Stormwater U Education Program:
Stormwater BMP Introduction

Master Water Steward

Stormwater 101

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Water Resources Team

DATE
Place

UNIVERSITY OF MINNESOTA
EXTENSION

Course Information--*Draft*

- Course Title: Stormwater 101
- Course instructor: Shahram Missaghi; miss0035@umn.edu
- Course Objectives:
  - To understand the connection between clean water and stormwater—The Big Picture
  - Learn about the potential harmful environmental impact of excessive stormwater runoff—The problem excessive runoff causes, and
  - Learn about ways to minimize the harmful environmental impact of stormwater runoff—The solutions

Tonight's Agenda:

Time	Topic
6:00 pm	**Introductions, review, readings**
6:20 pm	**The big picture** Assignment # 1 (~ 10 min)
6:30 pm	**The problem** Assignment # 2 (~10 min)
6:50 pm	**Break**
7:00 pm	**Solutions** Assignment # 3 (~15 min)
8:00 pm	**Break**
8:10 pm	**There are no silver bullets**
8:11 pm	**Our home site** Assignment # 4 (~10 min)
8:45 pm	**Q & A**

Water Resources

http://www.extension.umn.edu/environment/water/

The University of Minnesota Extension Water Resource team's mission is to make a difference by connecting community needs and University resources to address Minnesota's critical water resource issues by providing and modeling effective education to ensure safe and sustainable water resources.

- About the Water Resources program
- Water Resources team

Search Water Resources:

Go

Subscribe to From Shore to Shore newsletter

Past issue archive

Watershed education program

Educating to increase stakeholders' knowledge in local water resource planning, protection, and improvement, and providing input to meet clean water goals

NEMO program

Teaching community leaders about water resources, the impacts from land use and land management, and strategies for protection and restoration

Stormwater education program

Developing and delivering training to stormwater professionals and staff

Shoreland education program

Offering education and training to promote good land use practices on shorelines to protect and improve water quality

State of Water Conference 2014

Links to materials

What is a watershed?

Actions on the land, impacts in the water

The Watershed Game

Understand the connection between land use and water quality

Better living on our lakes and rivers

Nine short videos for lake or river shoreline property owners

Calendar of events

- Dark green— stormwater education for resid and community member
- Red—stormwater education for professionals
- Lime green— NEMO education for elected a appointed officials and community leaders
- Blue— watershed education program events

Today

Showing events after 1/18.
Look for earlier events

Showing events until 2/15.
Look for more

Google Calen

Stormwater Education Program

The University of Minnesota Stormwater Education Program works with stormwater professionals and communities through research-based, locally-tailored workshops. With green infrastructure concepts, we minimize the impact of our developments by mimicking natural hydrology.

- About the Stormwater Education Program
- Stormwater Education Program team

Stormwater U

Stormwater management practice education for professionals: contractors, developers, engineers, and field staff. Learn more about Stormwater U here.

Soil infiltration video, ed. 4

This video demonstrates the use of the MPD infiltrometer and the use of a spreadsheet that translates the MPD data into a soil hydraulic conductivity and suction head.

Soil compaction field day videos

These videos demonstrate different management techniques to help take control of soil compaction.

Stormwater training opportunities around Minnesota

Stormwater workshops sponsored by the University of Minnesota and our water resource partners around the state.

Minnesota Water Resources Modeling Group

Documentation, forums, and references for water resource modeling professionals.

Winter maintenance for small sites training video

These short videos are excellent resources to educate people on best ways to handle winter maintenance for small sites.

Stormwater pond management video

Pond Sediment Excavation Best Practices to protect water quality in the

Stormwater Education Program home

NEMO

Stormwater U

About the Stormwater Education Program

Stormwater Education Program team

Stormwater U

Print an info sheet (353 KB PDF)

Our main goal is to promote environmentally sound Water Resources Management and Policy best practices among stormwater professionals: contractors, developers, engineers, and field staff through locally tailored workshops currently known as Stormwater U. More about Stormwater U.

Past workshops

July 30–31, 2014
Stormwater Practices Maintenance and Certification

June 26, 2014
An introduction to stormwater practices maintenance

May 28, 2014
An introduction to stormwater practices maintenance

April 1, 2014
Innovation in BMPs

Nov. 12 & 26, 2013
A pilot workshop: Planning to Reduce Nutrient Loading through Street Sweeping

- End of Introduction

- Start of Hydrology 101 review

1st things 1st: Reading Assignment

Examples of:

- **Flooding event**: where did it happen and what was the damage?
- **Impacted water quality** (ground water, lakes, streams, wetlands,…)
- **Rain**

REVIEW: Hydrology 101

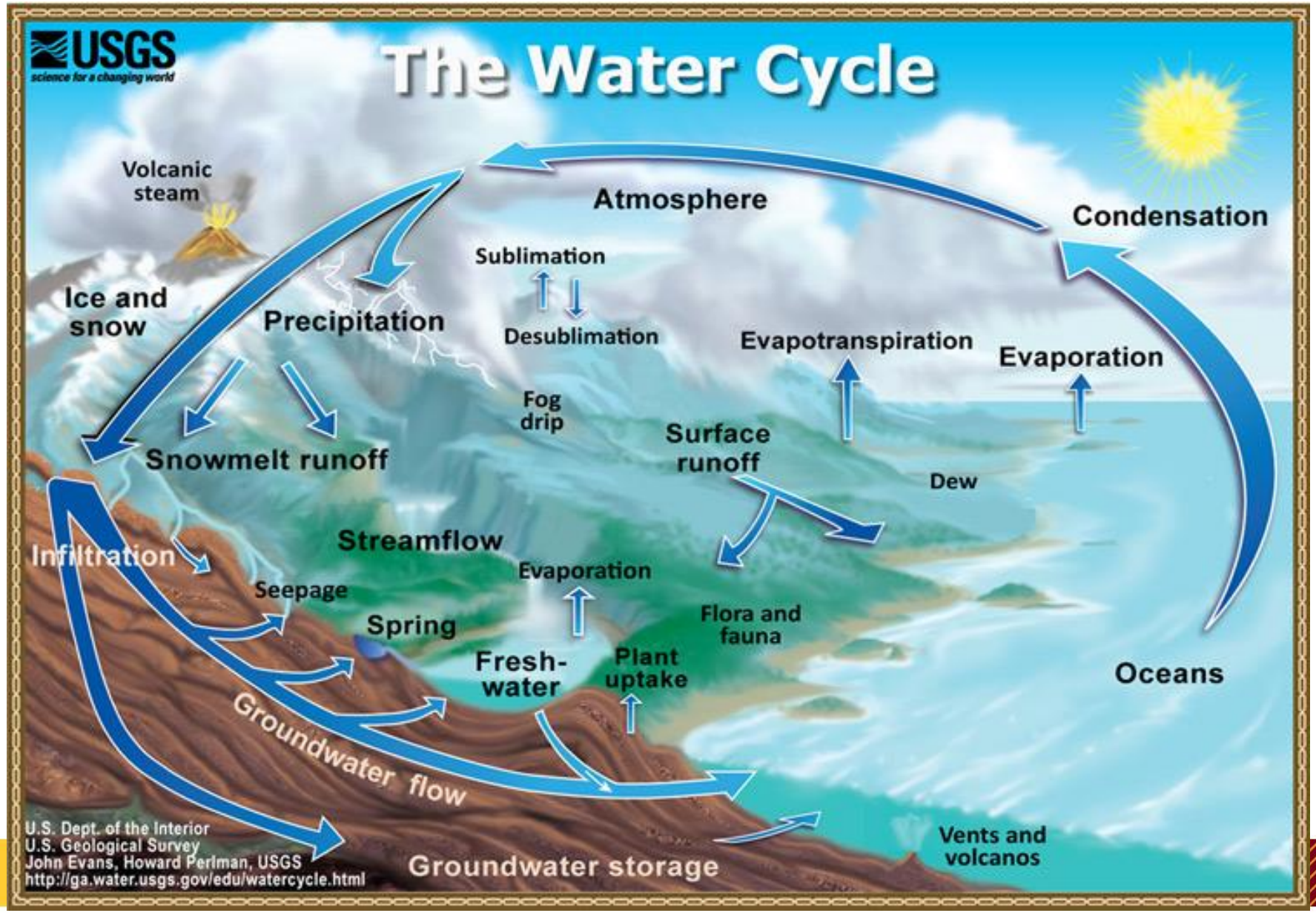
Objective 1: Understand how rainfall, runoff, and the movement of water are described, calculated, and measured.

Objective 2: Understand the factors that influence how water moves.

Objective 3: Understand how water shapes the land and our water resources.

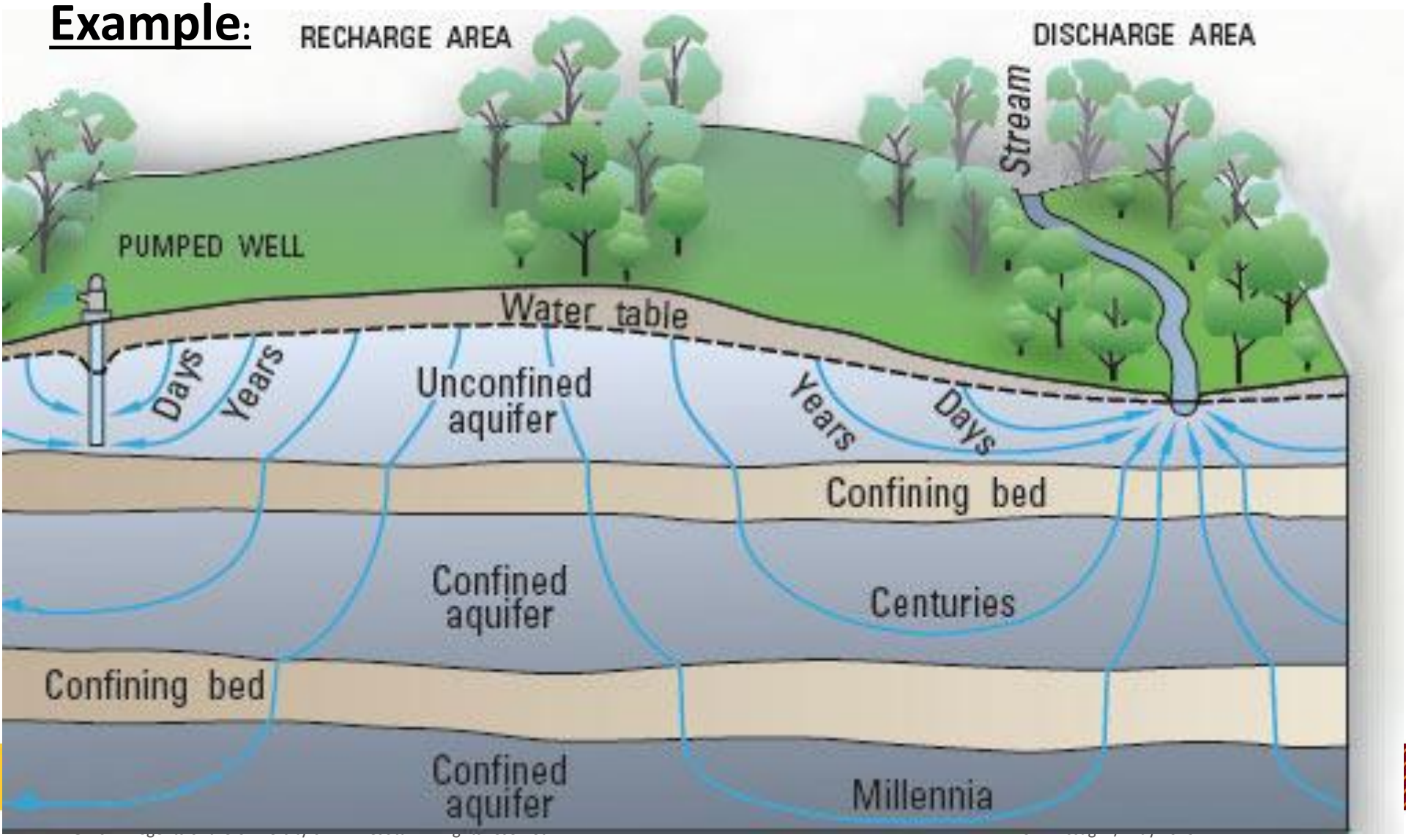
Objective 4: Understand how precipitation patterns are changing and how that may impact our water resources.

Obj. 1—Movement of Water



Obj. 2—How Water Moves [Note Length of Times]

Example:

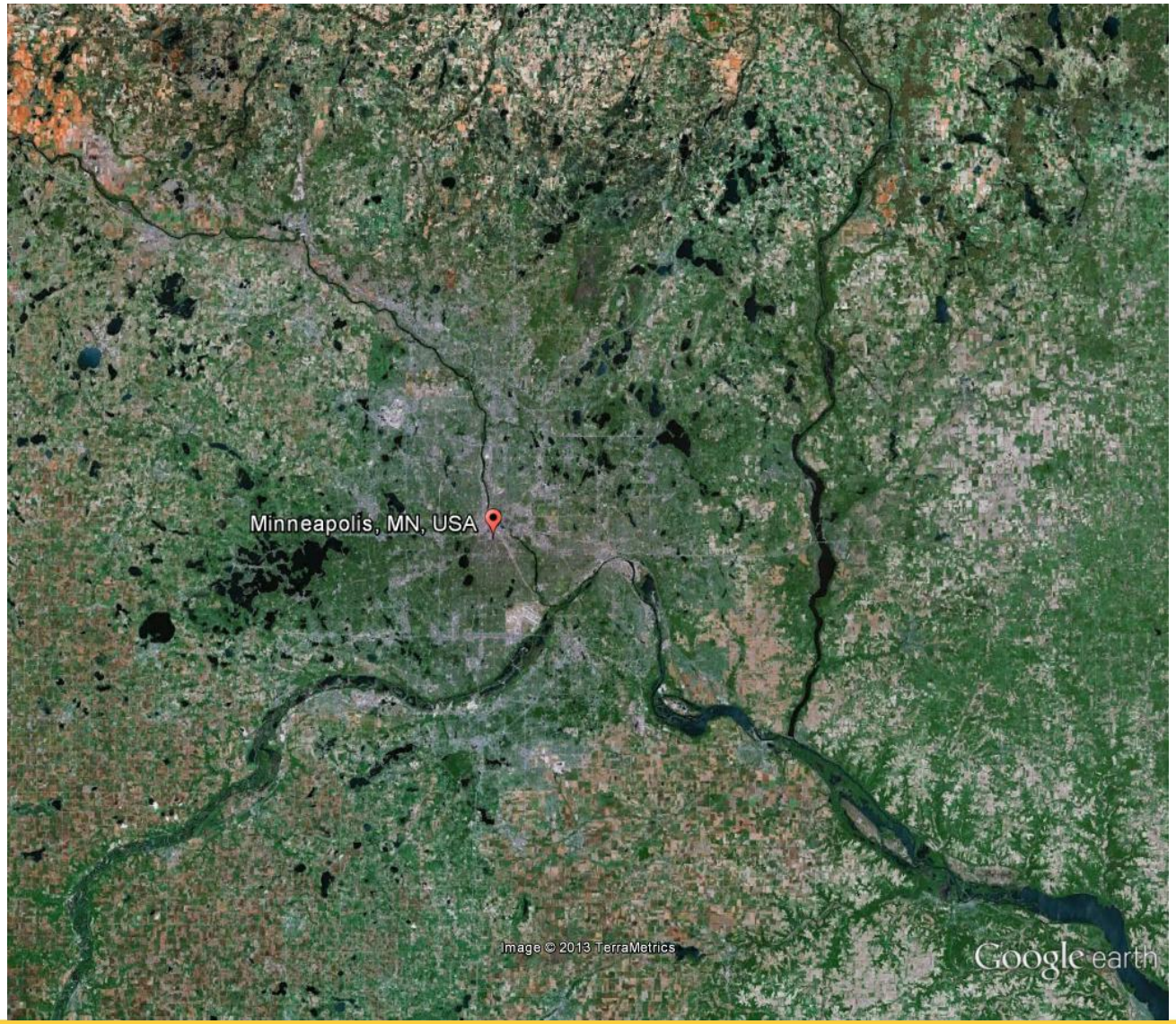


OBJ. 3—Water Shapes the Land

Vertical

OBJ. 3—Water Shapes the Land

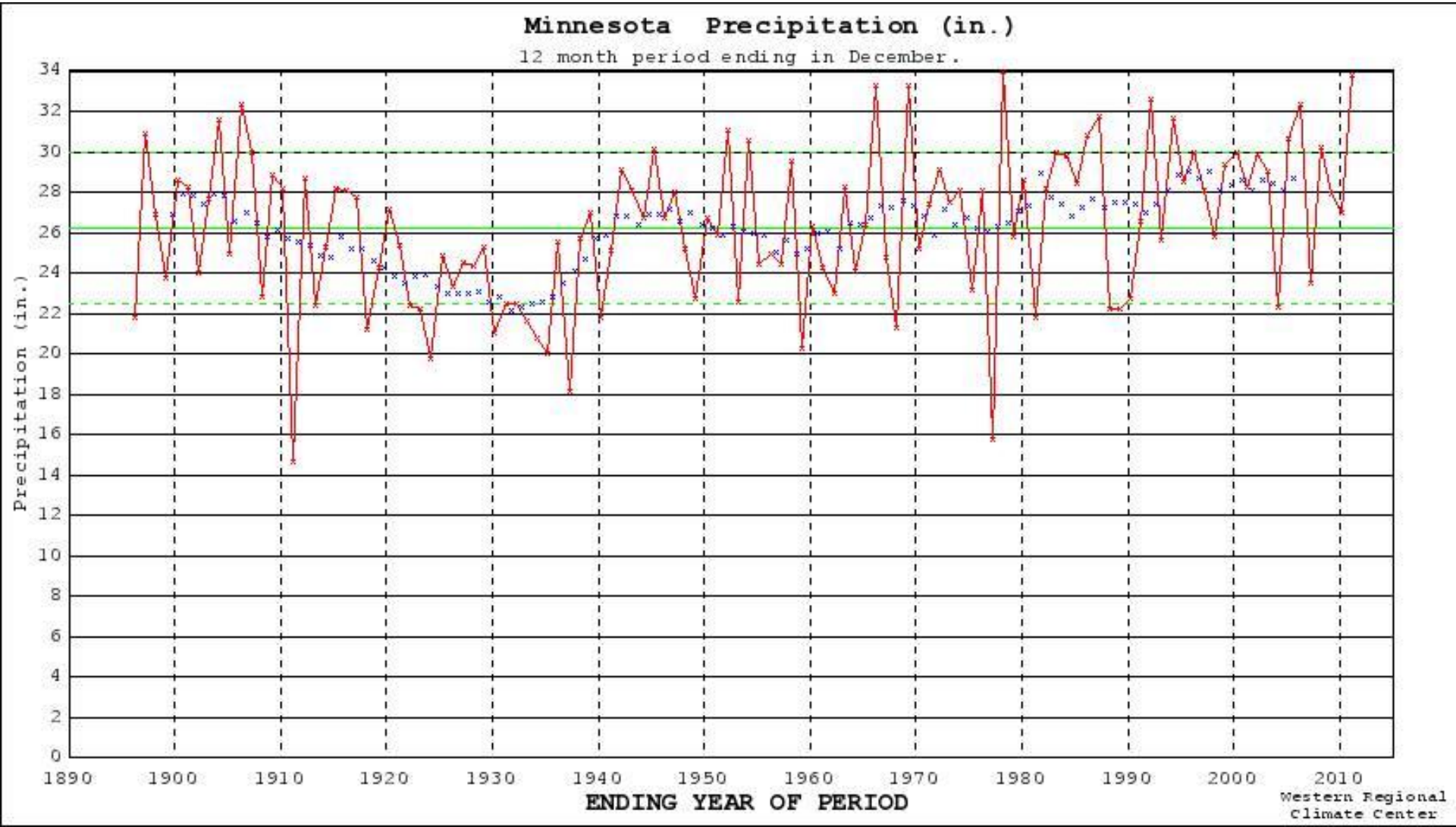
Surface



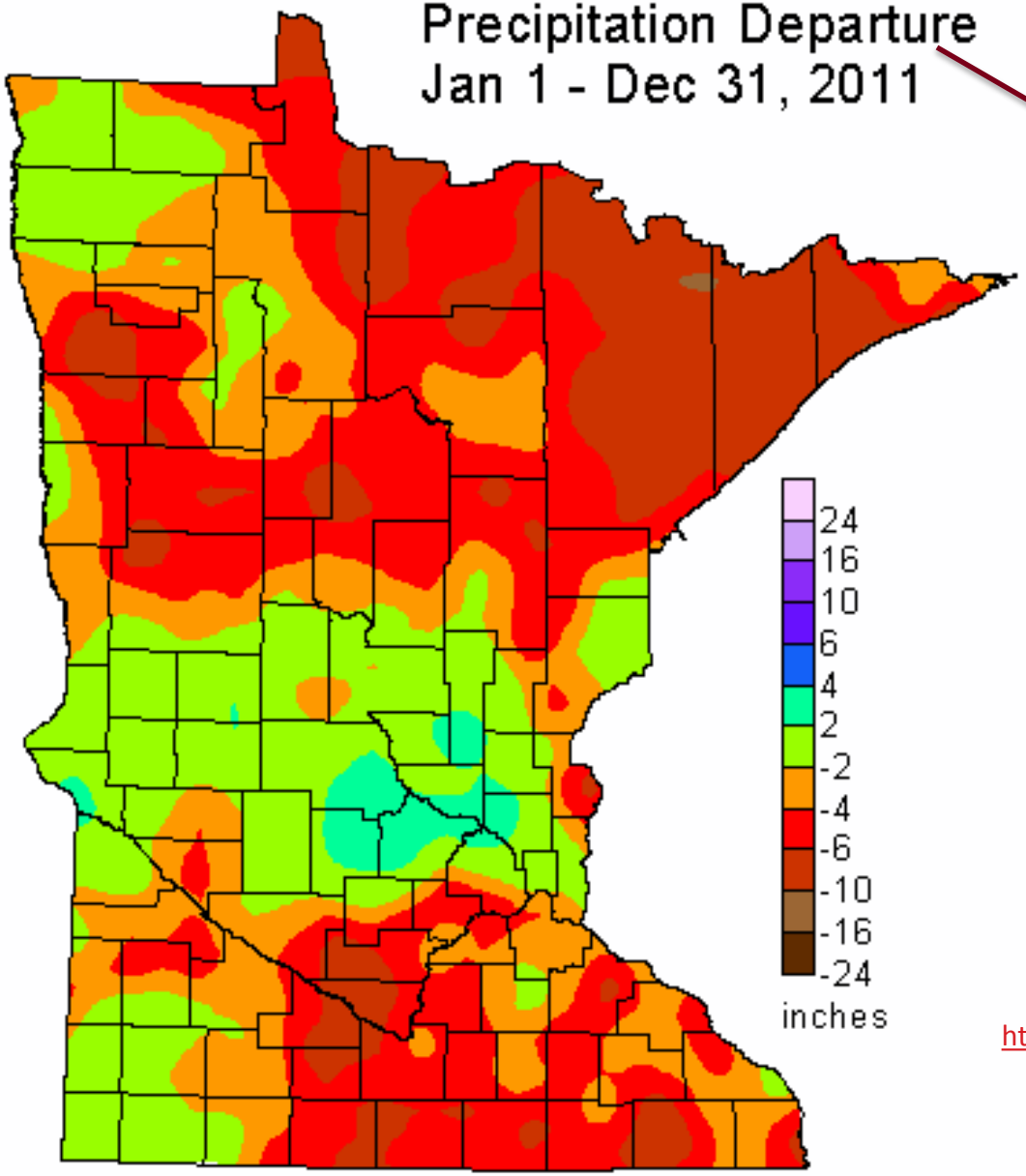
OBJ. 4—Precipitation Patterns

The quantity and character of precipitation is changing

Annual Changes



OBJ. 4—Precipitation Patterns



Spatial & Temporal Changes

Departure from Normal

http://climate.umn.edu/img/annual/p2011dept.gif

REVIEW: Hydrology 101

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Objective 3: Understand how water shapes the land and our water resources.

Objective 4: Understand how precipitation patterns are changing and how that may impact our water resources.

Take Away→ Water = Energy = Action

TIME SO FAR ~ 15 MIN.

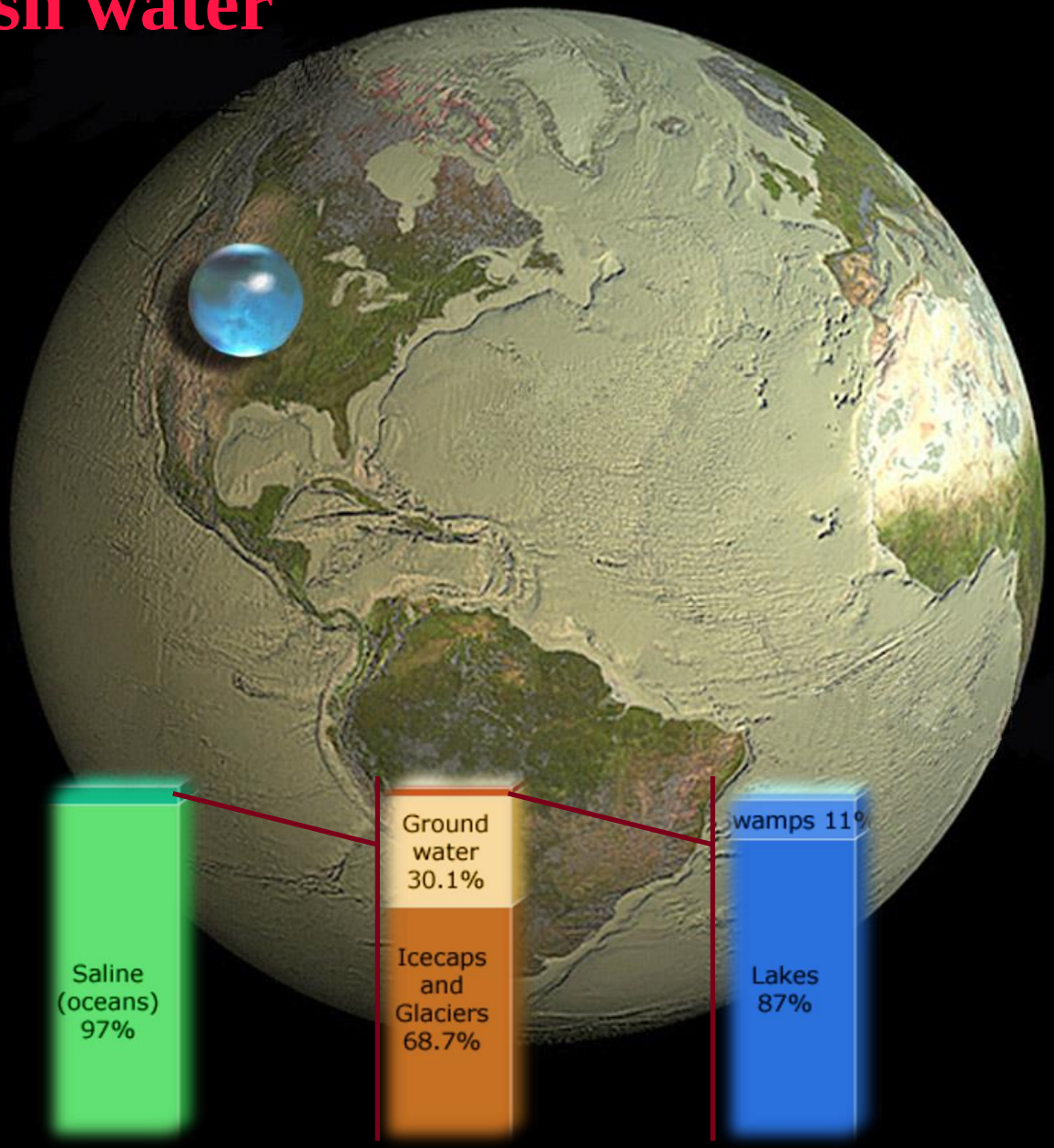
- End of Hydrology 101 review
- Start of Stormwater 101

STORMWATER 101

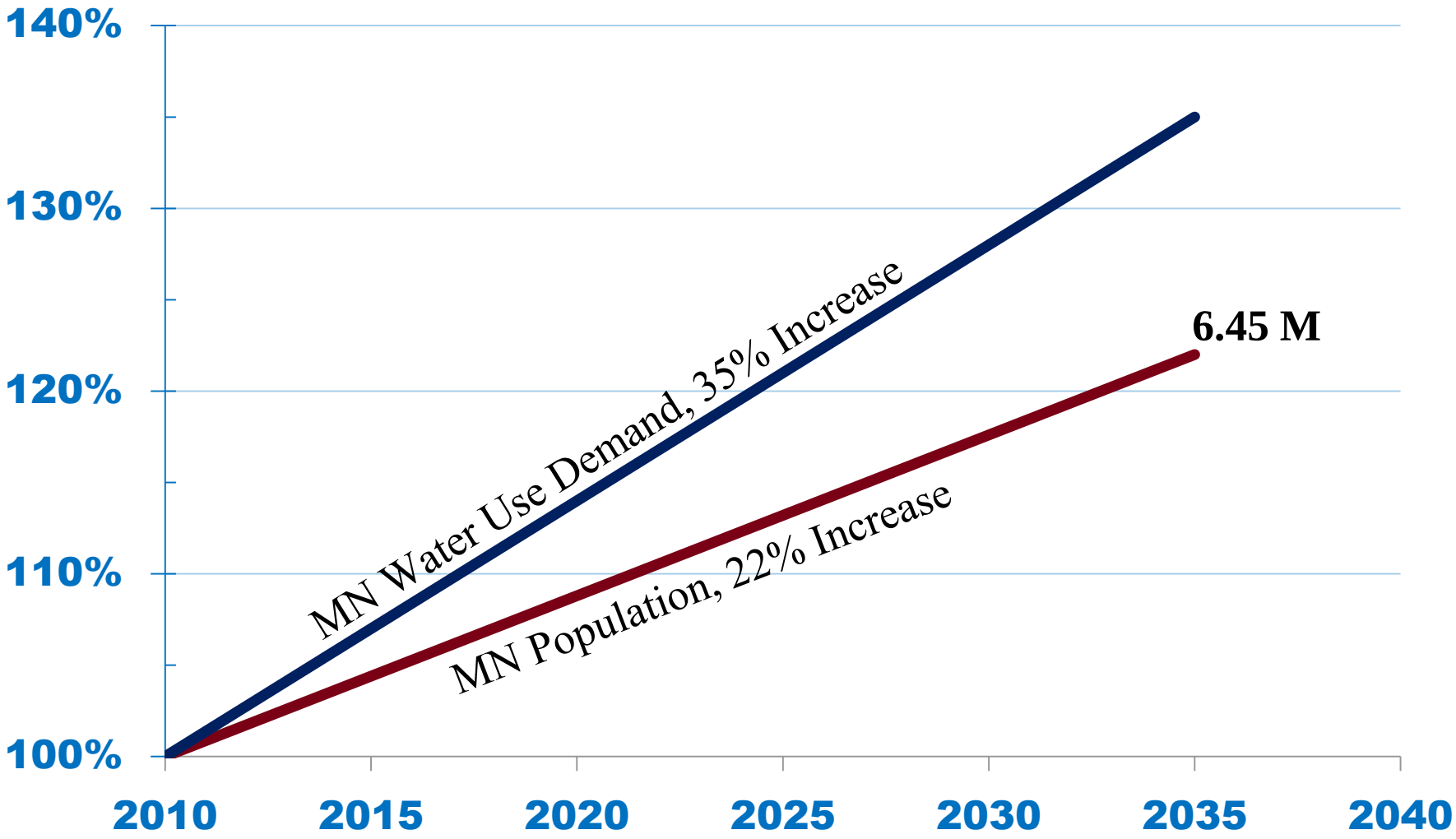
6:15 Chapter One **The big picture ?**	•**The big picture & issues facing our finite fresh water resources:** *1) aging ecosystem, 2) increasing demand, and 3) a changing climate*
Chapter Two **The Problem**	• **What does Stormwater have to do with it?** *Both the natural drainage systems and the constructed ones are susceptible to excessive runoff.*
Chapter Three **Solutions**	• **the feature, function, and the benefits of stormwater BMPs** *and how they fit into the whole system (watershed*
Chapter Four **Plan & Our Home Site**	• **there are no silver bullets** *but a series of BMPs in protecting our water* • **a system within the system**

The Big Picture

finite fresh water

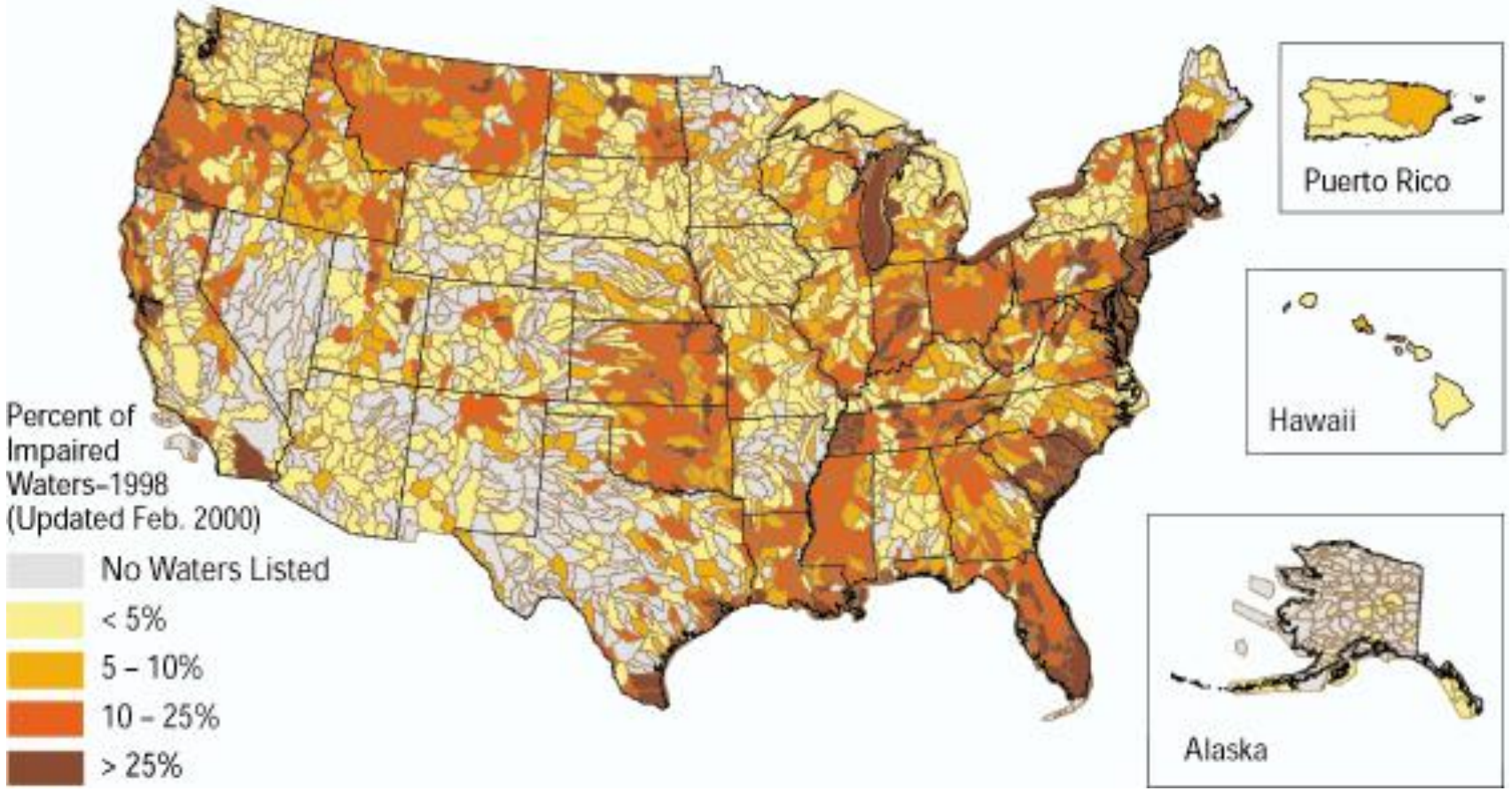


Finite Fresh Water-Demand

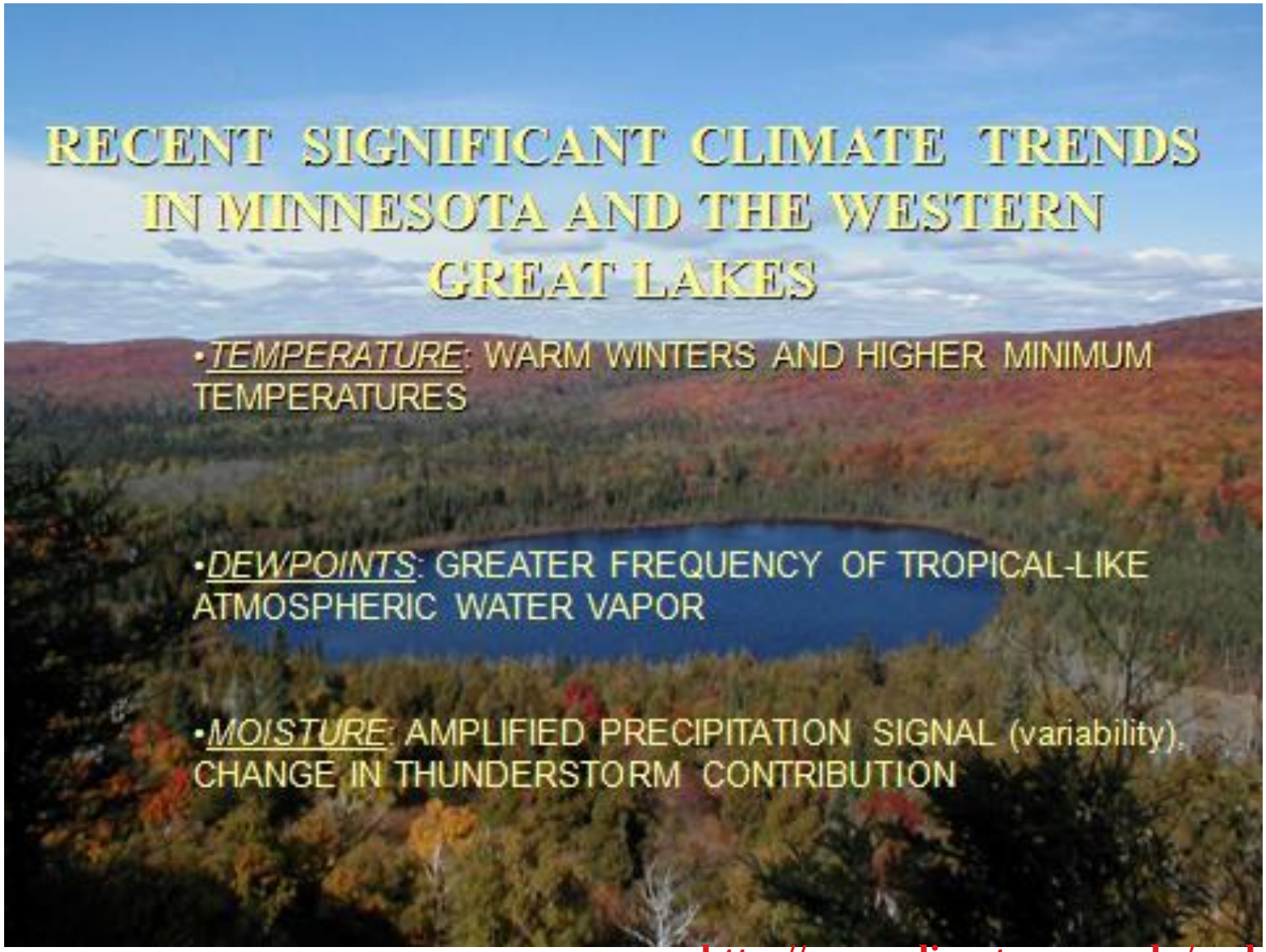


Finite Fresh Water-Eutrophication

Watersheds containing impaired water bodies. (the U.S. Environmental Protection Agency's 1998 list of impaired water, USEPA, 2000).

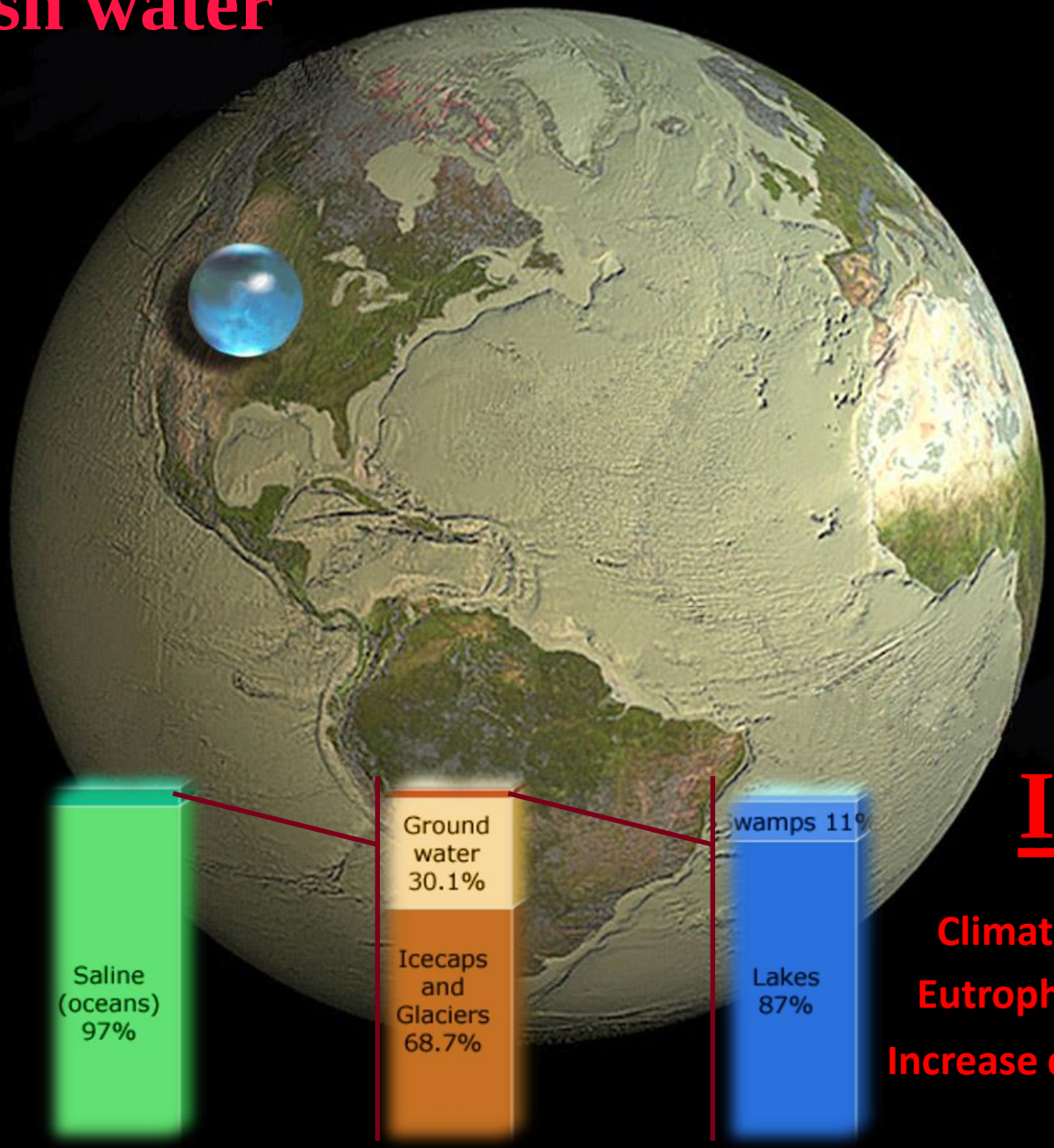


Finite Fresh Water-A Changing Climate



Seely, M. (2011), Climate Change in Minnesota: Current Trends and Projections, http://www.climate.umn.edu/seeley/

finite fresh water



Issues:

Climate change

Eutrophication

Increase demand

Stormwater 101: Chapter One-Take Away

protect and manage

Clean Water

Stormwater 101–Assignment # 1 (Individual)

- write your own answers to the question of: **<u>what are the issues facing our finite fresh water resources?</u>**

- **How would you summarize in your own words (interpretations)?**
- **How would you prioritize?**

The answer should incorporate some of the research articles /30-50 words and completed in < 10 minutes

STORMWATER 101

Chapter One **The big picture ?**	•**The big picture & issues facing our finite fresh water resources:** *1) aging ecosystem,* *2) increasing demand, and* *3) a changing climate*
6:30 Chapter Two **The Problem**	• **What does Stormwater have to do with it?** *Both the natural drainage systems and the constructed ones are susceptible to excessive runoff.*
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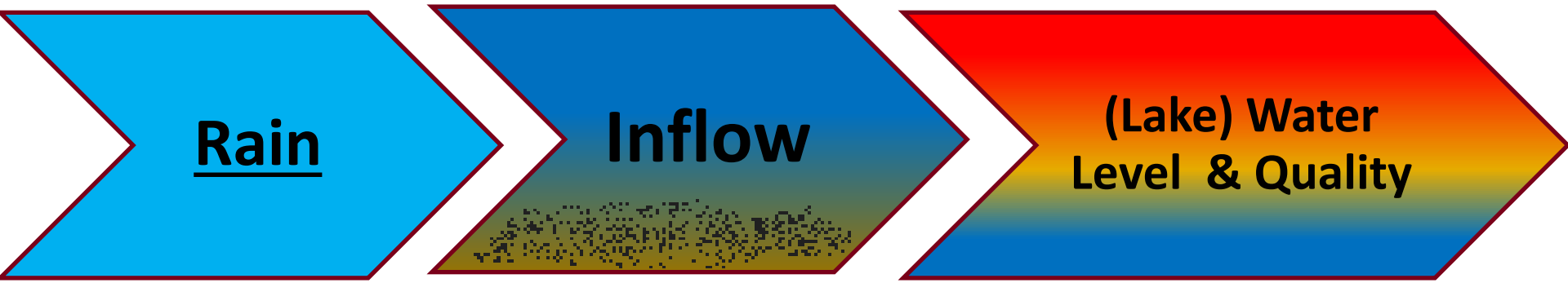
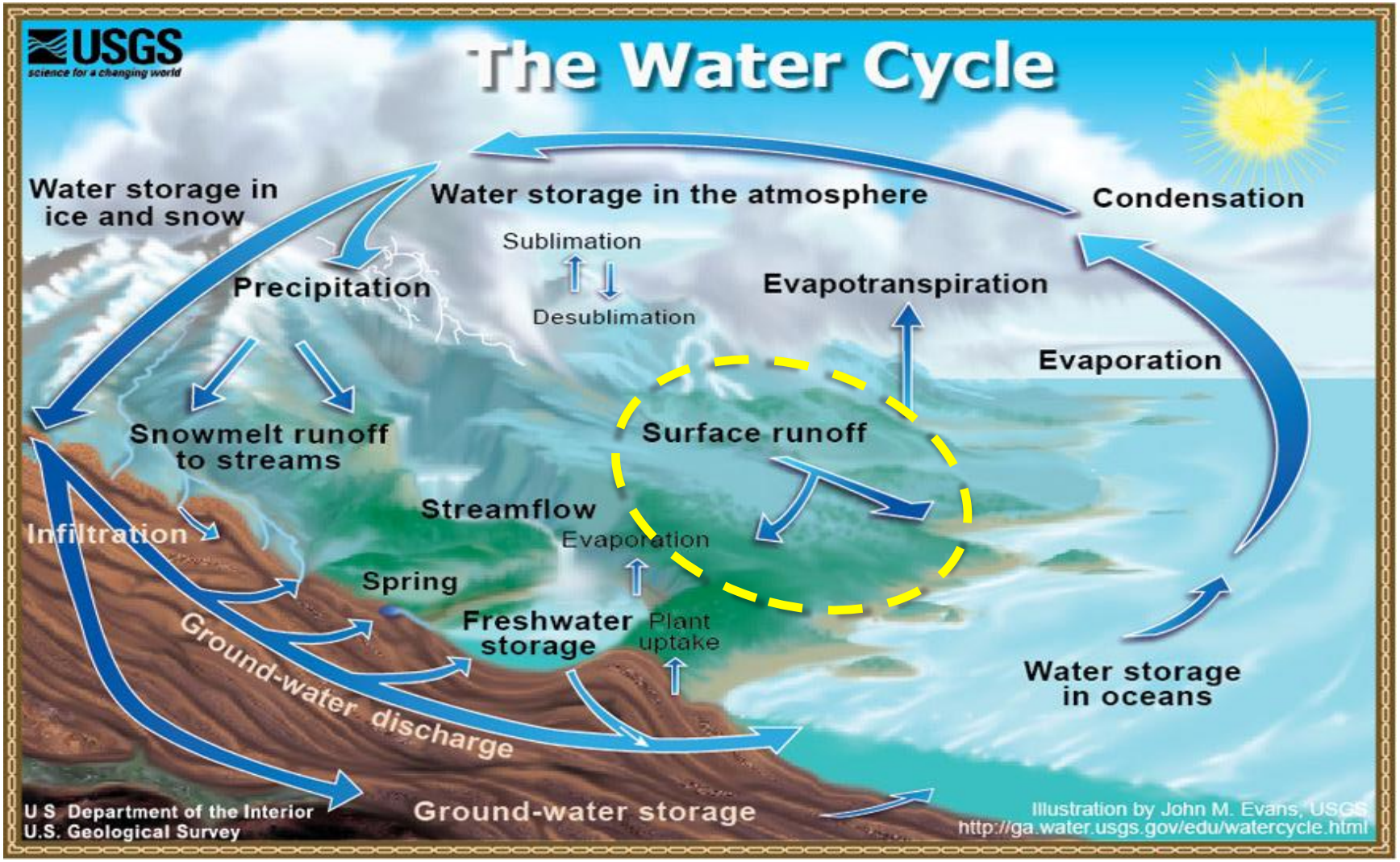
From Rainfall (volume & patterns) to Stream flow, and (Lake) Water Quality

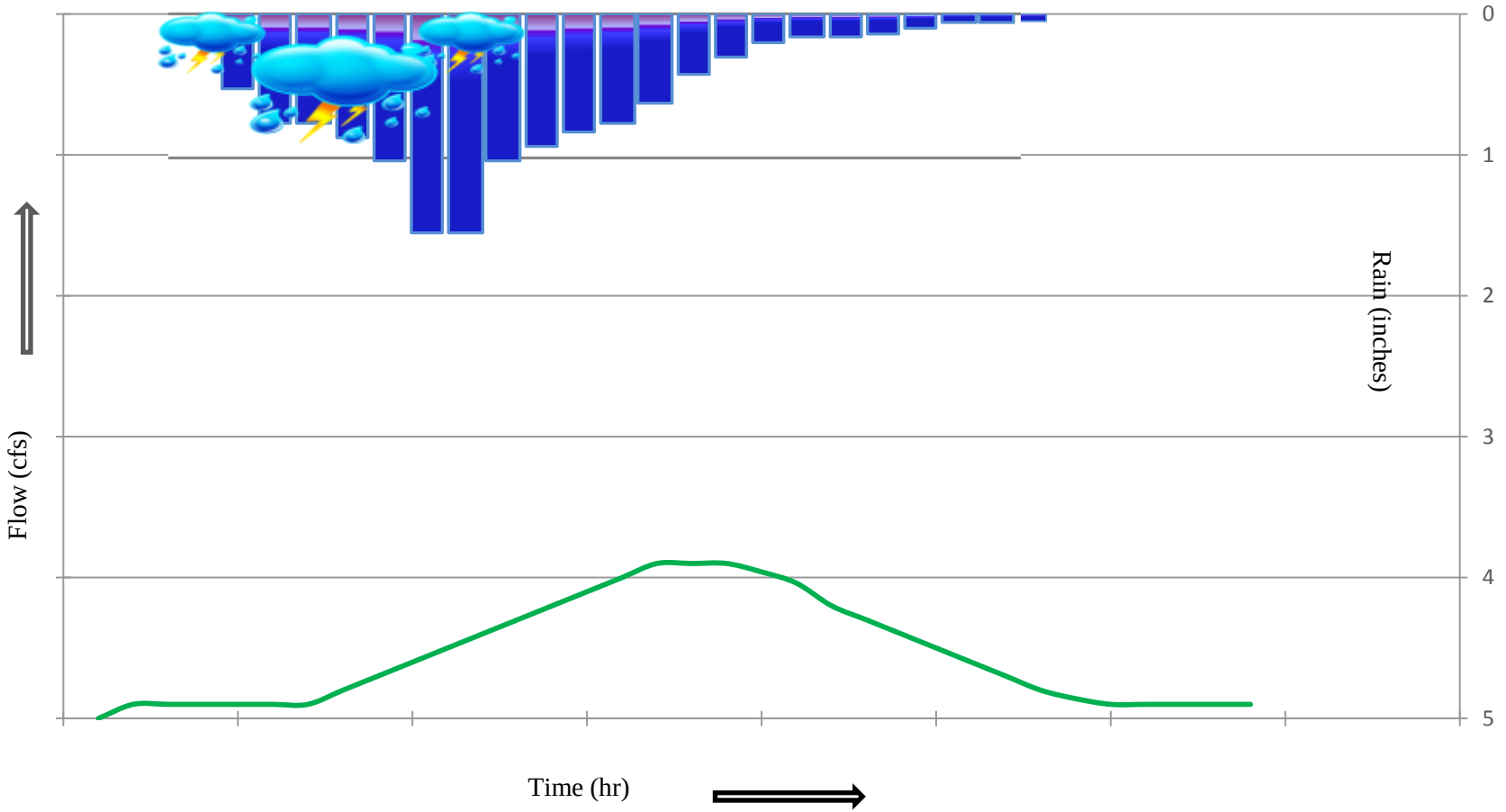


Stormwater 101: Chapter Two—The Water Cycle

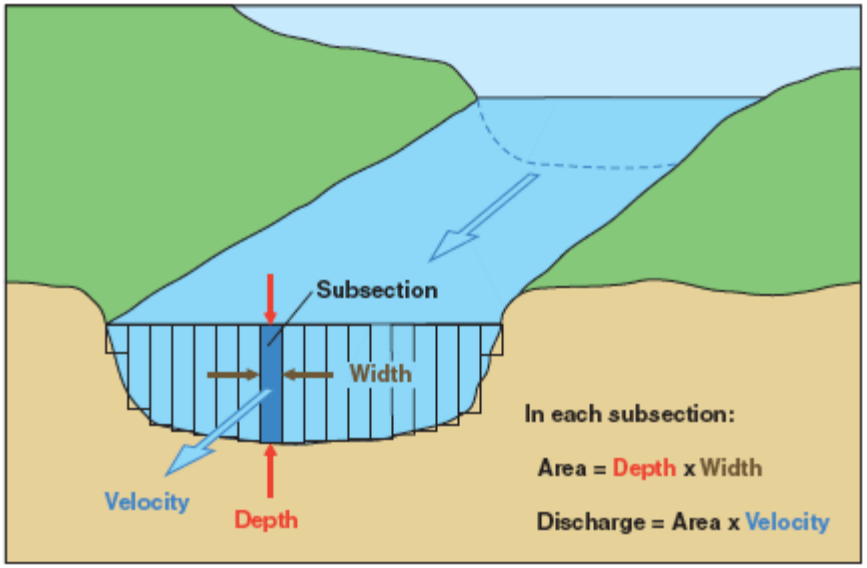


Rain

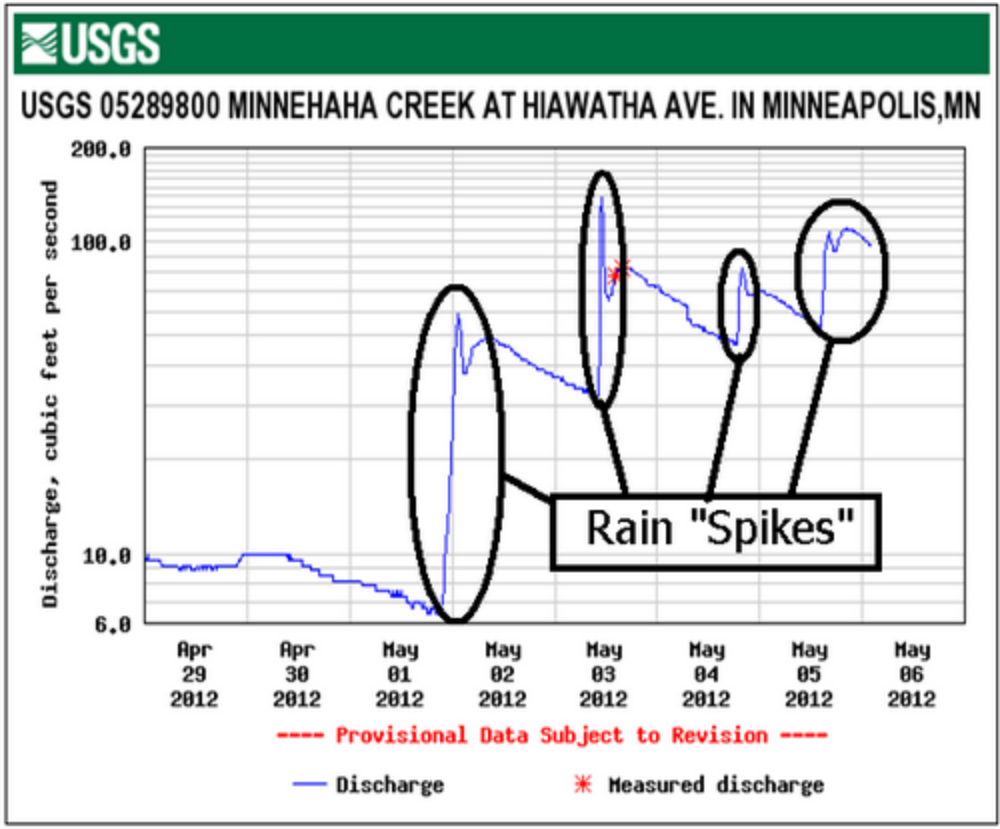
Streams



Water Measurement-Streams ~ Runoff



Current-meter discharge measurements are made by determining the discharge in each subsection of a channel cross section and summing the subsection discharges to obtain a total discharge.

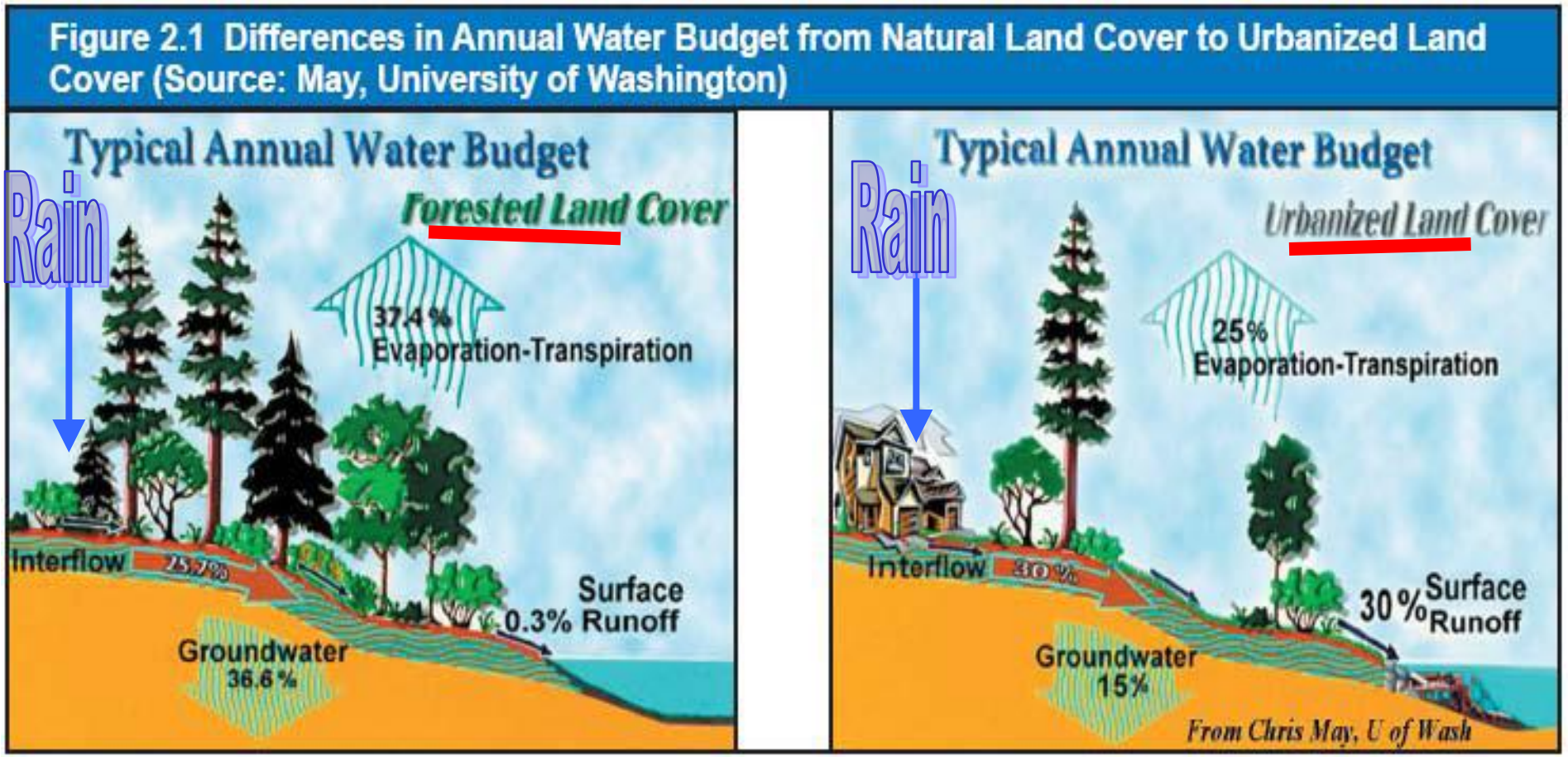


Factors Affecting Runoff (stream)

Meteorological factors	Physical characteristics
Type of precipitation (rain, snow, sleet, etc.)	** **Land use** **
Rainfall **intensity**, amount, duration, distribution	Vegetation, **Soil** type,
Direction of storm movement	Drainage area, Basin shape
Precipitation that occurred earlier and resulting soil moisture	Drainage network patterns Ponds, lakes, reservoirs, sinks
temperature, wind, relative humidity, and season	Elevation, Topography, slope

Direct Source➔ http://ga.water.usgs.gov/edu/watercyclerunoff.html

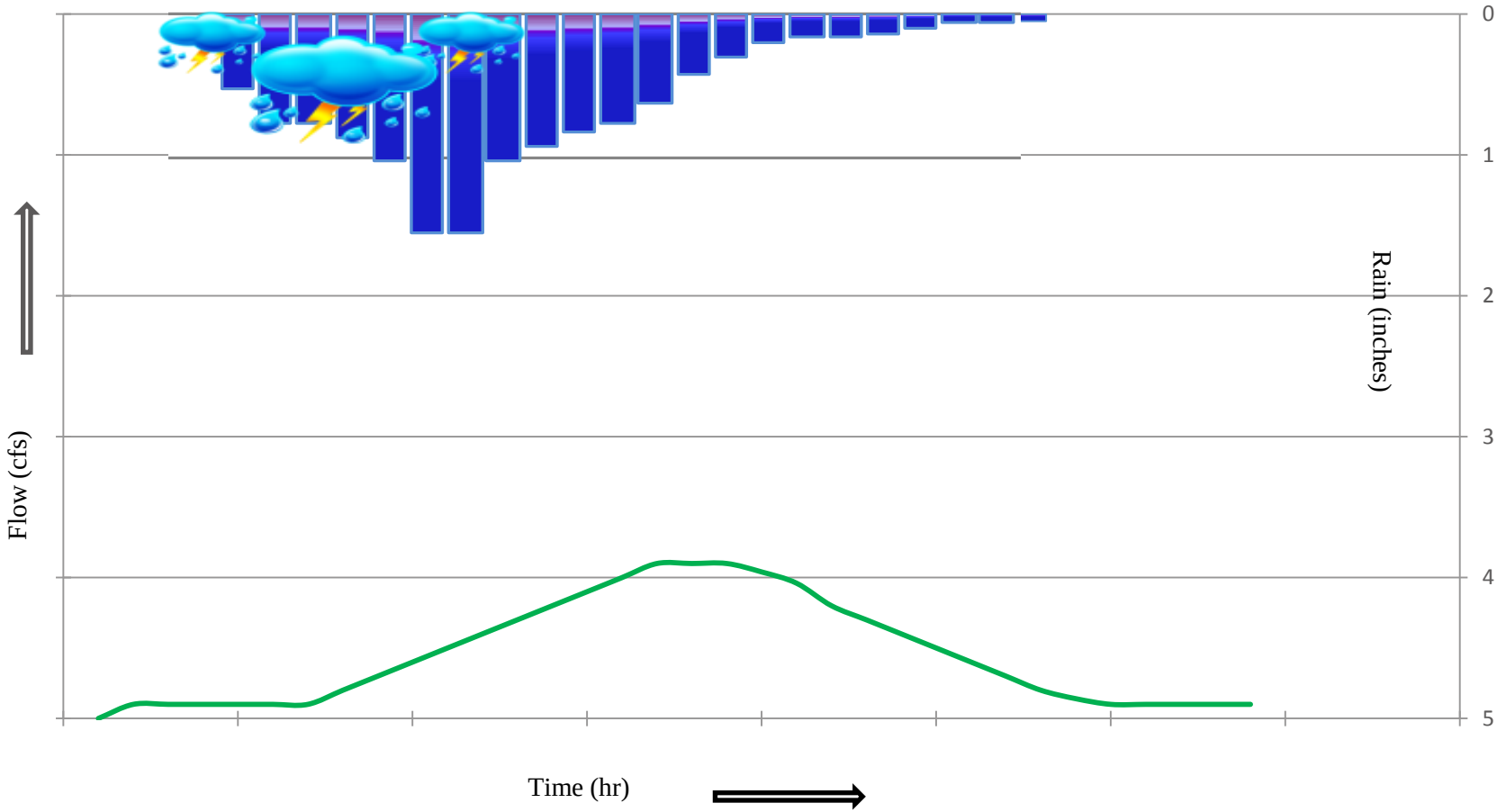
Natural and Constructed Stormwater System

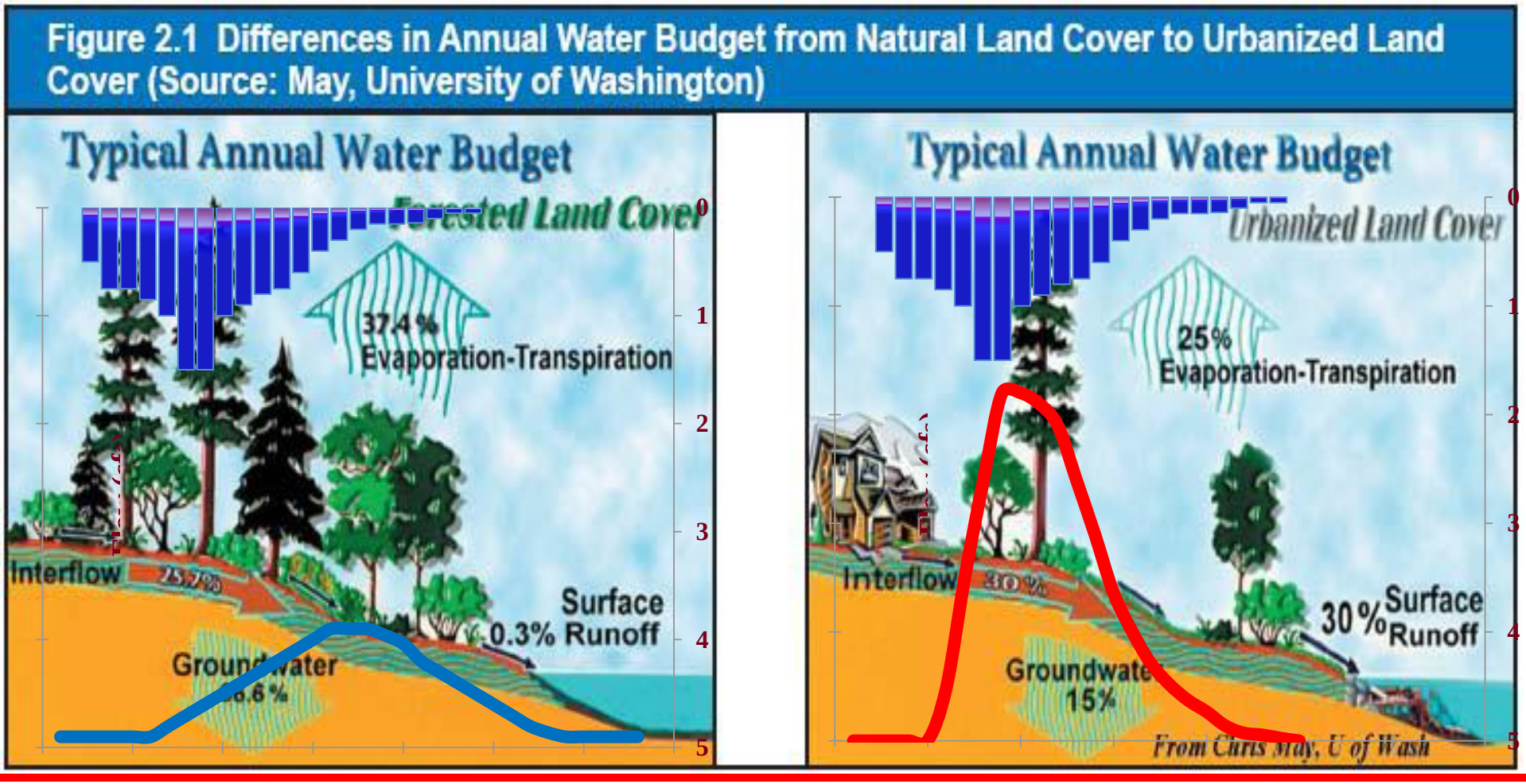


SOURCE ➔ MN Stormwater Manual

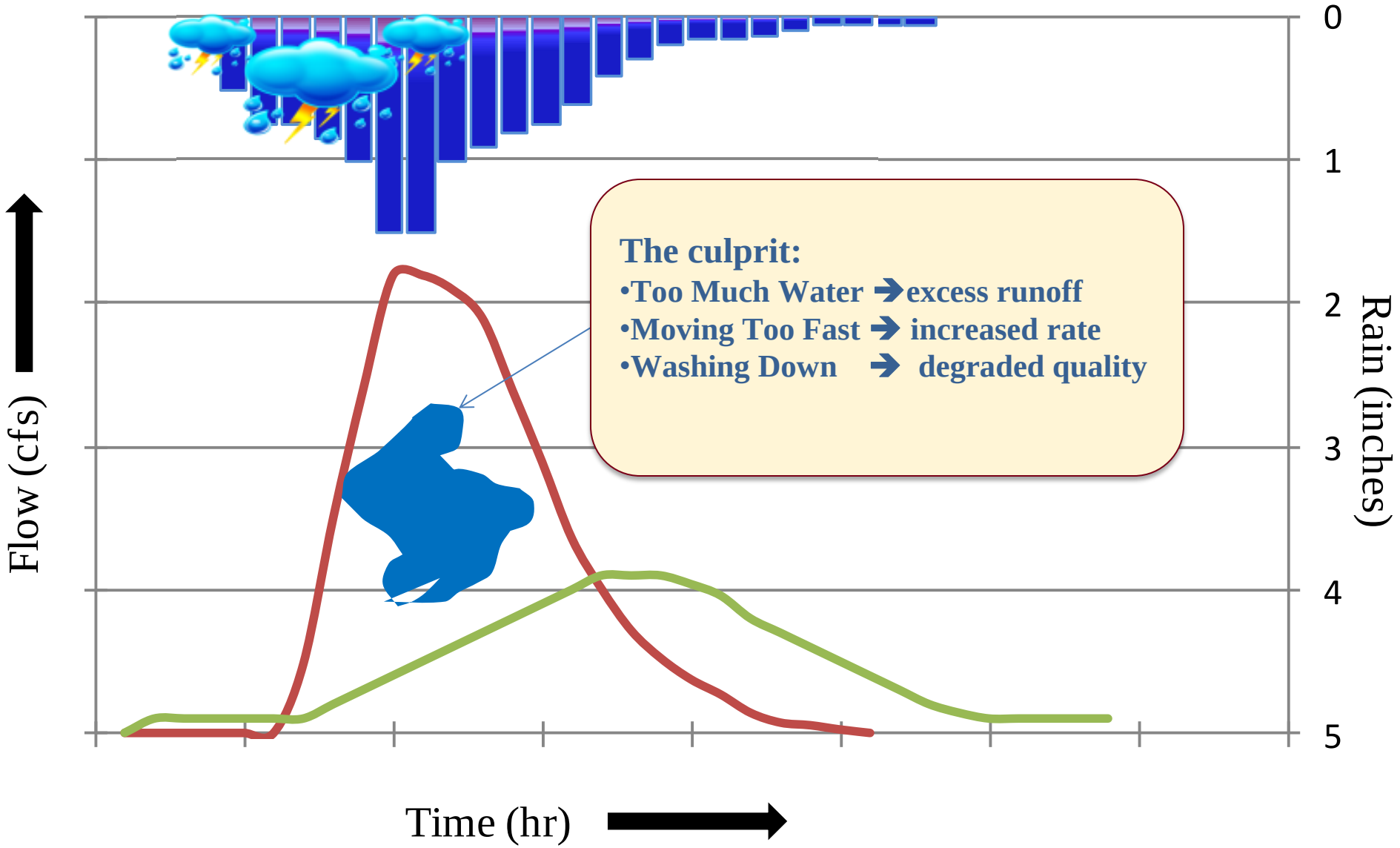
Rain

Streams





The Problem(s)



Problems:

Quantity (too much)

Quality (degradation)

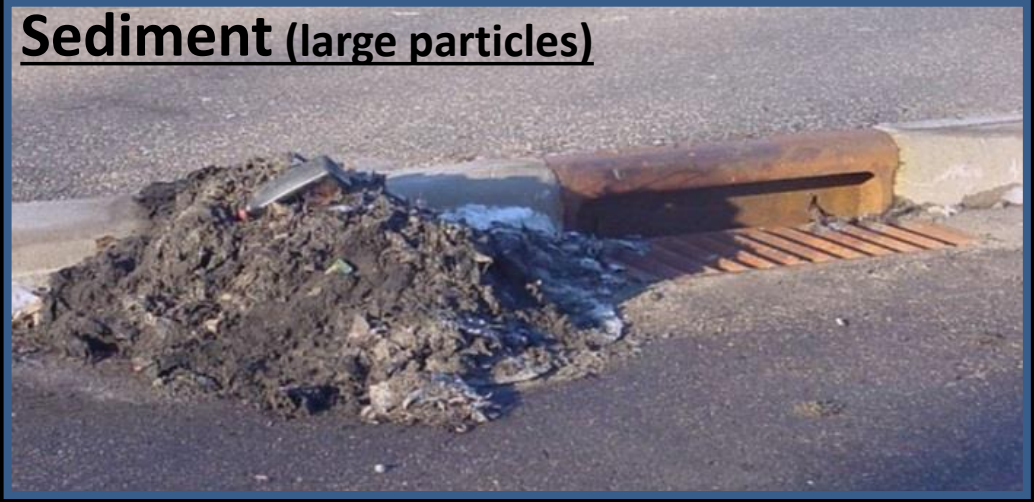
Rate (moving too fast)

SOURCE: Redwood-Cottonwood Rivers Control Area, http://www.rcrca.com/cost%20share.ht

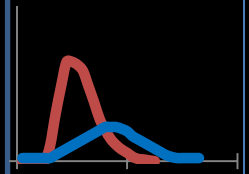
Pollutants: Physical, Chemical, and Biological

***Quality** (degradation)*

Sediment (large particles)

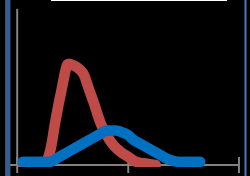


Rate — **problem**



-erosion!
-
-
-

Quantity — **problem**

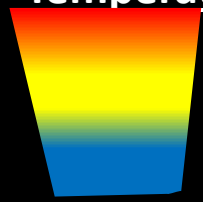


-bounce !
-
-
-

Turbidity — **problem**

-fish, breathing!
-
-
-

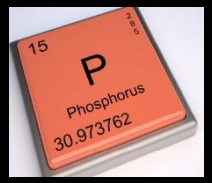
Temperature — **problem**



-streams!
- lakes
- trout
-

Pollutants: Physical, **Chemical**, and Biological

***Quality** (degradation)*



0.45 µm

0.005 µm | 0.2 µm | 2 µm | 75 µm | 4250 µm

Colloids

Soluble / **Dissolved**

Clay

Silt

Sand

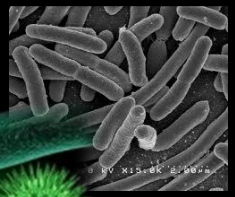
Gross Solids

Organic / Float

1 µm = 0.001 mm ~ 0.00004 In

Pollutants: Physical, Chemical, and **Biological**

***Quality** (degradation)*



0.005 µm | 0.2 µm | 0.45 µm **2 µm** | 75 µm | 4250 µm

Colloids

Soluble / **Dissolved**

Clay

Silt

Sand

Gross Solids

Organic / Float

1 µm = 0.001 mm ~ 0.00004 In

How do we minimize these problems?

From Problem to Solutions

FEDERAL WATER POLLUTION CONTROL ACT

(33 U.S.C. 1251 et seq.)

AN ACT To provide for water pollution control activities in the Public Health Service of the Federal Security Agency and in the Federal Works Agency, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

TITLE I—RESEARCH AND RELATED PROGRAMS

DECLARATION OF GOALS AND POLICY

SEC. 101. (a) The objective of this Act is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. In order to achieve this objective it is hereby declared that, consistent with the provisions of this Act—

(1) it is the national goal that the discharge of pollutants into the navigable waters be eliminated by 1985;

(2) it is the national goal that wherever attainable, an interim goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water be achieved by July 1, 1983;

(3) it is the national policy that the discharge of toxic pollutants in toxic amounts be prohibited;

(4) it is the national policy that Federal financial assistance be provided to construct publicly owned waste treatment

From Problem to Solutions

U.S. EN

Managing Wet Weather with Green Infrastructure

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- Types, Applications, & Design Approaches
- Case Studies
- News
- Green Infrastructure Partnership
- Regulatory Integration
- Research
- Models & Calculators
- Municipal Handbook
- Funding Opportunities
- Links
- Training & Conferences

Managing Wet Weather with Green Infrastructure

Green infrastructure is an approach to wet weather management that is cost-effective, sustainable, and environmentally friendly. Green Infrastructure management approaches and technologies infiltrate, evapotranspire, capture and reuse stormwater to maintain or restore natural hydrologies. See examples of green infrastructure and design approaches.

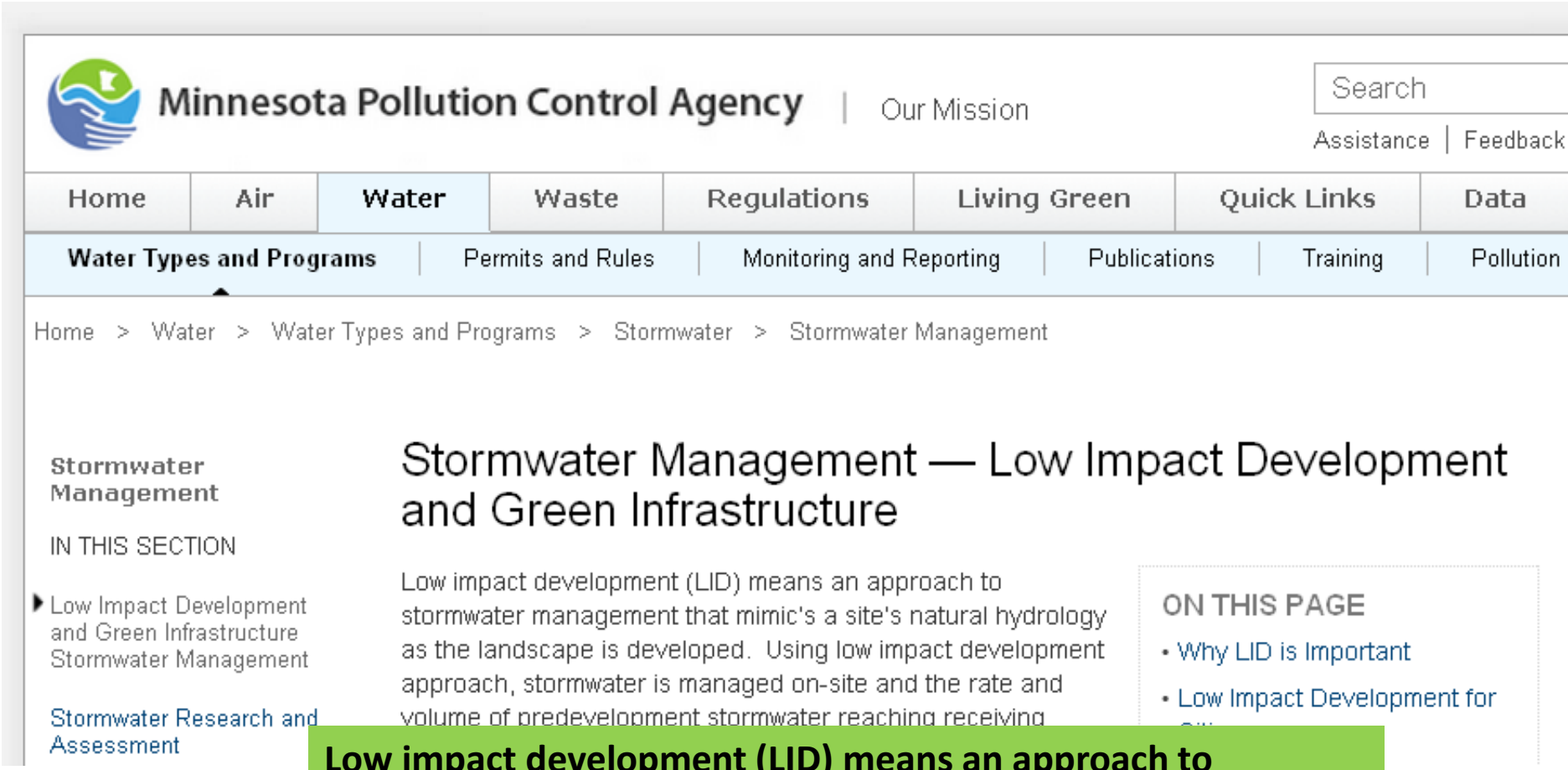
restore natural hydrologies

tion of natural landscape features (such as forests, floodplains and wetlands) ar
cture. By protecting these ecologically sensitive areas, communities can
improve water quality while providing wildlife habitat and opportunities for outdoor recreation.

On a smaller scale, green infrastructure practices include rain gardens, porous pavements, green roofs, infiltration planters, trees and tree boxes, and rainwater harvesting for non-potable uses such as toilet flushing and landscape irrigation.

- Green Infrastructure Case Studies: Municipal Policies for Managing Stormwater with Green Infrastructure (PDF) (76 pp, 8.23MB)
- Green Infrastructure in Arid and Semi-Arid Climates (PDF) (9 pp, 1.3MB)

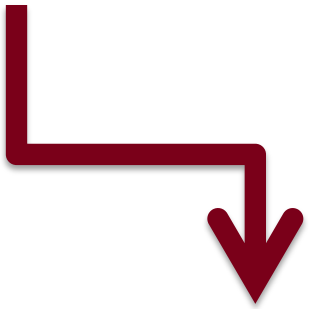
From Problem to Solutions



Low impact development (LID) means an approach to stormwater management that <u>mimic's a site's natural hydrology</u> as the landscape is developed.

Minnesota Statutes 2009, section 115.03, subdivision 5c

From Problem to Solutions



Mimicking Natural Drainage Systems

Mimicking Natural Drainage Systems

components of a natural & constructed drainage systems

Landscape: soils (permeable) , **vegetation, trees, forest , rocks ,..**

Low spots: Puddles, floodplains, pools, wetlands,…

Conduits: Springs, Runs, Brooks, streams, creeks, …

Green space, pervious , trees….

Bio basins…

Engineered swales, pipes, culverts, stream restoration,

Ponds

drainage systems components (functions):

natural	constructed
Landscape	
vegetation, trees, forest , rocks ,..	Green space, pervious , trees….
Low spots	
Puddles, floodplains, wetlands,…	Biobasins, raingardens, …
Conduits	
Springs, Brooks, streams, creeks	swales, pipes/culverts, stream (rest.)
Storage	
Wetlands, lakes,	Ponds

Mimicking Natural Drainage Systems

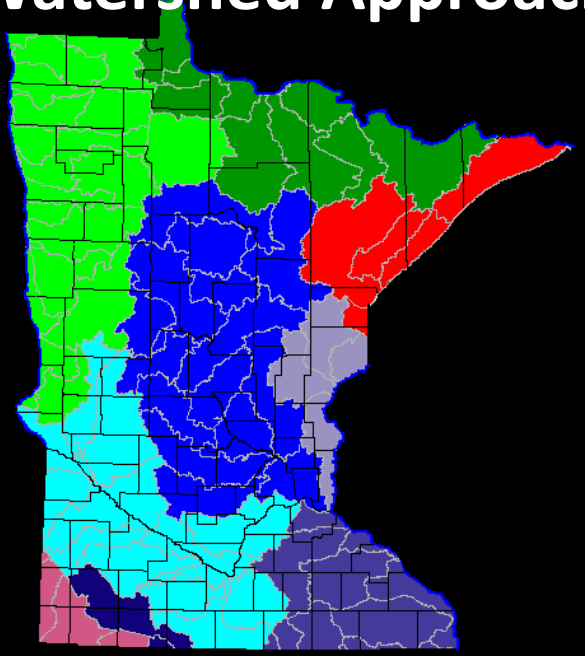
Designing like nature

yeah but !

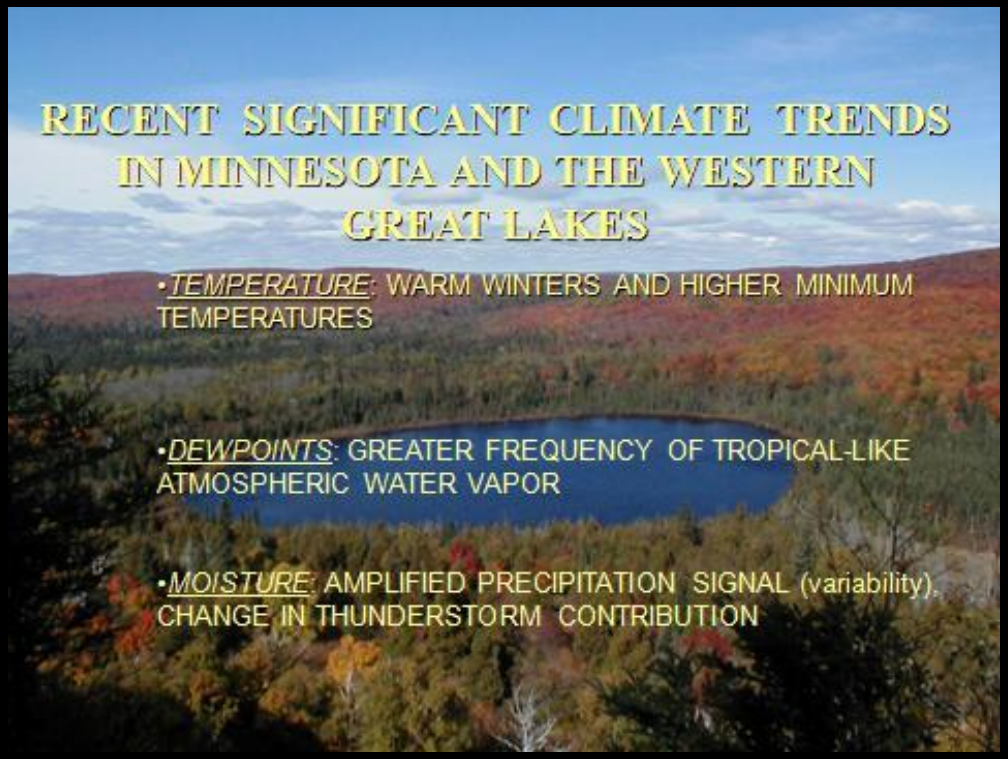
Considerations for Mimicking Natural Drainage Systems

Where does water come from that enters my site and where does it ultimately go when it leaves?

The Watershed Approach



Designing for a changing climate!



Jan. 23, 2014, climate change will be included in the EPA Stormwater Calculator

Stormwater 101: Chapter Two—Take Away

Chapter One

Why?

The big picture

- **The big picture & the issues facing our finite fresh water resources:**

  1) aging ecosystem,

  2) increasing demand, and

  3) a changing climate

Chapter Two

The Problems

- **Problem is the excessive runoff**
  - Quantity (too much)
  - Rate (moving too fast)
  - Quality (washing and eroding)
- ***Need to mimic nature and be mindful of climate, & "Where does water come from that enters my site and where does it ultimately go when it leaves?"***

Stormwater 101– Group (2-3) Assignment # 2—5 min.

What is the Q?

If the answers:

1)Quantity, Rate, & Quality?

2)Watershed approach & Climate Change

Quick Check in:

Let's take 2 min. and write down, what is working so far & what is not!!

6:50

STORMWATER 101

Chapter One **The big picture ?**	•**The big picture & issues facing our finite fresh water resources:** *1) aging ecosystem,* *2) increasing demand, and* *3) a changing climate*
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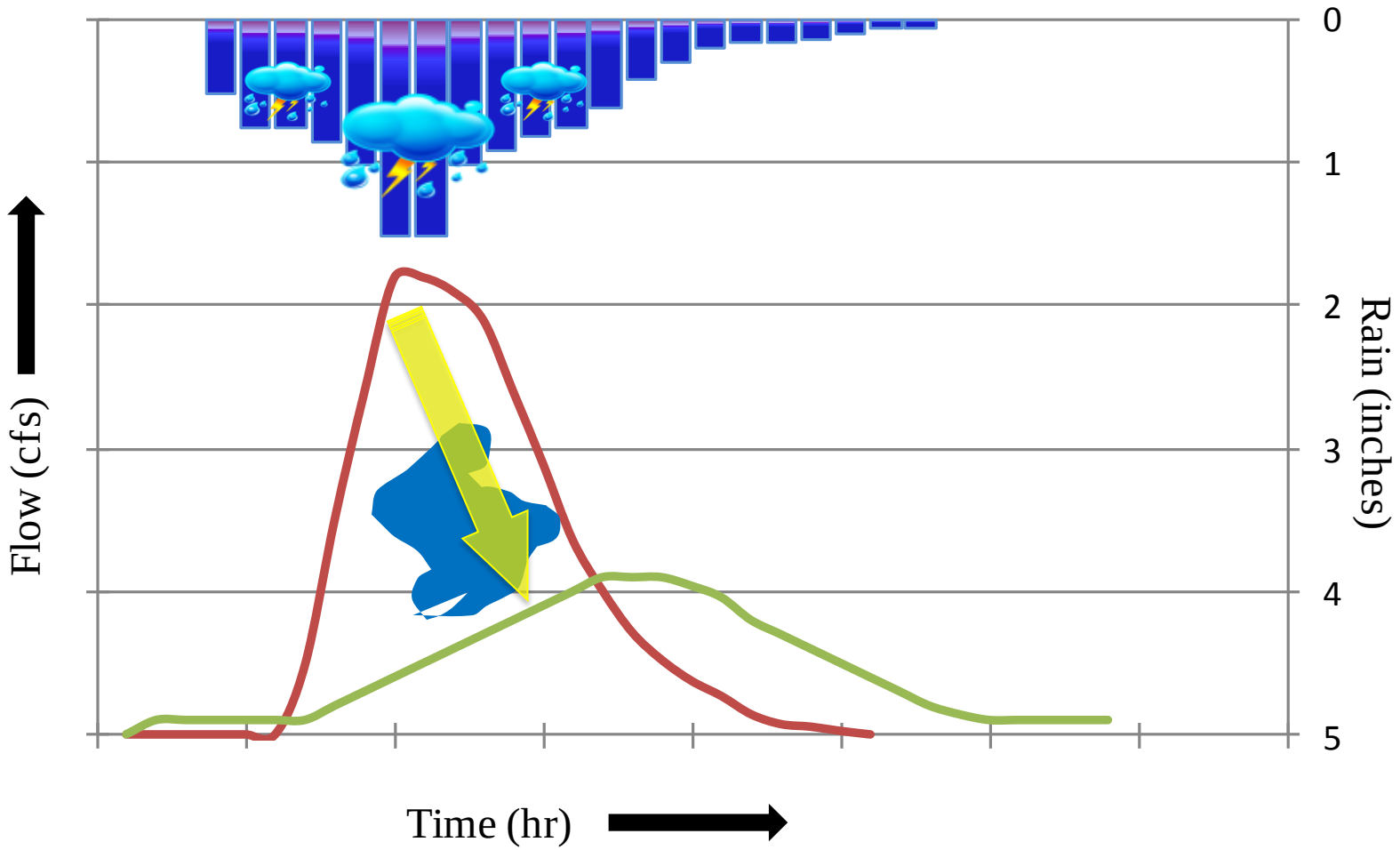
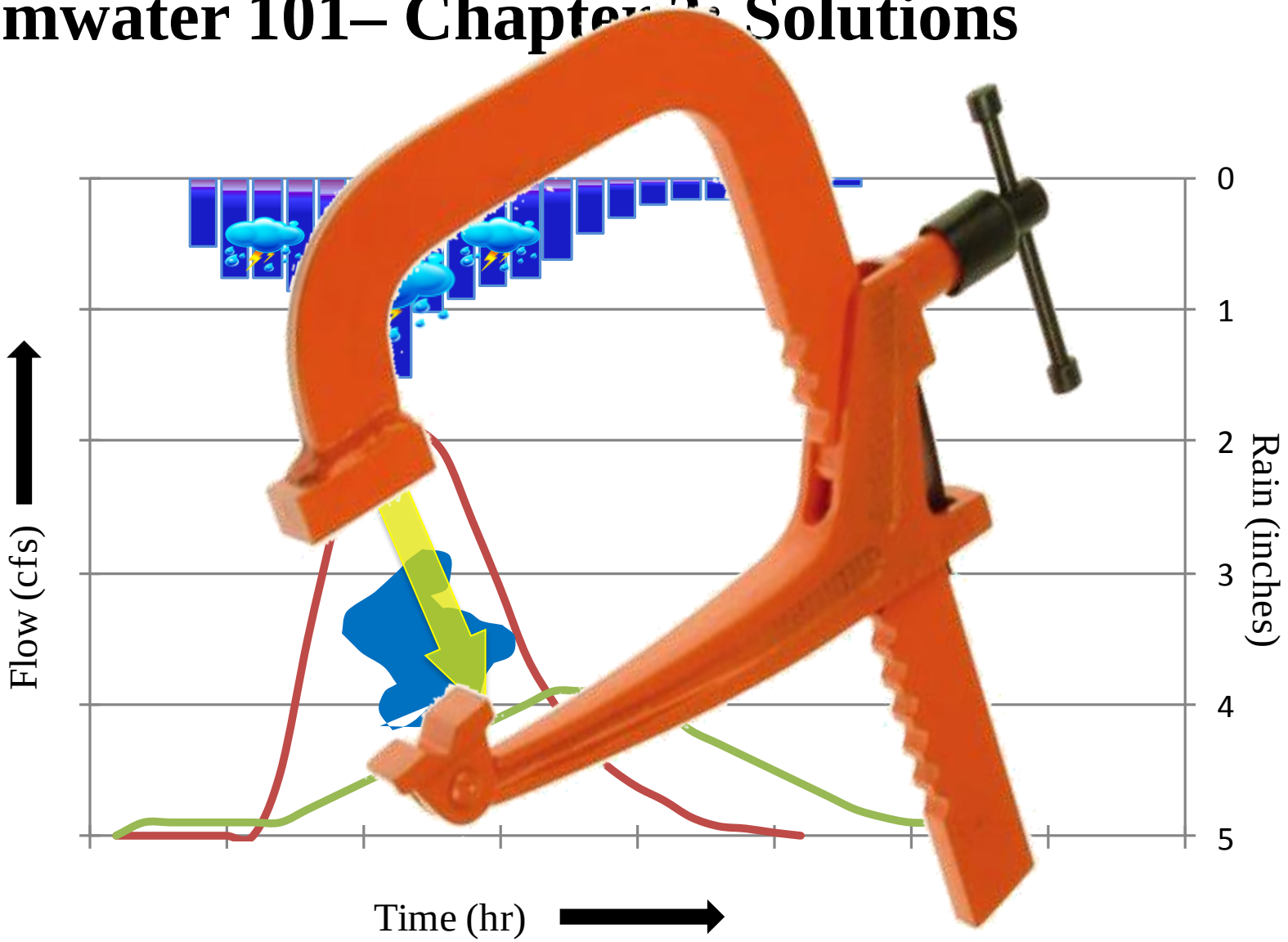
7:00 Chapter Three **Solutions**	• **the feature, function, and the benefits of stormwater BMPs** *and how they fit into the whole system (watershed)*
Chapter Four **Plan & Our Home Site**	• **there are no silver bullets** *but a series of BMPs in protecting our water* • **a system within the system**

Mimicking Natural Drainage Systems

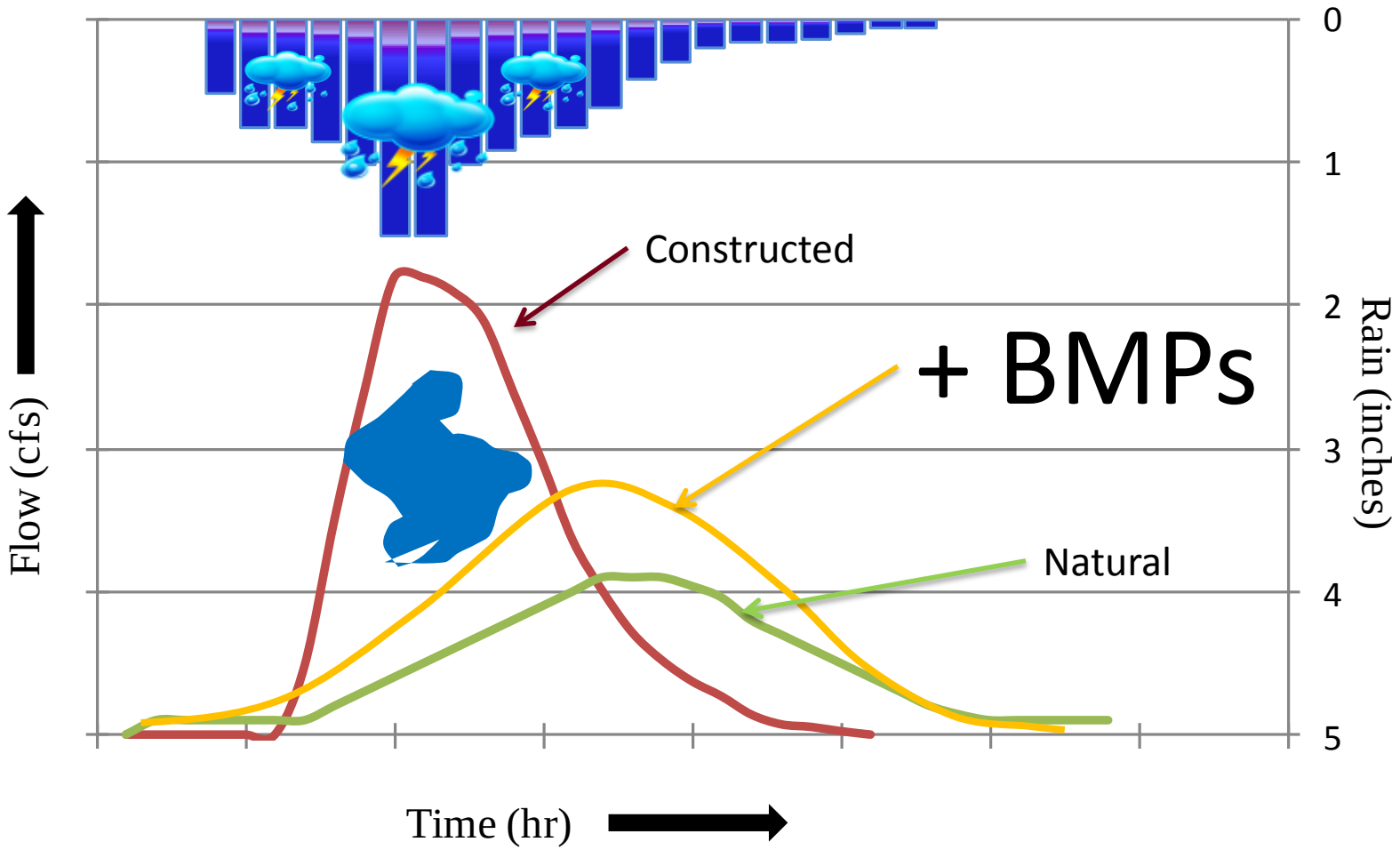
Stormwater 101– Chapter 3: Solutions



Stormwater 101– Chapter 2: Solutions



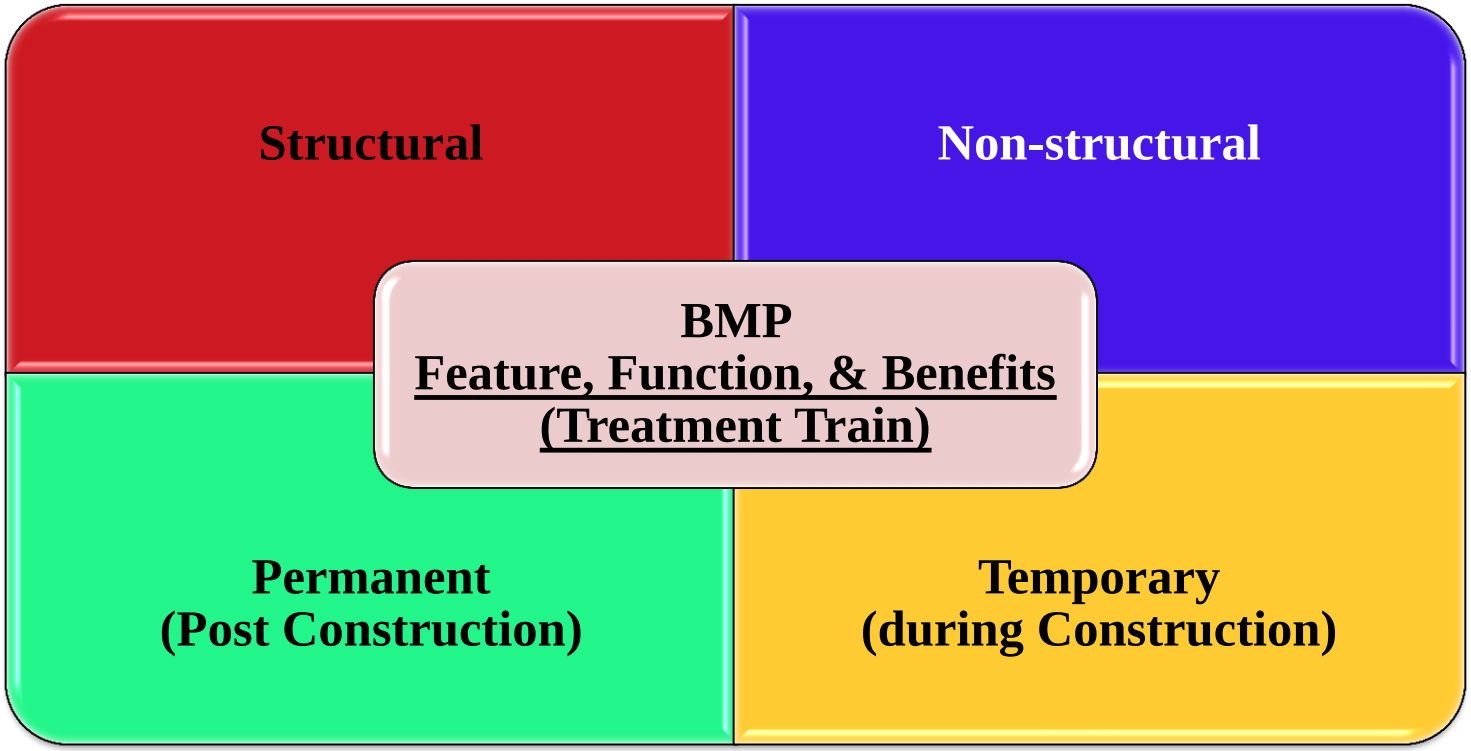
Stormwater 101– Chapter 3: Solutions = BMPs



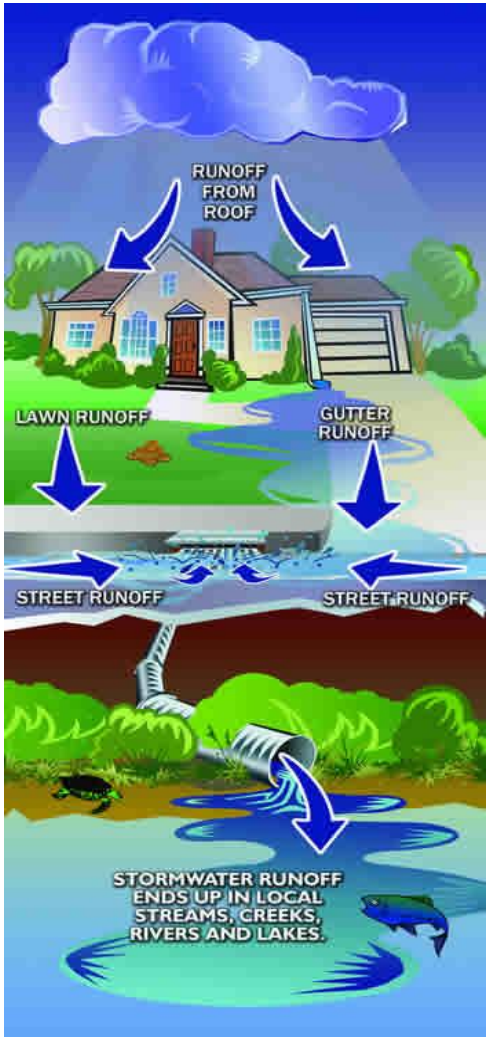
Solutions = BMPs

- **Best Management Practices**. All permitted activities shall incorporate best management practices (BMPs). For purposes of these rules, the term
- ***"best management practices"*** shall mean practices, techniques, and measures that prevent or reduce water pollution from nonpoint sources and which will minimize erosion of soil and deposition of sediment in private or public drainage systems or waters by using the most effective and practicable means of achieving water quality and runoff goals. **BMPs include, but are not limited to, structural controls, nonstructural controls, operational procedures, and maintenance procedures.**

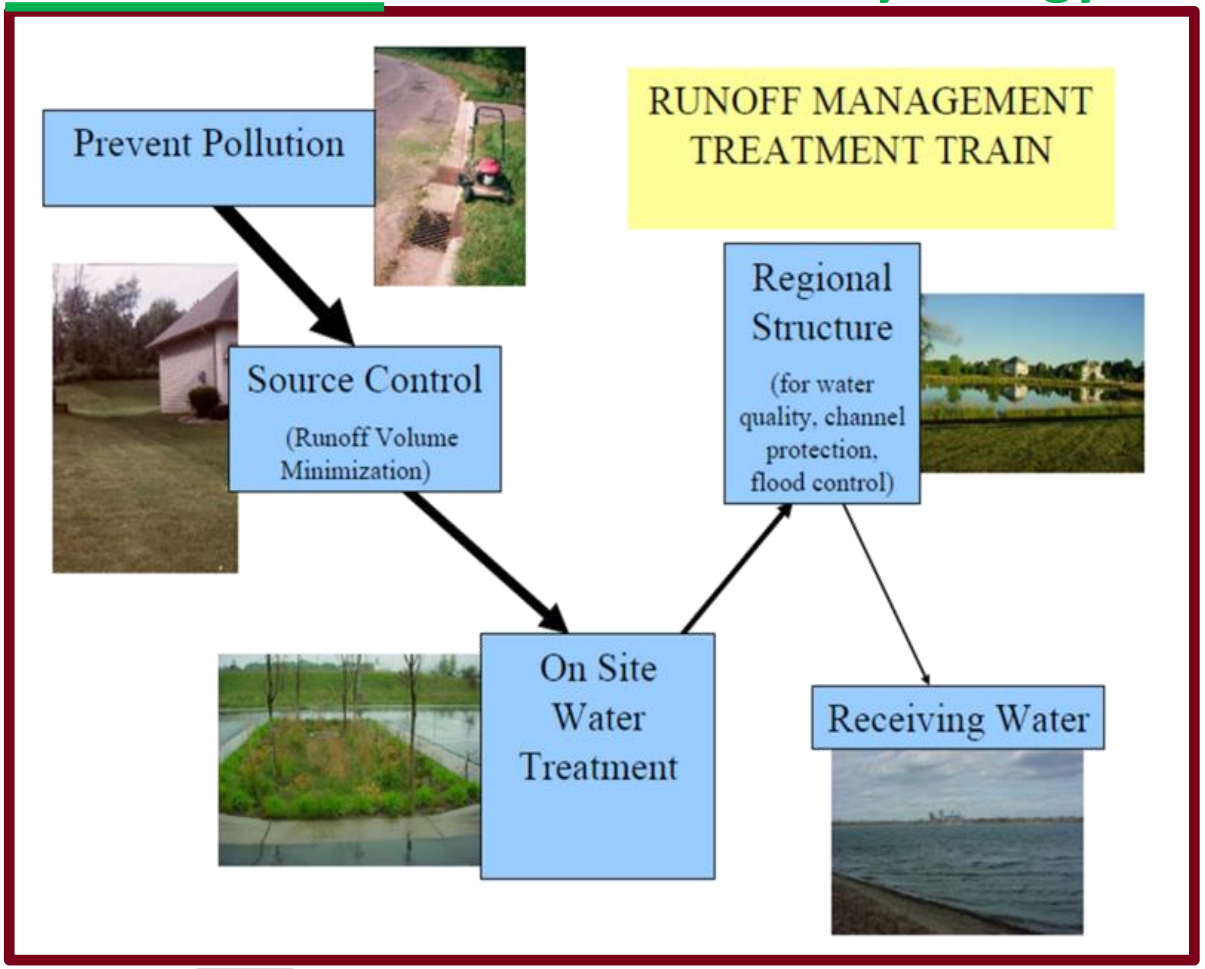
Solutions = BMPs



Problems:



Solutions: restore natural hydrology

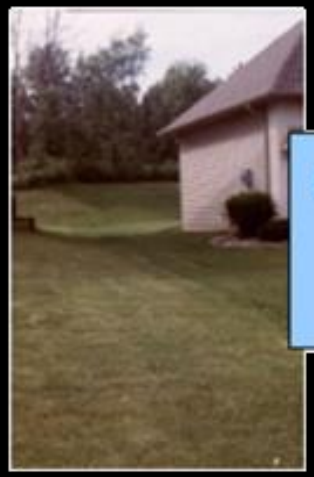


☐ Quantity ☐ Rate ☐ Quality

BMPs: Feature, Function, and The Benefits

Prevent Pollution
Purpose & Function

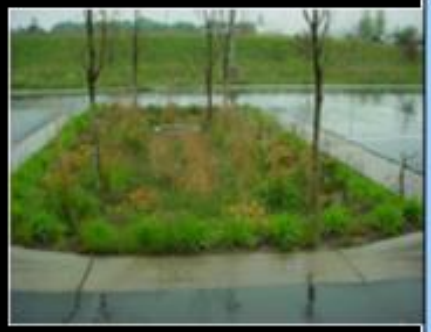
RUNOFF MANAGEMENT TREATMENT TRAIN
application of BMPs



Source Control
(Runoff Volume Minimization)

BMPs

Regional Structure
(for water quality, channel protection, flood control)



On Site Water Treatment

Receiving Water

Many P^2 BMPs: *Purpose & Function*

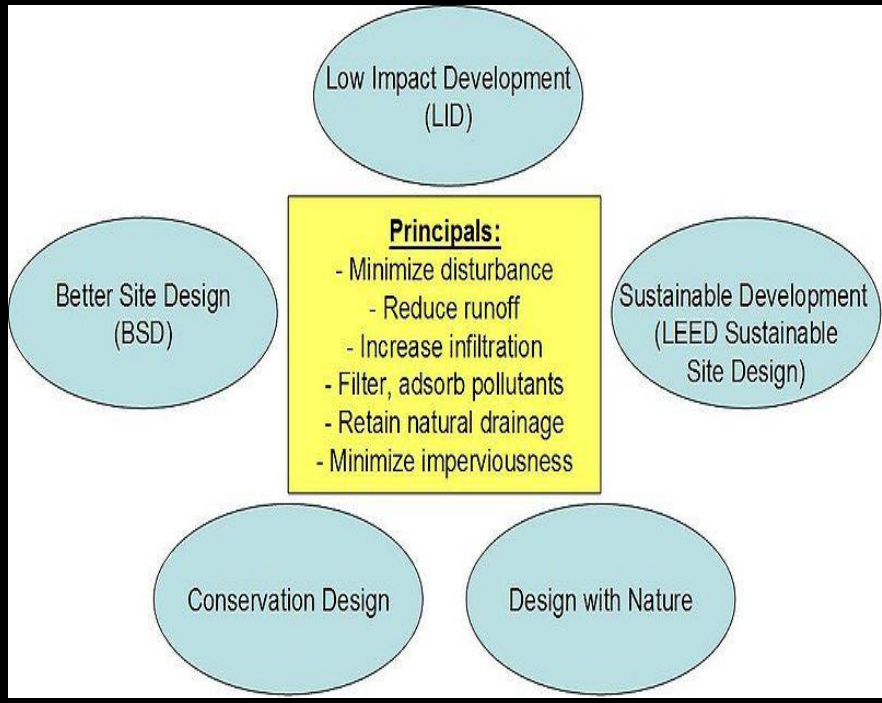
Residential	Municipal	Industrial
Yard Waste Management	Temporary Construction Sediment Control →	
Household Hazardous Waste (HHW) Control	Wind Erosion Control →	
Alternative Product Use	Streambank Stabilization	Emission Regulation
Better Car and Equipment Washing	Material Storage Control	Material Storage Control
Better Sidewalk/Driveway Cleaning	Dumpster and Landfill Management	
Better Sidewalk/Driveway Deicing	Better Turf Management →	
Proper Pool Discharge	Better Street/Parking Lot Cleaning	Better Impervious Surface Deicing
Exposed Soil Repair	Better Street/Parking Lot Deicing	Proper Vehicle Management
Native Landscaping	Storm Sewer System Maintenance →	
Healthy Lawns	Litter and Animal Waste Control	Better Parking Lot Cleaning
Proper Pool Discharge	Proper Vehicle Management	Sanitary Sewer System Maintenance

Staff, Employee, and Volunteer Education Public Education →

Methods of P^2 BMPs:

Better site design

(approach)



Preserving natural areas
Site reforestation
Open space design
Soil compost amendments

Rooftop disconnection
Stormwater landscaping
Reducing impervious cover in site design
Slimmer sidewalks
Shorter driveways

Natural area conservation
Stream and shoreline buffers
Disconnecting and distributing runoff
Disconnection of surface impervious cover
Grass channels
Narrower streets
Narrower streets

Smaller cul-de-sacs
Smaller parking lots

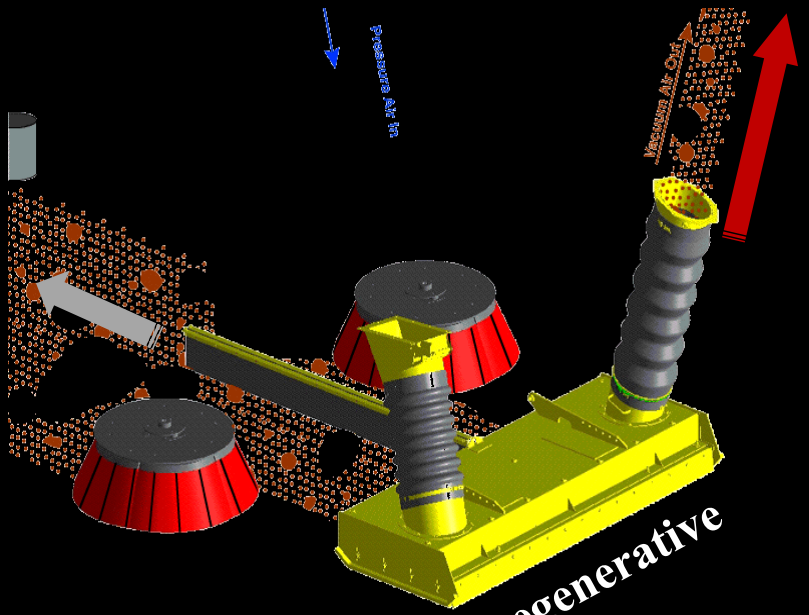
Purpose & Function:

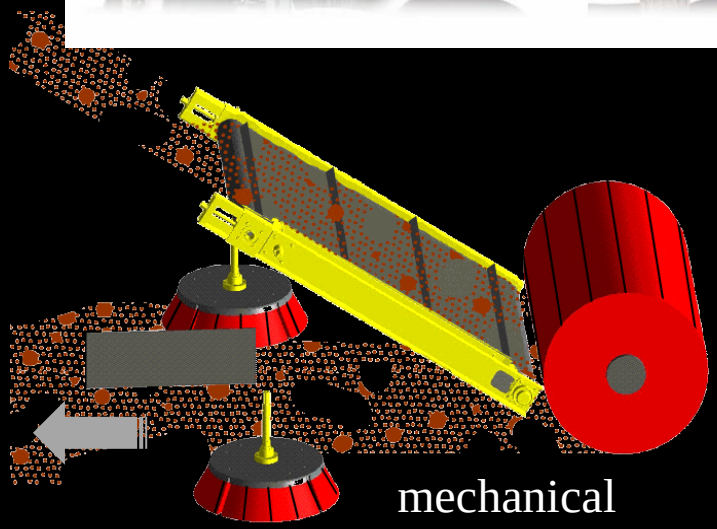
Green Infrastructure

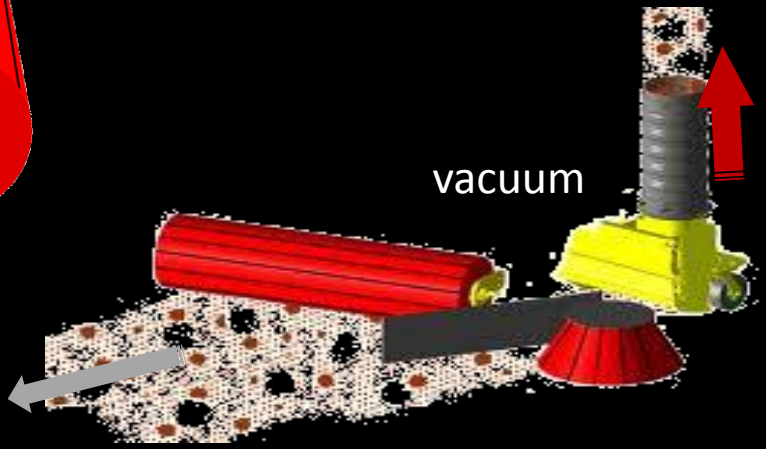
P^2 BMPs: Parking Lot and Street Cleaning

Purpose = capture pollutant, aesthetics, & leaf management

Function = capture pollutants before entering our systems







P^2 BMPs: Reduced Street Widths

Purpose = Reduced Impervious Surface

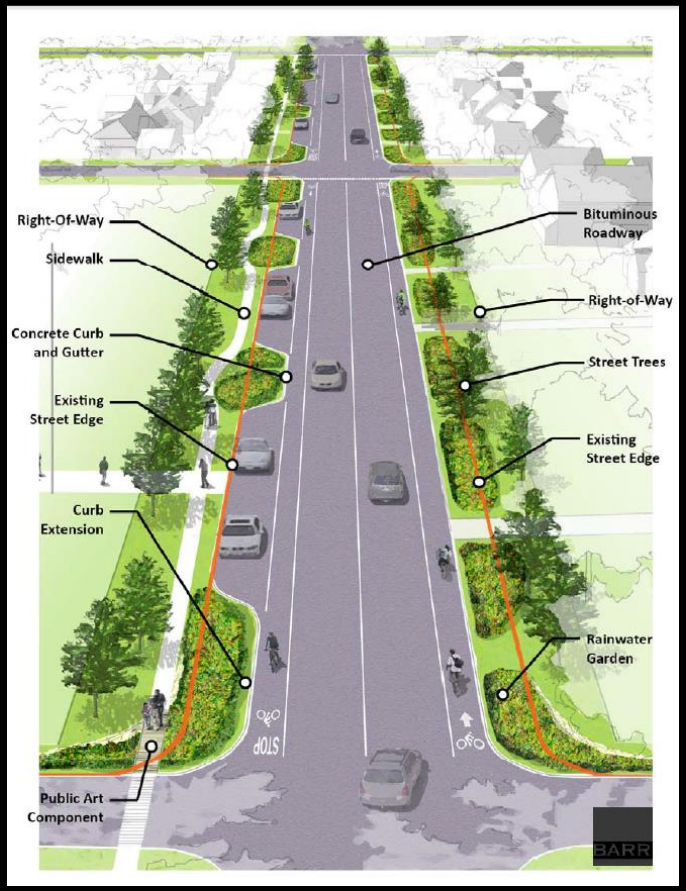
Function = Reduces Impervious Surface

Source: Ramsey Washington Metro Watershed District

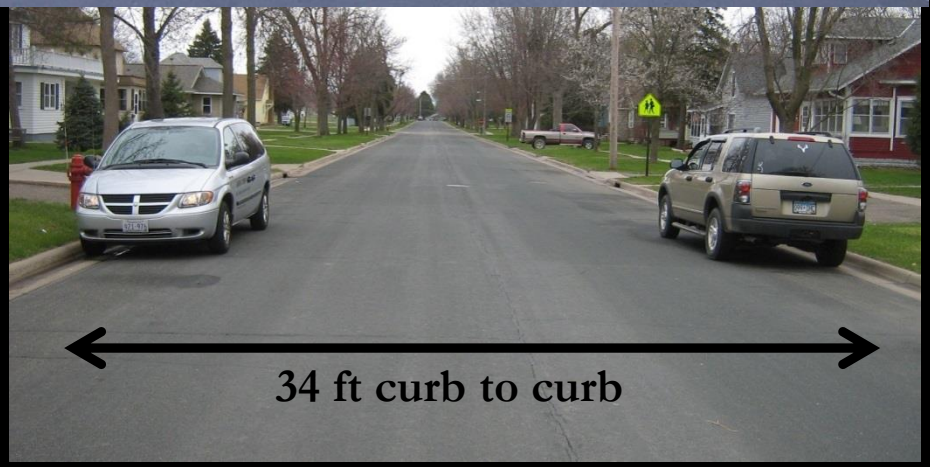
P^2 BMPs: Reduced Street Widths

Purpose = Reduced Impervious Surface

Function = Reduces Impervious Surface



Multi-functional Landscapes



Mimicking Natural Drainage Systems Through **Prevention**

Pollution Prevention BMPs

Public Education

Pollution Prevention BMPs

Public Education

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"

Pollution Prevention BMPs

Public Involvement

Source: bluethumb.org

Pollution Prevention BMPs

Public Involvement---Street Sweeping

Pollution Prevention BMPs

Illicit Discharge Detection & Elimination

Pollution Prevention BMPs

Good House Keeping, (businesses & using it at home)

What is BSD?

Quick Check in:

Let's take 2 min. and write down, what is working so far & what is not!!

6:50

Pollution Prevention BMPs

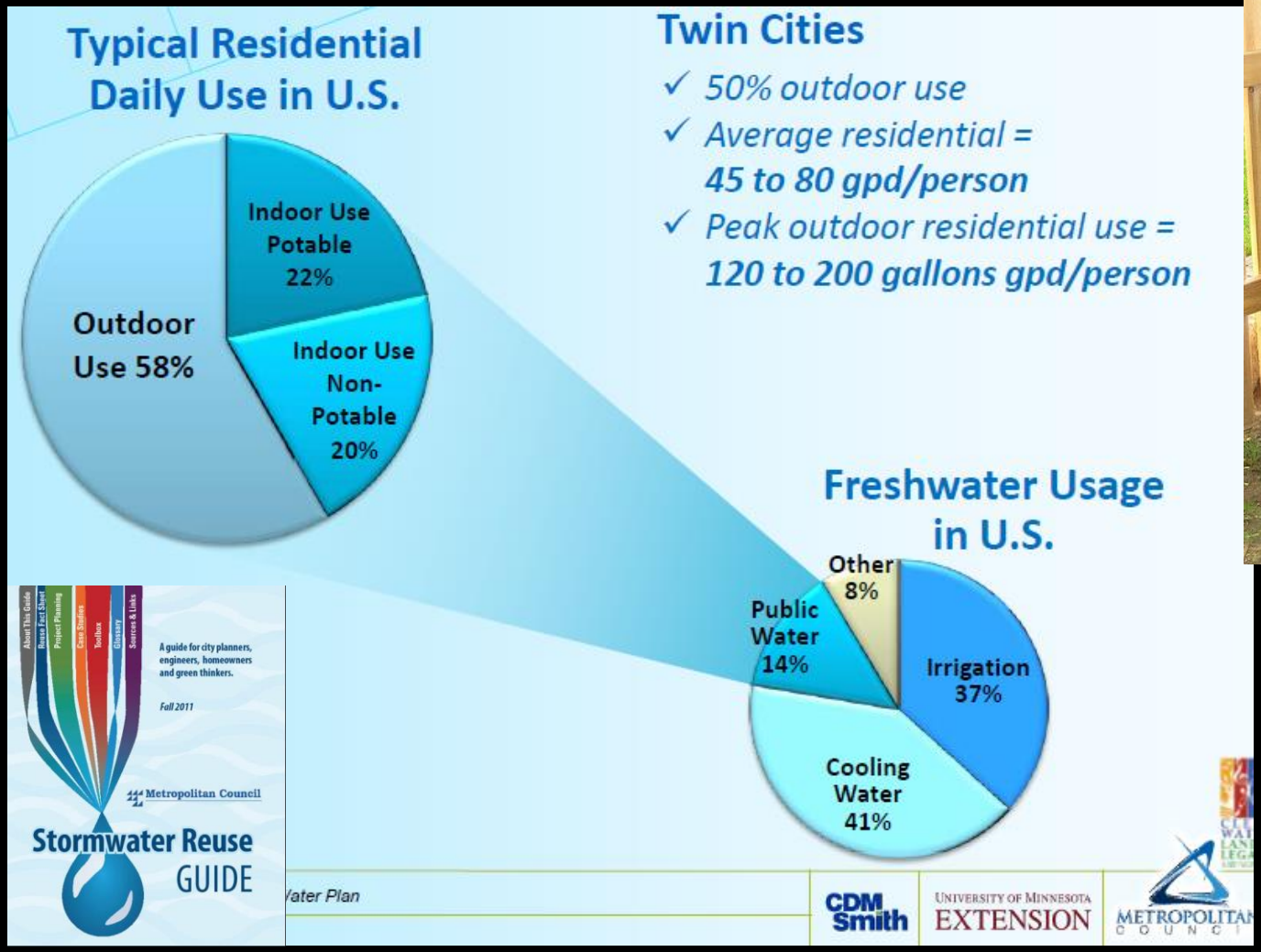
Better Site Design (as home owner, be open to the idea)

SOURCE: http://www.lowimpactdevelopment.org/index.html

P^2 BMPs: Stormwater Reuse

Purpose = Reduced Runoff

Function = Captures runoff & reuse



Barrier's:

Maintenance,

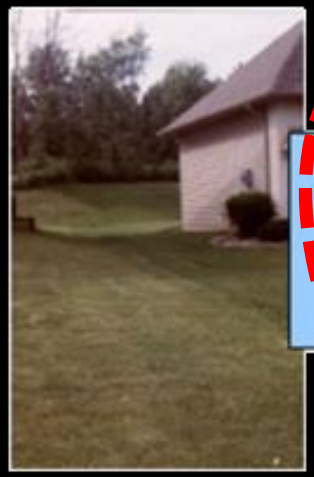
Not suitable for all roofs

Outdated rules & Regulations

BMPs: Feature, Function, and The Benefits

Prevent Pollution

RUNOFF MANAGEMENT TREATMENT TRAIN



Source Control

(Runoff Volume Minimization)

BMPs

Regional Structure

(for water quality, channel protection, flood control)

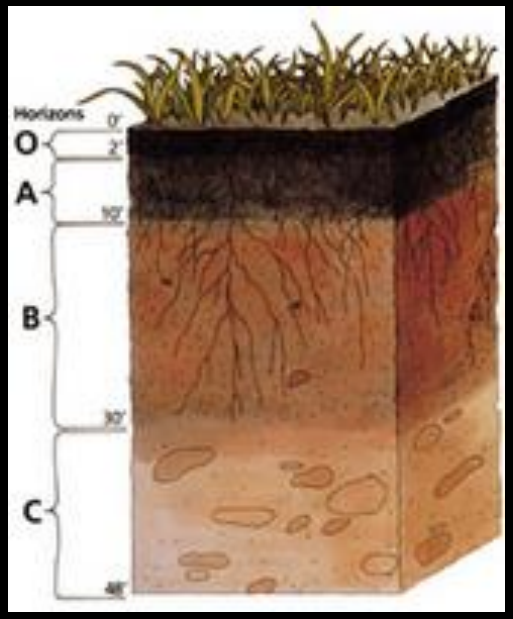
Purpose & Function

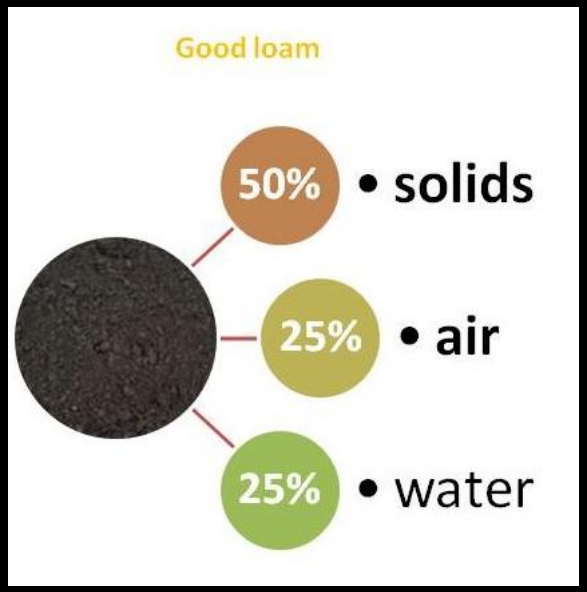
On Site Water Treatment

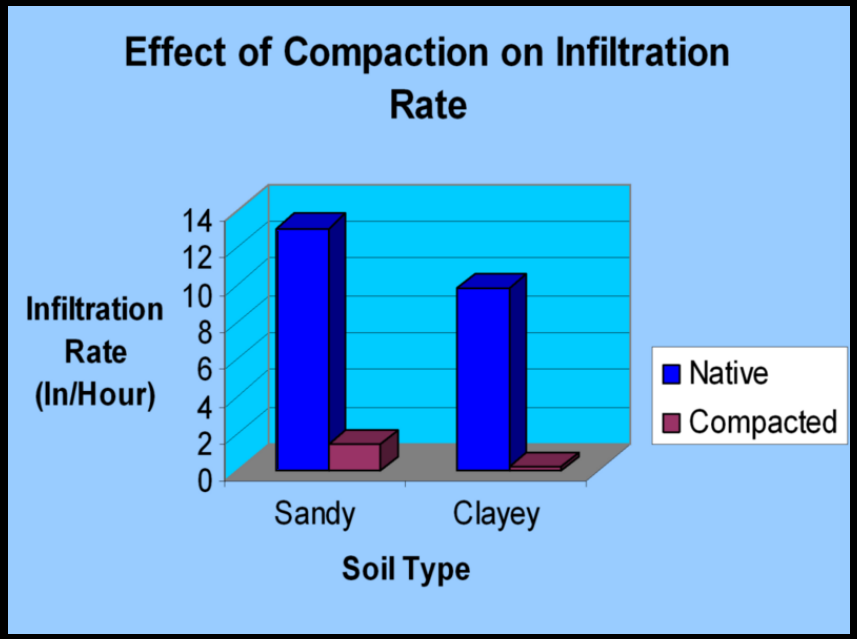
Receiving Water

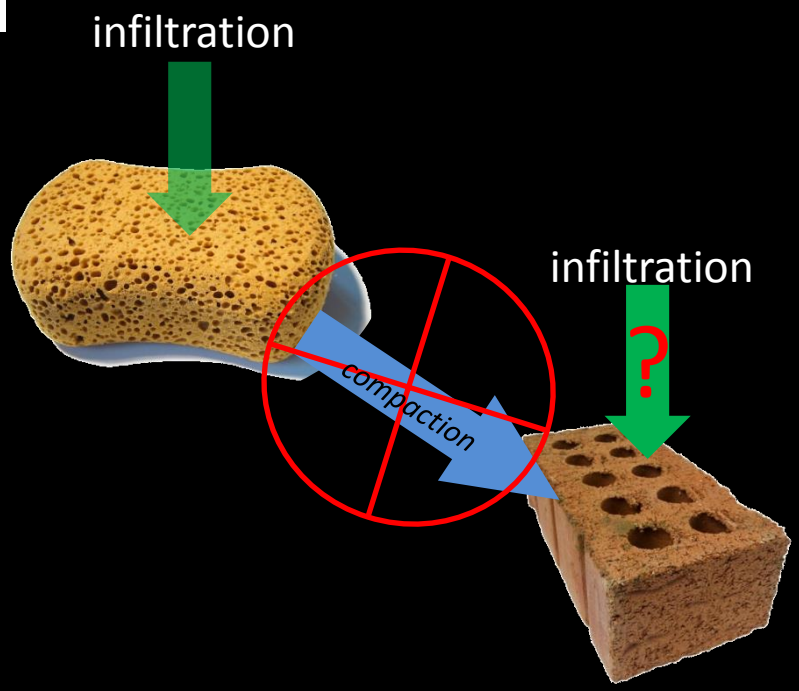
1st Things 1st

Need Healthy Soils





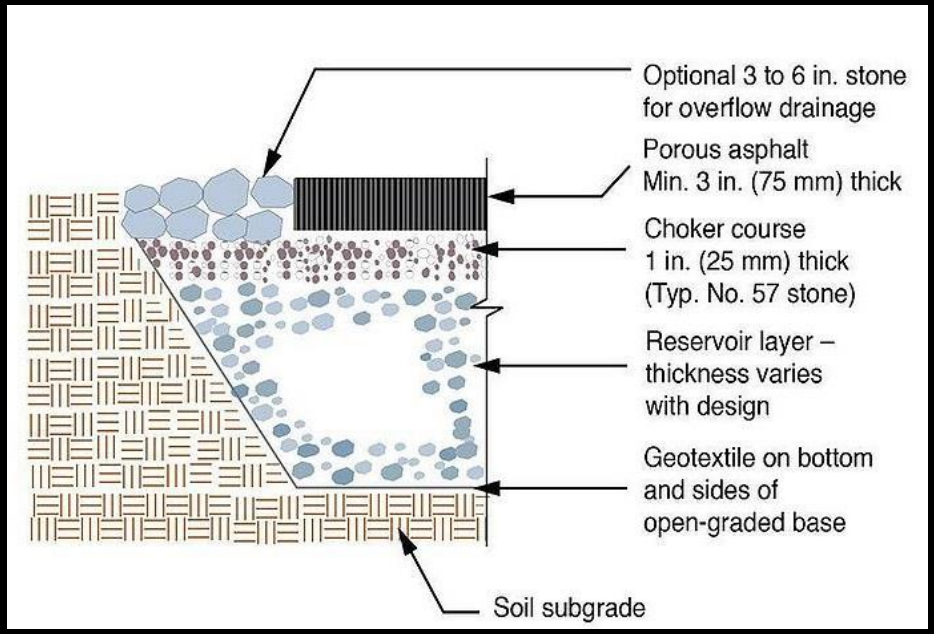


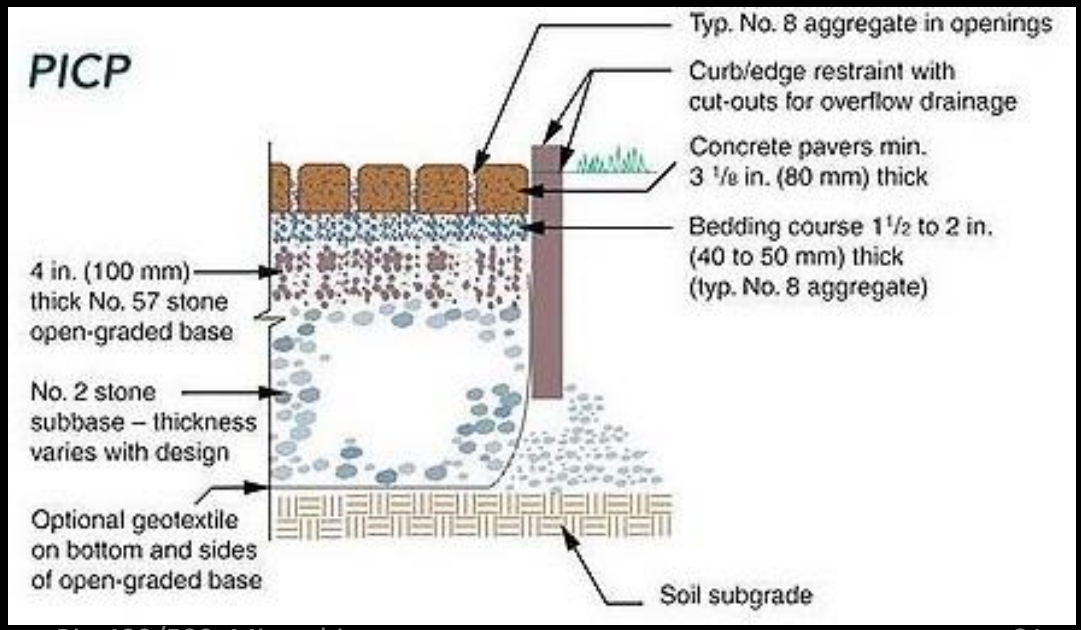


Soil Restoration, Remediation , Correction ,...

Permeable Pavement

Purpose = Reduce runoff (volume)
Function = allow stormwater runoff to filter through surface voids into an underlying stone reservoir for temporary storage and/or infiltration.





- Pervious Asphalt
- Pervious Concrete
- Pervious Pavers
- Grass Structures

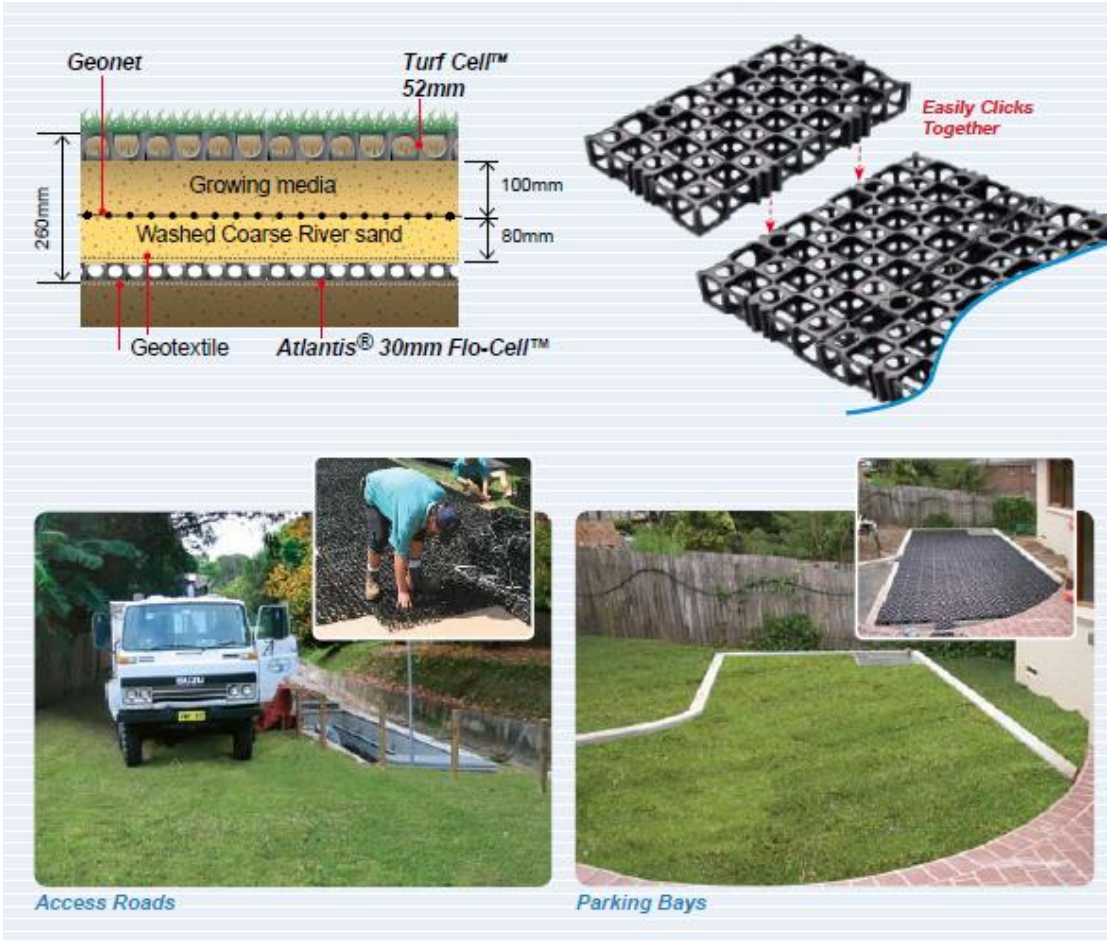
http://**www.seattle.gov**/util/groups/public/@spu/@usm/documents/webcontent/spu02_020023.pdf

Brain Break

What is going on?

Source Control BMPs

Pervious Pavement / Turf



SOURCE: TurfCell

Source Control BMPs

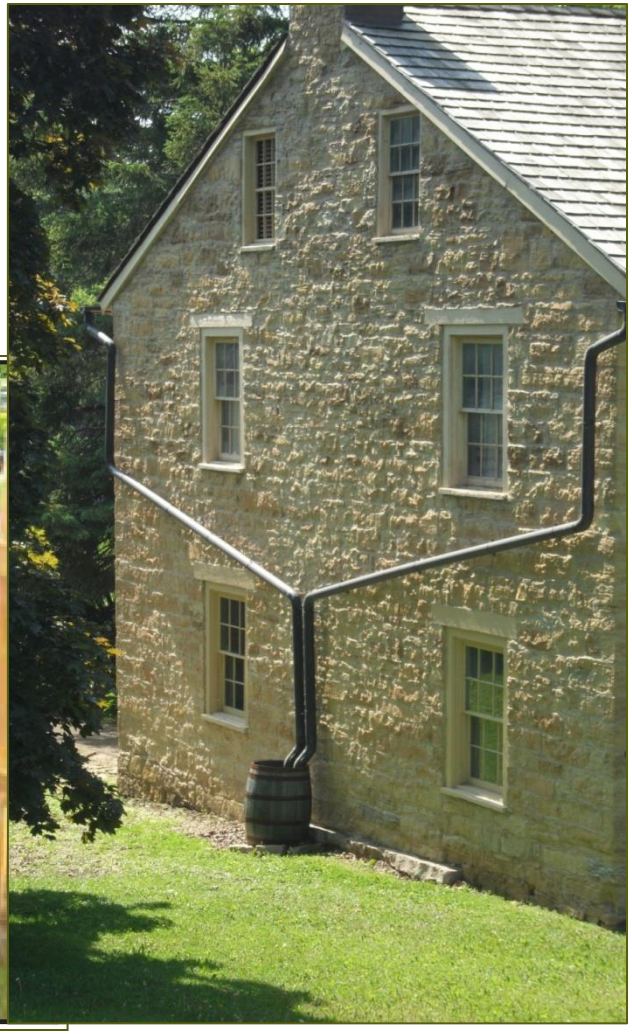
Pervious Pavement / Turf

SOURCE: http://www.blairconservationdistrict.org/SWBMP.htm

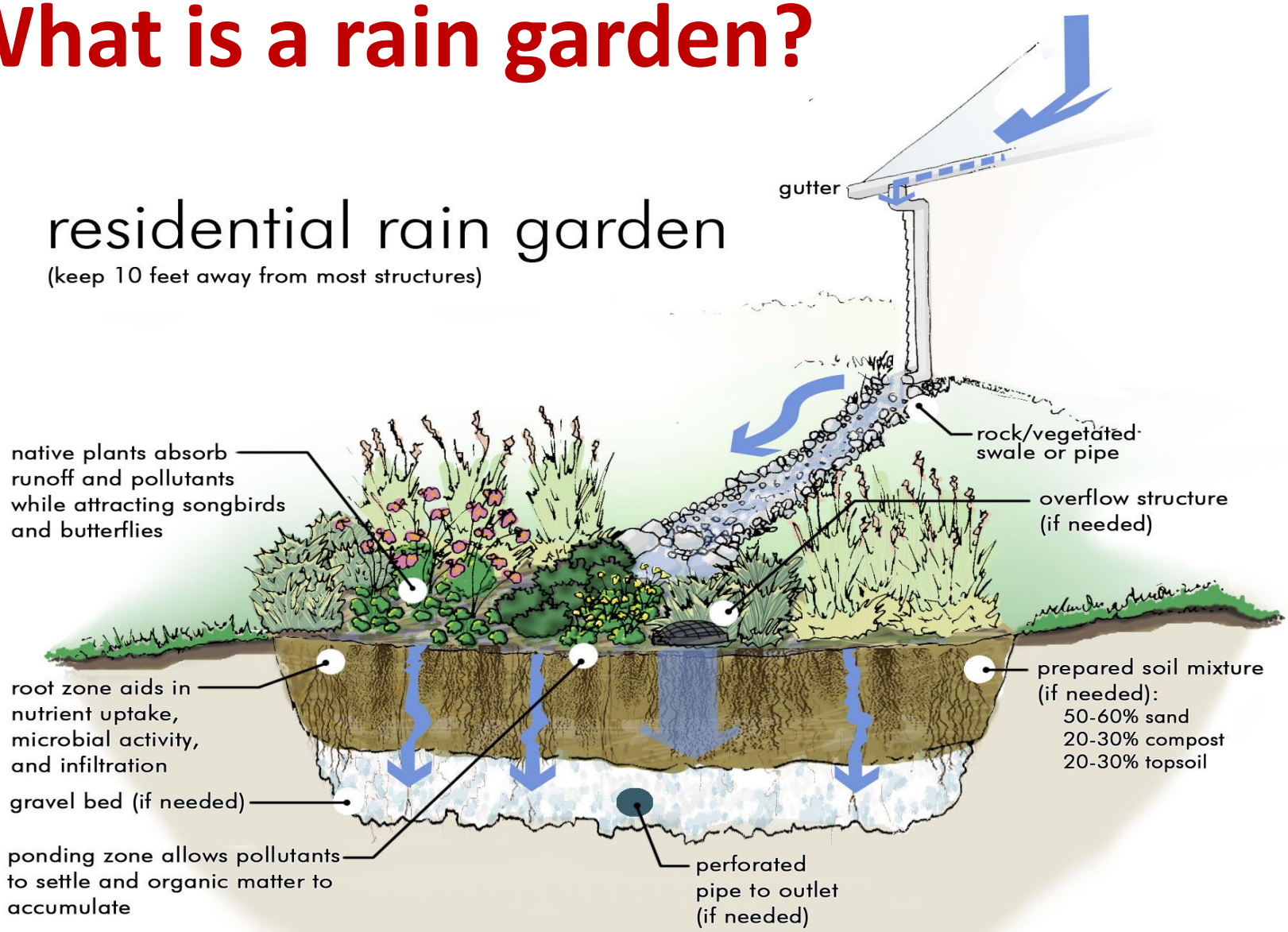
Source Control BMPs

EPA: http://water.epa.gov/infrastructure/greeninfrastructure/gi_performance.cfm

Rainwater Harvesting



What is a rain garden?

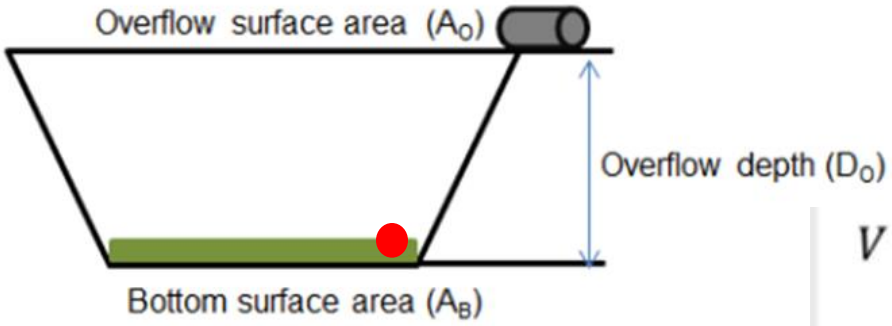


Bioretention, Raingarden,….:

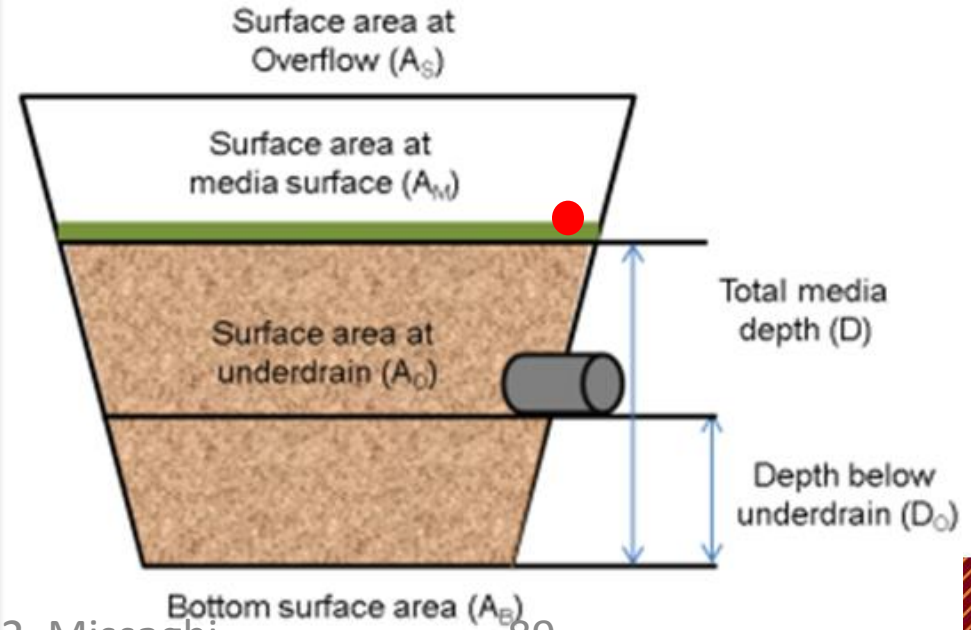
Bioretention, Raingarden,….:

$$V = \left[\frac{A_O + A_B}{2} * (D_O) \right]$$

Volume



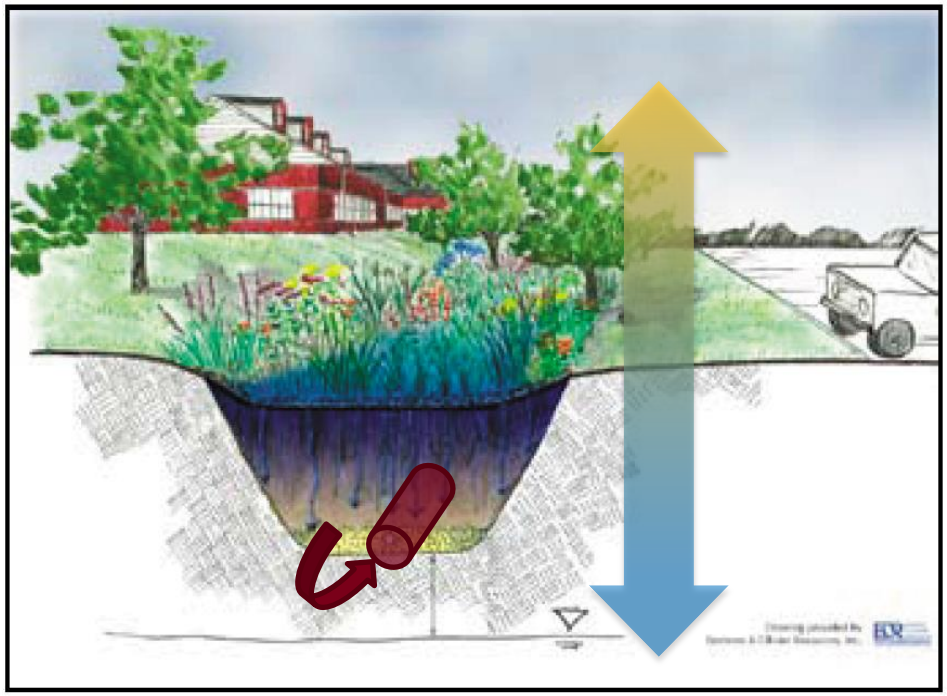
$$V = V_{\inf\_b} + V_{\inf\_s} + V_{ET}$$



Filtration
&
Infiltration

Source Control BMPs

Bioretention / infiltration / filtrations /…



Source Control BMPs

Bioretention / infiltration / filtrations /…

NOTE : Picture taken during a rain event. There is just enough standing water to saturate the mulch—else most of the water is infiltrated into the ground

Source Control BMPs

Bioretention / infiltration / filtrations /…

Source Control BMPs

Bioretention / infiltration / filtrations /…

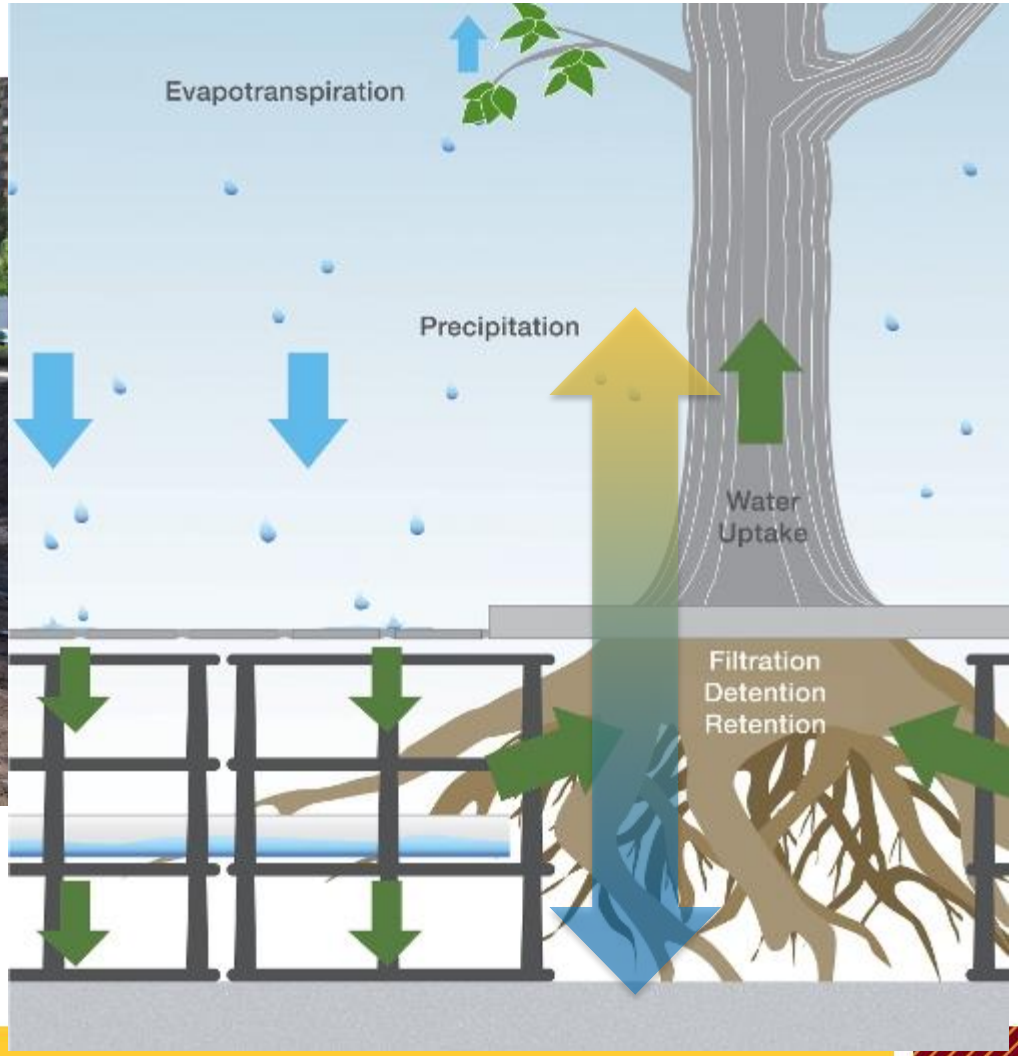
Purpose = Reduce runoff (volume)
Function = A terrestrial (*above water table*) stormwater treatment practice that provides opportunity for runoff infiltration, filtration, storage, and water uptake (loss) by vegetation through interception and plant growth.

Name 3 features

Source Control BMPs--TREE TRENCHES:

Purpose = Reduce runoff (volume)

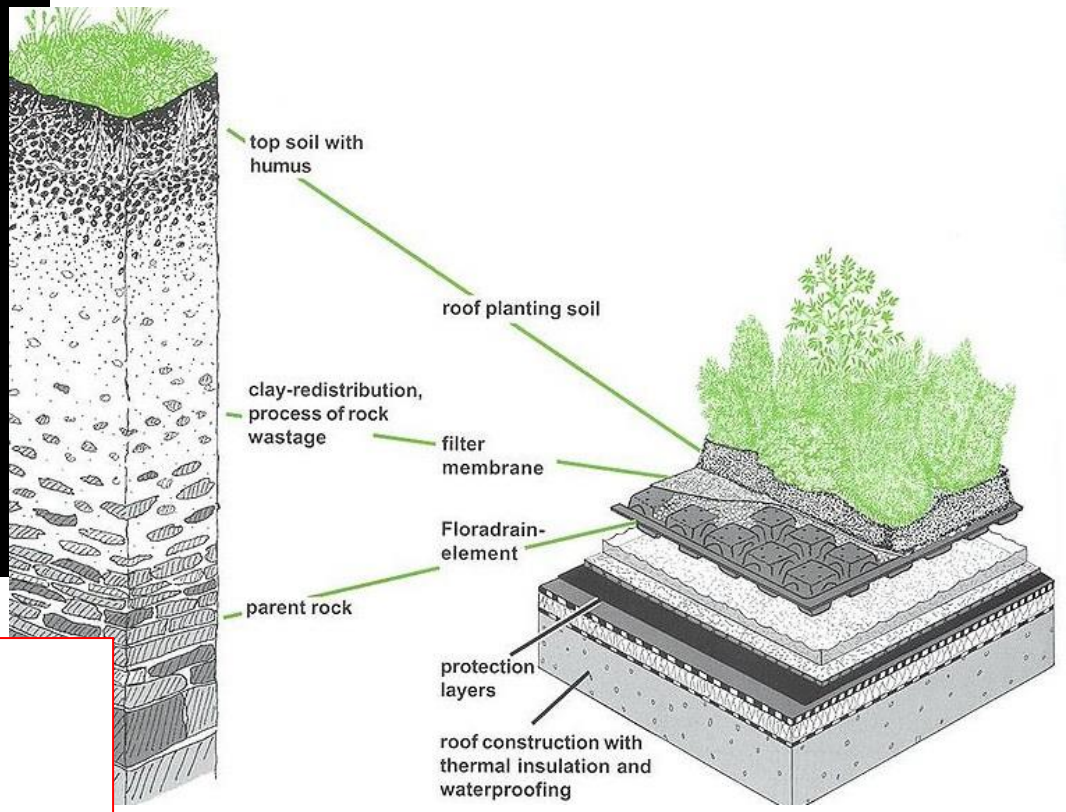
Function = loss stormwater runoff by trees through interception, infiltration, filtration, and tree growth.



Green Roof

Purpose = Reduce runoff ➔ quantity, rate, and water quality

Function = filtering of suspended solids and pollutants associated with those solids



$$V = 0.33 * A_S * D_M$$

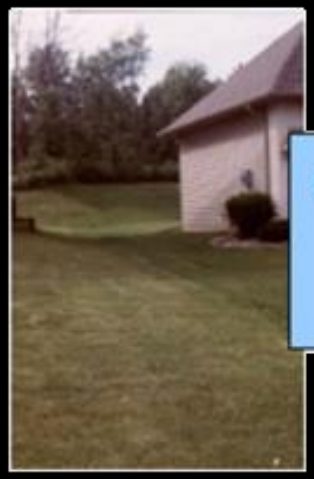
Top surface area (A_S)

Source Control BMPs

Green wall

RUNOFF MANAGEMENT TREATMENT TRAIN

Prevent Pollution



Source Control

(Runoff Volume Minimization)

BMPs

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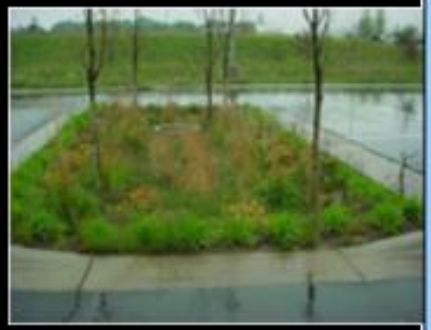
(for water quality, channel protection, flood control)



On Site Water Treatment

Receiving Water

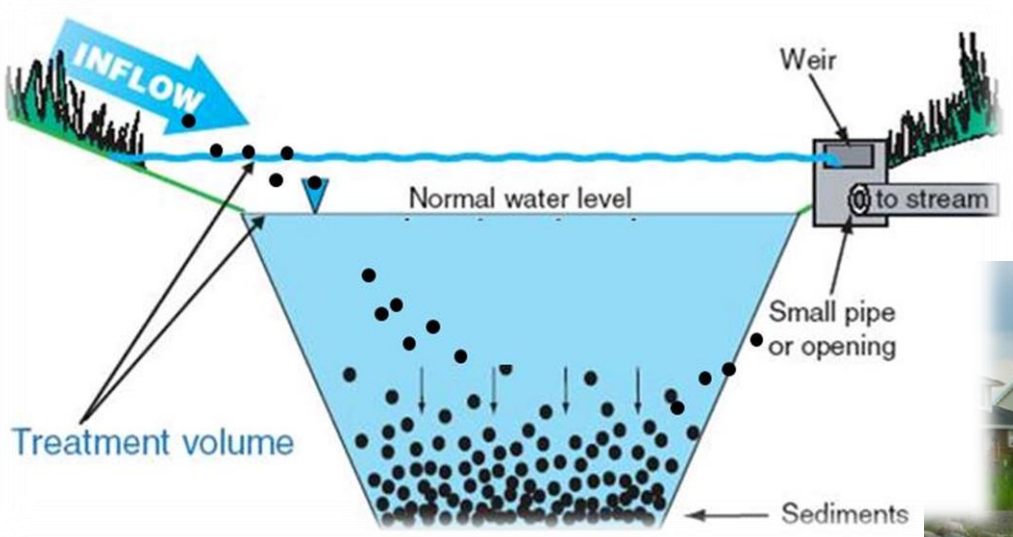
On Site Water Treatment BMPs

All of the Above

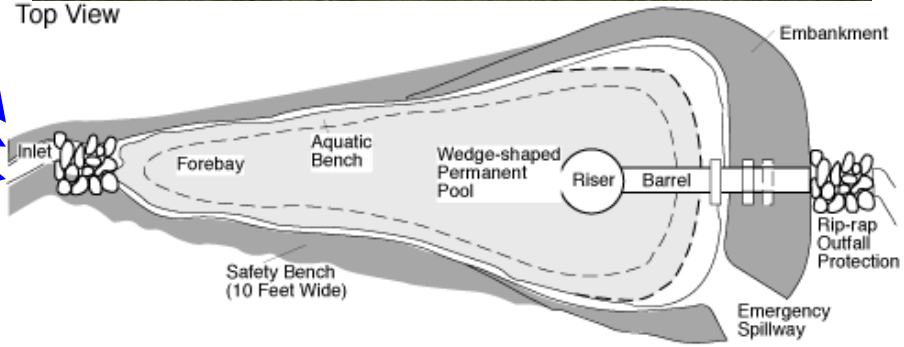
On Site Water Treatment BMPs

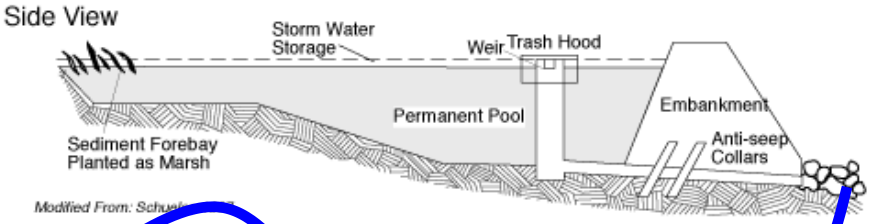
Stormwater Pond

Purpose = Rate Control & Water Quality
Function = Capture & hold (detain) runoff



Stormwater Pond





Stormwater Pond

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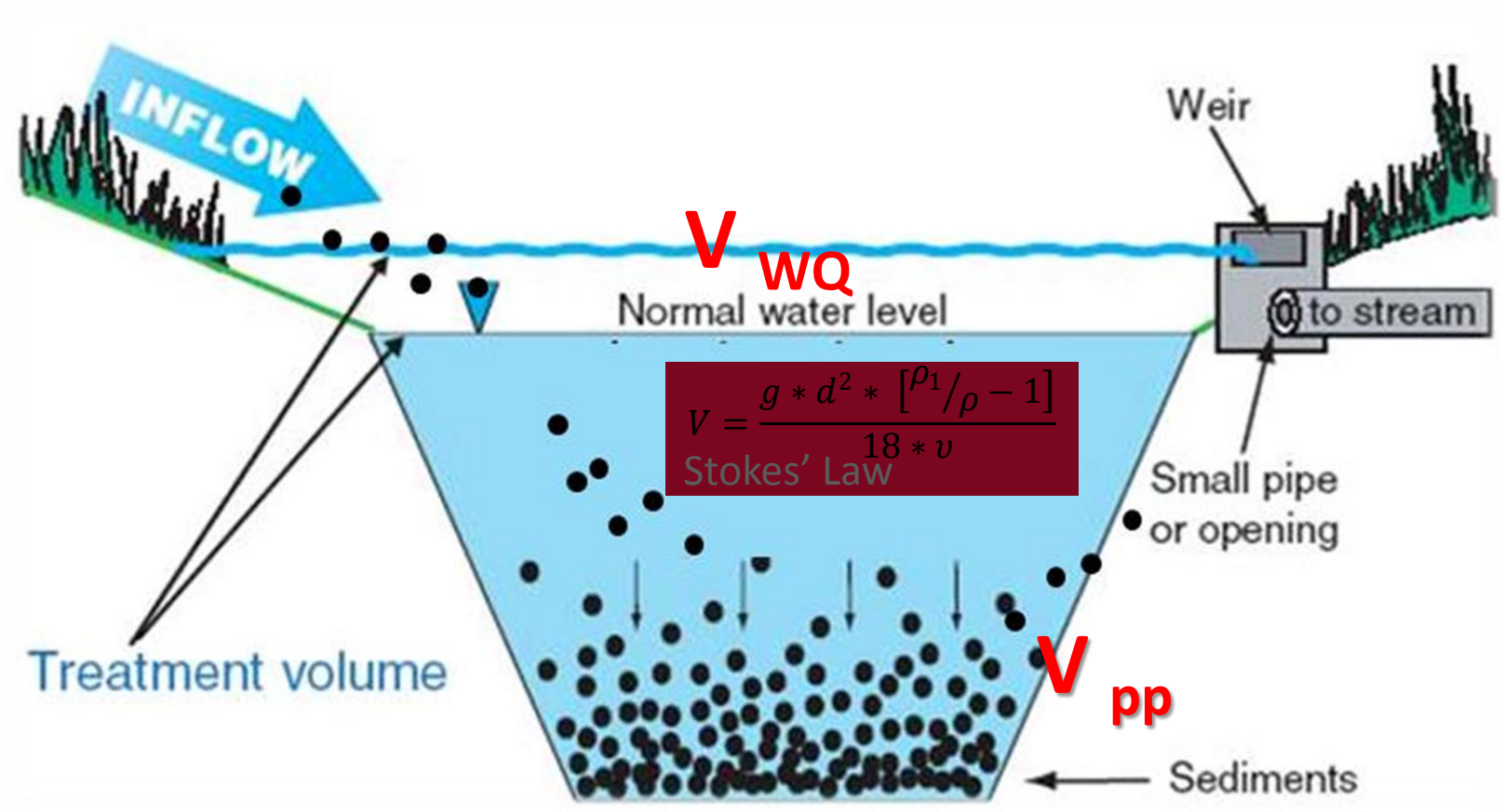


On Site Water Treatment BMPs

Stormwater Quality Ponds

Plymouth MN

Stormwater 101– Group (2-3) Assignment # 3

- **identify three (3) types of Stormwater tools**
- For each type give an example
  - List their function(s) and how it (they) address or resolve the specific problem(s) caused by excessive stormwater runoff.
  - Provide pros & cons for each example
- How would you go about selecting them?
- Why would you recommend them?
- How would you rate them and how would you evaluate them?

Review:
Designing like nature

Example of Preserving Natural Areas
Wayzata High School
City of Plymouth
“Fit development into the landscape”

Champlin
Park
109th Ave N
610
Coon Rapids
County Rd 50
Corcoran
County Rd 19
94
169
Brooklyn Park
252
694
Brooklyn Center
Maple Grove
County Rd 116
County Rd 47
52
Skyway
Whispering Meadows
55
Crystal Airport
Lind-Bohanon
Hamel Rd
Medina
Hamel
494
County Rd 9
Crystal
Victory
County Rd 24
100
Plymouth
Morris T Baker County Park
County Rd 6
Golden Valley
Willard-Hay
Long Lake
Wayzata
U.S. Route 12 in Idaho
394
U.S. 12
Orono
St Louis Park
Google Map

What are our on site resources?

DEAN S BEENINGA, AIA, LEED-AP
Partner / Architect
A T S R

Fitting development into the landscape

DEAN S BEENINGA, AIA, LEED-AP
Partner / Architect
A T S R

http://geo.lib.umn.edu/Hennepin_County/y1956/HHJ-531.jpg

http://geo.lib.umn.edu/Hennepin_County/y1956/HHJ-531.jpg

Stormwater BMPs: Preserving Existing Natural Resources

Image by **Google**

Green Space

#1 BMP: Preserving Natural Areas

Key Elements:

- ❑ Goal is to reduce runoff (*benefit*)
- ❑ Multifunctional landscape (integrate BMPs into the landscape)
- ❑ Water is a resource
- ❑ Know the site's flow (path) of water
- ❑ Restore natural benefits (wetland, soils,..)
- ❑ AND ***Fit development into the landscape***

BMPs: Feature, Function, and Benefits

Designing like nature, and if

Feature (streams, wetlands, pot holes,…) are gone

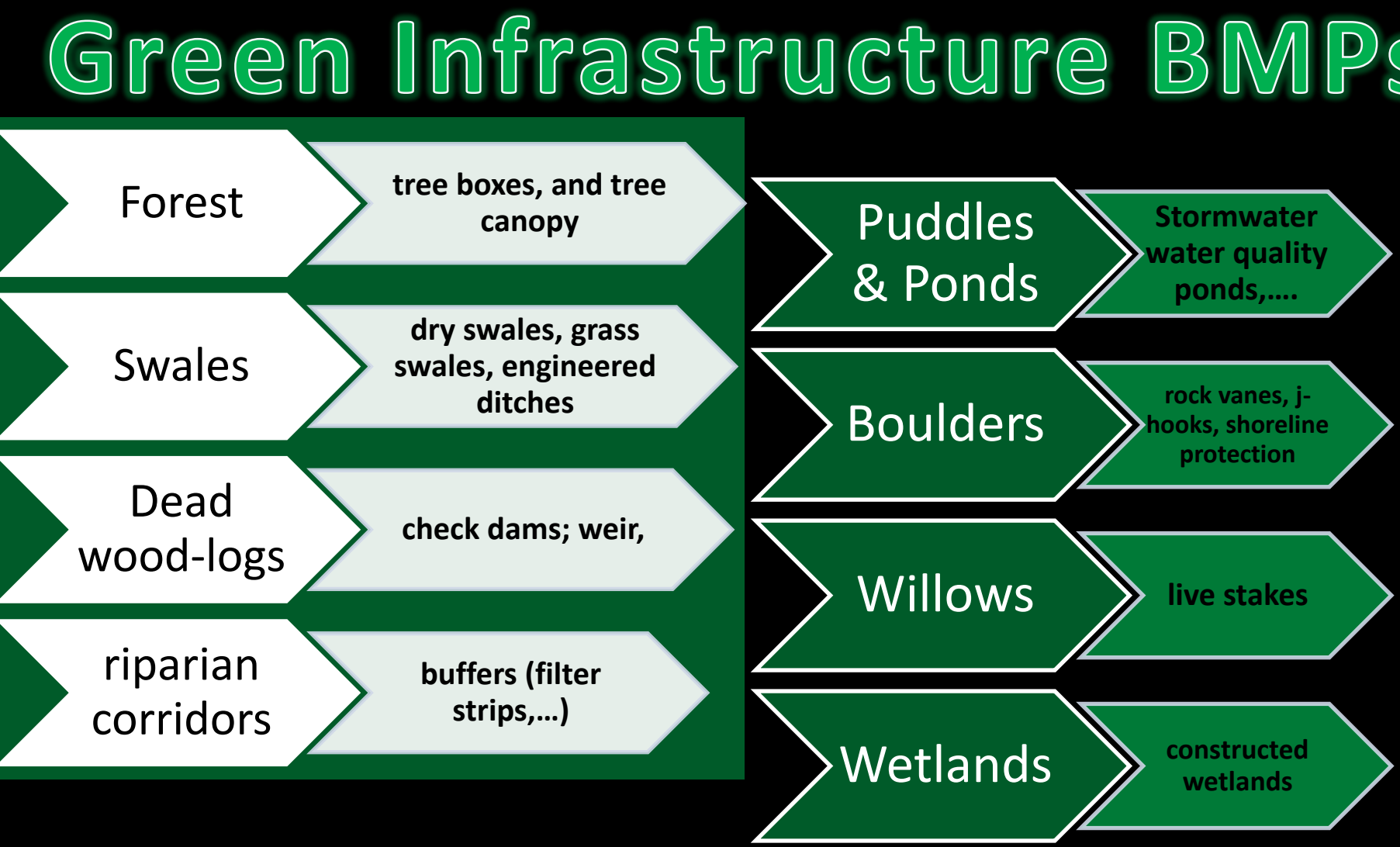
then bring back

Function, and the Benefits

drainage systems components (functions):

natural	constructed
Landscape	
vegetation, trees, forest , rocks ,..	Green space, pervious , trees….
Low spots	
Puddles, floodplains, wetlands,…	Biobasins, raingardens, …
Conduits	
Springs, Brooks, streams, creeks	swales, pipes/culverts, stream (rest.)
Storage	
Wetlands, lakes,	Ponds

drainage systems components (functions):



CHAPTER THREE-TAKEAWAY

Mimicking Natural Drainage Systems

We have _____

STORMWATER 101

Chapter One **The big picture ?**	•**The big picture & issues facing our finite fresh water resources:** *1) aging ecosystem,* *2) increasing demand, and* *3) a changing climate*
Chapter Two **The Problem**	• **What does Stormwater have to do with it?** *Both the natural drainage systems and the constructed ones are susceptible to excessive runoff.*
Chapter Three **Solutions**	• **the feature, function, and the benefits of stormwater BMPs** *and how they fit into the whole system (watershed*
8:10 Chapter Four **Plan & Our Home Site**	• **there are no silver bullets** *but a series of BMPs in protecting our water* • **a system within the system**

Stormwater BMPs: **Takeaways**

- Why ➔ Clean water
- Problem ➔ too much runoff moving too fast.
  Quality, Quantity, & Rate

- **To solve the problem *(mimic natural hydrology)*:**
  - ✓ **Need to ask:** "where does water come from that enters my site and where does it ultimately go when it leaves?"
  - ✓ **Design for** a changing climate, and
  - ✓ **Use**: Treatment Train Runoff Management – **there is no super BMP**

There Are No Silver Bullets—Always solutions, rarely just a solution

If all you have is a hammer, everything looks like a nail

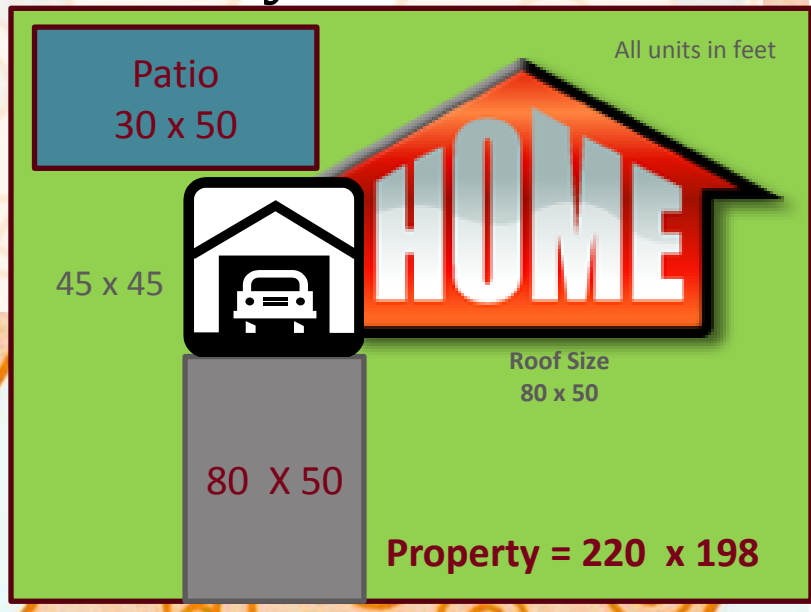
Our home site: a system within the system (watershed)

Stormwater runoff is a watershed scale problem that can be managed at small scale where the rain falls such as our **home sites**

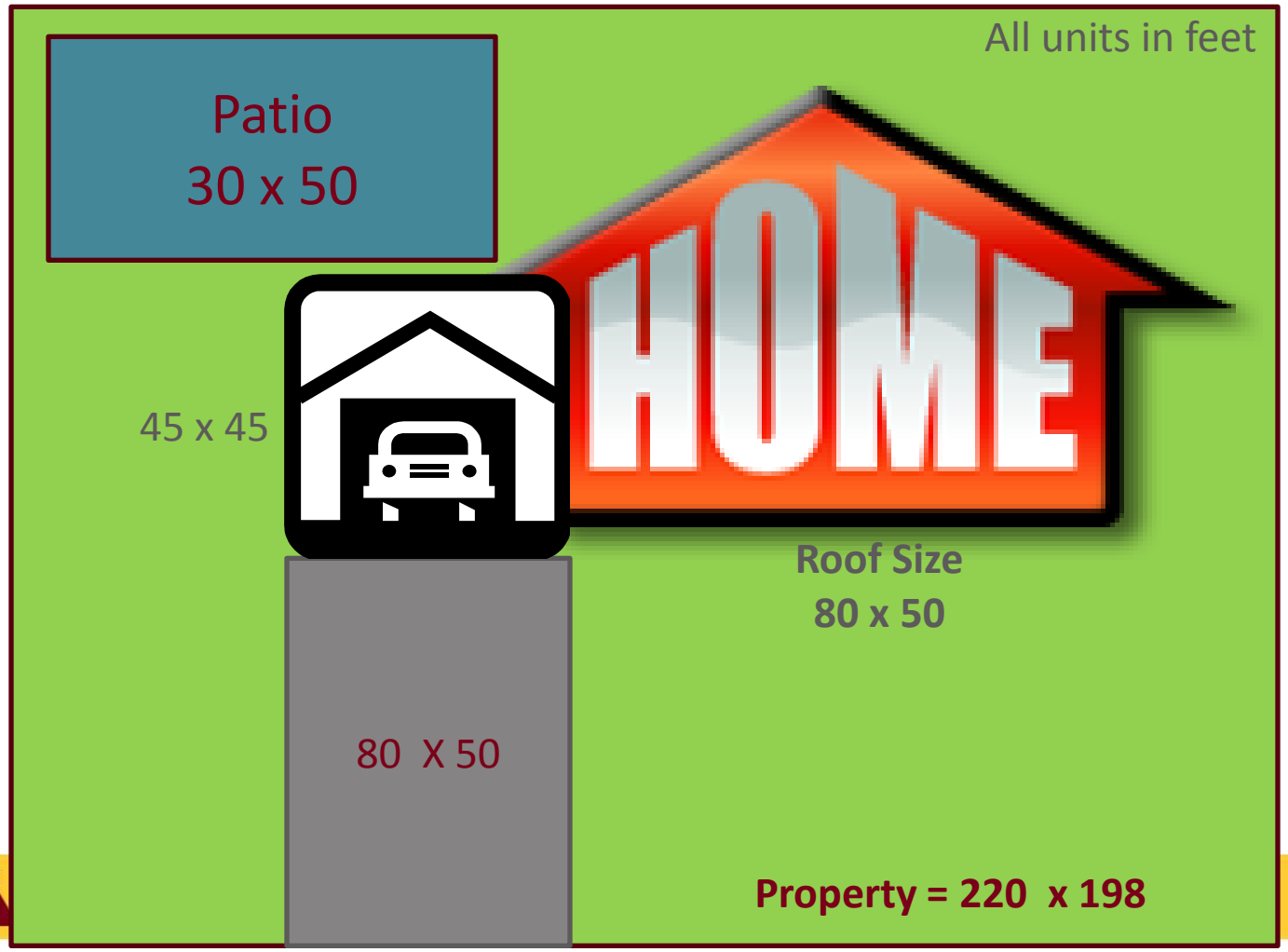
Stormwater 101– Practice ~ 10 min.

Draw a diagram illustrating the flow pattern of your home site, and show sources of runoff

1. **Identify sources of water (where is it coming from)**
2. **How does the water leave the site (exit points)**
3. **Can you estimate the amount that is generated from our site, leaves our site and stays on our site for a 1 inch rain event?**
4. **How would you deal with the runoff?**



I am building this house and the City has required
One water quality pond to treat all of the runoff from a 1 inch rain
Please design the WQ Pond.



NEXT

To prepare for Session 4-
Environmental Decision-making and Behavior Change

Expectations for Preparation:

Bring in a news article related to water policy and identify the policy issue in that article

(current is best, but ok from the past 3 months)

Tonight's Agenda:

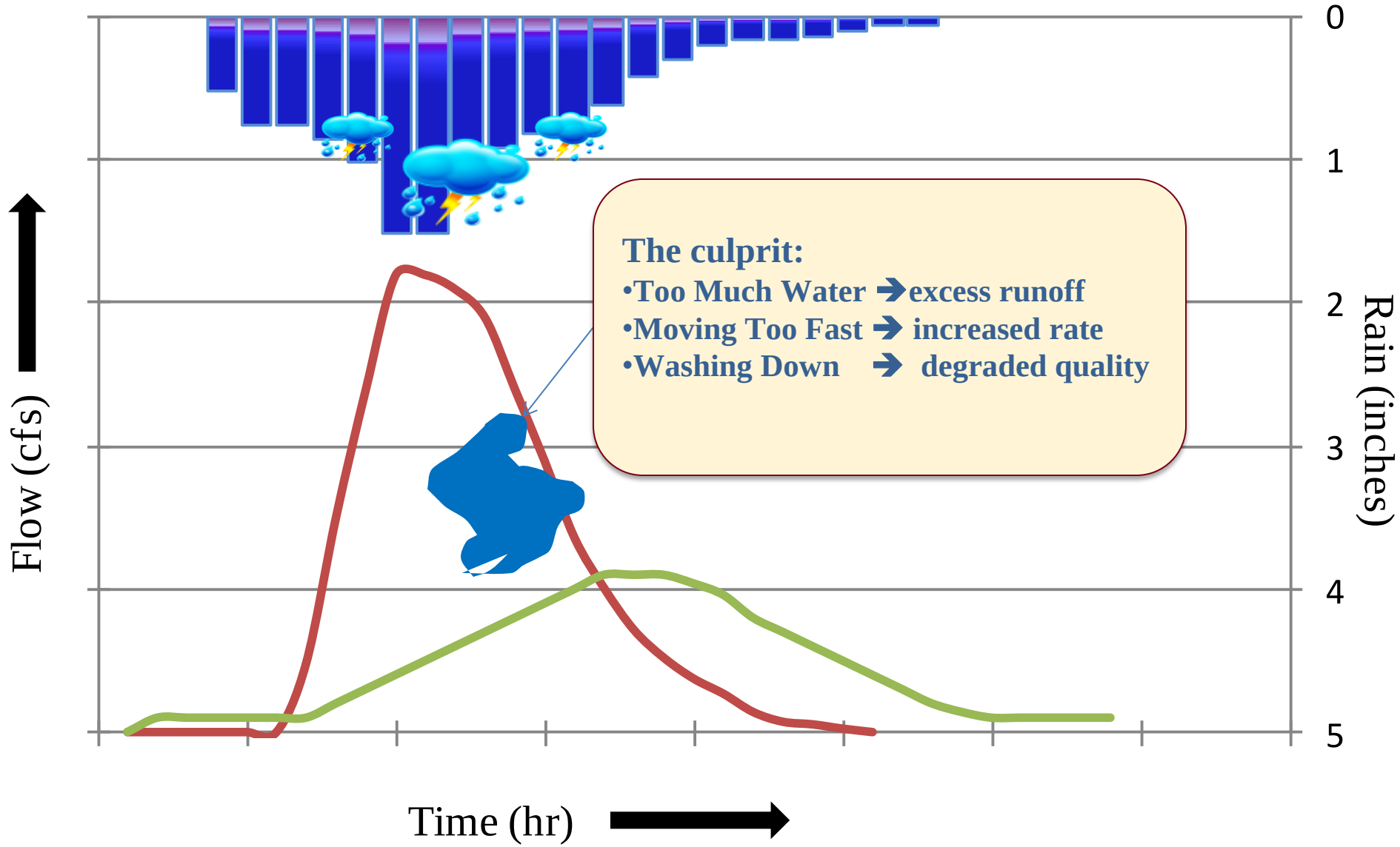
Time	Topic
6:00 pm	**Introductions, review, readings**
6:20 pm	**The big picture** Assignment # 1 (~ 10 min)
6:30 pm	**The problem** Assignment # 2 (~10 min)
6:50 pm	**Break**
7:00 pm	**Solutions** Assignment # 3 (~15 min)
8:00 pm	**Break**
8:10 pm	**There are no silver bullets**
8:11 pm	**Our home site** Assignment # 4 (~10 min)
8:45 pm	**Q & A**

Shahram Missaghi

miss0035@umn.edu ; Water Resources Team

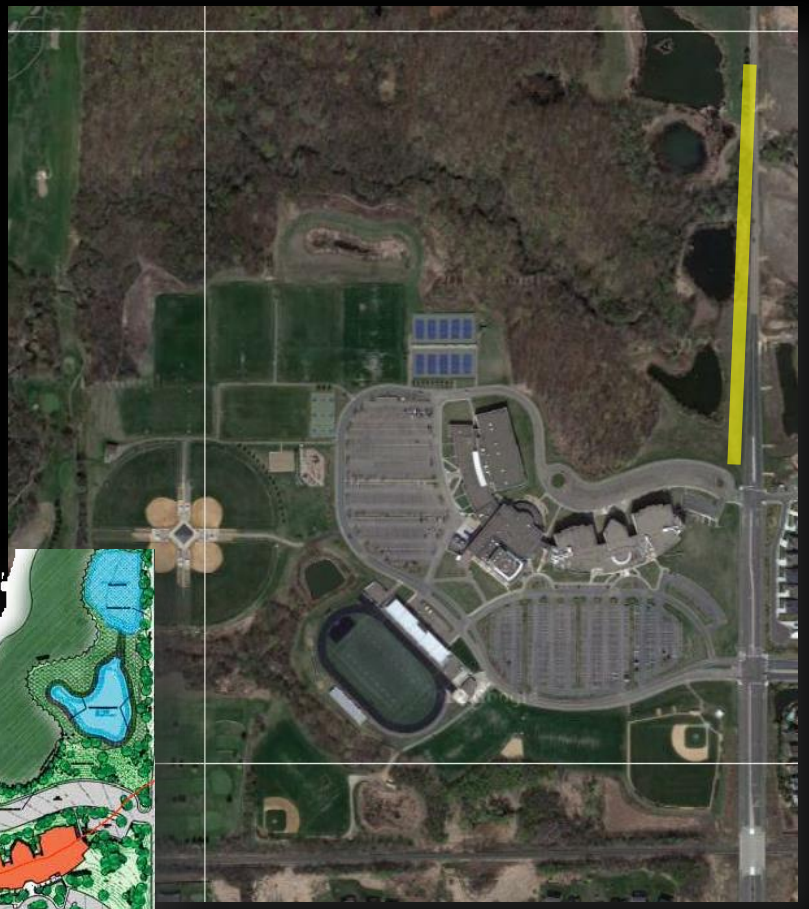
Review!

The Problem(s)



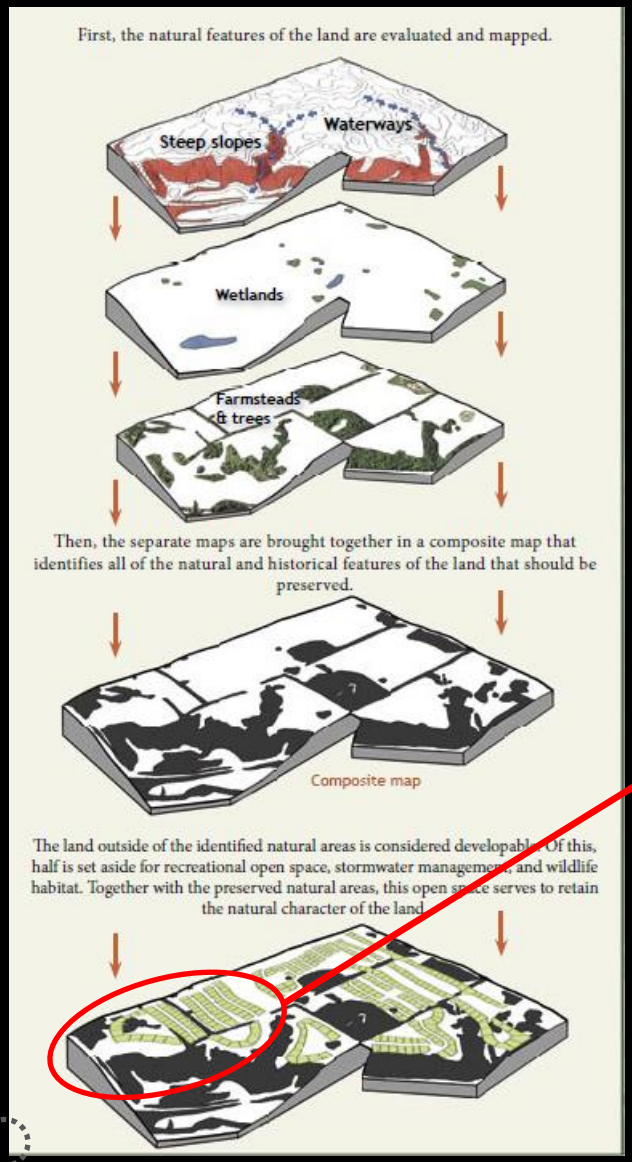
#1 BMP: Preserving Natural Areas-a choice

Purpose & Function = to mimic natural Hydrology



P^2 BMPs: Preserving Natural Areas-HOW

Purpose & Function = to mimic natural Hydrology



1: Inventory

2: Evaluation

3: Design

Resource: MPCA: p-gen3-05.pdf

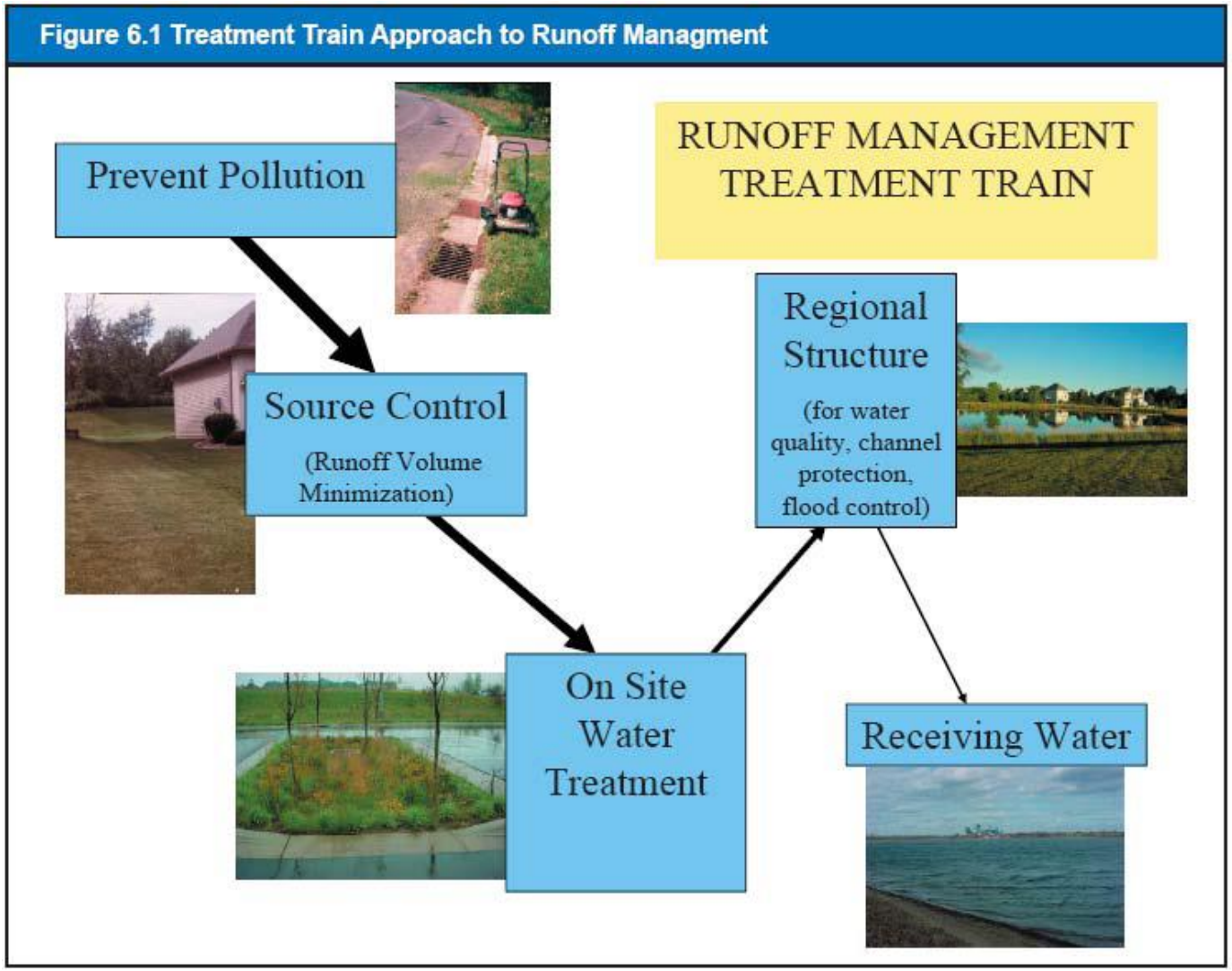
#1 BMP: Preserving Natural Areas

features :

- Reducing impervious cover (minimize impact)
- Preserve natural lands, open space, promote conservation, and
- Use pervious areas for more effective stormwater treatment

Resource: MN Stormwater Manual

Solutions



Bioretention, Raingarden,….:

Pretreatment = sediment

Source Control BMPs

Bioretention / infiltration / filtrations /…

http://**www.seattle.gov**/util/groups/public/@spu/@usm/documents/webcontent/spu02_020023.pdf

Source Control BMPs (less homeowner, more commercial)

Infiltrations

http://www.creditvalleyca.ca/sustainability/lid/images/CVC%20LID%20Manual-DRAFT%209-23-11.pdf

On Site Water Treatment BMPs

Stormwater Quality Ponds- *a choice*

SOURCE: Stormwater & Wetland Maintenance Guidebook

Ponds: home owner's challenges

What is on / in my pond?

Sheens*, slimes, & Films

Trash

Foams*

Algae, plants

*Source: http://www.dnr.sc.gov/cwcs/pdf/Ponds.pdf

Ponds: home owner's challenges

Duckweed

Purple loosestrife

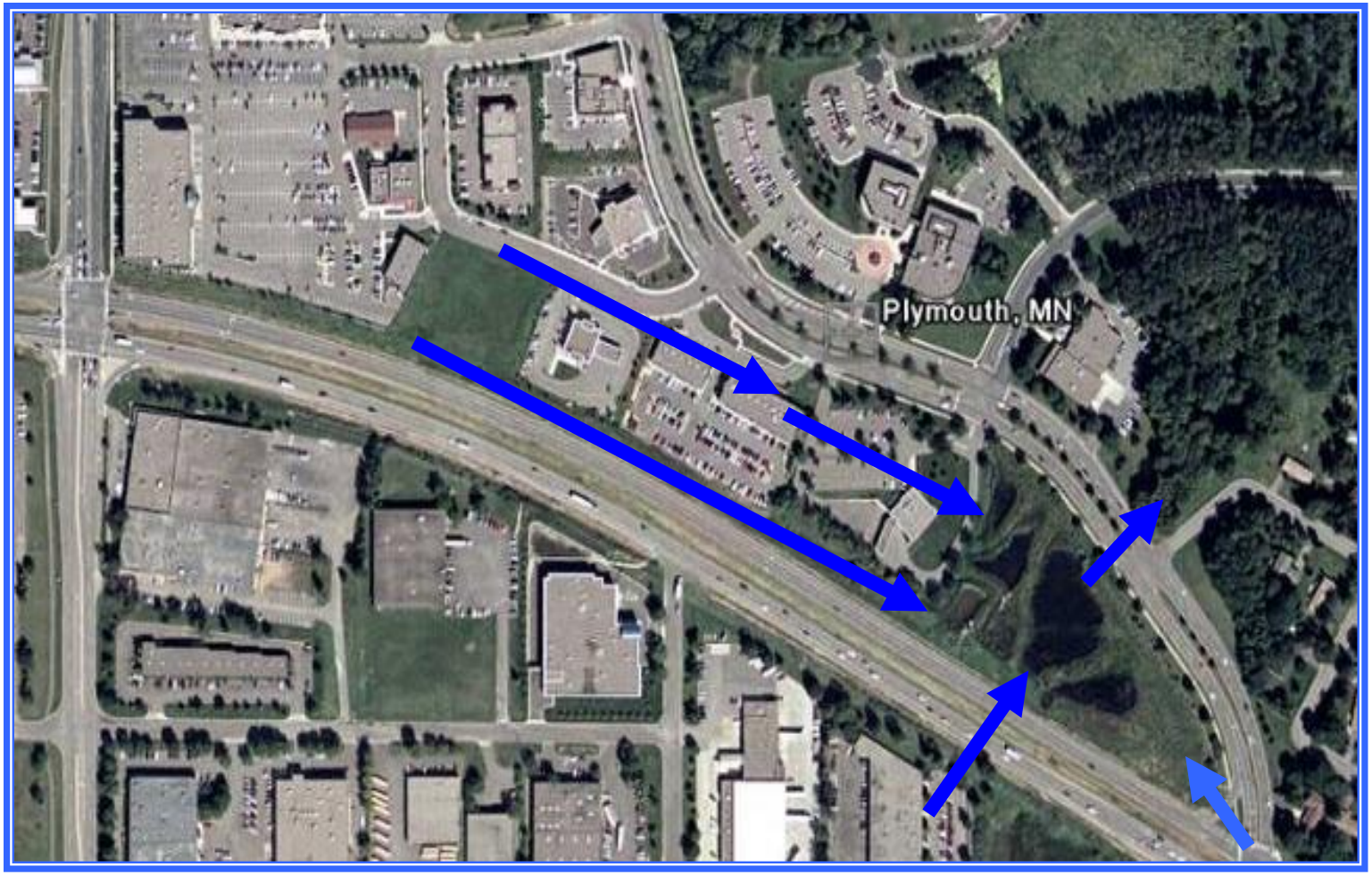
Canada thistle

Smart Weed

Cattail

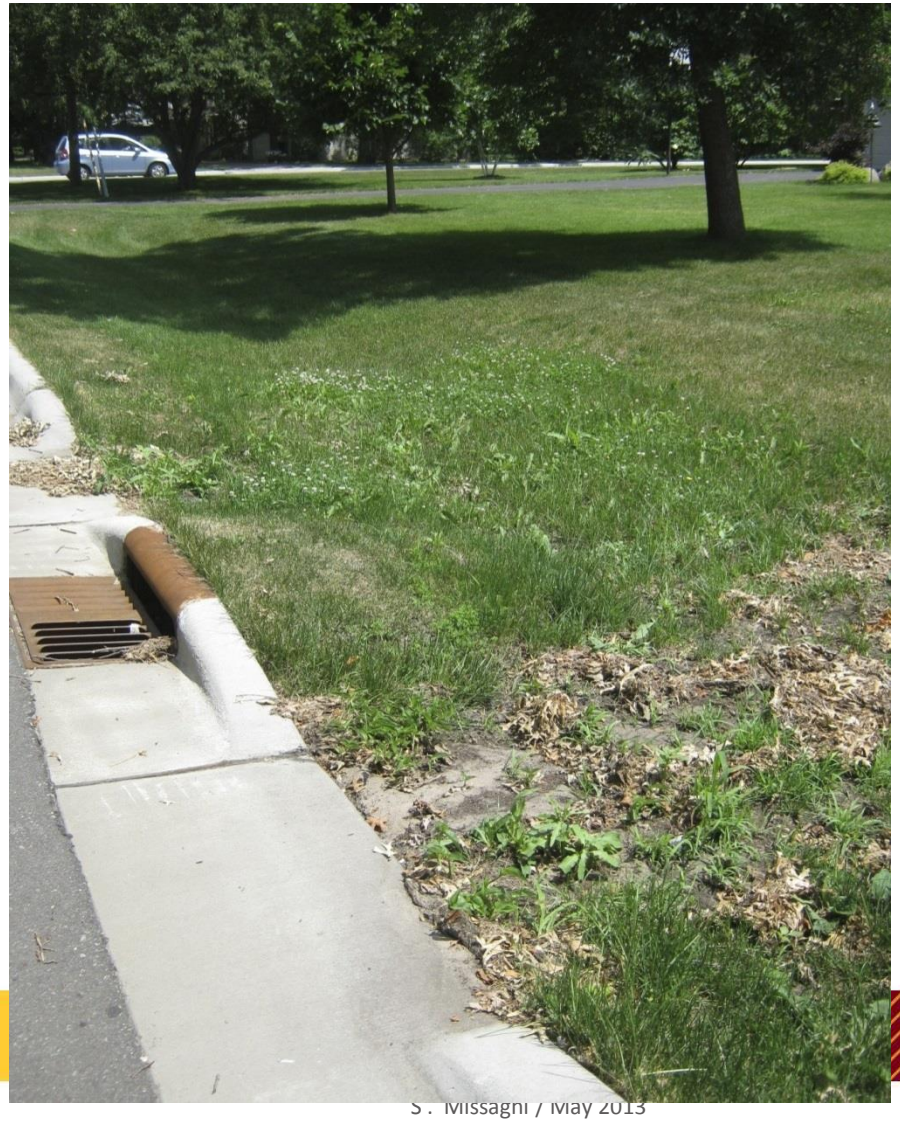
On Site Water Treatment BMPs

Regional Stormwater Quality Ponds



Bioretention, Raingarden,….:

Pretreatment = sediment



Wetland!

Vegetation as pretreatment

http://www.creditvalleyca.ca/sustainability/lid/images/CVC%20LID%20Manual-DRAFT%209-23-11.pdf

Biorentention clogged with construction sediment (Pre-treatment area?)

http://www.creditvalleyca.ca/sustainability/lid/images/CVC%20LID%20Manual-DRAFT%209-23-11.pdf

From Problem to Solutions

U.S. EN

Managing Wet Weather with Green Infrastructure

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- Types, Applications, & Design Approaches
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- Models & Calculators
- Municipal Handbook
- Funding Opportunities
- Links
- Training & Conferences

Managing Wet Weather with Green Infrastructure

Green infrastructure is an approach to wet weather management that is cost-effective, sustainable, and environmentally friendly. Green Infrastructure management approaches and technologies infiltrate, evapotranspire, capture and reuse stormwater to maintain or restore natural hydrologies. See examples of green infrastructure and design approaches.

restore natural hydrologies

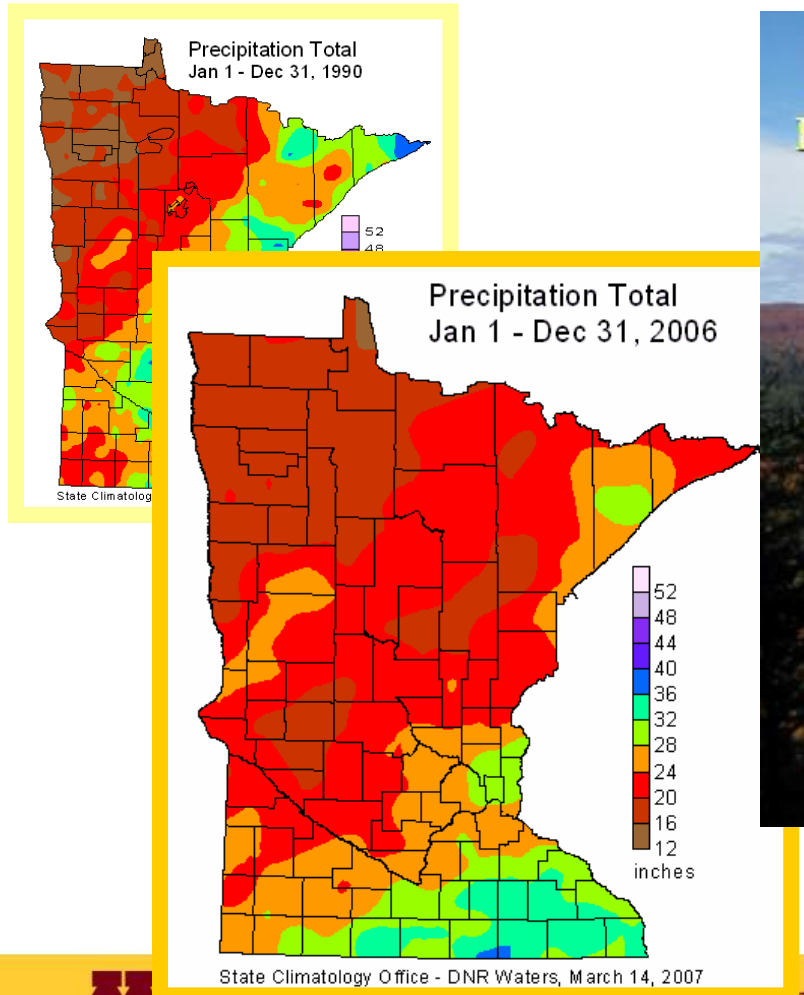
tion of natural landscape features (such as forests, floodplains and wetlands) ar
cture. By protecting these ecologically sensitive areas, communities can improve water quality while providing wildlife habitat and opportunities for outdoor recreation.

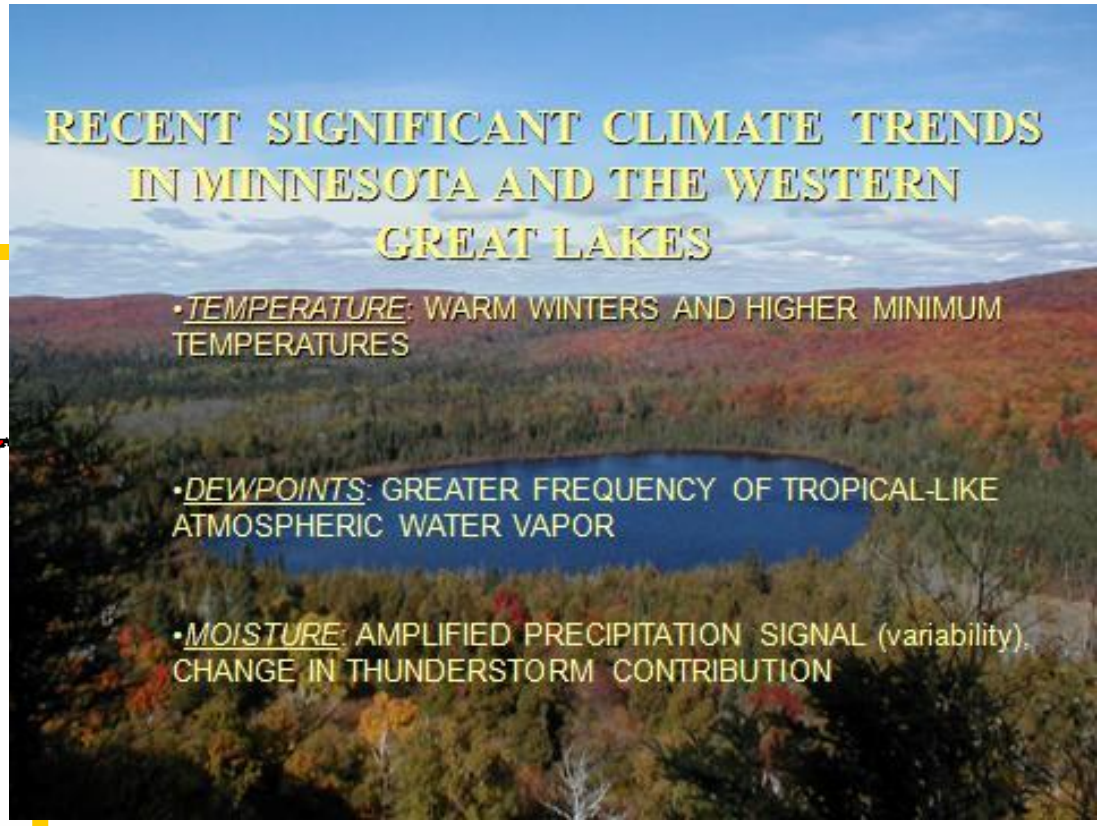
On a smaller scale, green infrastructure practices include rain gardens, porous pavements, green roofs, infiltration planters, trees and tree boxes, and rainwater harvesting for non-potable uses such as toilet flushing and landscape irrigation.

- Green Infrastructure Case Studies: Municipal Policies for Managing Stormwater with Green Infrastructure (PDF) (76 pp, 8.23MB)
- Green Infrastructure in Arid and Semi-Arid Climates (PDF) (9 pp, 1.3MB)

Considerations for Mimicking Natural Drainage Systems

Designing for a changing climate!





http://www.climate.umn.edu/seeley/

Considerations for Mimicking Natural Drainage Systems

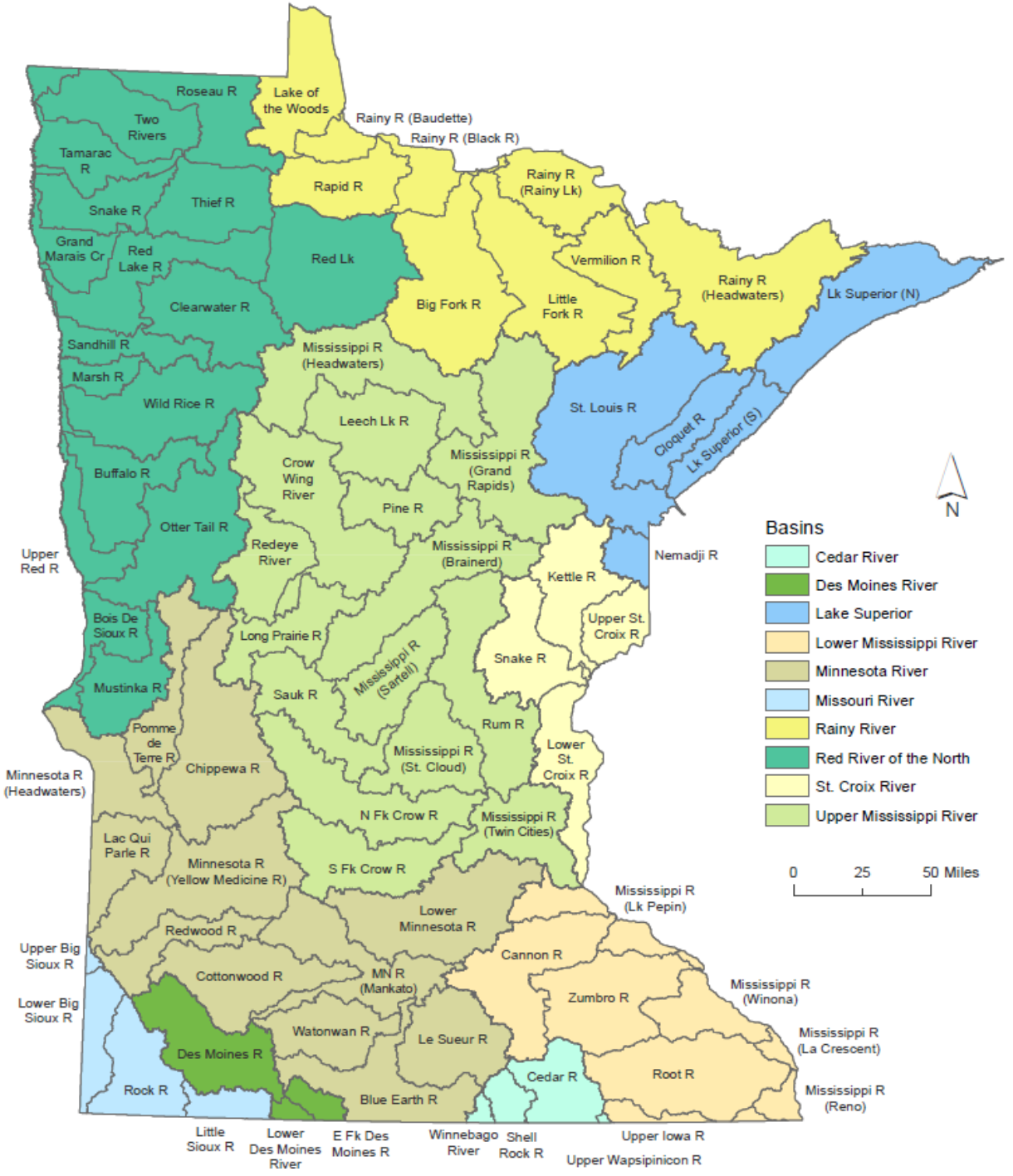
Watershed Approach:

"Where does water come from that enters my site and where does it ultimately go when it leaves?"

SOURCE ➔ MN Stormwater Manual

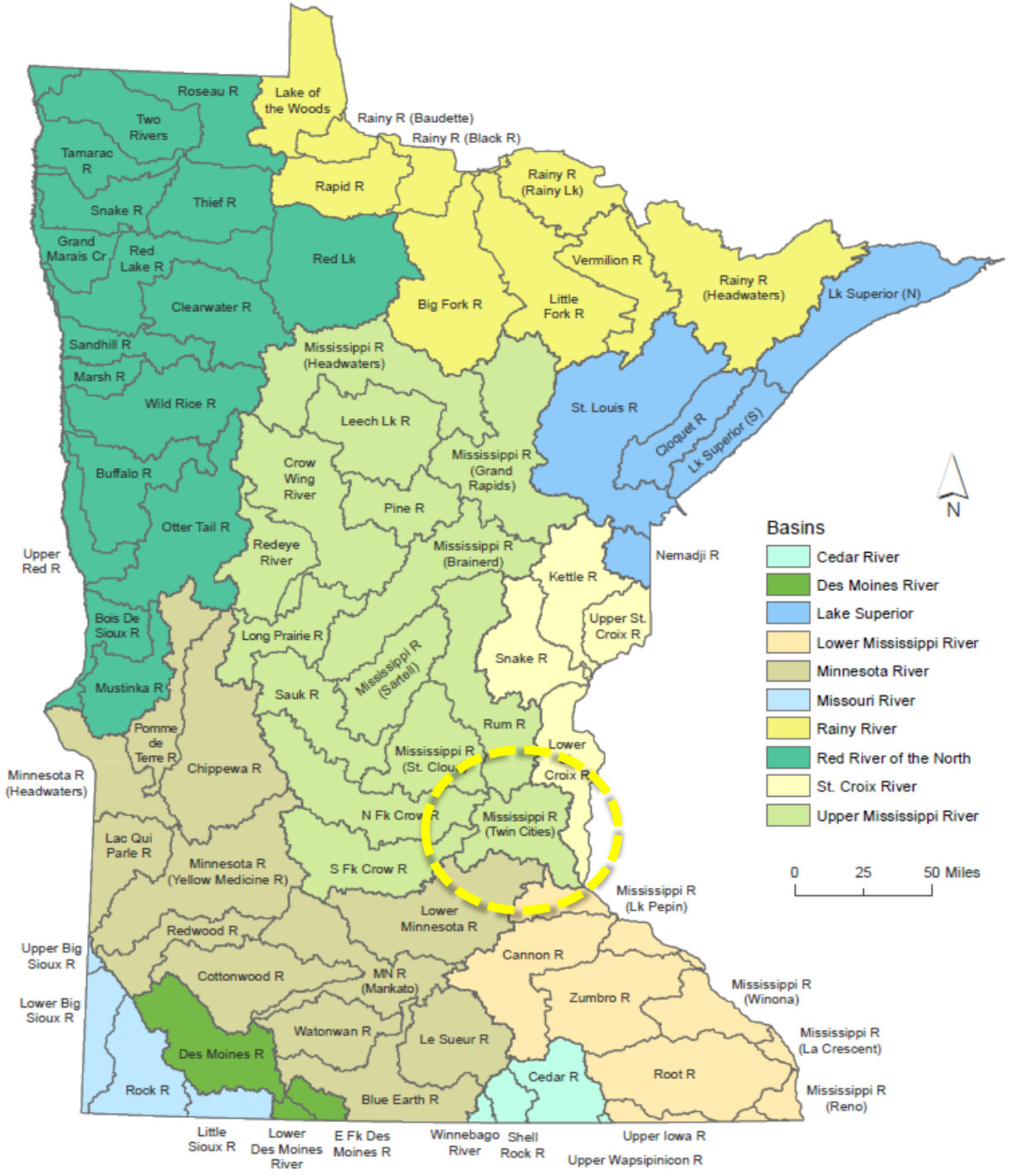
What is a Watershed?

Minnesota Watersheds

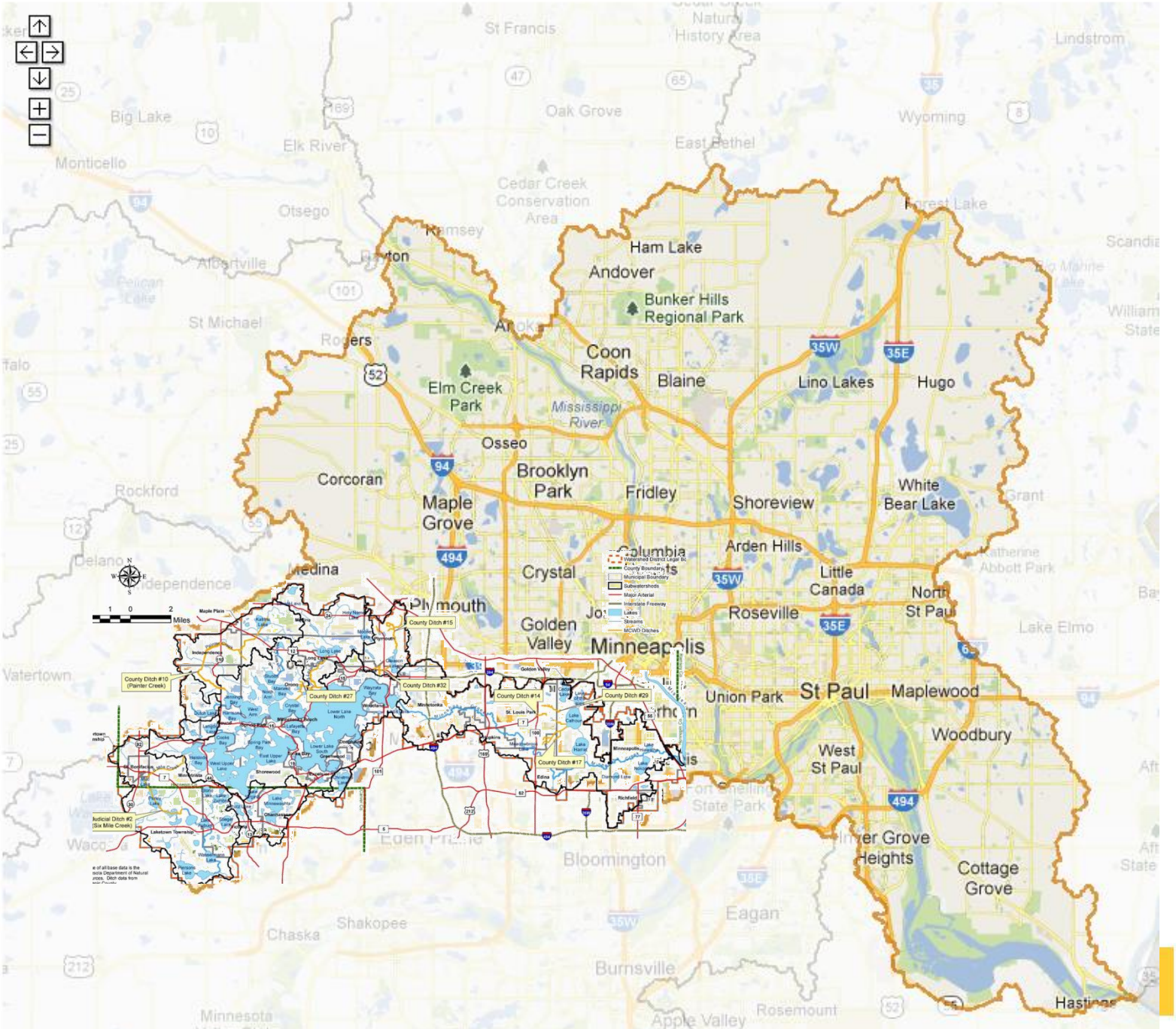


UNIVERSITY OF MINNES

Minnesota Watersheds




St Francis
Natural History Area
Lindstrom
Big Lake
Oak Grove
Wyoming
Elk River
East Bethel
Monticello
Cedar Creek Conservation Area
Otsego
Forest Lake
Ham Lake
Andover
Albertville
Bunker Hills Regional Park
St Michael
Coon Rapids
Blaine
Lino Lakes
Hugo
Elm Creek Park
Mississippi River
Osseo
Corcoran
Brooklyn Park
Fridley
Shoreview
White Bear Lake
Rockford
Maple Grove
Delano
Columbia Heights
Arden Hills
Medina
Crystal
Little Canada
Independence
Plymouth
Jordan
Roseville
North St Paul
Golden Valley
Minneapolis
Lake Elmo
Orono
Wayzata
Phillips
St Louis Park
St Paul
Maplewood
Union Park
Powderhorn
Mound
Woodbury
Shorewood
Lake Minnetonka
Nokomis
West St Paul
Minnesota Landscape Arboretum
Eden Prairie
Bloomington
Cottage Grove
Chaska
Shakopee
Eagan
Burnsville
Apple Valley
Rosemount
Hastings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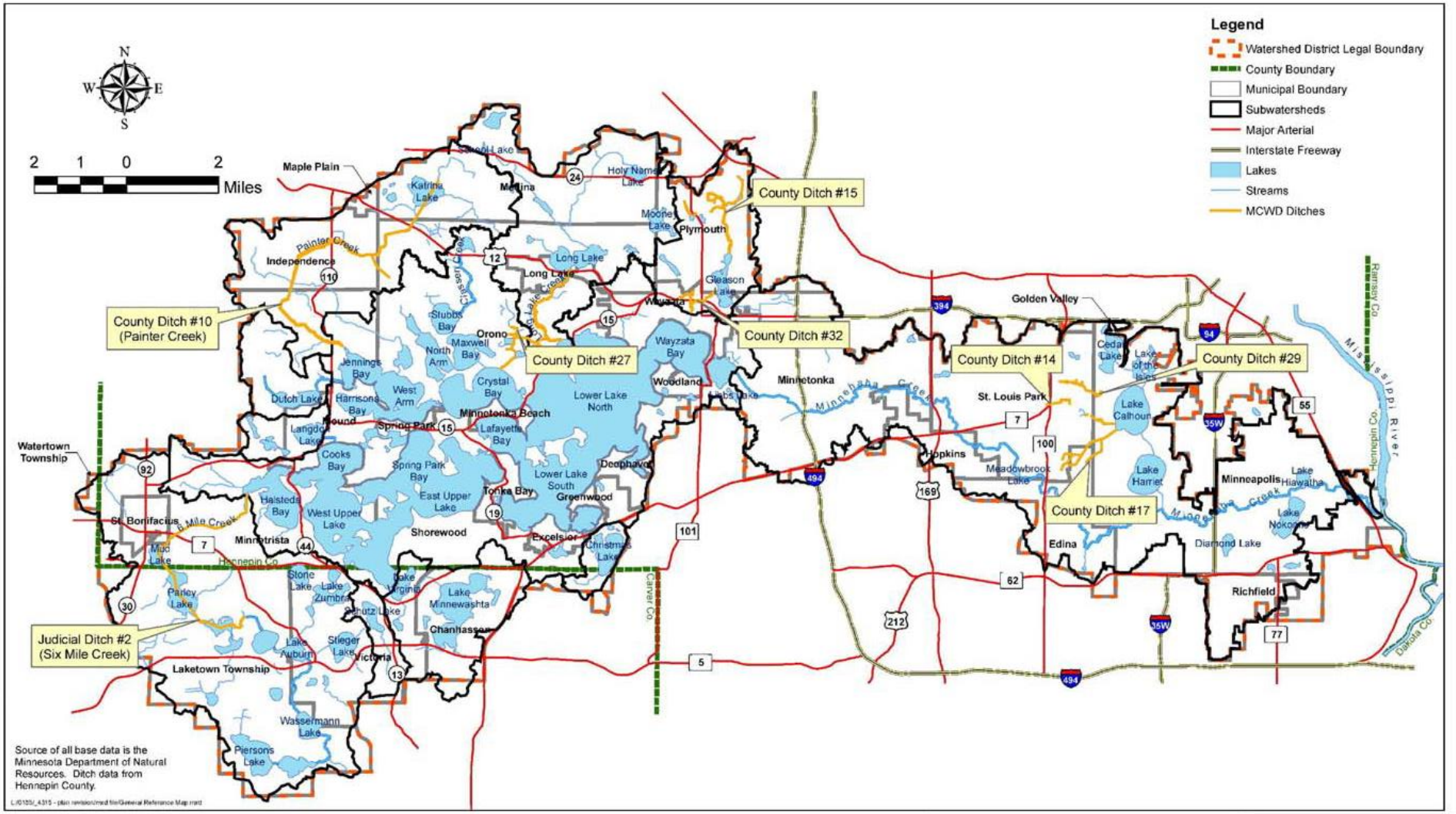
Fridley
Shoreview
White Bear Lake
Rockford
Maple Grove
Arden Hills
Medina
Crystal
Columbia Heights
Little Canada
Roseville
North St Paul
Golden Valley
Minneapolis
Union Park
St Paul
Maplewood
Woodbury
West St Paul
Cottage Grove
Bloomington
Eagan
Shakopee
Chaska
Burnsville
Apple Valley
Rosemount
Hastings
Miles
County Ditch #15
County Ditch #10 (Painter Creek)
County Ditch #27
County Ditch #32
County Ditch #14
County Ditch #29
County Ditch #17
Judicial Ditch #2 (Six Mile Creek)



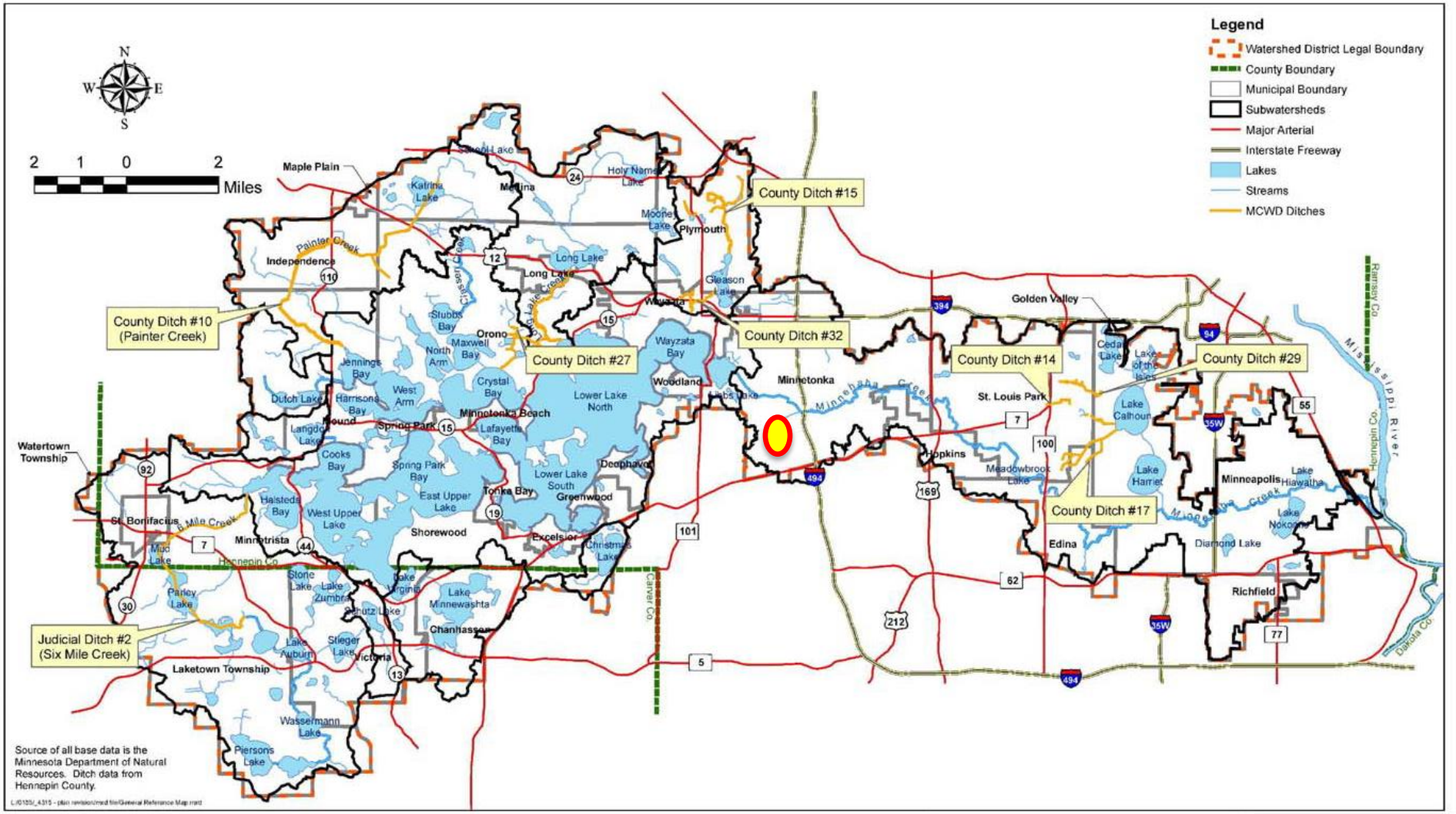
MINNEHAHA CREEK WATERSHED DISTRICT

County and Judicial Ditches Under the Jurisdiction of the Minnehaha Creek Watershed District

Minnehaha Creek Watershed District

JAN 2006

Figure 1



MINNEHAHA CREEK WATERSHED DISTRICT

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Minnehaha Creek Watershed District

JAN 2006

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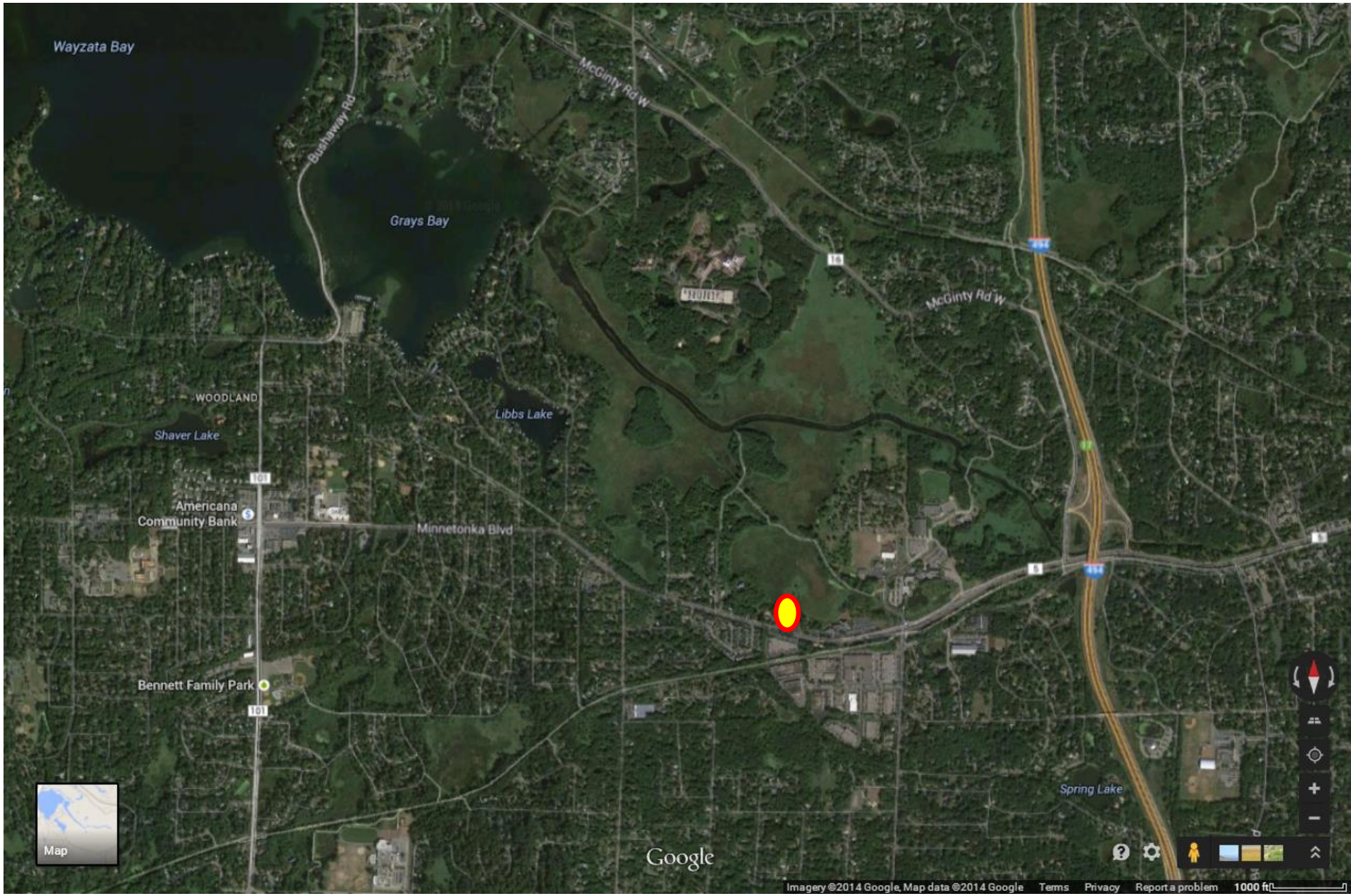
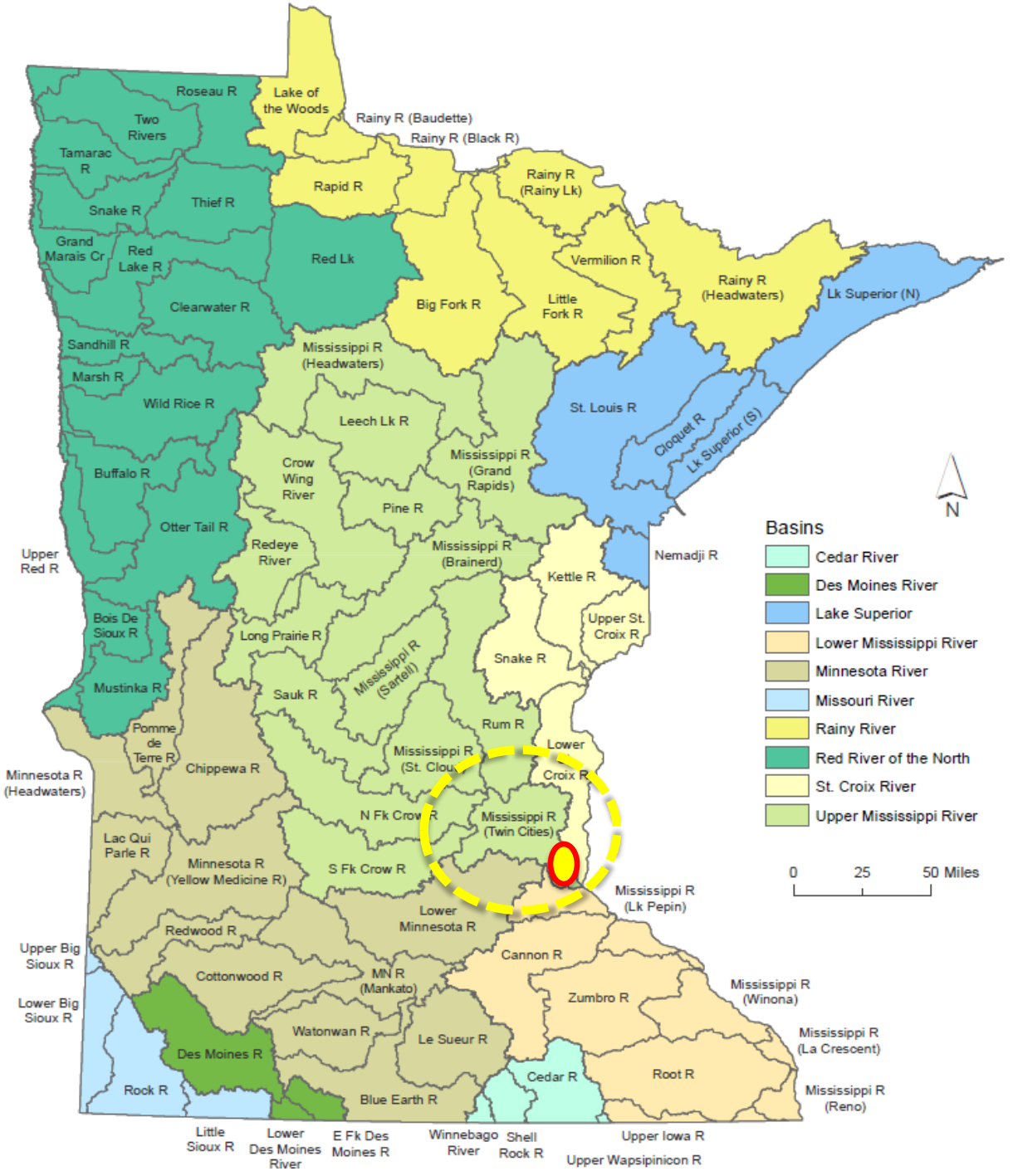


What is a Watershed?

How/where water flows



Our home site: a system within the system (watershed)

Stormwater runoff is a watershed scale problem that can be managed at small scale where the rain falls such as our **home sites**

Thank you!

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miss0035@umn.edu
Water Resources, University of Minnesota Extension