of ways with different model parameter values to accurately simulate the historical events, however, the calibrated models projected very different peak flow rates of the PMF ranging from 10,000 cfs to nearly 40,000 cfs. This presentation will focus on the HEC-HMS modeling methodologies used for this analysis, the calibration approaches, model parameters, the projected estimates of the PMF, and how the most reliable calibration method was selected.

Watershed Models in Karst: HSPF/SWAT Models of the Root River Watershed, Minnesota

Saumya Sarkar (saumya.sarkar@tetratech.com) and Jon Butcher (jon.butcher@tetratech.com), Tetra Tech, Inc.

Watershed models are needed to predict nutrient and sediment loads from the Root River to the Mississippi and to evaluate BMPs to mitigate loads. Karst in the watershed influences both hydrology and water quality, but is not addressed in typical watershed models. Local-scale SWAT models (to evaluate BMPs) and a basin-scale HSPF model were built to assess total export incorporating the SWAT results. Both models were modified to address karst: HSPF simulated karst features using a set of subsurface reaches that route flow from sinkholes and as subsurface inputs to springs, while SWAT uses a modification of the ponds routine to address karst seepage. LiDAR topography and flow tracing were used to specify the karst connections. Both models were successfully calibrated and validated for flow and quality using spatially distributed NEXRAD precipitation. Model scenario applications help demonstrate the basin-scale pollutant load reduction benefits of different management practices.

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

Track A: Planning Tools

Stormwater Reuse Design Calculator

Meghan Jacobson (mjacobson@eorinc.com) and Brett H. Emmons (bemmons@eorinc.com), Emmons & Olivier Resources, Inc.

Reuse and harvesting of stormwater has been used throughout history, but seems to have been overlooked in modern times. With water sustainability concerns and stronger stormwater restrictions in place, reuse is primed to reemerge.

Goals: A method is needed to quantify the benefits (stormwater volume capture) and optimize the system (storage volumes, operations). With some applied research funding, we were tasked with developing a tool that quantifies volume reductions and water quality benefits.

The Approach & Methods: A thorough literature review was first conducted. The calculator quantifies annual removals of runoff and phosphorus for three scenarios: wet, dry, and typical year. The calculator provides visual output to interpret the results. Several example sites were analyzed using the model.

Results: From the various scenarios and events, sensitivity to storage size, which is costly, was identified. Also of concern in highly urban sites, availability of green space for irrigation can quickly become a constraining factor.

Minnesota's Nutrient Reduction Strategy: A Path to Progress in Achieving Healthy Waters

Jennifer Olson (jennifer.olson@tetratech.com) and Kellie DuBay (kellie.dubay@tetratech.com), Tetra Tech, Inc.; Dave Wall (david.wall@state.mn.us) and Wayne Anderson (wayne.p.anderson@state.mn.us), Minnesota Pollution Control Agency

In response to the 2008 Gulf Hypoxia Action Plan and EPA's memo in 2011 urging greater progress in accelerating reductions in nutrients to the nation's waters, agencies in Minnesota initiated the development of the Minnesota Nutrient Reduction Strategy (NRS) in 2012. The goal of Minnesota's NRS is to identify statewide strategies to reduce both phosphorus and nitrogen discharges to Minnesota lakes, streams, and rivers and to address downstream nutrient concerns in the Gulf of Mexico, Lake Winnipeg, and the Great Lakes. The 2008 Gulf Hypoxia Action Plan calls for 12 Task Force member states with land draining to the Mississippi/Atchafalaya River Basin to develop similar nutrient reduction strategies. The NRS is a collaborative effort that complements the existing watershed approach in the state, as well as TMDL development and the impending river eutrophication standards.

An Interagency Coordination Team (ICT) consisting of individuals from various state agencies, including the MPCA, DNR, MDH, MDA, NRCS, DEED, FSA, USGS, and Met Council, participated in the development of the strategy. The draft NRS is expected to be released in September 2013 for public input. Existing work served as the basis of the NRS, including the MPCA's Nitrogen Study; USGS SPARROW modeling, monitoring and evaluation conducted by the MPCA, USGS, and Met Council; the MDA's Nitrogen Fertilizer Management Plan; and BWSR's efforts to track BMP implementation.

The NRS presents a series of basin-wide goals and milestones for nutrient reduction, along with an evaluation of the current conditions and progress made to date. The effectiveness of current nutrient-reducing programs in the state are evaluated based on input from the ICT and new initiatives are explored including program optimization, focused implementation activities (spatially and by program element), and research needs.

This presentation will outline and summarize the goals and milestones for nutrient reduction, provide an overview of the current status of nutrient reduction in the state and the progress made over the past few decades, summarize existing programmatic efforts to reduce nutrients and their estimated effectiveness, and identify the recommended statewide strategies to reduce nutrients both in-state as well as downstream. The suite of indicators for tracking and evaluating progress made towards NRS goals and milestones are also presented.

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

Track A: Planning Tools *(continued)*

Restoring the Balance: Water Supply Planning in the Twin Cities Metropolitan Area

Ali Elhassan (ali.elhassan@metc.state.mn.us), Brian Davis (brian.davis@metc.state.mn.us), and Lanya Ross (lanya.ross@metc.state.mn.us), Metropolitan Council

In 2005, the Metropolitan Council began a regional water supply planning effort. Five years of community outreach, data collection, and technical analysis culminated in the 2010 development and approval of the seven-county Twin Cities Metropolitan Area Master Water Supply Plan. That plan recognized that our current "business as usual" approach to water supply, supporting over half of Minnesota's population, is not sustainable. Solutions are possible if communities in the region work cooperatively. To support a change of course, the Metropolitan Council has undertaken technical projects including the regional evaluation of alternative water supplies. Regional groundwater flow modeling and analysis of groundwater and surface water connections were a key component of this work. Results indicate that a more balanced portfolio of water supply sources may relieve stress on the region's aquifers and the high-value surface water features that they support.

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

Track B: Historical and Recent Effects of Wastewater Effluent on River Water Quality

The Mississippi River and Wastewater Treatment: A History of Water Quality Improvements

Kent Johnson (kent.johnson@metc.state.mn.us), Metropolitan Council

The Metropolitan Wastewater Treatment Plant (Metro WWTP) in Saint Paul, MN has a 75-year history of protecting public health and improving water quality in the Mississippi River. Owned and operated by the Metropolitan Council Environmental Services (MCES), the Metro WWTP has been expanded four times since 1938, and currently employs advanced secondary treatment.

With marked improvements in the wastewater treatment process at the Metro WWTP (advanced secondary treatment, nitrification, dechlorination, and phosphorus reduction), with a highly effective industrial pretreatment program, and with separation of storm and sanitary sewers, Mississippi River water quality improvements have been dramatic. Today, the Mississippi River supports a diverse abundance of aquatic life, including game fish, mayflies, and mussels. River-dependent wildlife have also returned in large numbers. Economic and social benefits of an improved Mississippi River include increased recreational use, riverfront revitalization, and establishment of the Mississippi National River and Recreation Area (MNRRA).

The Mississippi River and Wastewater Treatment: Recent Treatment Technology Improvements and Water Quality Impacts

Larry Rogacki (larry.rogacki@metc.state.mn.us), Metropolitan Council

The Metropolitan Wastewater Treatment Plant (Metro) is the largest MCES facility and the 10th largest facility (by capacity) in the country. Beginning in the mid-1990s, various technologies were explored for removing phosphorous. This resulted in the conversion of the entire plant to include biological phosphorous removal in 2003 and a 92% decrease in phosphorous loading to the Mississippi River. In addition, a cooperative program with the Minnesota Dental Association and installation of advanced air pollution control technology, mercury discharge to the environment has decreased 99% since 2003. Discharges of heavy metals have decreased by 94% since 1980 with the implementation of an industrial pretreatment program and upstream recovery. This presentation will discuss recent enhancements to the MCES industrial pretreatment program and implementation of biological phosphorous removal, which have led to large reductions in effluent metals and phosphorus concentrations as well as a vision of future challenges.

Antibiotic Resistance Determinants in Treated Wastewater and in the Upper Mississippi River

Timothy Lapara (lapar001@umn.edu) and Matthew Madson (madso077@umn.edu), University of Minnesota

Prior research has demonstrated that treated wastewater effluents are a pertinent point-source of antibiotic resistance genes (ARGs), however relatively little is known regarding the importance of multiple treated wastewater discharges into a single river system. In this study, samples were collected from twelve different locations along the upper Mississippi River (from the headwaters to the Minnesota-Iowa border) as well as from fourteen different wastewater treatment plants discharging to this watershed. Quantitative real-time PCR was used to enumerate five different ARGs targeting four different classes of antibiotics (tet(A), tet(X), tet(W), erm(B), qnrA and sul1) as well as the integrase gene of class 1 integrons (intI1) and Inc A/C plasmids. Results indicate that the quantity of ARGs in treated wastewater vary significantly among wastewater treatment facilities. Nonetheless, raw wastewater typically contained several-hundred fold higher concentrations of ARGs than treated wastewater effluents; similarly, wastewater effluents contained several-hundred fold high concentrations of ARGs than the Mississippi River.

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

Track C: Rivers/Bio

Investigating River Conditions in Minnesota: What Those Conditions May Mean for the Aquatic Fauna that Call These Rivers Home

April Lueck (april.lueck@state.mn.us), Minnesota Pollution Control Agency

What are the conditions of Minnesota's rivers? Have they improved or degraded over time? Since 1996 the MPCA has used probabilistic surveys as part of their biological monitoring efforts on rivers and streams. The survey design allowed data from a few sites to represent the population of Minnesota's rivers. Landuse, water chemistry, aquatic habitat, fish and macroinvertebrate data were used to explore conditions from multiple perspectives. Data were collected from two surveys utilizing MPCA biological monitoring protocol. Estimates from these surveys lay the foundation for where Minnesota's rivers are today and provides indication of the parameters that are most closely tied to the health of aquatic communities. In addition, comparisons made between the two surveys revealed preliminary information on temporal changes. Despite being simple questions to ask, the answers are often nuanced and complex; however, the results are laying a critical foundation for understanding one of Minnesota's most vital resources.

Effects of In-Stream Fine Sediments on Benthic Macroinvertebrates

Valerie Brady (vbrady@d.umn.edu), Natural Resources Research Institute, University of Minnesota Duluth; Larissa Herrera (risahary@gmail.com), Water Resources Science, University of Minnesota

Excess fine sediments are a problem for stream macroinvertebrates when they embed rocky substrates. Previous studies correlated macroinvertebrate traits such as burrowing vs. clinging behavior, case building, and fragile gills with fine sediments. These traits may make macroinvertebrates vulnerable to high sediment loads and would inhibit them from being dominant community members. Western Lake Superior streams have a wide range of fine sediment amounts due to clay and sand soils, but low amounts of other stressors, and thus are a good region to investigate relationships between macroinvertebrate traits and fine sediments. We created a combined sediment variable comprised of embeddedness, depth of fine sediments, and total proportion fine sediments. Macroinvertebrate traits significantly correlated with the sediment stress axis included EPT richness, fragile gill taxa richness and proportion taxa with hard exoskeletons. Together, the traits create an indicator that helps determine whether or not macroinvertebrate impairment is due to excessive sediments.

Two-Stage Ditch Fish IBI Scores: Implications

Brenda (Asmus) DeZiel (brenda.deziel@state.mn.us), Minnesota Pollution Control Agency; Joe Magner (magne027@umn.edu), University of Minnesota

Pre- and post-ditch construction monitoring in southern Minnesota for fish, identified positive changes in fish IBI metrics. Fish IBIs are being used extensively across Minnesota to assess water quality. Public and private funding was used to retrofit over 2000 meters of private ditch in Mower County near the Iowa border. Changes in channel dimension and profile moved an unstable trapezoidal ditch toward a stable two-stage channel with pools and riffles.

Total fish numbers in the new ditch doubled from 2009 to 2011; two additional fish species were collected in 2011and benthic insectivores, simple lithophilic spawners increased by 21% and 9% respectively; whereas, pollution tolerant species decreased by 44%. To control for yearly variation, data was also collected in the Little Cedar River (1.5 mi east of the two-stage ditch) within 48 hours of two-stage ditch fish collection. Fish metrics for the Little Cedar River showed a 20% decrease in benthic insectivores; whereas simple lithophilic spawners and pollution tolerant species increased by 1% and 32% respectively. These results suggest that habitat in headwater ditches influences fish IBI metrics.

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

Track D: Wetlands

Brown's Preserve Wetland Restoration: Innovation in the Hydrologic and Ecologic Restoration of a Wet Meadow Wetland Complex

Mark Deutschman (mdeutschman@houstoneng.com), Chris Otterness, and Emmy Baskerville, Houston Engineering, Inc.; Phil Belfiori, Rice Creek Watershed District; Jason Husveth, Critical Connections Ecological Services, Inc.

In the spring of 2010 the Rice Creek Watershed District (RCWD) embarked on a major wetland restoration project. A 100 acre wet meadow (peat)wetland complex bisected by the Anoka County Ditch 15 / Anoka Washington Judicial Ditch 4 (ACD 15 / JD 4) public drainage system located in Columbus, Minnesota had become ecologically degraded. The reasons for degradation included the presence of the public drainage system, years of human interference, fire suppression, poor ecological management, and the invasion of non-native plant species.

The project constructed in 2012 developed and used new and unique hydrology and vegetation performance standards for receiving credit under the Minnesota Wetland Conservation Act. Restoring the hydrology required a different mindset than a traditional wetland restoration. Rather than ponding water, hydrologic restoration focused on rehydrating the peat. The Project Team accomplished hydrologic restoration by rerouting a portion of the public drainage system thereby reducing the size of the upstream drainage area and placing a water control structure on the drainage system to render it ineffective. Multiple methods were used to restore the vegetative quality of the wetland complex. These methods included the use of prescribed burning, herbicide application, removal of accumulated vegetative thatch and peat surface scarification to stimulate the dormant native seed bank. Flouristic quality assessment methods rather than a traditional MnRAM became an effective tool for assessing vegetation quality and restoration success.

Identifying Wetlands Using Vegetation: Variability and Bias

Ken Powell (ken.powell@state.mn.us), Minnesota Board of Water and Soil Resources; Jason Naber (jnaber@eorinc.com), Emmons & Olivier Resources, Inc.

Wetlands are highly regulated water resources resulting in the need to precisely identify and define them. Wetland regulatory agencies have developed a set of standards and procedures for identifying and delineating wetlands involving vegetation tests at sampling plots. This 3-year study examines vegetative changes in sampling plots over time, compares different vegetation tests, and examines changes resulting from a recent plant list update. Selected vegetation sampling plots in diverse wetland-upland transition zones were monitored monthly during the growing season over a 3-year period. Preliminary data suggest that early season observations are more likely to identify sampling plots as upland compared to later in the growing season. The study also indicates that some vegetation tests are more consistent in classifying plots throughout the growing season. The results of the study will facilitate interpretation of the vegetation component of wetland delineation sampling plots in diverse transitional areas.

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

Track D: Wetlands *(continued)*

Developing a Geographic-Information-System-Based (GIS) Wetland Restoration Prioritization Tool for Minnesota

Jeremy Erickson (eric0792@d.umn.edu), Terry Brown (tbrown2@d.umn.edu), Lucinda Johnson (ljohnson@d.umn.edu) and Valerie Brady (vbrady@d.umn.edu), Natural Resources Research Institute, University of Minnesota; Mark Gernes (mark.gernes@state.mn.us), Minnesota Pollution Control Agency

A university-state partnership has developed a GIS based wetland prioritization decision web tool for Minnesota that prioritizes wetland restoration or protection for improved water quality and/or habitat and that will result in high functioning sustainable wetlands. The tool consists of a base layer of all the possible "restorable" wetlands derived from soils and elevation data, three thematic decision layers (stress, viability, and benefits) created from readily available GIS data, and a final output modifier comprised of available environmental data for the desired region. For the decision layers stress reflects anthropogenic activities that negatively influence water quality and habitat, viability ranks areas for their likelihood of supporting high functioning sustainable wetlands, and benefits identify locations where wetland restoration could reduce nutrients or enhance wildlife habitat. The relative importance of each GIS data input in the decision layers was determined by wetland experts comprised of university, state, and federal officials.

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

Track A: Policy/Education

Designing and Demonstrating the Minnesota Water Research Digital Library

Christine Yaeger (christine.yaeger@state.mn.us), Minnesota Department of Agriculture

Is the research article you need buried in a website or government report? The Minnesota Water Research Digital Library is a new, searchable online database of articles about all types of water research relevant to Minnesota from aquifers to zooplankton. This Clean Water Fund supported tool was created to help water researchers and restoration and protection partners quickly access research in support of on-the-ground projects and provide greater accountability for research dollars. We will demonstrate how to use the Digital Library and share our experiences creating the tool, including basic questions such as what to include in the library and who decides. We will also share details about how you can contribute.

Minimal Impact Design Standards (MIDS): A New Paradigm for Stormwater Management in Minnesota

Jay Riggs (jriggs@mnwcd.org), Washington Conservation District; John Bilotta, (bilot002@umn.edu), University of Minnesota Extension and Minnesota Sea Grant; Anne Gelbmann (anne.gelbmann@state.mn.us), Minnesota Pollution Control Agency; Jim Hafner (jhafner@ci.blaine.mn.us), City of Blaine; Mike Isensee (misensee@mnwcd.org), Middle St. Croix Watershed Management Organization; and Jay Michels (jmichels@eorinc.com), Emmons & Olivier Resources, Inc.

The new Minimal Impact Design Standards (MIDS) will roll out in 2013 and will usher in a new era of stormwater management in Minnesota. MIDS provides clear guidance about how to meet state and federal water quality goals by developing performance standards, design standards, and tools to enable and promote the implementation of LID to protect and restore natural hydrology. A key component of MIDS is to help communities comply with federal regulations and requirements under Total Maximum Daily Load (TMDL), Municipal Separate Storm Sewer System (MS4), Anti-Degradation, and Outstanding Resource Value Waters (ORVW) programs. Accordingly, in addition to agency staff and designers, local units of government, developers, and builders play a central role in defining and guiding the process and outcomes. Through the MN Stormwater Steering Committee, a work group of diverse professionals has spent 3+ years in developing performance standards for new development, redevelopment andlinear projects; a credit calculator to guide the design and implementation of and allow credit for site appropriate BMPs; and a community assistance package featuring model ordinances for the adoption of the MIDS package.

This presentation will describe the work group process, how the standards were developed, a process flowchart to meet performance standards and alternative scenarios. The presentation will also demonstrate the new GUI (Graphic User Interface) BMP calculator that provides volume, nutrient, and total suspended sediment credits for the incorporation of practices into project sites. An additional part of MIDS is the Community Assistance Package (CAP). The CAP includes model ordinances developed to meet the new performance goals of MIDS including MS4, TMDL, and Antidegradation; instructions about how to use the Package, flowcharts, checklists, training materials from the pilot implementation, and how communities can incorporate the MIDS BMPO calculator into local policies. The presentation will feature the results of pilot implementation in four communities.

MIDS was initiated when the Governor of MN signed LID into law in the spring of 2009. Statute now reads: "The [state] shall develop performance standards, design standards, or other tools to enable and promote the implementation of low impact development and other storm water management techniques. For the purposes of this section, "low impact development" means an approach to storm water management that mimics a site's natural hydrology as the landscape is developed. Using the low impact development approach, storm water is managed on site and the rate and volume of predevelopment storm water reaching receiving waters is unchanged. The calculation of predevelopment hydrology is based on native soil and vegetation"

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

Track A: Policy/Education *(continued)*

Updates to the Minnesota Stormwater Manual

Michael Trojan (mike.trojan@state.mn.us), Anne Gelbmann (anne.gelbmann@state.mn.us), and Paul Leegard (paul.leegard@state.mn.us), Minnesota Pollution Control Agency

The Minnesota Stormwater Manual is widely used for stormwater management by engineers, managers, regulators, hydrologists, and others. The Manual was last updated in 2008. Recent advances in our knowledge of stormwater management led to the conclusion the Manual needed updating and long-term maintenance.

In 2011, the Minnesota Pollution Control Agency secured Clean Water Legacy funds to update the Manual. We will discuss two major changes to the Manual. First, considerable new information is being incorporated. This includes new information on bioretention, permeable pavement, green roofs, iron enhanced treatment, trees, swales, reuse, and turf. Second, the Manual has been converted to an online version using a wiki format. The online version has powerful search capabilities and allows almost instantaneous updates to content. In addition to content updates and the development of an online version, we will discuss our vision for the Manual over the next few years.

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

Track B: Water Quality and Agricultural Practices

Targeted Variable Rate Fertilizer Application: A Rare Win for Water Quality and Farmers

Rebecca Kluckhohn (rkluckhohn@wenck.com) and Wes Boll (wboll@wenck.com), Wenck Associates, Inc.; Dennis Loewen (loewen.dennis@yahoo.com), Clearwater River Watershed District

Solving Minnesota's water quality problems often put water quality professionals at odds with agricultural producers. Many organizations implement agricultural BMPs through a patchwork of government programs. Because farming practices and water quality issues vary across the state, program goals don't always align with water quality needs (think conservation drainage) and program limitations don't always appeal to producers. In 2009, the Clearwater River Watershed District implemented a pilot project to test whether cost share would motivate area producers to test soil for nutrient requirements, and then apply fertilizer at a variable rate based on the results. The district then tracked the resulting reduction in fertilizer application, crop yield, nutrient export and cost savings for the producer. The results were so promising the District secured a 319 grant to expand the program. The results are shared here as well as a discussion of technical challenges and implications for use in greater Minnesota.

Response to Minnesota's First Pesticide Impairments

Ron Struss (ron.struss@state.mn.us), Minnesota Department of Agriculture

An alternative to the TMDL process was chosen for Minnesota's first pesticide water quality impairments. Violations of the aquatic life standard for the herbicide acetochlor in the Le Sueur River and Beauford Ditch were addressed through an Acetochlor Impairment Response Report completed through the Minnesota Pollution Control Agency (MPCA), Minnesota Department of Agriculture, and an advisory committee.

Finalized June 2013, the report addresses: "Is the absence of acetochlor standard exceedances since 2005 the result of a change in acetochlor management, or an absence of rainfall events during critical runoff periods?"

The report summarizes activities conducted to answer that question, including intensive monitoring, computer modeling, surveys of acetochlor use and management, and acetochlor loss field studies. It concludes changes in management have resulted in reduced acetochlor levels and the two water bodies should be removed from the impaired waters list; a recommendation that MPCA is taking under consideration.

Case Studies – Drainage Water Management

Tim Gillette (tim.gillette@state.mn.us) and Al Kean (al.kean@state.mn.us), Minnesota Board of Water and Soil Resources

Drainage water management includes a number of relatively new conservation practices designed to help manage agricultural drainage water quantity and quality in conjunction with crop production. This presentation will focus on controlled subsurface drainage and denitrifying woodchip bioreactor practices. Brief descriptions of the science behind these practices will be followed by two or three case studies addressing the planning, engineering design, implementation challenges and project outcomes to date. Case studies will be from the Minnesota River Basin and the Red River Basin in Minnesota.

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

Track C: Regional and Statewide Stream and River Assessment

Metropolitan Council Long-Term Stream Monitoring Program: Results of a Comprehensive Water Quality Assessment of Metropolitan Area Streams

Emily Resseger (emily.resseger@metc.state.mn.us), Jennifer Kostrzewski (jennifer.kostrzewski@metc.state.mn.us), Karen Jensen (karen.jensen@metc.state.mn.us), and Joe Mulcahy (joe.mulcahy@metc.state.mn.us), Metropolitan Council

Metropolitan Council Environmental Services (MCES) and its partners monitor metropolitan area streams to assess compliance with water quality standards, extent of nonpoint source pollution, and progress towards improving water quality. MCES has continuously monitored flow and regularly sampled base flow and storm events at each site for a period of record ranging from 11 to 23 years.

MCES has completed its first comprehensive study of 22 streams in its program. Annual pollutant loads were calculated using the Flux32 load estimation program. Water quality was assessed through intra- and inter-annual comparison of concentration and loads, load duration curves, biological assessment, and trend analysis using the USGS QWTREND statistical method. Load and concentration statistics for all 22 streams were compared to understand relative water quality and contributions to the region's major rivers.

This presentation will provide a general overview of the study results, with a focus on trend analysis and stream-to-stream comparisons of assessment metrics.

Watershed Pollutant Load Monitoring Network: Program Overview and Statewide River Water Quality Results

Patrick Baskfield (pat.baskfield@state.mn.us), Minnesota Pollution Control Agency

The Watershed Pollutant Load Monitoring Network is designed to obtain spatial and temporal pollutant load information from Minnesota's rivers and streams. This long-term program utilizes state and federal agencies, universities, local partners, and Minnesota Pollution Control Agency staff to collect water quality and flow data for pollutant load calculations. Monitoring sites span three ranges of scale: basin, major watershed, and subwatershed. When fully operational, there will be over 200 monitoring sites in the network with twenty-five to thirty-five grab samples collected annually. Pollutant loads are computed using the "Flux32" pollutant load model. The data will be used to assist with: impaired waters assessments; watershed and water quality studies; watershed modeling; water quality trend analysis; watershed protection and restoration plans; and effectiveness monitoring. Statewide maps depicting 2007-2010 average water quality statistics such as load, yield, and flow weighted mean concentration will be presented for nitrogen, phosphorus, and sediment parameters.

The State of the River Report

Trevor Russell (trussell@fmr.org), Friends of the Mississippi River; Lark Weller (lark_weller@nps.gov), Mississippi National River & Recreation Area

How is the health of the Mississippi River in the twin cities? Can I safely swim in it? Is water pollution improving? Can I eat the fish I catch? What can we do about Asian carp?

Friends of the Mississippi River and the National Park Service have teamed up to publish the first-ever "State of the River Report." The report details the status and trends of 13 key indicators of river health, highlighting the swimming, fishing, aquatic life and emerging contamination issues facing the river--as well as priority solutions for each. Published in 2012, the report shows improvements in aquatic life, but troubling trends in a variety of water quality and river health indicators.

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

Track D: Unique Stream Restoration Techniques and Assessment

Golf, Trains and Highways –Addressing Three Unique Impairments to Brown's Creek

Kevin Biehn (kbiehn@eorinc.com), Emmons & Olivier Resources, Inc.; Karen Kill (klkill@mnwcd.org), Brown's Creek Watershed District

The Brown's Creek Watershed District (BCWD) has recently completed two stream rehabilitation projects in their effort to improve the cold-water fishery of their namesake. A third stream project in partnership with the Department of Natural Resources (MNDNR) is also currently underway. Each of these projects addresses a distinctly different but common impairment of Minnesota streams. The presentation will touch on the impairments, solutions vetted, funding, cost, metrics of success and lessons learned along the way.

Project #1: Improved fish passage [completed]

Modifications of two box culverts under two state highway were designed to raise the critical water depth and maintain critical connectivity during low stream flow. Project provides fish habitat and refuge within the 80' long crossings.

Project #2: Coldwater stream restoration [completed]

Restoration addresses a highly manicured reach through a public golf course, which had become excessively wide and shallow. The newly established stream buffer contributes to habitat creation, helps reduce instream warming, and improves course aesthetics while still meeting the strict playability standards of the golf course.

Project #3: Restoring floodplain connectivity [underway]

As part of the MN/DNR rails to trails development of the Brown's Creek Trail, this project will serve to alleviate a century-old entrenchment caused by the rail line. A constructed two-stage channel will provide a flood release thereby reducing bank erosion and stabling the trail's cross section.

Restoring a Native Creek Buffer Through a Residential Neighborhood: Approach, Challenges, and Lessons Learned

Becky Houdek (bhoudek@minnehahacreek.org), Minnehaha Creek Watershed District; Lucius Jonett (ljonett@wenck.com), Wenck Associates, Inc.

Minnehaha Creek passes through a variety of land uses on its way from Lake Minnetonka to the Mississippi River, including a stretch of residential neighborhoods in Edina where the banks are highly managed with riprap, retaining walls, and turf grass. The Minnehaha Creek Watershed District identified this section as a priority area for restoration and has been working with sixteen individual homeowners who volunteered to participate in this effort to re-establish native vegetation along the banks. The project presented a number of challenges as the District worked to meet its goal of creating a healthy and functional stream buffer while also meeting the goals of each homeowner in terms of aesthetics, viewshed, usability of the property, and ease of maintenance. The presentation will discuss the approach the District used to engage residents, the challenges faced throughout the project, and lessons learned for the future.

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

Track D: Unique Stream Restoration Techniques and Assessment *(continued)*

Basin-Scale Geomorphology and Sediment Transport for Preliminary Impact Analysis

Peter Hinck (phinck@barr.com), Benjamin Sheets, Miguel Wong, and Amy Mikus, Barr Engineering Company

Understanding the basin-scale geomorphology and dominant sediment transport processes active in any river system is an important first step when evaluating the potential impacts of large civil works projects. This paper focuses on the study of the Mouse/Souris River watershed in north-central North Dakota, conducted as part of the Mouse River Enhanced Flood Protection Plan.

The geologic history of the basin and key present-day watershed characteristics (e.g., topography, soils, land use) provide the framework that shapes how sediment is mobilized through the watershed and riverine system. The present-day characteristics of the Mouse/Souris River are highly constrained by the area's glacial history, resulting in distinct river segments delineated by major geomorphologic features. Stream classification using basin-scale data affords a foundational understanding of the natural tendencies of the river with respect to sedimentation that is essential in order to adequately evaluate the potential impacts associated with the proposed project.

Poster Session 4:45 p.m. – 5:45 p.m.

1. Swale Infiltration and Swale Runoff

Farzana Ahmed (ahmed262@umn.edu), John Gulliver (gulli003@umn.edu), and John Nieber (nieber@umn.edu), University of Minnesota

Swales or drainage ditches are an attractive BMP for linear road projects as they can infiltrate water into the soil, filter sediments and associated pollutants out of the water, and settle solids onto the soil surface. Infiltration rate is a controlling factor for the water quality performance of swales. In this study infiltration measurements were taken in a swale which is located in Madison, WI, at 108 locations. A model has also been developed to estimate the outflow and infiltration of that swale for certain rainfall intensity. This model is a combination of Green-Ampt infiltration model and St. Venant equation for routing the channel. The model takes into consideration the moisture condition of the soil, Green-Ampt parameters and the geometry of the channel. With this combined model the outflow rate of the swale was estimated for monitored rainfall intensity and compared with actual flow rate in that swale. This poster will show how our measured infiltration parameters can be used to determine the water quality performance of a given swale.

2. Ecological Risk Screening Methods for Pesticide Ranking and Prioritization

Dan Balluff (dan.balluff@state.mn.us), Minnesota Department of Health

Objective: This screening level comparative ecological risk assessment can be used along with other MDH screening assessments, in consultation with other State Agencies, to assess relatively large numbers of pesticides for ranking and prioritization of full MDH assessments.

Approach and Methodology: Toxicity and exposure data for three hypothetical pesticides (an insecticide, a fungicide and a herbicide) were used to demonstrate the step-by-step screening assessment method.

Five-Step Screening Risk Assessment Procedure: The first step is to identify the most sensitive aquatic and terrestrial species tested in toxicity studies. The second step is to calculate terrestrial and aquatic Estimated Environmental Concentrations (EECs) for major agricultural crops. The third step is to calculate Risk Quotients (RQs) for aquatic organisms, terrestrial organisms and plants. The fourth step, if the pesticide has been detected in the aquatic environment, is to calculate Risk Quotients by dividing the maximum environmental residue levels detected by the toxicity values. The final step is to rank the pesticides from high to low risk by comparing the maximum RQs and range of RQs.

Preliminary Results: Pesticide A posed the highest risk to non-target plants with risk quotients ranging from 2.5 to 153. Pesticide B posed the highest risk to terrestrial wildlife with a risk quotient of 240. Pesticide C posed the highest risk to aquatic wildlife with risk quotients ranging from 5 to 6,100.

3. Assessing the Bioavailability of PAHs after Remediation and Restoration

Amanda Brennan (brenn411@umn.edu) and Nathan Johnson (nwjohnso@d.umn.edu), University of Minnesota Duluth

The St. Louis River Estuary (SLRE) in Duluth, MN is designated as an area of concern (AOC) in part due to sediment contamination from PAHs as a result of past industrial practices. In an attempt to delist this AOC, remediation and restoration projects have been completed or are currently underway, many of which involve the placement of a clean layer of material over contaminated sediment. The effectiveness of capped layers is best monitored with bioavailability based techniques which predict organism exposure by quantifying the fraction of dissolved contaminants in the porewater or the bioavailable phase. These techniques include passive sampling with solid phase microextraction and bioaccumulation assays. Preliminary data suggests little to no PAH contamination of surficial sediments at remediated areas. This project will serve as a template for the integration of bioavailability based techniques into remediation and restoration efforts in the SLRE.

Poster Session 4:45 p.m. – 5:45 p.m.

4. Mercury Trends in Four Lakes in Voyageurs National Park, Northern Minnesota, 2000-2012

Mark Brigham (mbrigham@usgs.gov) and David Krabbenhoft (dpkrabbe@usgs.gov), U.S. Geological Survey; Mark Sandheinrich (msandheinrich@uwlax.edu), University of Wisconsin-La Crosse

Epilimnetic water was sampled two to three times annually for methylmercury in four lakes in Voyageurs National Park. Year-old yellow perch were sampled from three of these lakes several times throughout the study period. Simple linear regression was used to evaluate temporal trends. Over the study period, epilimnetic methylmercury declined by 50 percent in Peary Lake, and 44 percent in Ryan Lake. In Ryan Lake, mercury in yellow perch declined by 47 percent. These declines coincide with a 38 percent decline in wet mercury deposition from 1998-2011, based on two Mercury Deposition Network sites in northern Minnesota. In contrast, epilimnetic methylmercury doubled in Brown Lake; perch mercury levels showed no trend. In Shoepack Lake, eplimnetic methylmercury levels declined between 2000 and 2006, but have since increased; water-level changes may have driven the apparent trend reversal in Shoepack Lake.

5. Predicted Risk of Brook Trout to Climate Change in Lake Superior's North Shore Streams

Meijun Cai (mcai@d.umn.edu), National Resources Research Institute, University of Minnesota Duluth; William Herb (herb0003@umn.edu) and Lucinda Johnson (ljohnson@d.umn.edu), University of Minnesota

Brook trout in the North Shore region of Lake Superior are very sensitive to temperature and hydrology changes. Climate change is expected to cause increases in water temperature and more frequent extreme runoff events. This presentation will describe the relationships of current hydrology, stream temperature and land cover to brook trout presence or absence using empirical models, forecast future flow and stream temperature with projected climate data, and predict the future (2020-2089) risk to brook trout in more than 400 survey sites located in 329 streams in this region. Results indicated that 20% of current trout streams may lose trout in 50 years, particularly in the lower shore area, where trout were predicted to disappear from almost all streams. Streams in the upper shore were less affected by climate change. Overall, suitable brook trout habitat in North Shore streams was predicted to shift northward in response to climate change.

6. GIS as a Decision Support System

Erik Cedarleaf Dahl (edahl@minnehahacreek.org), Minnehaha Creek Watershed District; Nat Kale (nkale@plslwd.org), Prior Lake Watershed District

GIS and spatial data are tools that water organizations should be familiar with. This presentation will focus on simple tools anyone with a basic understanding of computers and freely available data can use to better inform the decision making process for capital projects, best management practices, programmatic solutions and institutional decisions. GIS is a decision support system for water organization staff and policy makers.

This presentation will detail three simple examples of analysis that can be performed in ArcGIS or open source GIS that will act as a decision support system for staff and policy makers. 1) Combine social, economic and natural resource data together to analyze when MCWD rules will be triggered and what treatment can be expected—this was then compared to regional treatment scenarios that will treat the area immediately but will cost more upfront to decide on the best course of action. 2) Integrated Watershed Planning: Analyze parcel datasets to determine where right-of-way, rail-corridors, forfeited land, intersects with MCWD conservation corridors and other agency's trail corridors. 3) Use LiDAR data recently distributed by the DNR to identify buildings in the OHW or 100-year floodplain of a lake.

Poster Session 4:45 p.m. – 5:45 p.m.

7. Dendroecological Study on the Effects of Chlorides on Trees within a Wetland Wastewater Outflow in Onamia, Minnesota

Alan Cibuzar (awc@awlab.com), A.W. Research Laboratories, Inc.

A.W. Research Laboratories, Inc. completed a dendroecological study on aspen trees within the wetland outflow system of a wastewater plant. The wetland has been closely monitored since the beginning of plant operations in 2004. The purpose of the study was to determine if ring-width anomalies exist historically within the trees, and if the trees were impacted by chlorides from the municipal wastewater plant, when the impact began, and whether or not the impact has worsened over time.

Slices from 5 trees were collected at three test sites within the wetland and one control site outside of the wetland. Each tree was analyzed for chloride concentrations in old and new growth rings. A ring-width analysis was also completed for each tree.

The ring-width analysis showed that the health of the majority of the trees sampled had been declining many years before the plant began operating. We also found that the trees at the site closest to the wastewater plant outflow had the highest chloride concentrations, yet these trees also showed the strongest growth. There was no significant difference in chloride concentrations between the old growth and new growth at all sites measured. We therefore determined that any anomalies or depressed growth in wetland trees was unrelated to the wastewater plant operations and that chloride from the wastewater effluent has had no negative impact on tree growth.

8. Manure Application Guided by Grid Soil Sampling: Minnesota Case Studies

Leslie Everett (evere003@umn.edu), Water Resources Center , University of Minnesota; Jose Hernandez (jahernan@umn.edu) and Randy Pepin (pepin019@umn.edu), University of Minnesota Extension

The objective was to motivate livestock producers to avoid application of manure in areas of fields that are already high in phosphorus (P), and thus reduce potential loss of P in runoff. Case studies evaluating the economic and environmental effects of using grid soil sampling compared to field-average sampling to guide manure application were prepared for eight farms with different livestock species and manure types in southern Minnesota. The economic comparisons were made using the University of Minnesota spreadsheet "What's Manure Worth?" available at http://z.umn.edu/manureworth. Results indicated that the fertilizer savings value obtained by targeting manure application with grid soil sampling exceeded by up to three times in the first year, the increased cost of grid sampling on these farms that had a history of non-uniform manure distribution. The case studies were presented in twelve interactive workshops with livestock producers, agricultural professionals, and agency staff across Minnesota in 2013. The case studies, an introduction, and associated video presentations are at http://manure.umn.edu.

Poster Session 4:45 p.m. – 5:45 p.m.

9. Impacts of Climate Change on Lake Superior's North Shore Trout Habitat

William Herb (herb0003@umn.edu), University of Minnesota; Lucinda Johnson (ljohnson@umn.edu), and Meijun Cai (mcai@umn.edu), University of Minnesota Duluth

The North Shore of Lake Superior has one of the largest concentrations of trout streams in Minnesota. These streams lack substantial groundwater aquifers, and are therefore particularly susceptible to climate change. To develop management strategies to address climate change impacts, this project aimed to forecast future streamflow and temperature regimes, and to project the corresponding future spatial distribution of trout habitat. This presentation will focus on the deterministic hydrologic and stream temperature models that were developed for the Knife River, the Baptism River, and Amity Creek. These models were calibrated based on historical climate and stream data, and then used to project future (2020-2089) stream flow and temperature conditions based on climate data from several global climate models. Overall, stream flows were projected in increase slightly with some seasonal shifts, while stream temperatures were projected to increase 1.3 to 3.5 °C, depending on the month and climate model used.

10. Reflections on 10 Years of West Nile Virus Vector Mosquitoes in Stormwater Structures

Kirk Johnson (kjohnson@mmcd.org) and Sandy Brogren (sandybrogren@mmcd.org), Metropolitan Mosquito Control District

Episodic outbreaks of West Nile Virus continue to affect human health in various parts of North America. In the Minneapolis-St. Paul metro area, the Metropolitan Mosquito Control District has been tracking vector mosquito species and focusing on control in larval habitats. One species responsible for epidemic WNV transmission, Culex pipiens, is frequently found in stormwater structures, as is Culex restuans, the main amplification vector maintaining virus activity in birds. We have been following populations of these and other vector species in constructed and natural habitats since WNV arrived in this area in 2003. This poster presents trends over the last 10+ years in species distribution and abundance, including influence of seasonal temperature patterns on populations and infection rates.

11. Kingston Wetland: Nutrient Trap or Oxygen Demand Source?

Rebecca Kluckhohn (rkluckhohn@wenck.com), Wenck Associates, Inc.; Dennis Loewen (loewen.dennis@yahoo.com), Clearwater River Watershed District

A TMDL study showed that the 465-acre Kingston Wetland, a riparian wetland of the Clearwater River, contributes to the dissolved oxygen impairment in the river. This is a common problem in agricultural areas. The river was straightened and ditched through the wetland to facilitate agricultural drainage, the dominant watershed land use. The wetland in its altered state sometimes trapped particulate nutrients, acting as a buffer to protect downstream lakes, and sometimes released soluble phosphorus and oxygen demand contributing to downstream impairments. The Clearwater River Watershed District secured a 319 grant to study the system and design a restoration. The resulting restoration of the riverine wetland complex had to balance the need to protect the river from oxygen demand in wetland sediments yet retain the natural assimilative capacity of the wetland to protect downstream impaired lakes. Technical and regulatory challenges will be discussed as well as applications in greater Minnesota.

Poster Session 4:45 p.m. – 5:45 p.m.

12. A SWAT model for Farmers in the Whitewater River Watershed: The Importance of Local Input in Model Creation

Thomas Miller (tmiller@eorinc.com), Emmons & Olivier Resources, Inc.; Jim Almendinger (dinger@smm.org), Science Museum of Minnesota - St. Croix Research Station; Brian Green (brian.green@state.mn.us), Minnesota Pollution Control Agency

Creating an accurate SWAT model relies heavily on the ability to simulate existing cropping practices in the watershed. In most cases modelers are forced to use default values for corn and soybean rotations because little additional information is available. In creating the Whitewater River SWAT model, input was solicited from local farmers on all aspects of farming from tilling and planting to fertilizer application and manure management. The result was an exceptionally detailed SWAT model that is being used by the farmers and MPCA to identify conservation practices that are practical and effective for the watershed. This presentation will focus on SWAT model refinements made possible by receiving local farmer input.

13. Citizen-Based Water Quality Solutions: The Le Sueur River Watershed Civic Engagement Project

Kimberly Musser (Kimberly.Musser@mnsu.edu), Minnesota State University, Mankato; Patrick Moore (riverartisan@gmail.com), Riverartisan

The heavily studied Le Sueur River Watershed is a major pollutant loader in the Minnesota River Basin. In order to engage citizens to address nonpoint source pollution across the watershed, a multi-disciplinary team of University, agency, landowners, NGOs and private communication consultants worked to foster increased public awareness about the state of the river. Through a two-year process, this collaborative group formed and worked with a Citizen Advisory Committee to develop citizen-based recommendations for improving water quality in the Le Sueur River watershed. Diverse civic engagement techniques such as appreciative inquiry, small group discussions, field tours and river outings were used in the project, which engaged more than 500 citizens and landowners.

Other key collaborators included Larry Gunderson & Paul Davis (MPCA), Rick Moore (MSU WRC), Linda Meschke (Rural Advantage), Anne Queenan (Queenan productions).

14. City of Burnsville Stormwater Asset Management Program

Jacob Newhall jnewhall@wsbeng.com), WSB & Associates, Inc.; Ryan Peterson (ryan.peterson@ci.burnsville.mn.us), City of Burnsville

The City of Burnsville desired a way to efficiently manage stormwater infrastructure inspection and maintenance and identify pond dredging projects that achieve a high pollutant reduction to cost ratio. This program also needed to meet the City MS4 permit requirements for inspecting and maintaining its stormwater system as well as provide an accounting tool for TMDLs and other pollutant driven studies.

WSB & Associates was hired by the City of Burnsville to develop a program that would provide a standard operating procedure for the inspection and maintenance of the City's stormwater basins.

This presentation will focus on the development considerations for Burnsville's SWAMP and how this program assists the City in managing its stormwater infrastructure. Integration of the SWAMP data with the City's asset management program, as well as a web-based SWAMP application will also be presented.

Poster Session 4:45 p.m. – 5:45 p.m.

15. Minnesota Well Owners Organization (MNWOO) - A New Non-profit for Private Well Owners

Karuna Ojanen (ojanenlaw@gmail.com), Ojanen Law Offices; Paul J. Wotzka (pjwotzka@aol.com), Land and Water Consulting

The Minnesota Well Owner's Organization was recently incorporated to provide education and resources to private well owners so that they can preserve, protect and restore Minnesota's groundwater. MNWOO recognizes that there are 1.1 million private wells in the State and that the owners of these wells may not be knowledgeable about the hydrogeology, laws, policies and behaviors affecting their well water. To bridge the gulf between well owners and groundwater policy makers and scientists MNWOO will provide practical information and services to well owners so they understand their rights and responsibilities as a private water utility. MNWOO, moreover, will advocate for well owners to protect their rights to clean water. Private well owners have a large impact on an important Minnesota resource – groundwater. MNWOO will be an effective partner to speak on behalf of the well owners.

16. Stormwater Solutions for Cancer Cardio Research Building, Biomedical Discovery District, University of Minnesota

Rhonda Pierce (rhonda@piercepini.com) and Kevin Gardner (kevin@piercepini.com), Pierce Pini & Associates

Creative, multi-faceted stormwater management techniques include a green roof, underground infiltration system, bioinfiltration swales and gardens, permeable paving and roof ponding to meet B3, University of Minnesota, Minnesota Pollution Control Agency and City of Minneapolis requirements for the new approximately $300 million Cardio Cancer Research Building at the University of Minnesota campus. Challenges included an immense building, high water table, and extensive utility corridors. Stormwater management was designed to integrate into the aesthetic, maintenance and needs of the campus. The implementation of the various stormwater features in the district stormwater system reduced the rate and volume of runoff and improved the water quality before it entered the Mississippi River.
The Cardio Cancer Research Building is scheduled to open in June of 2013.

Poster Session 4:45 p.m. – 5:45 p.m.

17. Discovery Farms Minnesota – Field Scale Monitoring in Real World Conditions

Tim Radatz (radatz@mawrc.org) and George Rehm (rehmx001@umn.edu), Discovery Farms Minnesota

Discovery Farms Minnesota is a farmer led effort organized and established for the purpose of gathering field-scale information to quantify the impact of a variety of farming enterprises across Minnesota. The mission of the program is to collect water quality information under real-world conditions and provide practical, credible, and site-specific information to support better farm management decisions. The program is coordinated by the Minnesota Agricultural Water Resources Center, in partnership with the Minnesota Department of Agriculture.

There are currently ten Discovery Farm sites stretching from the Red River Basin to Southeastern Minnesota. Water quality data is collected from overland surface runoff and tile drainage monitoring stations. This presentation summarizes water quality data, including precipitation, runoff, sediment, phosphorus, and nitrogen, collected at Discovery Farm locations in 2011 & 2012.

18. Using Value-Based Models Along with an Analytic Hierarchy Process to Prioritize Areas for Watershed Management

Paul Radomski (paul.radomski@state.mn.us) and Kristin Carlson (kristin.carlson@state.mn.us), Minnesota Department of Natural Resources

As threats to Minnesota's watersheds continue to mount, it is becoming increasingly important to identify and conserve high-priority areas to produce multiple benefits. Two of the most common approaches for conservation prioritization are system-based models and value-based models. Unfortunately, we often do not have system models that can accurately identify where in the watershed specific good management practices should be applied or that have the ability to simulate alternative land management actions and predict consequences at specific locations in the watershed. Value-based models use a compilation of individual criteria of valuable landscape features (heterogeneous content) and aggregated criteria (context and connections) with an objective function to prioritize places within the landscape for conservation. Feature-specific weights used in these models should reflect social valuation. Collaborations with multiple watershed groups throughout the state have yielded watershed-wide land prioritizations that can guide local resource protection efforts. We present example values-based model prioritizations with feature-specific weights set using an analytic hierarchy process.

Poster Session 4:45 p.m. – 5:45 p.m.

19. Side-By-Side Comparison of Denitrification Performance between a Woodchip Bioreactor and a Wetland System

Andry Ranaivoson (rana0001@umn.edu), University of Minnesota; Gary Feyereisen (gary.feyereisen@ars.usda.gov), Soil & Water Management Research Unit, U.S. Department of Agriculture

A woodchip denitrifying bioreactor and a wetland have been monitored concurrently since fall 2011 in Central Minnesota. The tile-drained areas flowing into the bioreactor (west site) and a 4.0-ha wetland (east site) cover 51 and 41 ha, respectively. The cropped area is in a corn (Zea mays)-corn-soybean (Glycine max.) rotation. Water parameters are measured at 30-m intervals along the length of the 1.8 x 1.8 x 107 m bioreactor. In 2012, precipitation was 523 mm well below the long-term average of 749 mm. Load reductions for nitrate-N + nitrite-N, dissolved reactive phosphorus (DRP), and total suspended solids (TSS) were 100, 93, and 61%, respectively.

The east site wetland water depth is 12.4 cm. Bi-directional flow to and from the lake was observed. Nitrate-N concentration comparisons at the east pump station and at the wetland outlet showed a decrease of 98%. Total phosphorus and TSS loads were relatively high at the wetland outlet.

20. What's in your EAW? Incorporating Health and Climate Change into Environmental Review.

Michele Ross (michele.ross@state.mn.us), Kelly Muellman (kelly.muellman@state.mn.us), Kristin Raab (kristin.raab@state.mn.us) and Ginny Yingling (virginia.yingling@state.mn.us), Minnesota Department of Health

The Minnesota Department of Health (MDH) reviewed the Environmental Assessment Worksheet (EAW) template and guidance document for evaluation of health and climate change impact assessment. Based on this review, recommendations were suggested to the Environmental Quality Board (EQB) in specific areas including flood management, storm water, and groundwater quality. Additionally, MDH has been reviewing EAW for proposed silica ("frac") sand mining operations in Southern and Southeast Minnesota and submitting comments on water, air quality and other concerns. This presentation will primarily provide an overview of MDH's recommendations to the EQB on revising the EAW template as well as provide a brief update of water quality and other issues related to frac sand mining.

Poster Session 4:45 p.m. – 5:45 p.m.

21. Stormwater Management on Minneapolis Northeast Green Campus

John Slack (john.slack@stantec.com) and Dan Edgerton (dan.edgerton@stantec.com), Stantec, Inc.

The Northeast Green Campus area of Minneapolis encompasses Jackson Square Park, Edison High School, and a City flood mitigation basin. Open space and stormwater are managed within the area by multiple entities. The Mississippi Watershed Management Organization (MWMO) asked Stantec to develop sustainable stormwater management approaches that could be applied collaboratively across the area.

The Edison High School stormwater management project is the first project in the feasibility study to be implemented. The project involves a tree trench, pervious pavers, and a rain garden to capture, treat, and infiltrate runoff from the north parking lot. Numerous techniques and structures are included adjacent to the high school building to address and make visible the stormwater on the site. A variety of approaches were selected so as to demonstrate stormwater techniques to students and neighbors. A science teacher at the school will use the project to incorporate stormwater into her curriculum.
The Northeast Green Campus feasibility study facilitates a collaborative effort among Minneapolis Public Works, Park & Recreation Board, Public Schools, and MWMO for managing open space and stormwater within the area. It is hoped that this plan will be a prototype that will be replicated in other areas of the City.

The presentation will summarize the design considerations, illustrate construction activities and lessons learned, and discuss collaboration and educational opportunities.

22. Hydrological Modeling of a Catchment Using SWAT-CN and SWAT-WB Approaches in the Upper Blue Nile Basin of Ethiopia

Tewodros Taffese (ttaffese@gmail.com), Bahir Dar University; Birhanu Zemadim International Water Management Institute

Hydrological models are essential to understand the hydrological response of the catchment. The current paper focuses on the comparisons of SWAT model performance using its two versions, SWAT-CN and SWAT-WB. The model was applied on two watersheds, Mizewa (27km2) and Gumara (1500km2) that are located in the upper Blue Nile basin of Ethiopia in Fogera district.

Initially Gumara and Mizewa watershed was modeled. Model outputs were compared using long term and short term records for Gumara and Mizewa watershed respectively. After these initial findings, the SWAT-CN model was calibrated and validated for the two catchments. In the Mizewa watershed the model was calibrated at upstream gauging station and validated at the outlet of the catchment. The results indicate that there is no significance difference between the two SWAT model versions, catchment size and period of observations were not found to be constraints in improving the performance of SWAT model.

Poster Session 4:45 p.m. – 5:45 p.m.

23. Buoyant Flow Devices for Pond Outlet Control: Full-Scale Testing & Evaluation

Craig Taylor (tayl0423@umn.edu) and Jon Hilsendager (hils0005@umn.edu), St. Anthony Falls Laboratory, University of Minnesota

Buoyant Flow Devices (BFDs) are floating orifice discharge control systems which allow for smaller detention volumes and increased BMP volumes for pollution abatement. Stage-discharge curves were measured in a laboratory setting for four different Thirsty-Duck® BFDs. The stage-discharge curves were found to have nearly constant discharge over a wide range of water depths. The systems were debris tested using leaves, tall grass, soda cans, and plastic bottles. This discussion will include a comparison of the stage-discharge data to an analytic model and a description of the debris testing results. This research concluded that the Thirsty Duck® BFD's stage-discharge relationships can be closely modeled using analytic methods, and the BFDs are no more susceptible, and often less susceptible, to clogging than traditional fixed orifices.

24. Permanent Groundwater Interception System in Bovey, Minnesota

Brent Theroux (btheroux@sehinc.com) and Justin Klabo (jklabo@sehinc.com), SEH, Inc.

The Canisteo Mine Pit in Bovey, Minnesota, is known as a lake approximately 5 miles long and ½ mile wide on average. The pit itself is actually a series of smaller surface mine pits, which have progressively filled with precipitation and groundwater to form one continuous lake since being abandoned in 1985. The rising water level within the pit has impacted the local long term water table elevation. Higher water tables within portions of Bovey have contributed to wet and flooded basements, structural damage, and poor performance of local streets.

The pit water level has risen over 20 feet since 1999. As of July, 2010, the water pit was measured to be within 10 feet of the lowest point around the rim, and more than 5 feet higher than the ground surface elevation at the corner of 1st Street and First Avenue in Bovey.

To alleviate the rising water table and mitigate impacts to local streets and basements, the Minnesota Department of Natural Resources constructed a drain tile system along local Bovey streets adjacent to the pit. Subsurface flow collected by the system was directed to a ditch outlet downgradient of the pit that connected to nearby Trout Lake.

Poster Session 4:45 p.m. – 5:45 p.m.

25. Engineering Outside Our Comfort Zone

Amanda Weber (amanda.weber@kljeng.com), KLJ Inc.

As our world becomes more globalized there becomes opportunities to uses our engineering skills outside of the United States. With these opportunities come new challenges. During the 2011-2012 school year KLJ mentored the North Dakota State University chapter of Engineers without Borders as they completed a water distribution system in Las Tablitas, Guatemala. The objective and results was to design and build a system to bring water to 15 families in the community without easy access to water. The design of the system used straightforward techniques such as using Water CAD software in design. From community priorities and language barriers to food and work hours, the challenge in this project lied in working within a different culture and without the technologies upon which we depend. This project proved to be a lesson in project implementation for all involved.

26. Exploring Constraints to Community Engagement in an Urban Watershed Restoration Project

Leslie Yetka (lyetka@minnehahacreek.org), Minnehaha Creek Watershed District; Amit Pradhananga (prad0047@umn.edu) and Mae Davenport (mdaven@umn.edu), Department of Forest Resources, University of Minnesota

Strategies to engage citizens and promote water resource stewardship must be tailored to specific audiences and respond to the unique assets and needs of a community. Prior to engaging people in watershed planning initiatives, community planners and water resource professionals must consider the question: What is the capacity of the community to engage in sustainable water resource management? The University of Minnesota and the Minnehaha Creek Watershed District completed a pilot assessment of a community's capacity to engage in restoration initiatives along Reach 20, a highly urbanized portion of Minnehaha Creek. The specific research objectives were to explore local stakeholders' perspectives on (1) community assets and vulnerabilities, (2) constraints to community engagement in water resource issues, and (3) opportunities to engage the community in water resource management. Study findings suggest ways to build capacity, with a focus on addressing cultural constraints and increasing minority group engagement in watershed planning initiatives.