Assessing Rain Garden Effectiveness

Brooke C. Asleson
Graduate Research Assistant
University of Minnesota

Water Resources Center
University of Minnesota

SAFL

Metropolitan Council

Minnesota Pollution Control Agency

University of Minnesota
Stormwater Management Practice Assessment Project

Stormwater Management Program

- Phase II stormwater program
  - Extended to small MS4s
  - March 10, 2003 over 200 MS4s applied for general permits in Minnesota
  - Permittees must **EVALUATE the EFFECTIVENESS** of storm water BMPs within 5 years => March 10, 2008

Stormwater BMP Protocol

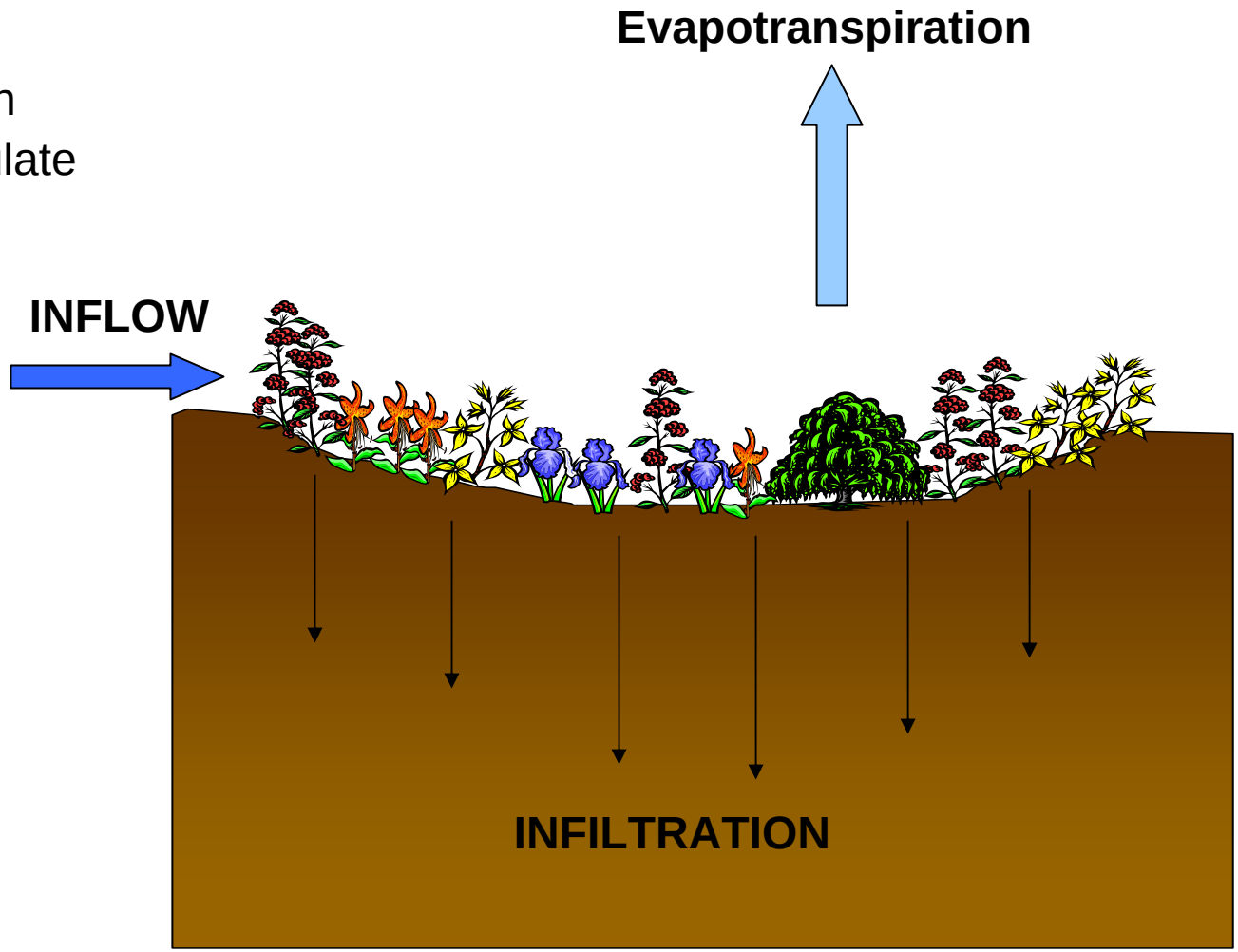
- Collaborative team at the University of Minnesota is creating a protocol to:
  - Establish dialog and collaboration on stormwater monitoring.
  - Develop assessment criteria and protocol.
  - Training and outreach for stormwater BMPs.
  - Introduce alternatives to monitoring.

Stormwater BMPs

- Five major categories:
  - Source Reduction
  - **Bioretention Systems**
  - Filtration Practices
  - Infiltration Practices
  - Sedimentation Practices
- Rain gardens under Bioretention systems

Rain Gardens as Stormwater BMPs

- Benefits
  - Natural infiltration
  - Sediment/particulate removal
  - N & P removal
  - Aesthetically pleasing



Vision of Rain Garden Assessment

- Two-person crew assesses rain gardens
- Follow standard protocol for field measurements
- Compile field data into standard worksheets
- Input data into model
- Run model for TMDL requirements

Four Level Assessment Process

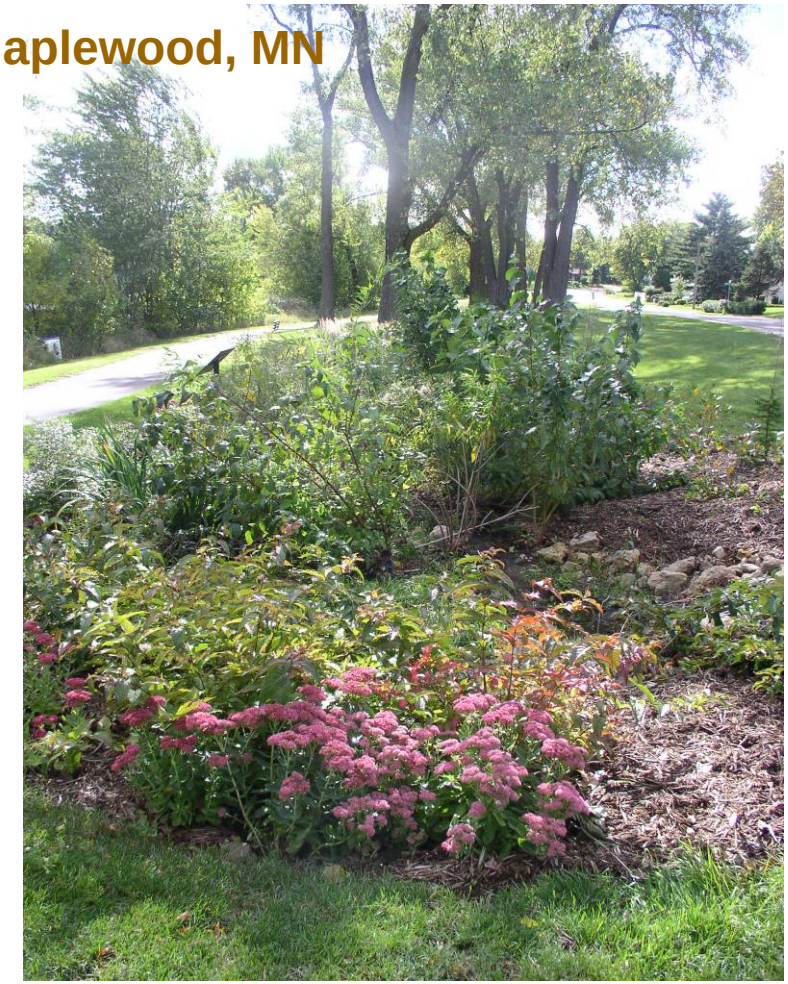
- Proposed 4 levels of assessment include:
  - 1. Visual evaluation
  - 2. Field measurements of soil properties
  - 3. Simulated runoff test
  - 4. Monitoring

Impact Of Alternative Stormwater Management Practices On Adjacent Highway Infrastructure, Appendix F, 2005.

Level 1 – Visual Evaluation

Functioning rain garden

Maplewood, MN

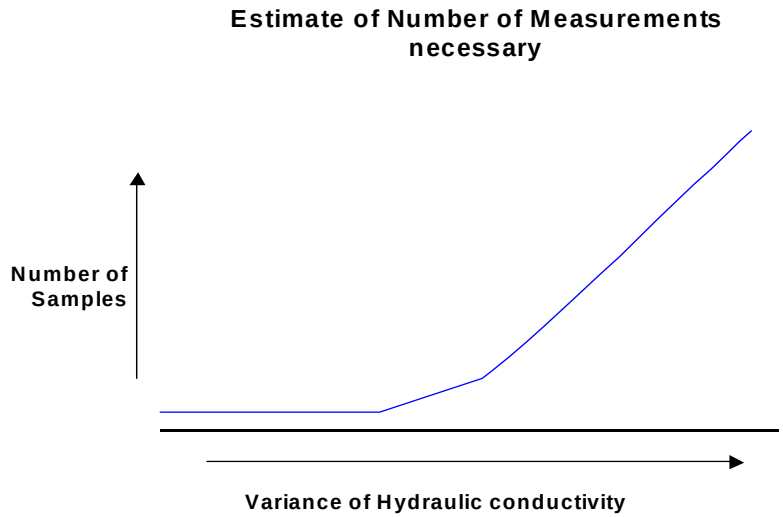


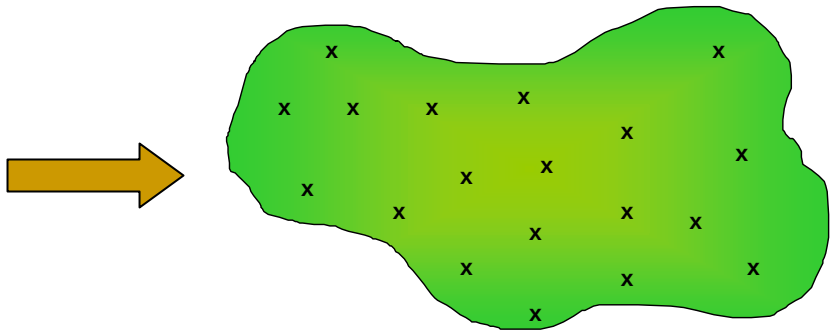
Non-functioning rain garden

Maplewood, MN

Level 2 – Field Measurements

- Select appropriate devices
- Estimate number of measurements





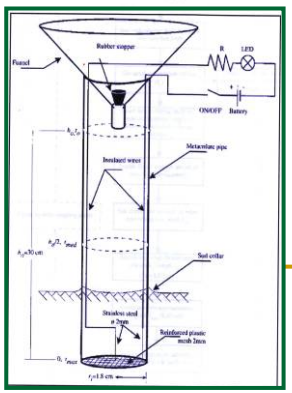
- Measure soil parameters
- Compute infiltration rates

Level 2 – Field Measurement Devices

Mini-disk Infiltrometer – Decagon Devices, http://www.decagon.com/instruments/infilt.html

Guelph Permeameter – Guelph permeameter manual, Soilmoisture Equipment Corp

Tension Infiltrometer - Photo from Sam Johnson, Graduate Student, University of Minnesota



Philip-Dunne Permeameter - Munoz-Carpena, et al., Soil Science. Vol 167(1), January 2002.

Double-Ring Infiltrometer - Thompson Lake rain garden, West St. Paul

Level 2 – Field Measurement Device Comparison

CRITERIA	Philip-Dunne Permeameter	Guelph Permeameter	Tension Infiltrometer
Transportability of equipment	1	2	3
Volume of water needed	1	2	3
Experiment duration	1	2	2
Simplicity of operation	1	2	3
Cost	1	2	3
Personnel requirements	1	2	2
Accuracy	?	?	?

Criteria evaluation: 1 = most desired, 2 = second-most desired, 3 = least desired

Johnson, S.M. 2006. Evaluation of the Philip-Dunne Permeameter in determination of the effectiveness of alternative storm water practices. University of Minnesota.

Level 2 – Field Measurement Devices

- Laboratory verification:
  - Measure hydraulic conductivity using the same porous media.
  - Verify measurements with actual hydraulic conductivity of the media.
  - Compare actual hydraulic conductivity to the measurements made with devices.

Level 3 – Simulated Runoff Test

- Required water volume
- Soil moisture
- Flow measurements
- Verification for field methods

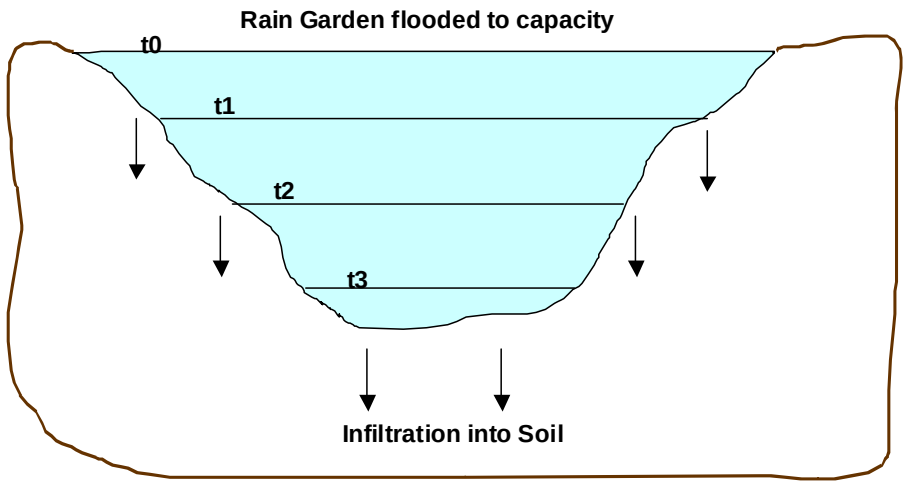


Photo: Matt Wilson, University of Minnesota, SAFL.

Level 4 - Monitoring

- Need preliminary measurements
- Set up monitoring stations
- Wait for precipitation
- Measure inflow and outflow discharge and constituents
- Analyze performance

University of Minnesota Arboretum rain gardens, USGS monitoring equipment

Watershed Modeling

Soil-water Properties

+

Rainfall/Runoff Data

- Input parameters measured in the field to simulate watershed characteristics
- Run storms through computer model
- Analyze for TMDL requirements
- Compare results with and without stormwater BMP to show reduction in TMDL

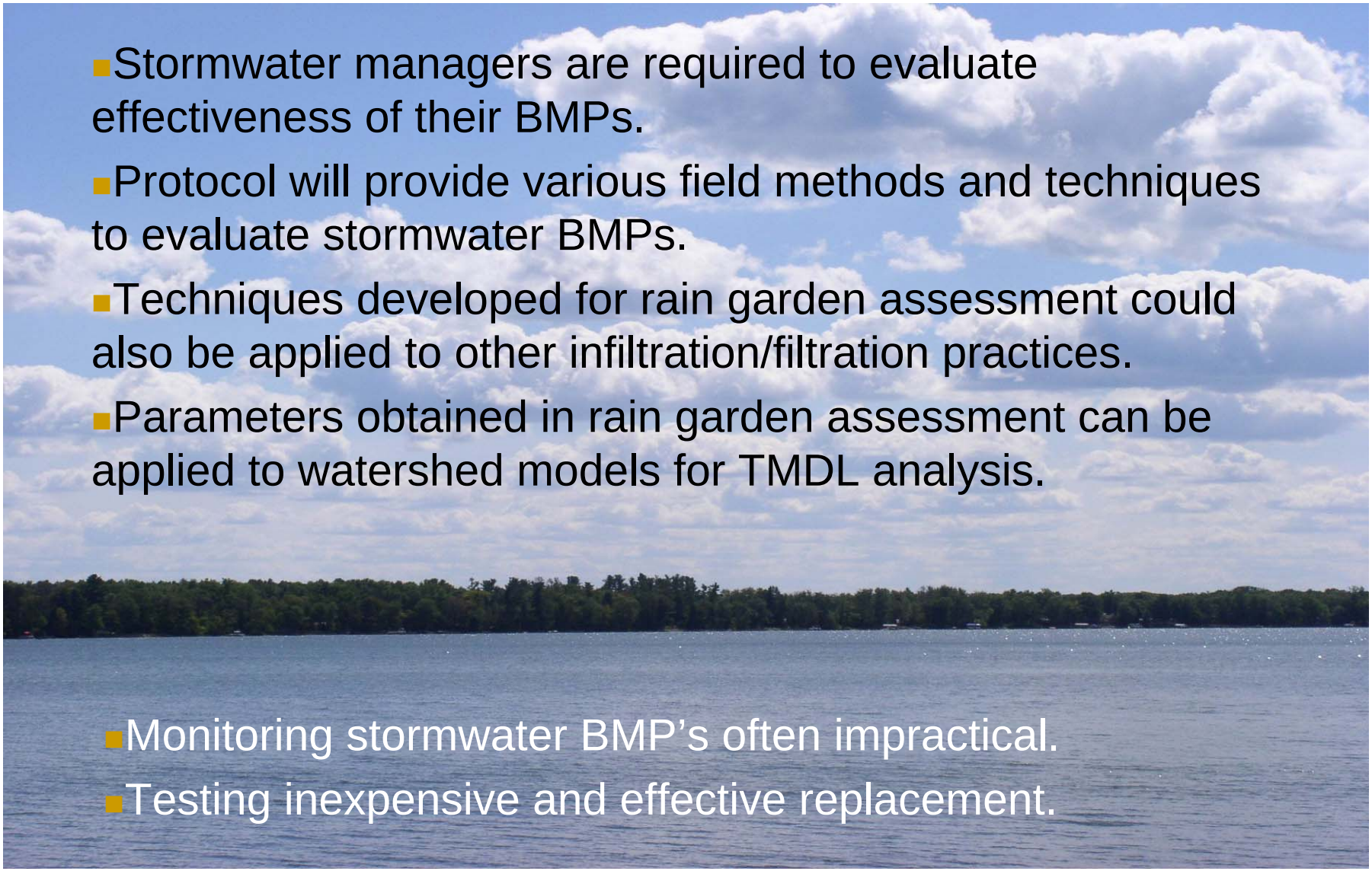
Simulated Runoff Testing vs. Monitoring

- Simulated Runoff Testing
  - Not dependent on rain events
  - Reproducibility
  - Initial pollutant concentration known
  - Inexpensive

- Monitoring
  - Water volume and location constraints
  - Actual runoff
  - Assumptions about pollutants
  - Security issues

SS Smith Samplers and data logger, Brad Hansen, BAE, University of Minnesota

Conclusion



- Stormwater managers are required to evaluate effectiveness of their BMPs.
- Protocol will provide various field methods and techniques to evaluate stormwater BMPs.
- Techniques developed for rain garden assessment could also be applied to other infiltration/filtration practices.
- Parameters obtained in rain garden assessment can be applied to watershed models for TMDL analysis.

- Monitoring stormwater BMP's often impractical.
- Testing inexpensive and effective replacement.

Acknowledgements

- Co-authors: Dr. John S. Gulliver, Dr. Raymond Hozalski, Dr. John Nieber and Sam Johnson
- Sponsors: Metropolitan Council Environmental Services and the Minnesota Pollution Control Agency

Metropolitan Council

Minnesota Pollution Control Agency

Thank You!!

Comments/Questions?