APPENDIX 1. Publications and Presentation Abstracts


APPENDIX 2. Examples of poster presentations from national conferences and public venues


3. Harvest Day Festivals, September 2002 and 2003
Duluth Streams: Community partnerships for understanding urban stormwater and water quality issues at the head of the Great Lakes

Marion Lonsdale¹, Richard Axler ², Cynthia Hagley³, George Host ², Carl Richards³, and Bruce Munson³

¹ Duluth Public Works and Utilities, Duluth, MN; ² Natural Resources Research Institute, U. Minnesota-Duluth; ³ Minnesota Sea Grant, U. Minnesota-Duluth

**BACKGROUND**

Setting

- 42 named streams; one of the highest densities of stream corridors in any US metro area
- Urban and rural development impact these streams by increasing water volume, temperature, suspended sediments, road salts, organic matter and nutrients

Partnership

- City, UMD researchers, education and outreach professionals, local resource agencies and other educational institutions

Chief Goal

- Enhance public understanding of aquatic ecosystems and their connections to watershed land use to provide both economic and environmental sustainability.

Objectives

1. Link real-time remote water quality sensing in 4 urban streams and GIS technology to current and historic WQ and biological databases using advanced data visualization tools in a website and information kiosks;
2. Incorporate visually engaging interpretive text, animations and videos into the website to illustrate the nature and consequences of degraded stormwater and the real costs to society;
3. Engage the public in the stormwater issue to facilitate development and implementation of the Duluth Stormwater Management Plan by:
   - Establishing high school stewardship of 3 streams
   - Adapting the NEMO nonpoint education program to the greater Duluth Metropolitan Area
   - Developing high school and college curricula
   - Hosting a Duluth Streams congress as a community forum for presenting all project results

**DATA**

**WEBSITE**

**SETTING**

- 42 named streams; one of the highest densities of stream corridors in any US metro area
- Urban and rural development impact these streams by increasing water volume, temperature, suspended sediments, road salts, organic matter and nutrients

**PARTNERSHIP**

- City, UMD researchers, education and outreach professionals, local resource agencies and other educational institutions

**CHIEF GOAL**

- Enhance public understanding of aquatic ecosystems and their connections to watershed land use to provide both economic and environmental sustainability.

**OBJECTIVES**

1. Link real-time remote water quality sensing in 4 urban streams and GIS technology to current and historic WQ and biological databases using advanced data visualization tools in a website and information kiosks;
2. Incorporate visually engaging interpretive text, animations and videos into the website to illustrate the nature and consequences of degraded stormwater and the real costs to society;
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**WEBSITE**

**VISUALIZING A SUMMER STORM'S EFFECT ON STREAM WATER QUALITY**

**GIS**

**DIAGRAMS**

**PRINCIPAL INVESTIGATORS, STAFF AND COLLABORATORS**

- Duluth Utility Operations, Stormwater Utility
  - Marnie Lonsdale, Jerry Walker, Todd Carlson, Richard Bunton
- NRRI-UMD
  - Rich Axler, George Host, Jerry Henneck, Jane Reed, George Sjerven, Gary Spindler
- MN Sea Grant-UM
  - Carl Richards, Cindy Hagley, Bruce Munson, Jesse Schomberg
- MN Extension Service – Nate Meyer
- MN Pollution Control Agency – Jesse Anderson
- Western Lake Superior Sanitary District – Keith Anderson, Mike Guite
- Great Lakes Aquarium – Mike Janis
- Lake Superior Zoo – Mike Juska
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- Lake Superior Zoo – Mike Juska
**Setting**
- One of the highest densities of stream corridors in any US metro area – 42 named streams
- Urban and rural development impact these streams by increasing water volume, temperature, suspended sediments, road salts, organic matter, and nutrients

**Partnership**
- City of Duluth, UMD researchers, education and outreach professionals, local resource agencies and other educational institutions

**Primary Goal**
- Enhance public understanding of aquatic ecosystems and their connections to watershed land use to improve land use decision-making, contributing to economic and environmental sustainability.

**Objectives**
1. Link real-time remote water quality sensing in 4 urban streams and GIS technology to current and historic WQ and biological databases using advanced data visualization tools in a website and information kiosks;
2. Incorporate visually engaging interpretive text, animations and videos into the website to illustrate the nature and consequences of degraded stormwater and the real costs to society;
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   - Adapting the Nonpoint Education for Municipal Officials (NEMO) program to the greater Duluth Metropolitan Area

**Field Checking**
- Contractors were improperly dewatering the stream channel at an upstream bridge reconstruction although BMPs were in place

**Making the Data Make Sense – Creating the Educational Context**
- Expand Duluth Streams through Minnesota’s Lake Superior Coastal Program to include neighboring communities and whole watersheds
- Provide a website home for contractors – access to up to date best management practices for construction and road building

**Background**
- [Image of Duluth Minnesota]

**Investigating Real Problems with Duluth Streams Data**
- **Real Time Data Collection**
  - Stream monitoring units continually collect data from Tischer, Chester and Kingsbury Creeks.
  - On-line Data Visualization Tools provided easy, visual access to data collected on the day in question.

- **Further Data Analysis**
  - 3 days later a big rainstorm leads to truckloads of mud washed downstream

**Watershed Analysis**
- Contractors were improperly dewatering the stream channel at an upstream bridge reconstruction although BMPs were in place

**Field Checking**
- Contractors were improperly dewatering the stream channel at an upstream bridge reconstruction although BMPs were in place

**Education and Outreach**
- Schools collect their own data and compare it with our remotely collected data
- National Water Quality Monitoring Day – data recorded on our site and contributed to national database.

**Future Directions**
- Expand Duluth Streams through Minnesota’s Lake Superior Coastal Program to include neighboring communities and whole watersheds
Duluth Streams: Community partnerships for understanding urban stormwater and water quality issues at the head of the Great Lakes

Marion Lonsdale1, Richard Axler2, Cynthia Hagley3, George Host2, Carl Richards3, and Bruce Munson3

1 Duluth Public Works and Utilities, Duluth, MN; 2 Natural Resources Research Institute, U. Minnesota-Duluth; 3 Minnesota Sea Grant, U. Minnesota-Duluth

The project has the following specific objectives:

1. Integrate real-time data from new and existing real-time in-stream sensors with historical and current monitoring data;
2. Gather historical water quality and biological (fish, stream insects, etc.);
3. Combine these data with appropriate watershed-based land use and cultural data into a GIS-linked database;
4. Develop advanced interactive data visualization tools to animate and simplify the presentation and interpretation of complex, real-time stream data;
5. Place these data into a web, kiosk, and programmatic framework that provides not only public access to data, but also the educational materials required for data interpretation.
6. Develop curricula to accompany the data for area high schools and Lake Superior Community College;
7. Develop and implement mechanisms for incorporating public input into the decision-making process and evaluating the success of our approach.

Duluth, Minnesota lies at the westernmost end of Lake Superior, the source and headwaters of the entire Laurentian Great Lakes ecosystem. Although perhaps better known for its extremely cold winters, Duluth residents and visitors know it as a city of forested hills, wetlands and trout streams. With 42 named creeks and streams running through the City, it is also one of the most densely forested urban areas. Duluth’s park system is one of the most extensive in the nation, and the City owns and maintains 11,000 acres, including 151 municipal parks. Streams form the heart of the aesthetic appeal and character of Duluth (Duluth Vision 2000), but also the core of the City’s stormwater runoff system, with 250 miles of storm sewer, 13 sediment basins, and over 138 miles of roadway ditches.

Urbanization and rural development are placing increased pressure on Duluth’s streams, and in particular, on the 12 that are designated as Trout Streams and 14 that are classified as Protected Waters (MPCA 1999). Streams contribute their dilution capacity, necessary to maintain the quality of Lake Superior. Duluth’s spring freshets and crested wheatgrass are unique to the Great Lakes and have the potential to be a sensitive indicator of increased inputs of nutrients, suspended solids, turbidity and organic matter. And lastly, the littoral habitat is one of the 45 Great Lakes Areas of Concern (AOCs) because of serious impairments to its beneficial uses (MPCA 1992; UC 1998).

The education program will:

1. Increase citizen awareness and understanding of their streams;
2. Encourage citizen efforts to protect and improve them by identifying practices that threaten waters and BMPs to reduce these threats;
3. Promote citizen and student monitoring of local streams.
APPENDIX 3. Examples of Fact Sheets used for Lake Superior (i.e. Duluth) Zoo Kiosk and for distribution at various local public events

1. Project Abstract
2. Where does stormwater come from?
3. Where does stormwater go?
4. What is in stormwater?
5. How does stormwater runoff impact streams?
6. Everyone lives in a watershed!
7. Reduce polluted urban runoff - things you can do to protect the waters of our streams, rivers and Lake Superior
Duluth Streams:  
Community partnerships for understanding urban stormwater and water quality issues at the head of the Great Lakes

- Urban and rural development are placing increased pressure on Duluth’s 42 streams, and in particular, on the 12 that are designated as Trout Streams and 14 that are classified as Protected Waters.

- Animals like fish, frogs and aquatic insects are being negatively impacted by increased temperature, too much sediment, road salt, organic matter and nutrients.

- Stream water quality monitoring stations have been located in Kingsbury, Chester, Tischer, Miller, and Amity Creeks.

- Our goal is to use the data from these stream monitoring stations and the Duluth Streams.org website to help people better understand the impacts of stormwater on the natural waterways in Duluth.

Duluth Streams is funded by a grant from the US Environmental Protection Agency
Where does stormwater come from?

- Stormwater is rainwater and snow melt that flows across impervious or hard surfaces.
- Impervious surfaces do not allow water to soak into the ground.
- The water flows to catch basins or storm sewers which carry it to a nearby natural water body like a stream, wetland, or lake.
Where does stormwater go?

- Most stormwater and snow melt runoff goes directly into Duluth streams and eventually into Lake Superior.

- Stormwater is **NOT** treated before it enters the streams or Lake Superior.

- Stormwater that enters the sanitary sewer system (“I and I”) causes major problems for the City’s wastewater treatment plant (WLSSD).

- Everything that happens on the land in your watershed affects its water quality.
What is in stormwater?

Urban Stormwater contains the following common pollutants:

• Suspended sediments and salts
• Phosphorus, nitrogen and organic matter
• Oils and debris
• Heavy metals (cadmium, chromium, lead, zinc, copper, mercury)
• Fecal coliform bacteria (indicators of pathogens)
• Higher temperatures, pesticides, pH, low dissolved oxygen
How does stormwater runoff impact streams?

- Stormwater runoff increases the amount of water the streams carry which:
  - Erodes natural drainage ways and feeder streams
  - Straightens meandered streams
  - Erodes stream banks and bottoms, scouring and smothering bottom habitats
- Degrades habitat for aquatic insects, amphibians, fish and other wildlife
- Degrades water quality by increasing pollutants
Rainfall at Duluth Airport
7/31 to 8/02/2002

7/31/02 9am
8/1/02 2 pm
What’s in the box at the zoo?

- An automatic water sampler. It collects a half liter of stream water every 2 hours if the water level increases during a rainstorm.

The water sampler is connected to sensors in the stream that measure water depth, temperature, turbidity, and dissolved salts.

All the information collected will be available on our website.
Take a look at Duluth Streams.org to find your favorite stream, get to know your watershed, and learn how you can help reduce stormwater impacts.
What can you do to protect your watershed?

✓ Take advantage of car washes that send their water to the sanitary sewer so the water will be treated.

✓ Decrease the impervious area on your property

✓ Look for home methods of treating stormwater

✓ Never allow anything but natural rainwater to enter a catch basin

✓ Limit your use of fertilizer and pesticides to just what is needed.

✓ Store all household chemicals carefully

✓ Clean up after pets

✓ Don’t use creeks, streams and the ravines that lead to them as dumping sites
The City of Duluth is made up of many watersheds, all connected together like the pieces of a puzzle.

Do you know which watershed is yours?

This map only shows the larger watersheds. There are actually 42 streams within the Duluth city limits, each with its own watershed.
A watershed is the area of land that drains to a particular lake, wetland or stream.

Everything that happens on the land in your watershed affects its water quality.
EVERYONE lives in a watershed!

A watershed is the area of land that drains to a particular lake, wetland or stream.

The City of Duluth is made up of many watersheds, all connected together like the pieces of a puzzle.

Do you know which watershed is yours?

Everything that happens on the land in your watershed affects its water quality.
A word from the curb and gutter watch dogs.

Street storm drains flow to our creeks and streams, the St. Louis River and finally Lake Superior - the source of our drinking water. The water that enters storm drains is not treated.

**Dumping debris in the street is damaging to our streams and is illegal.**

Duluth City Code Chapter 24-5 says: "No person shall dump, throw or any manner deposit or cause to be dumped, thrown, or deposited upon or in any street, highway, alley, waterway or public or private premises, except as provided in this chapter, any solid waste, manure, household hazardous waste, tires, used motor oil, lead acid batteries, yard waste or infectious waste."

**When you clean your yard or sidewalk:**

- Sweep up sand and gravel and put it in the trash or mix it in the garden to loosen up that clay soil.
- Clean up around the storm drain in the street and report clogged drains to the City at 730-4130.
- Never hose dirt and materials into the street.
- Never wash your car in the street. (Wash it on the lawn or take it to a car wash where the water is treated).
- Never dump anything down a storm drain.

Our street maintenance team sweeps streets from snowmelt to snowfall. Six street sweepers work 16 hours a day in the summer, but with 590 miles of streets there is only so much they can do - it is up to you. Don't end up in the gutter - obey the law and protect our pristine Lake.

**Remember - it all flows down to Lake Superior!**
### Designated Trout Streams of Duluth

<table>
<thead>
<tr>
<th>No.</th>
<th>Stream Name</th>
<th>2001 Stocking Report</th>
<th>Data Availability</th>
</tr>
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<tr>
<td>1.</td>
<td>Armitz Creek</td>
<td></td>
<td>data available</td>
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<tr>
<td>2.</td>
<td>East Branch Armitz Creek</td>
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<td>data available</td>
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<tr>
<td>3.</td>
<td>Chester Creek</td>
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<tr>
<td>4.</td>
<td>East Branch Chester Creek</td>
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<tr>
<td>5.</td>
<td>Keene Creek</td>
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<td>6.</td>
<td>Kingsbury Creek</td>
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<td>7.</td>
<td>Lester River</td>
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<td>8.</td>
<td>Miller Creek</td>
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<td>9.</td>
<td>Mission Creek</td>
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<td>10.</td>
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<td>11.</td>
<td>Stewart Creek</td>
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</tr>
<tr>
<td>12.</td>
<td>Tischer Creek</td>
<td></td>
<td>data available</td>
</tr>
</tbody>
</table>

**Where are the fishing holes?**
Find a few of them [here](#).

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[2001 stocking report](#)

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**Read detailed information about:**

- [Brook Trout](#)
- [Brown Trout](#)
- [Rainbow Trout](#)
- [other Duluth Stream fish](#)

**DNR 2002 Fishing Regulations**
[http://www.dnr.state.mn.us/regulations/fishing/index.html](http://www.dnr.state.mn.us/regulations/fishing/index.html)

**DNR Trout Management Summary**
[http://www.dnr.state.mn.us/fish/trout/management.html](http://www.dnr.state.mn.us/fish/trout/management.html)
Lake Superior
holds 10% of the world's fresh liquid

Surface water, three quadrillion gallons (which reads like 3,000,000,000,000,000). The lake is the largest freshwater lake in the world by surface area, 350 miles long and 160 miles wide. It encompasses 31,700 square miles, or the same area as the state of Maine. The Lake Superior Basin is one of the most pristine and unique ecosystems in North America. That is why it is so important to help regulate the runoff that enters the lake.

Regional Stormwater Protection Team Members

City of Duluth
City of Hermantown
City of Proctor
City of Superior
Duluth Township
Fond du Lac Reservation
Lake County, Minnesota
Minnesota Department of Transportation
Minnesota Pollution Control Agency
Natural Resources Research Institute
Nonpoint Education for Municipal Officials (NEMO)
St. Louis County
St. Louis River Citizens Action Committee
Sea Grant, Minnesota
South St. Louis Co. Soil & Water Conservation District
University of Minnesota Duluth
Western Lake Superior Sanitary District
Wisconsin Department of Natural Resources

For more information:
218-529-3281
www.wisconsinsrivers.org
www.duluthstreams.org

This Watershed Moment brought to you by the

Funded in part by Minnesota's Lake Superior Coastal Program
Printed on recycled paper with soy-based ink.
Everyone lives in a watershed.

Have you ever noticed...

...how fresh and clean everything looks after a good rain? That is because all the dirt, grease and trash from roads and parking lots are washed away into the storm drain system, which often flows directly into our rivers and lakes.

It is a problem, and its name is Stormwater Pollution. It all comes down to Your Water.

What is a Watershed?

A watershed is the area of land that drains to a particular wetland, creek, stream, river or lake. Each watershed has numerous smaller watersheds. Everything you do on the land affects those watersheds and quality of your water.

In the Lake Superior Basin, much of the stormwater from the municipal and other developed areas drains directly into the lake without being treated. Polluted runoff affects 90% of our inland lakes, 40% of our streams, many coastal waters, and much of our groundwater.

You can make a BIG difference in preventing stormwater pollution:

- Never dump anything onto the street or into a gutter or storm sewer drain
- Compost yard clippings
- Sweep leaves and soil from sidewalks and driveways back onto the lawn or compost
- Wash your vehicles in a car wash or on your lawn
- Fix oil, radiator and transmission leaks on your vehicles
- Eliminate or reduce your use of herbicides, pesticides and fertilizer
- If you live along a shoreline, plant a vegetated buffer of native plants
- Landscape and install walkways, driveways, and drainage to let water seep into the ground instead of running off your property
- Plant a rain garden
- Set up a rain barrel
- Pick up after your pets: bury or dispose of waste in the trash
- Bring leftover toxic material to a waste collection facility: 218-722-0761 or 715-395-1293
- Report illegal dumping
  Superior Hotline: 715-394-0392
  Duluth 24-hour: 218-730-4000

Common Stormwater Pollutants:

- Sediment: Soil, clay, sand and gravel washed from ditches, lawns and driveways. Sediment reduces water clarity, mucks up our streams and lakes, slows们的 habitat and carries attached pollutants to waterways.
- Nutrients and Organic Matter: Animal, yard and garden waste, soil, and products such as fertilizer contain nitrogen and phosphorus, which contribute to nuisance algae growth in rivers and lakes. Decomposing organic matter consumes oxygen, which can harm aquatic organisms.
- Pathogens: Disease causing organisms found in human, pet and other waste.
- Chemicals: Herbicides, pesticides and fertilizers from lawns and gardens, detergents from washing our cars, heavy metals and petroleum by-products. These toxic substances are harmful to aquatic, terrestrial and human life. Some stay in the environment and cause damage for many years.
- Chlorides: Road salt. Concentrations from winter months can be very high in stormwater runoff, which can be toxic to aquatic life.
- Thermal Impacts: Roads, roofs, and sidewalks can increase the temperature of stormwater as it runs off surfaces. Removing shoreline vegetation also warms streams, lakes and wetlands, stressing fish and invertebrates that are adapted to cooler temperatures.
- Litter: Trash and debris often end up in streams and lakes, diminishing their natural beauty, degrading habitat and harming fish and wildlife.
Polluted runoff affects 90% of our inland lakes, 40% of our streams, many coastal waters, and much of our groundwater.

www.wisconsinrivers.org

Everyone Lives in a Watershed

A watershed is the area of land that drains to a particular wetland, creek, stream, river or lake.

Each watershed has numerous smaller subwatersheds.

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Lake Superior holds 10% of the world’s fresh liquid surface water, three quadrillion (3,000,000,000,000,000) gallons.

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- Compost yard clippings
- Sweep leaves and soil from sidewalks and driveways back onto the lawn or compost
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- Eliminate or reduce your use of herbicides, pesticides and fertilizer
- If you live along a shoreline, plant a vegetated buffer of native plants
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- Plant a rain garden
- Set up a rain barrel
- Pick up after your pets; bury or dispose of waste in the trash
- Bring leftover toxic materials such as paint, household cleaners, used oil, and pesticides to a waste collection facility, in Minnesota, Western Lake Superior Sanitary District 218-722-0761 www.wlssd.duluth.mn.us or to a cleansweep collection Douglas County 715-395-1293
- Report illegal dumping Superior Hotline: 715-394-0392 Duluth 24-hour: 218-730-4000
- Photo of a carton and a bottle with the word "Respect Your Lake"
- Photo of a map of the Lake Superior Watershed
- Photo of a map of the Lake Superior Watershed
- Photo of a map of the Lake Superior Watershed

Visit www.duluthstreams.org to learn more
Stormwater is not just rain!

Ever notice how fresh and clean everything looks after a good rain?

All the dirt, grease, and trash from roads and parking lots are washed away into the storm drain system, which often flows directly into our rivers and lakes.

It is a problem, and its name is:

Stormwater Pollution

Common Stormwater Pollutants

**Sediment:** Soil, clay, sand and gravel washed from ditches, lawns and driveways. Sediment reduces water clarity, mucks up our streams and lakes, smothers habitat and carries attached pollutants to waterways.

**Nutrients and Organic Matter:** Animal, yard and garden waste, soil, and products such as fertilizer contain nitrogen and phosphorus, which contribute to nuisance algae growth in rivers and lakes. Decomposing organic matter consumes oxygen, which can harm aquatic organisms.

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**Chlorides:** Road salt. Concentrations from winter months can be very high in stormwater runoff, which can be toxic to aquatic life.

**Thermal impacts:** Roads, roofs, and sidewalks can increase the temperature of stormwater as it runs off surfaces. Removing shoreline vegetation also warms streams, lakes and wetlands, stressing fish and invertebrates that are adapted to colder temperatures.

**Litter:** Trash and debris often end up in streams and lakes, diminishing their natural beauty, degrading habitat and harming fish and wildlife.

Regional Stormwater Protection Team Members:

City of Duluth  218-730-4130
  mronsdale@ci.duluth.mn.us

City of Hermantown  218-729-3600
  llander@hermantownmn.com

City of Proctor  218-624-3641
  cityhall@ci.proctor.mn.us

City of Superior  715-394-0392
  hancocks@ci.superior.wi.us

Duluth Township  218-525-5705
  jcook@ci.duluth.mn.us

Fond du Lac Reservation  218-879-4593
  richardgitar@fdlrrez.com

Lake County, Minnesota  218-834-8321
  dick.sigel@co.lake.mn.us

Minnesota Department of Transportation 218-723-4960
  todd.campbell@dot.state.mn.us

Minnesota Pollution Control Agency  218-733-2358
  Chris.butler@pca.state.mn.us

Natural Resources Research Institute  218-720-4279
  http://www.duluthstreams.org/general/contactus.html

Nonpoint Education for Municipal Officials (NEMO) Minnesota  218-726-6182
  jschombe@d.umn.edu

Wisconsin  715-394-8525
  SOHallor@facstaff.uwsuper.edu

St. Louis County  218-625-3830
  ulringi@co.st-louis.mn.us

Sea Grant, Minnesota 218-726-8106
  chagley@umn.edu

South St. Louis Co. Soil & Water Conservation District 218-723-4867
  info@southstlouiswcd.org

University of Minnesota Duluth  218-726-8261
  cricharl@d.umn.edu

Western Lake Superior Sanitary District  218-740-4806
  joesepun@wlssd.duluth.mn.us

Wisconsin Department of Natural Resources  715-392-7988
  www.dnr.state.wi.us

This Watershed Moment Brought To You By The:

Funded in part by Minnesota’s Lake Superior Coastal Program

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It All Comes Down To Your Water

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KINGSBURY CREEK

Kingsbury Creek climbs the steep slopes of the western portion of Duluth. The watershed is over 5000 acres. The creek originates in the swamp drainage on Angle Lake, flows through the Lake along the railroad yard in Proctor, and then upstream through the zoo to St. Louis River. A mix of forest, grassland, and wetland, only about 10% of the watershed is developed.

CREEK STRESSES
Erosion and washout of culverts during storms.

Fishing Tip!
Good brown trout fishing can be found along the Munger Trail and above the zoo. There is a report of a possible lake run of trout or salmon in the lower creek below the zoo.

Protect our creeks! Visit www.duluthstreams.org

KEENE CREEK

Beginning in swampy drainage in Hermantown, this stream flows through light suburban development in the upper reaches and then drops rapidly down the bluff through forested wetland, residential, and urban areas to enter the St. Louis River at gravel pit, a wastewater treatment pond. The watershed is over 3800 acres of which 62% is forest and approximately 10% is urban development.

CREEK STRESSES
Development above the bluff, erosion and washout of culverts during heavy rains.

Fishing Tip!
There is good wild brook trout fishing at Keene Creek Park at Grand and at Skyline Drive and up stream.

Protect our creeks! Visit www.duluthstreams.org
APPENDIX 4 - duluthstreams.org major section pages (as of September 30, 2004)
Learn about streams and water pollution in natural and urban environments

Information for volunteers, homeowners, teachers and students

Data and maps from intensively monitored streams and information about each of Duluth's 42 streams

Learn how we manage our stormwater, wastewater and drinking water

The urban and natural setting of Duluth and western Lake Superior

Learn more about individual streams and stream conditions at the streams section of the website.

To discover and report issues, report them in the name of Duluth streams and our understanding improves.
Road Salt

After a November 2002 snowstorm the streams showed little change in flow or turbidity.

Big spikes in conductivity from road salt show how quickly water soluble pollutants get washed into our streams.

One example of how the stream data visualization tools can be used to illustrate changes in water quality due to runoff events.
APPENDIX 5. Home page for TV ads produced by the Regional Stormwater Protection Team (RSPT) in Fall 2004. These TV spots and additional radio spots will be aired in Spring 2005 to coincide with the snowmelt runoff.
Watershed Moments

These “Watershed Moments” are showing on area TV in Fall 2004.

The movies are in QuickTime format.
APPENDIX 6. Example of mini-lessons (data vignettes) using automated stream monitoring unit data

The following plots and slides were developed to illustrate how transient runoff events from summer rainstorms, from autumn snowstorms, and from spring runoff can cause dramatic effects on water quality and potentially aquatic organisms. The rainstorms in summer caused sharp increases in stageheight and flow, and turbidity, but EC25 decreased due to dilution. On occasion there were also significant increases in stream temperature. The snowstorms led to little if any change in stageheight and flow or turbidity but caused a dramatic increase in EC25 due to meltwater enriched with roadsalt. Spring runoff leads to greatly increased flows, increased salt (EC25 exceeded the criterion for brook trout for several weeks in Tischer Creek in 2004) and increased turbidity from suspended sediment. Greatly increased stormwater runoff also usually coincides with greatly increased sewage treatment plant discharge and sometimes sanitary sewer overflows because of widespread inflow and infiltration problems.
Appendix F: Examples of Stream Data Visualization Tool and Scenarios

May 9, 2003 Storm Flushing & Turbidity Cycle
- Tischer Creek site drains a lot of impervious surface
- First flush of crud
- The hourly loading actually decreased later on despite higher flows
  - Precip

June 8, 2003 Storm Flushing & Temperature
- 63 °F (17 °C) high temp
- 0.7 inches of rain
- Stream temperature is a major stressor of Duluth trout. See how roads and lots warm the water by 2 °F
  - Temp
  - Late afternoon rain

Where the Harbor and the Big Lake meet...
- Seiches and riverflow
Appendix I: Examples of Real-World Data

L. Washington pH - Oct 2003: OK Limnologists – Explain this pattern!

WA: South Lake Washington: pH

10/12/03 10/19/03 10/26/03 11/2/03

WA: South Lake Washington: Dissolved Oxygen

10/12/03 10/19/03 10/26/03 11/2/03

Duluth Ship Channel: Jun 30 – Jul 4, 2003

- rain late Jul 2
- velocity increases from harbor but continued seiche
- estimate TSS load from velocity, channel geometry, turbidity and turbidity-TSS calibration

May 9, 2003 Storm flushing & SSO

Sewage plant swamped with SSO’s; jumps from 30 mgd to 80 mgd

It rains ~ 1 inch all over the city
Summer Storm at Tischer Creek

Have you ever noticed the flow of your local stream changing from a lazy clear trickle to a brown torrent after a rain storm? Ever wonder what kind of changes are taking place? Let's look at an example.

Here's what happened in Tischer Creek after a couple of inches of rain fell in the middle of the night of July 7, 2003.

The black graph line shows how streamflow jumped an hour or two after it started raining. The brown smudge shows how muddy (turbid) the water became and how it tracked the changes in flow.

See this data animated.
Soil Erosion and Sediment Pollution

Although sediment is a part of the natural environment, human activities sometimes increase the amount that ends up in our streams. These sediments are usually fine grained sands, silts and clays that can cover up coarser sediments and the spaces between rocks and cobbles that provide habitat for aquatic life.

Responsible construction practices and landscaping can greatly reduce the amount of sediments entering our streams.

Excess eroded sediment degrades habitat
- Suspended sediment decreases the penetration of light into the water. This affects fish feeding and schooling practices, and can lead to reduced survival.
- Sediment reduces the amount of light penetrating the water, depriving the plants of light needed for photosynthesis.
- Sediment particles absorb warmth from the sun and thus increase water temperature. This can stress some species of fish.
- Settling sediment can bury and suffocate fish eggs and bury the gravel nests they rest in.

Learn more about erosion at:
- US EPA Erosion, sediment and Runoff control for Roads and Highways
- Center for Watershed Protection
- Stormwater Manager's Resource Center
Stream Temperature
Duluth Critters Can't Take the Heat

Temperature is one of the most important factors determining what lives in a stream. Warm streams support sunfish, bluegill, bass, and bullheads, and cold streams support trout species including our native Brook trout.

Brook trout need very cool water, cooler than most other trout species. They prefer temperatures between about 52°F (11°C) and 61°F (16°C), and can't live for long periods in water temperatures above about 70°F (21°C). The cooler water is needed for spawning and amphibian survival. Many of the streams in the Duluth area are cold water streams that support Brook trout; further south in Minnesota, streams are generally too warm for trout unless spring fed.

Warm water can also lead to oxygen problems, since warm water holds less gas than cold water when saturated (warm root bear goes flat). When flows are low and the water is warm in summer, relatively small amounts of extra decomposing organic matter can lead to low oxygen levels that stress fish.

Kingsbury Creek, Duluth, MN

This graph shows how often the temperature of Kingsbury Creek in the Duluth Zoo reaches unhealthy levels during the summer. For 15 straight days the temperature exceeded the optimal range for brookies, and on 10 days it exceeded their upper limit. We don't know how this really affects the fish. Perhaps they find cooler pools to get past those warm spells. Regardless, it's one additional chronic stress on top of sediment effects and other "insults" that result from how we treat the watershed.
APPENDIX 7. Example lesson developed for Washburn Edison Middle School Stream Elective science class. The context was that the class had been collecting stream invertebrate data in the spring plus limited chemical and physical data. *DuluthStreams* staff worked with the class to implement an intensive spring and fall monitoring program for transparency and EC25 in order to “capture” episodic stormwater and snowmelt runoff events. The data were also submitted to the *National Water Monitoring Day* website and the school now has joined the St. Louis RiverWatch program. These slides summarize class data for 2002-2003 and compare them to the automated sensor data set that is located <1 mile downstream.
Goal of DuluthStreams

Enhance public understanding of aquatic ecosystems and their connections to watershed land use to provide both economic and environmental sustainability

But with a focus on collecting and presenting real-time data

www.duluthstreams.org
Tischer Creek: Washburn Edison Middle School

- This slide show is adapted from slides used on 5/29/03 to introduce the website and discuss data collected by the 8th grade science class at Washburn Edison Middle School.
- It is viewable on-line via either the Netscape or Internet Explorer browsers and may be saved as a Powerpoint (.ppt) file for instructional use by educators.
- There are Notes attached to some of the slides that provide additional information.
- This slideshow will be incorporated into the Water-on-the-Web Curriculum (www.waterontheweb.org)
Tischer Creek: Washburn Edison Middle School

The first snowstorm of the season as seen by DuluthStreams.org from October 21-22, 2002

**Tischer Cr.**
**Chester Cr.**
**Kingsbury Cr.**

Higher chloride level = higher electrical conductivity

(Look for darker blue to magenta)
Drivers beware
Cold weather and a heavy dusting of snow Wednesday afternoon contributed to a rash of traffic accidents in and around the Twin Ports. Between 12:40 and 3 p.m., 65 accidents were reported in Duluth and 5 more in Superior, according to the Duluth and Superior police. The black ice conditions forced the temporary closure of several hilly roads in Duluth, including parts of Mesaba Avenue, until sand and salt trucks could... Source: Duluth News-Tribune (MN)
Duluth, MN – 2nd Snow November 13, 2002

Road Salt

Tischer Creek Stream Monitoring Unit Data
(Duluth International Airport precipitation data)

Chester Creek Stream Monitoring Unit Data
(Duluth International Airport precipitation data)

Kingsbury Creek Stream Monitoring Unit Data
(Duluth International Airport precipitation data)
Tischer Creek: Washburn Edison Middle School

Here’s your transparency tube data plotted against turbidity

<table>
<thead>
<tr>
<th>Turbidity (lab NTU)</th>
<th>Transparency (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.0</td>
<td>35</td>
</tr>
<tr>
<td>2.3</td>
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</tr>
<tr>
<td>135.2</td>
<td>7</td>
</tr>
<tr>
<td>29.2</td>
<td>10</td>
</tr>
<tr>
<td>6.1</td>
<td>100</td>
</tr>
<tr>
<td>1.8</td>
<td>120</td>
</tr>
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<td>1.2</td>
<td>120</td>
</tr>
<tr>
<td>1.3</td>
<td>103</td>
</tr>
</tbody>
</table>

Remember - a high transparency tube reading means turbidity is low and the water is clear
Here’s your transparency and turbidity data versus our automated sensors downstream

**MAY 19 – RAIN!**
- The creek “came up” (stage height increased)
- The water “clouded up” (turbidity increased)
- **Washburn transparency tube** – only 10 cm!

**MAY 20 – NO RAIN**
- The creek “came down” (stage height decreased)
- Water cleared (turbidity down)
- **Washburn transparency tube** – now 100 cm
And what happened to the salinity of the creek?

Not too much really

- There was an initial drop in EC25 as the creek “came up” (stage height increased)
- Dilution by rainwater
- Runoff into the stream must have been lower in salts or it would have increased
- Salinity soon leveled out
Stream Quality Assessment Index

Tally the number of major groups seen
(such as Caddisflies or clams)

Score by tolerance:
- I = Sensitive = 3 points
- II = Semi-sensitive = 2 points
- III = Tolerant = 1 point

Sum the points to characterize water quality:

- > 23 Excellent
- 17-22 Good
- 11-16 Fair
- < 10 Poor
Summary of Class Data – 7 groups

Mean Score: 21
GOOD
Range: 13-25
Median: 23
Mode: 23
Other *DuluthStreams* Data - Check out the GIS Utility

Map–based data: from a Geographic Information (GIS) System

You can zoom in and overlay streams, roads, land uses, etc.
Appendix 8. Regional Stormwater Protection created as an expansion of the *Duluth Streams* Partnership including *Memorandum of Understanding*

<table>
<thead>
<tr>
<th>Organization</th>
<th>Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>City of Duluth</td>
<td>(218)730-4130 <a href="mailto:mlonsdale@ci.duluth.mn.us">mlonsdale@ci.duluth.mn.us</a></td>
</tr>
<tr>
<td>City of Hermantown</td>
<td>(218)729-3600 <a href="mailto:llander@hermantownmn.com">llander@hermantownmn.com</a></td>
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<tr>
<td>City of Proctor</td>
<td>(218)624-3641 <a href="mailto:cityhall@ci.proctor.mn.us">cityhall@ci.proctor.mn.us</a></td>
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<tr>
<td>City of Superior</td>
<td>(218)394-0392 <a href="mailto:hancocks@ci.superior.wi.us">hancocks@ci.superior.wi.us</a></td>
</tr>
<tr>
<td>Duluth Township</td>
<td>(218)525-5705 <a href="mailto:jcook@ci.duluth.mn.us">jcook@ci.duluth.mn.us</a> or <a href="mailto:duluthwp@aol.com">duluthwp@aol.com</a></td>
</tr>
<tr>
<td>Facilities Management</td>
<td>University of Minnesota - Duluth (218)726-8261 <a href="mailto:crichar1@d.umn.edu">crichar1@d.umn.edu</a></td>
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<td>(218)878-8022 <a href="mailto:richardgitar@fdlrez.com">richardgitar@fdlrez.com</a></td>
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<tr>
<td>Lake County, Minnesota</td>
<td>(218)834-8321 <a href="mailto:dick.sigel@co.lake.mn.us">dick.sigel@co.lake.mn.us</a></td>
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<tr>
<td>Minnesota Department of Transportation</td>
<td>(218)723-4840 <a href="mailto:todd.campbell@dot.state.mn.us">todd.campbell@dot.state.mn.us</a></td>
</tr>
<tr>
<td>Minnesota Pollution Control Agency</td>
<td>(218)733-2358 <a href="mailto:chris.butler@pca.state.mn.us">chris.butler@pca.state.mn.us</a></td>
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<tr>
<td>Minnesota Sea Grant</td>
<td>University of Minnesota - Duluth (218)726-8106 <a href="mailto:chagley@umn.edu">chagley@umn.edu</a></td>
</tr>
<tr>
<td>Natural Resources Research Institute</td>
<td><em>Duluth Streams</em> group University of Minnesota-Duluth (218)720-4279</td>
</tr>
<tr>
<td>Nonpoint Education for Municipal Officials (NEMO)</td>
<td>Wisconsin Department of Natural Resources (715)392-7988 <a href="mailto:jerecj@dnr.state.wi.us">jerecj@dnr.state.wi.us</a></td>
</tr>
<tr>
<td>Northland NEMO at Minnesota Sea Grant</td>
<td>University Minnesota - Duluth (218)726-6182 <a href="mailto:jschombe@d.umn.edu">jschombe@d.umn.edu</a></td>
</tr>
<tr>
<td>St. Louis County</td>
<td>(218)625-3830 <a href="mailto:ulringj@co.st-louis.mn.us">ulringj@co.st-louis.mn.us</a></td>
</tr>
<tr>
<td>St. Louis River Citizens Action Committee</td>
<td>(218)733-9520 <a href="mailto:slrcac@stlouisriver.org">slrcac@stlouisriver.org</a></td>
</tr>
<tr>
<td>South St. Louis Co. Soil &amp; Water Conservation District</td>
<td>(218)723-4867 <a href="mailto:info@southstlouisswcd.org">info@southstlouisswcd.org</a></td>
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<tr>
<td>Western Lake Superior Sanitary District</td>
<td>(218)740-4806 <a href="mailto:joe.stepun@WLSSD.Duluth.MN.US">joe.stepun@WLSSD.Duluth.MN.US</a></td>
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MEMORANDUM OF UNDERSTANDING

to establish a
REGIONAL STORMWATER PROTECTION TEAM

A. INTRODUCTION
This Memorandum of Understanding (MOU) formalizes coordination of the Regional Stormwater Protection Team (RSPT), an information networking task force of agencies and jurisdictions including, but not limited to the signatory entities listed on page three.

The RSPT mission is to protect and enhance the region's shared water resources through stormwater pollution prevention by providing coordinated educational programs and technical assistance. Team members are committed to preventing and resolving issues of mutual concern for environmental protection on a regional watershed scale. This commitment is reinforced by policies internal to each agency. To sustain long-term commitment, the signatories agree to establish and implement the Interagency Stormwater Pollution Prevention Initiative described herein.

The goals of this initiative are to foster stormwater pollution prevention as the preferred environmental protection strategy within local and state agencies and to support and promote similar efforts within the private sector and at the community level. Benefits of working together include offering a focal point for pollution prevention, reducing expenses by sharing knowledge and resources, minimizing duplication of effort and increasing grant application success, all of which will help significantly enhance the protection of Lake Superior, the Duluth-Superior Harbor and all their tributaries.

In the spirit of these objectives, the agencies represented by the signatories on this document agree to maintain a cooperative working relationship to promote stormwater pollution prevention.

This MOU does not create enforceable legal obligations, but rather is an expression of intent by the signatories to work with one another as partners to reduce stormwater pollution.

Nothing in this agreement is intended, nor shall it act in any way to alter, impede, or interfere with the authorities and procedures of the agencies involved in carrying out their regulatory and law enforcement responsibilities or their individual missions.

B. PURPOSE
Through this document, the members of the Regional Stormwater Protection Team establish a common agenda to work together on pollution prevention objectives and specific goals in a cost effective and consistent manner. Successful implementation of this collaboration effort will help to:
1. Incorporate stormwater pollution prevention measures into local jurisdiction and agency programs and planning;
2. Avoid a piecemeal approach to stormwater pollution prevention and program development;
3. Share resources for stormwater pollution prevention projects;
4. Enhance efficiency in the delivery of prevention services;
5. Provide consistent regional environmental messages;
6. Improve communication and interrelationships between agencies and local jurisdictions;
7. Support existing agency missions and partnership agreements;
8. Reduce stormwater peak flows and pollutant loads within the Western Lake Superior Watershed.

C. AREAS OF AGREEMENT:
The signatories agree to promote stormwater pollution prevention and pursue issues of mutual concern. In particular, the parties will strive to:

1. Seek opportunities to collaborate on stormwater pollution prevention projects of mutual interest, to demonstrate pollution prevention technologies and techniques.
   a. Stage periodic environmental show and tell events,
   b. Develop educational materials and co-sponsor workshops focused toward specific audiences,
   c. Develop an information clearinghouse,
   d. Identify areas where policies conflict and may need to be revised to achieve goals,
   e. Develop collaborative grant proposals.

2. Share, exchange and learn stormwater pollution prevention technologies and techniques through periodic meetings and joint training programs.
   a. Share strategies and progress in implementation,
   b. Provide relevant technology updates,
   c. Participate in environmental roundtable discussions,
   d. Share innovative ideas.

3. Demonstrate watershed-wide environmental leadership in stormwater pollution prevention.
   a. Promote stormwater pollution prevention through press releases and other interpretive programs conducted by participating agencies,
   b. Enhance watershed-wide efforts to increase communications and education about the importance of stormwater pollution prevention.

4. Seek opportunities to eliminate or reduce stormwater pollution and encourage use of efficient pollution prevention technologies and techniques.
   a. Identify root causes of stormwater pollution and take steps to reduce or eliminate wastes through stormwater pollution prevention techniques,
   b. Identify and overcome barriers to adoption of stormwater pollution prevention practices,
c. Educate the general citizenry about stormwater pollution prevention through formal and informal education.

5. Cooperate in evaluating stormwater pollution prevention.
   a. Evaluate needs and goals of participating agencies,
   b. Determine what information is required to meet goals and needs,
   c. Measure progress in reducing stormwater pollution.

6. Develop and demonstrate environmentally benign and beneficial alternatives to current non-sustainable practices.

D. ORGANIZATION STRUCTURE (see Attachment A)
Each participant shall designate at least one contact to monitor pollution prevention coordination activities within their singular jurisdiction. These individuals shall provide input to the RSPT on the initiative. The RSPT will oversee the development and implementation of the interagency initiative to facilitate communication and coordination on stormwater pollution prevention.

The RSPT meets regularly. All ideas are encouraged and welcome. Appropriate projects, workgroup formations, and courses of action are determined by a consensus of the members.

E. CHANGES TO THE AGREEMENT:
Amendments or additional appendices may be developed and implemented by mutual written agreement of the signatories at any time without renegotiating the entire MOU. A party may also terminate its participation in this agreement after providing 30 days written notice to the other parties.

F. EFFECTIVE DATE OF AGREEMENT:
This agreement is effective April 1, 2004 and will remain in effect for all parties unless and until they choose to formally terminate.

G. SIGNATORIES

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<thead>
<tr>
<th>Name</th>
<th>City/Position</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herb Bergson, Mayor</td>
<td>City of Duluth</td>
<td></td>
</tr>
<tr>
<td>Richard Kieren, Mayor</td>
<td>City of Proctor</td>
<td></td>
</tr>
</tbody>
</table>
David Allen, City of Hermantown Date
Mayor

Dave Ross, City of Superior Date
Mayor

Marcus Hall, St. Louis County Date
Public Works Director

George Sundstrom, Duluth Township Date
Chairperson

Earl Elde, Midway Township Date
Chairperson

George Andrews, Rice Lake Township Date
Chairperson

Todd Campbell, MN Dept. of Transportation Date
District Hydraulics Engineer

Suzanne Hanson, Minnesota Pollution Control Agency Date
Duluth Manager

Sue O’Halloran, Lake Superior Research Institute Date
Water Quality Specialist University of WI, Superior

Greg Fox, University of MN-Duluth Date
Vice Chancellor Finance & Operations

R.C. Boheim, South St. Louis Soil and Water Date
Manager Conservation District

47
Kurt N.W. Soderberg, Western Lake Superior Sanitary Dist. Executive Director Date

Robert B. Peacock, Chairman Fond du Lac Reservation Business Committee Date

Carl Richards, Director University of MN Sea Grant Date

Lucinda Johnson, Associate Director Center for Water and the Environment Natural Resources Research Institute University of Minnesota-Duluth Date

Duane Lahti Wisconsin Department of Natural Resources Date

Lynelle Hanson St. Louis River Citizens Action Committee Date
Attachment A

BY-LAWS

Regional Stormwater Protection Team Operational Structure

The Regional Stormwater Protection Team shall work in the following areas:

I. Data collection and analysis
   A. Develop and maintain regional audiences’ mailing lists and list of groups, organizations and trade associations.
   B. Develop and maintain a measurement system that analysis and assays outreach and communication efforts.

II. Outreach
   A. Develop a joint stormwater pollution prevention message and share it with companies, organizations, associations and the general citizenry.
   B. Develop and maintain educational materials to achieve awareness and compliance on a cooperative basis from citizens and businesses.

III. Communication
   A. Meet monthly to discuss stormwater pollution prevention issues facing the region.
   B. Communicate status of local, regional, state or national activities.
   C. Communicate on the status of specific regulatory decisions to the extent such decisions affect development of a regional stormwater pollution prevention management system.
   D. Develop technical assistance roundtable discussion groups.
   E. Share information about current and planned written materials.
   F. Develop additional relationships with related groups and organizations.

IV. Organization
   A. Chairperson: This position will serve no less than 12 months and is responsible for organizing and leading meetings.
   B. Vice Chair: This position will serve no less than 12 months and will prepare to serve as chair for the following 12 months.
   C. Fiscal Agents: Fiscal Agents identified in each successful grant application will prepare and present periodic fiscal statements to the Team.
   D. Note taker: This position will serve on a monthly basis and is responsible for keeping and distributing meeting minutes.