MIDS Work Group Meeting

September 24, 2010

Introduction to Barr's Initial MIDS Tasks

BARR

Legislation Review

The agency shall develop performance standards, design standards, or other tools to enable and promote the implementation of low-impact development and other stormwater management techniques. For the purposes of this section, "low-impact development" means an approach to storm water management that mimic's a site's natural hydrology as the landscape is developed. Using low-impact development approach, storm water is managed on-site and the rate and volume of predevelopment stormwater reaching receiving waters is unchanged. The calculation of predevelopment hydrology is based on native soil and vegetation.

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The GOAL according to the legislation:

- The goal is to “promote LID”
- An approach “that mimic’s a site’s natural hydrology”
- “the rate and volume of predevelopment stormwater…… is unchanged”
- “based on native soil and vegetation”
- “storm water is managed on-site”

Definitions:

- Natural Hydrology = Pre-settlement conditions?
- Predevelopment = Pre-settlement?
- Pre-settlement considerations = soils and vegetation before any human alteration?
- Any other pre-settlement variables?

Intent:

- How much rainfall did nature keep from running off?
- Do that.
- (*That* may or may not meet anti-degradation or TMDL goals.) We'll find out.

Barr’s First Tasks

- Provide Background and Foundation for Defining Performance Goals
  - Vegetation and Soils
  - Regional Hydrologic Metrics
    - Precipitation
    - Infiltration
    - Abstractions
  - Performance Goal Alternative Evaluation and Runoff Volume Characterization

Barr's Anticipated Schedule – WO #1

Provide Background and Foundation for Performance Goals	September			October		
	13-29	20-26	27-1	4-10	11-17	18-24
Work Order Fully Executed (Sept. 13)	■					
Research Options to Define Performance Goals for Different Sectors in MN	■	■	■	■		
Define Regional Hydrologic Metrics	■	■	■	■		
Characterize Runoff Volumes	■	■	■	■		
MIDS Work Group Meeting (Sept. 24)		■				
MIDS Work Group Meeting (Oct. 15)					■	
Finalize Products					■	■

Barr’s Anticipated Overall Schedule

	Sept.	Oct.	Nov.	Dec.	Jan.
Performance Goal(s)					
Credits					
Calculator					

Suggested Decision Dates

- September 24:
  - – Eliminate one or more common volume control practices from further evaluation
- October 15 (or before):
  - – Direct Barr on which performance goal to pursue
- November 19:
  - – Finalize performance goal(s)
- December 17:
  - – Finalize credits method & model
- January 21:
  - – Approve calculator

Variables Affecting Runoff (hydrology)

- Climate (varies by eco-region)
  - – Precipitation
    - Amount
    - Duration
      - – Intensity
    - Time of year
  - – Growing season
  - – Air temperature
  - – Humidity

Variables Affecting Runoff (hydrology)

- Soils (varies across the state)
  - Infiltration rate
  - Vegetation type
- Groundwater elevation
  - Shallow
  - Deep
- Surface Water
- Bedrock

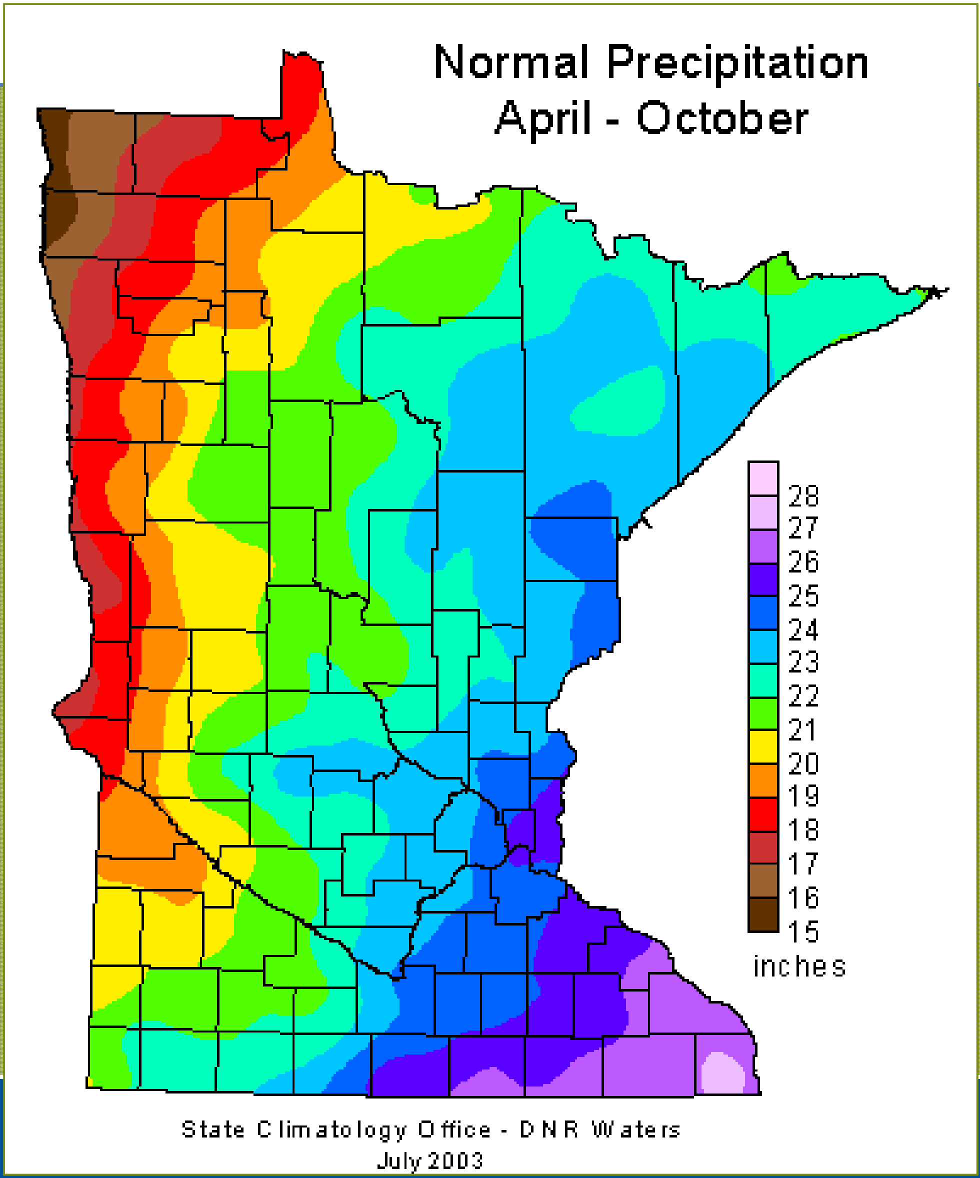
Variables Affecting Runoff (hydrology)

- Vegetation
  - Prairie
  - Deciduous forest
  - Boreal forest
  - Corn and Soybeans
- Topography
  - flat
  - Steep

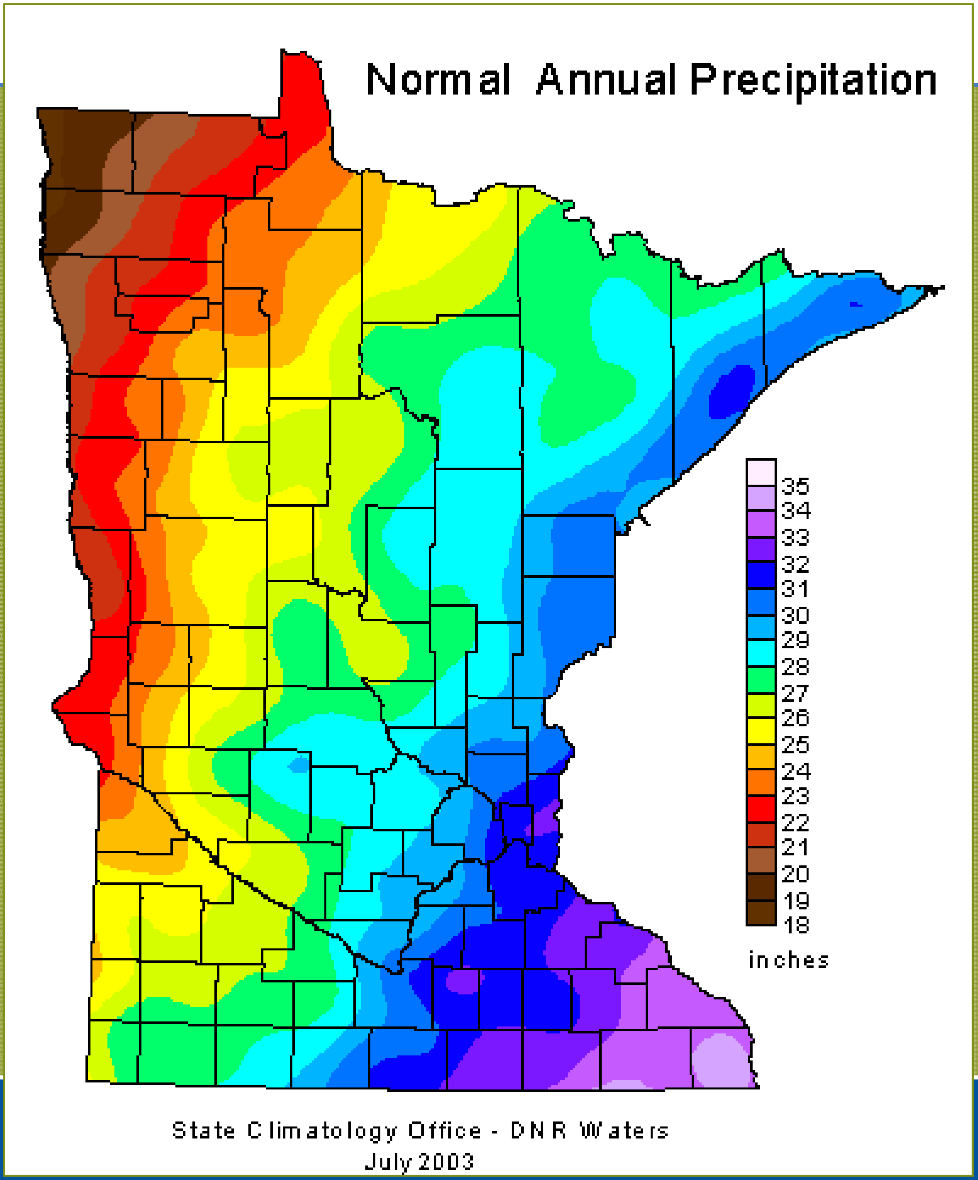
"Make everything as simple as possible, but not simpler."

- Albert Einstein

Precipitation Variability in MN: April - Oct



Normal Annual Precipitation Variability in MN: 18-35 inches



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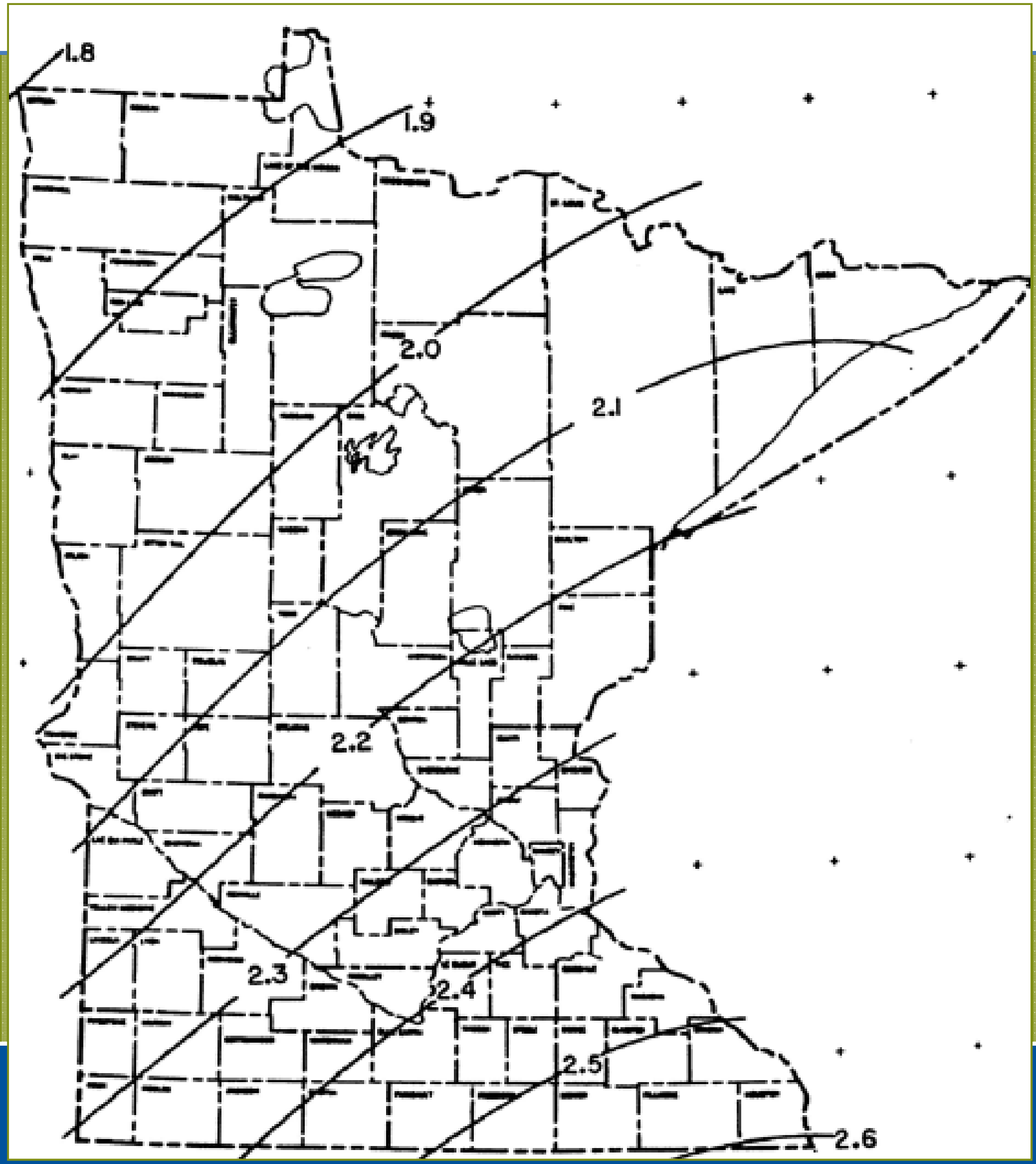
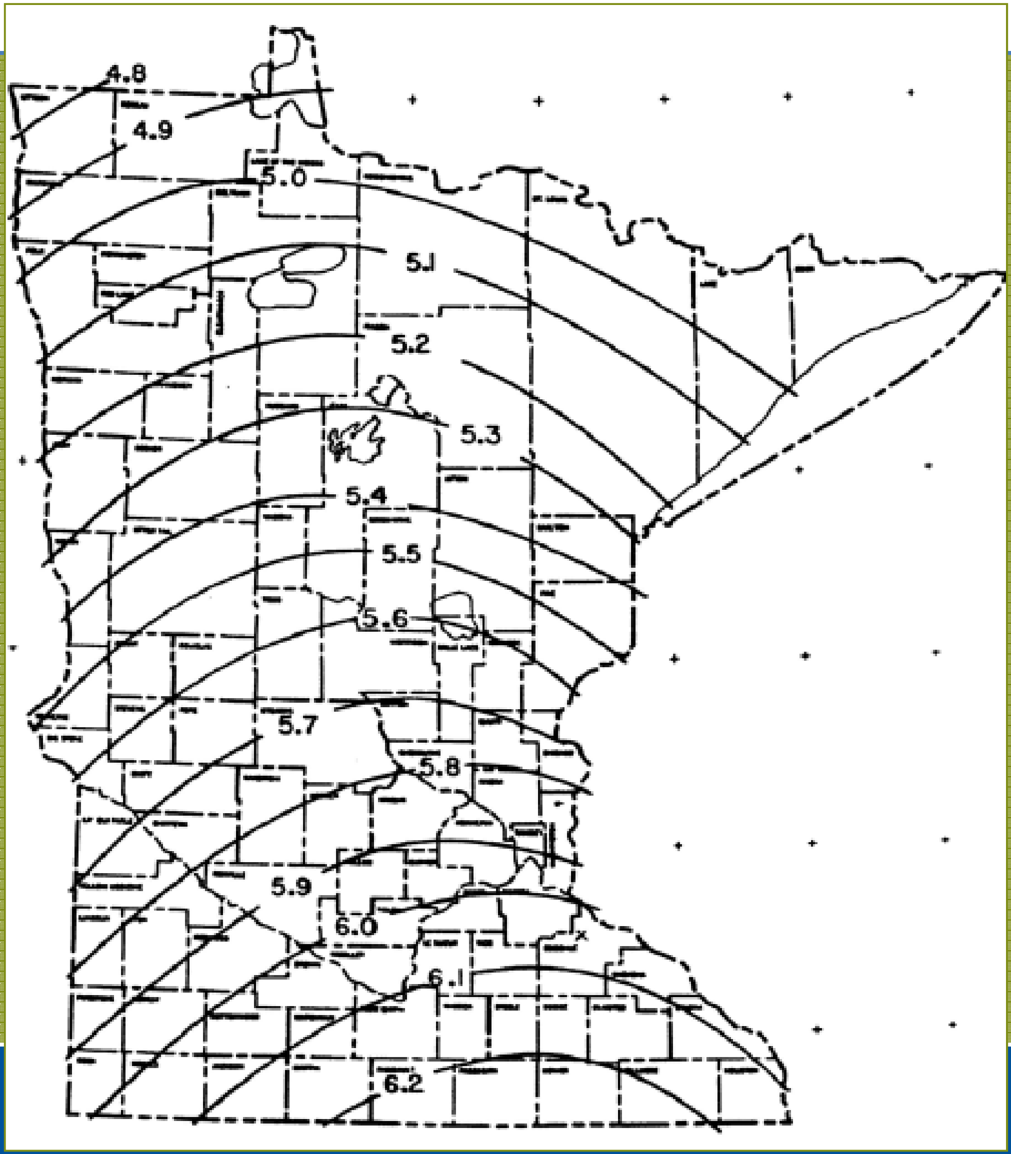
Variability in 1-year, 24-hour Rainfall in MN



Variability in 100-year, 24-hour Rainfall in MN



Variability in 24-hr Precipitation Events in MN

Recurrence Period	Range of Precipitation throughout MN (24-hour rainfall duration)
1-year	1.8 in – 2.6 in
2-year	2.1 in – 2.9 in
5-year	2.8 in – 3.7 in
10-year	3.3 in – 4.4 in
25-year	3.9 in – 5.0 in
50-year	4.4 in – 5.6 in
100-year	4.8 in – 6.2 in

Variability in Rainfall Intensity
Total amount vs. time

Recurrence Period	Minneapolis-St. Paul 24-hr rainfall (in)	Minneapolis-St. Paul 1/2-hr rainfall (in)
1-year	2.3	0.9
2-year	2.8	1.1
5-year	3.5	1.45
10-year	4.1	1.65
25-year	4.8	1.9
50-year	5.3	2.1
100-year	5.9	2.4

Abstractions

Depression Storage

- flat
- rolling
- steep
- roof – sloped vs flat
- pavement

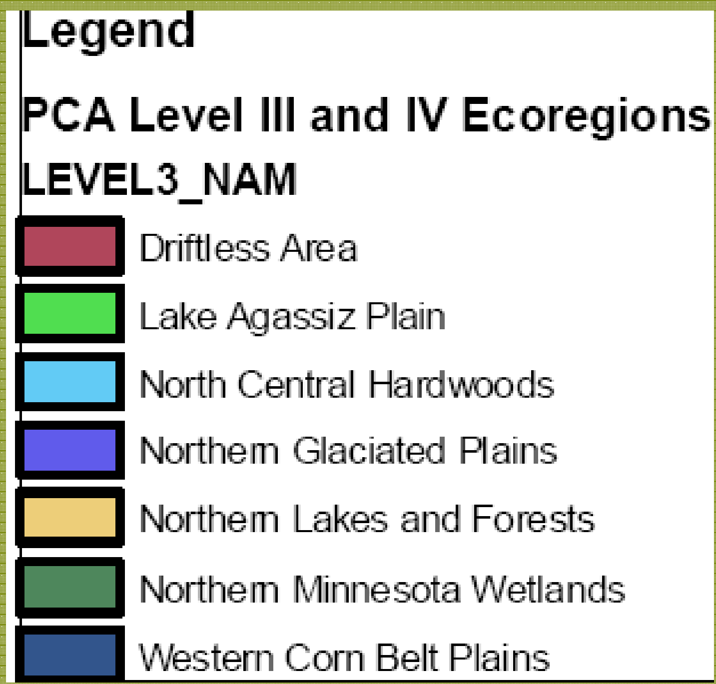
Abstractions

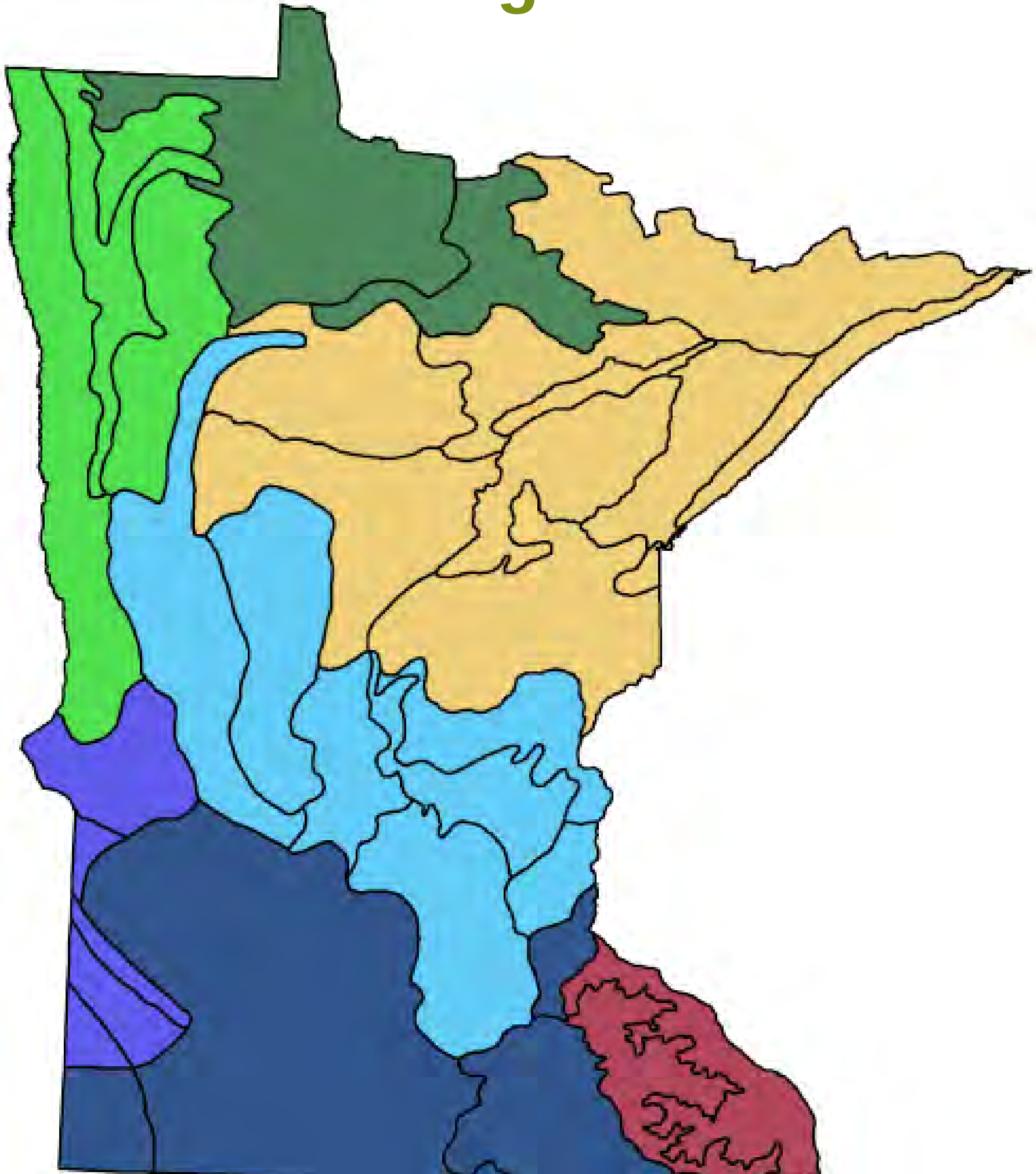
Interception

- Trees
  - big vs little
  - Species
- Prairie grass
- Corn
- Pavement

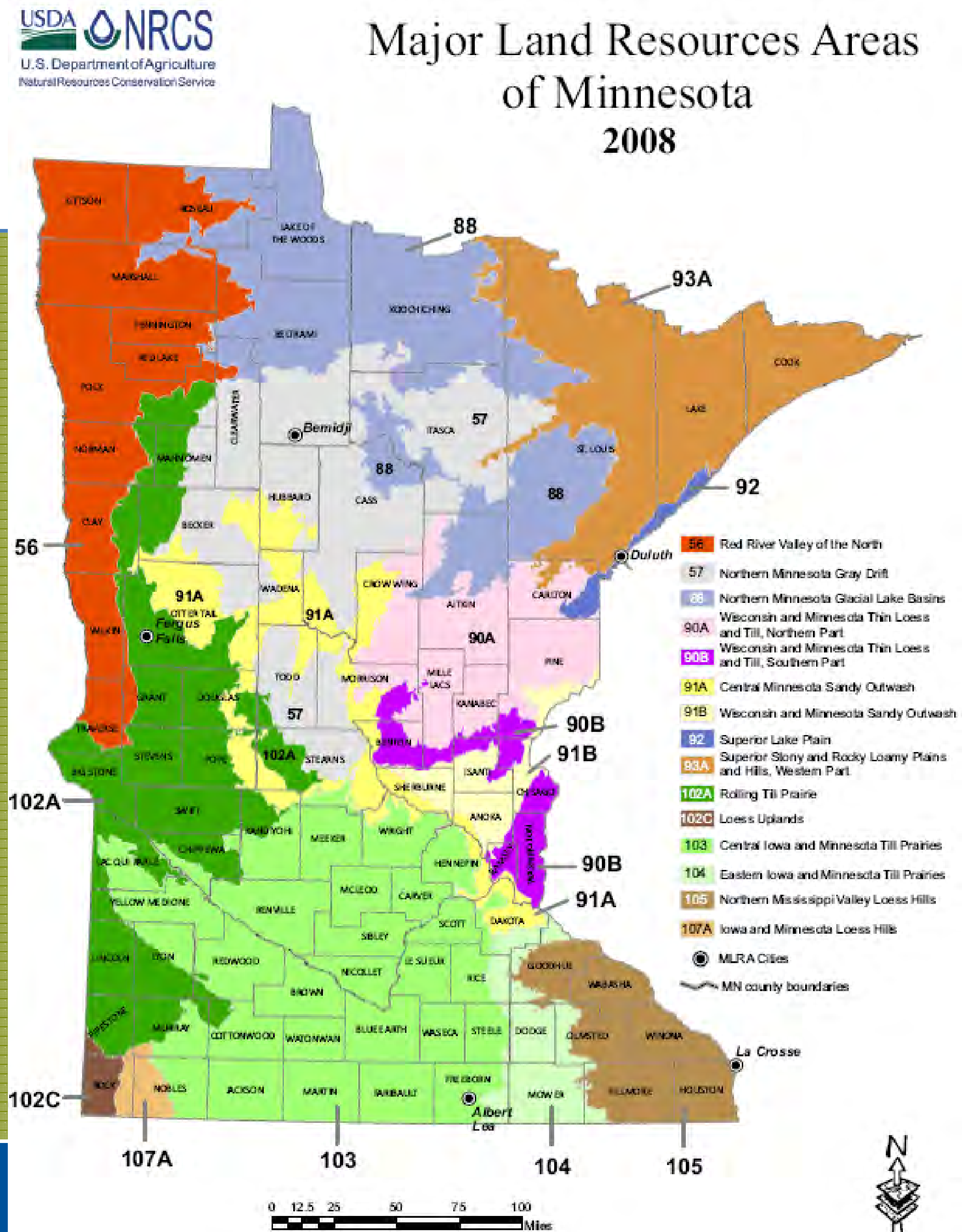
Regional Variations

EPA Level III/MPCA Level IV Ecoregions





MLRA

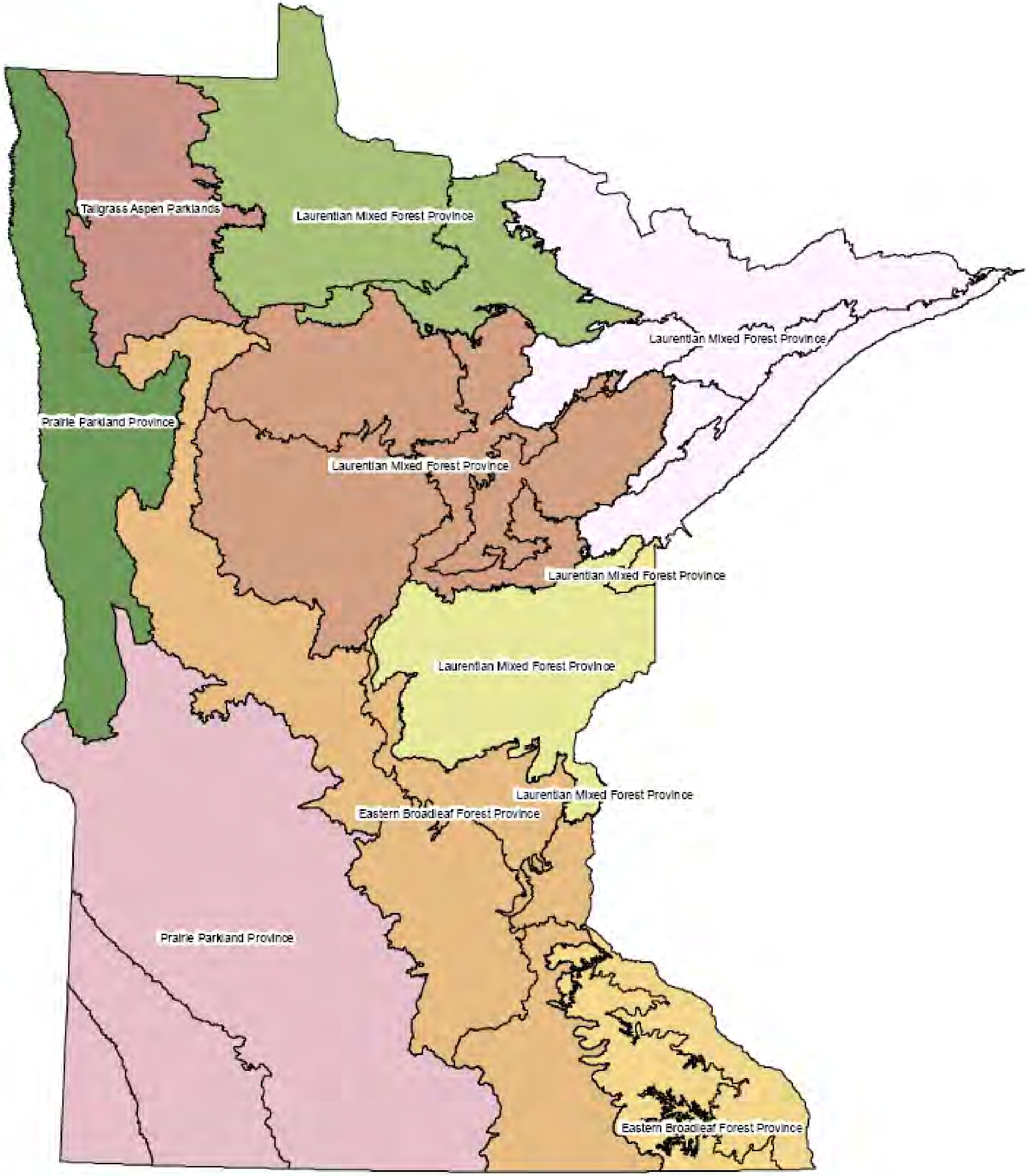

USDA NRCS
U.S. Department of Agriculture
Natural Resources Conservation Service
Major Land Resources Areas of Minnesota
2008
56 Red River Valley of the North
57 Northern Minnesota Gray Drift
88 Northern Minnesota Glacial Lake Basins
90A Wisconsin and Minnesota Thin Loess and Till, Northern Part
90B Wisconsin and Minnesota Thin Loess and Till, Southern Part
91A Central Minnesota Sandy Outwash
91B Wisconsin and Minnesota Sandy Outwash
92 Superior Lake Plain
93A Superior Stony and Rocky Loamy Plains and Hills, Western Part
102A Rolling Till Prairie
102C Loess Uplands
103 Central Iowa and Minnesota Till Prairies
104 Eastern Iowa and Minnesota Till Prairies
105 Northern Mississippi Valley Loess Hills
107A Iowa and Minnesota Loess Hills
MLRA Cities
MN county boundaries
Bemidji
Duluth
Fergus Falls
Albert Lea
La Crosse
0 12.5 25 50 75 100 Miles
N

MN DNR Ecological Sections

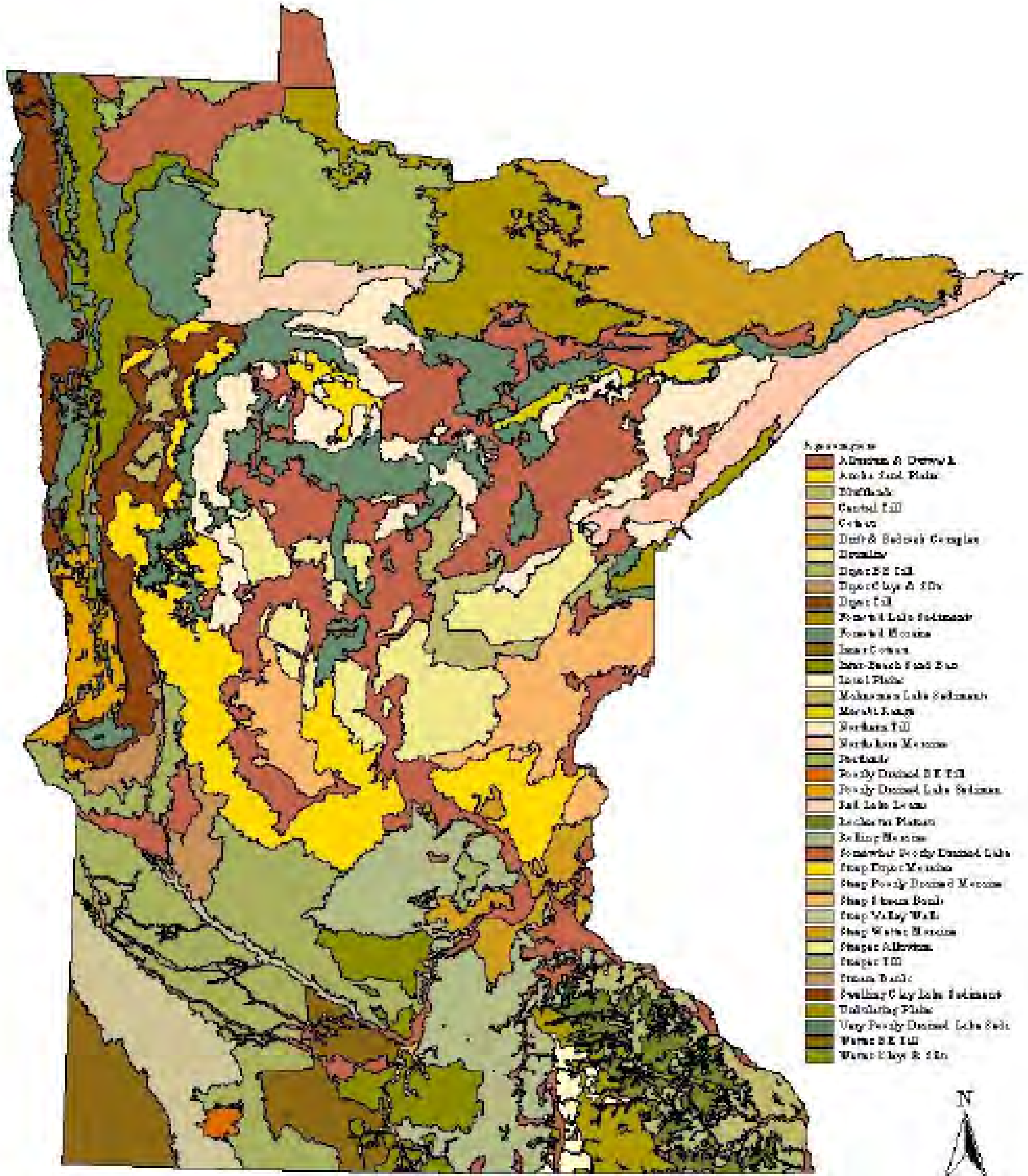
Ecological_Sections

SECNAME

- Lake Agassiz, Aspen Parklands
- Minnesota & NE Iowa Morainal
- N. Minnesota & Ontario Peatlands
- N. Minnesota Drift & Lake Plains
- North Central Glaciated Plains
- Northern Superior Uplands
- Paleozoic Plateau
- Red River Valley
- Southern Superior Uplands
- Western Superior Uplands



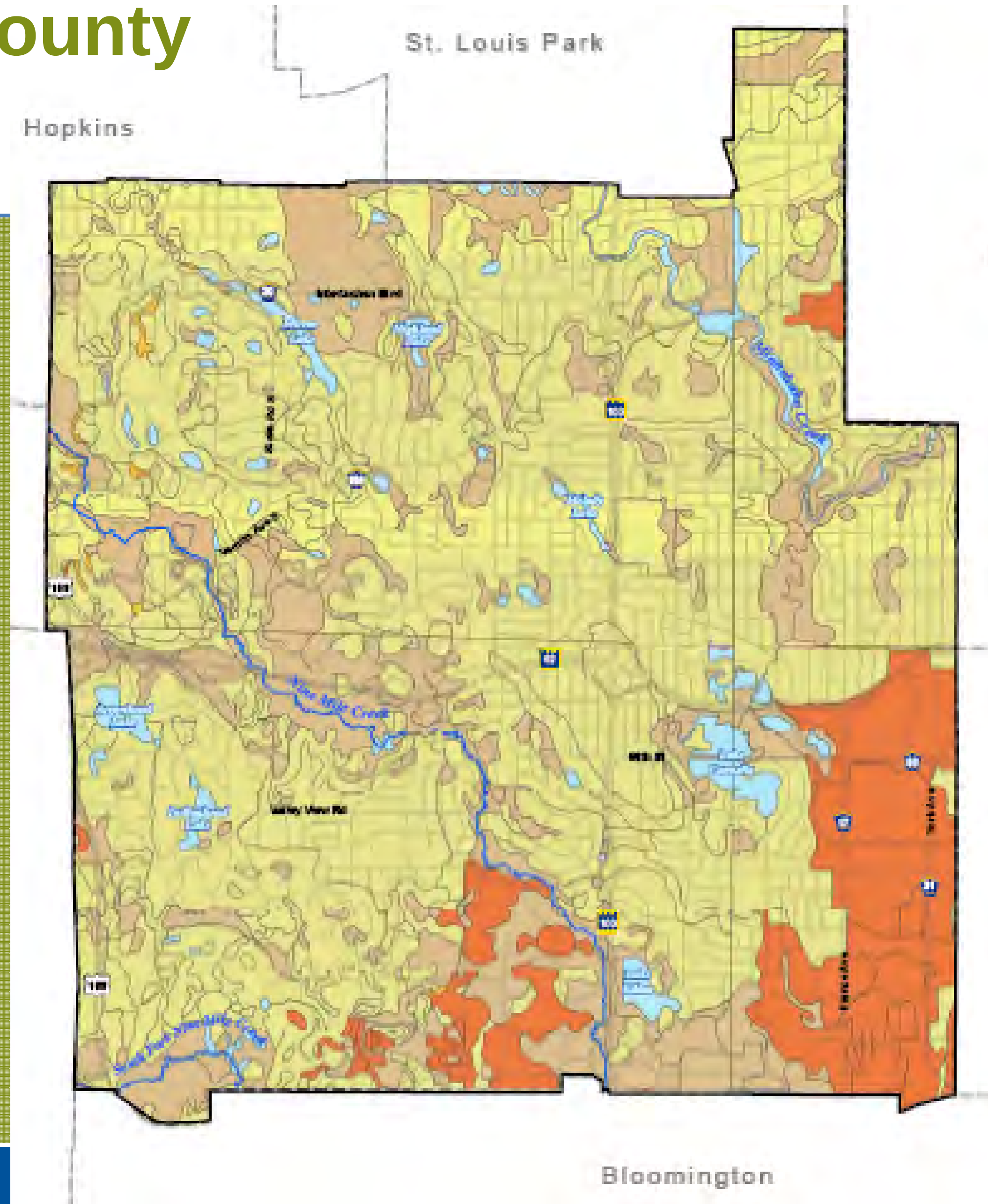
Agroecoregions



Soils – Hennepin County

Hydrologic Soil Groups

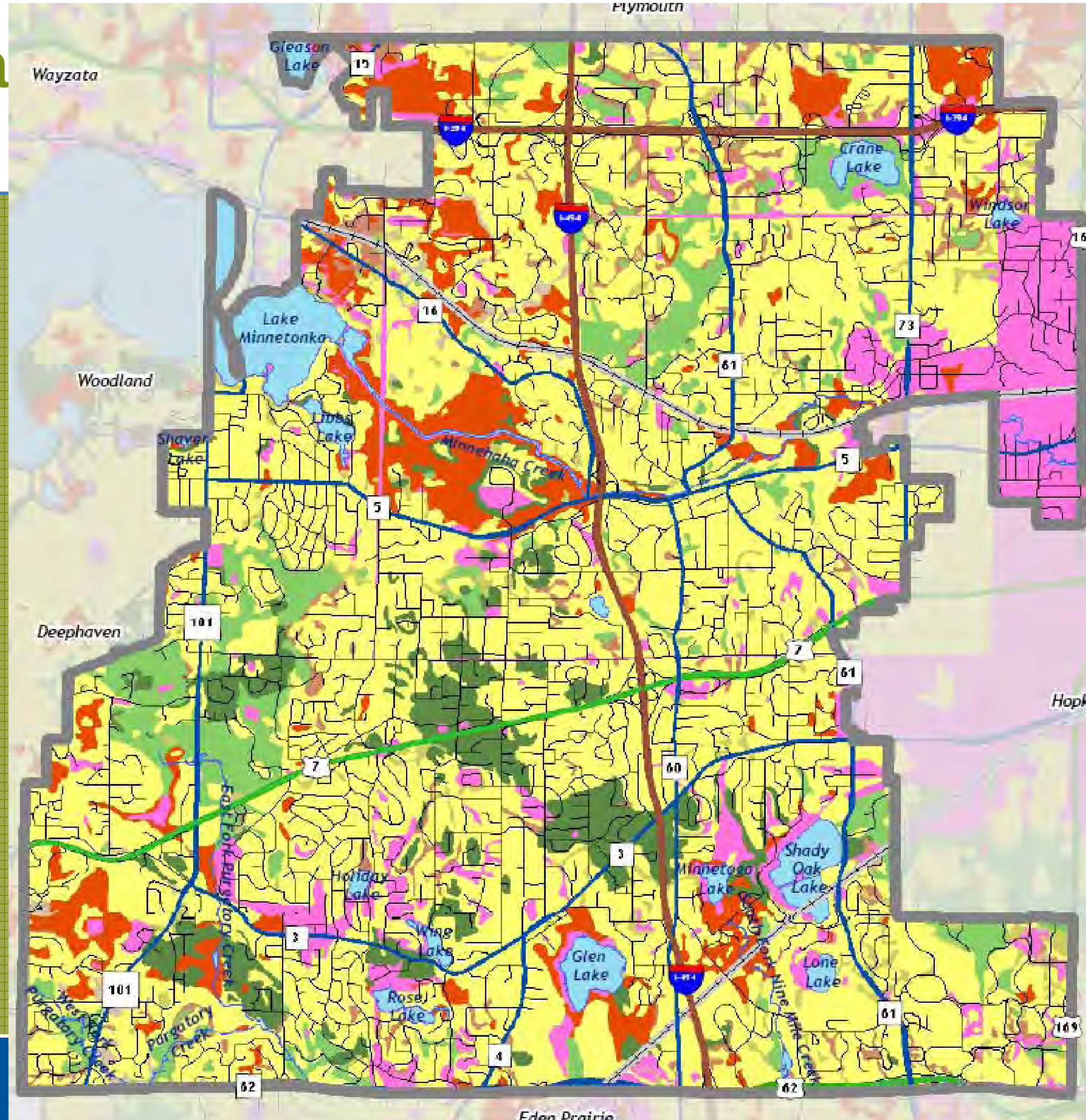
- A - High infiltration rates.
  Low runoff Potential.
- B - Moderate infiltration rates.
  Low to medium runoff potential.
- C - Slow infiltration rates.
  Medium to high runoff potential.
- D - Very slow infiltration rates.
  High runoff potential.
- Water



Soils – Minnetonka

Hydrologic Soils Group

- Undefined/Urban Soils
- A - High Infiltration Rates
- A/D - If Drained, acts as HSG A
- B - Moderate Infiltration Rates
- B/D - If Drained, acts as HSG B
- C - Slow Infiltration Rates
- C/D - If Drained, acts as HSG C
- D - Very Slow Infiltration Rates



"Make everything as simple as possible, but not simpler."

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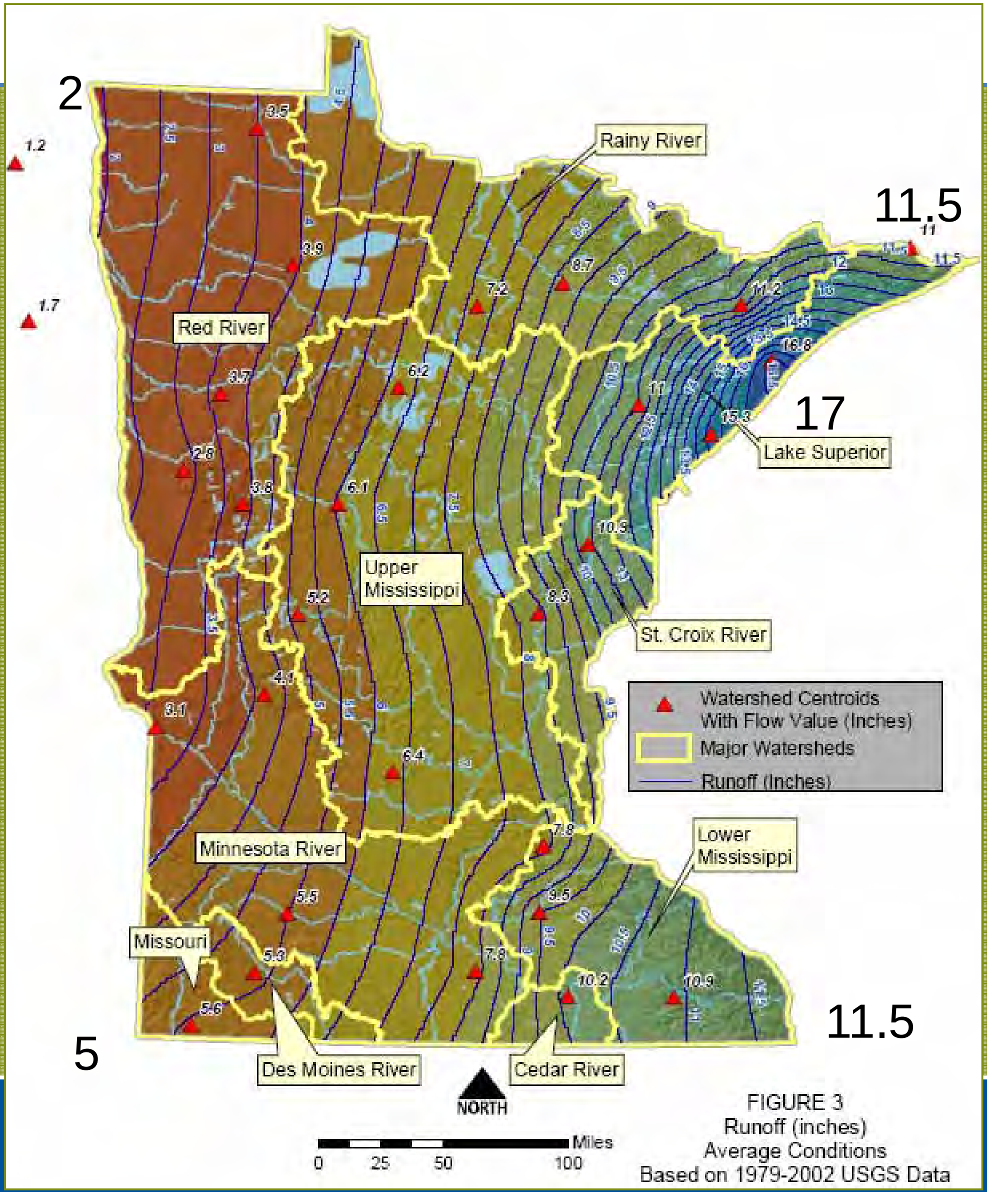
Average Annual Runoff Variability in MN



Introduction: Performance Goal Alternative Evaluation

Introduction: Performance Goal Alternative Evaluation

Goal: Mimic a site's natural hydrology

Another way of thinking of this…

Limit post-construction runoff to a volume equal to or less than the pre-settlement condition based on average annual precipitation vs single event precip.

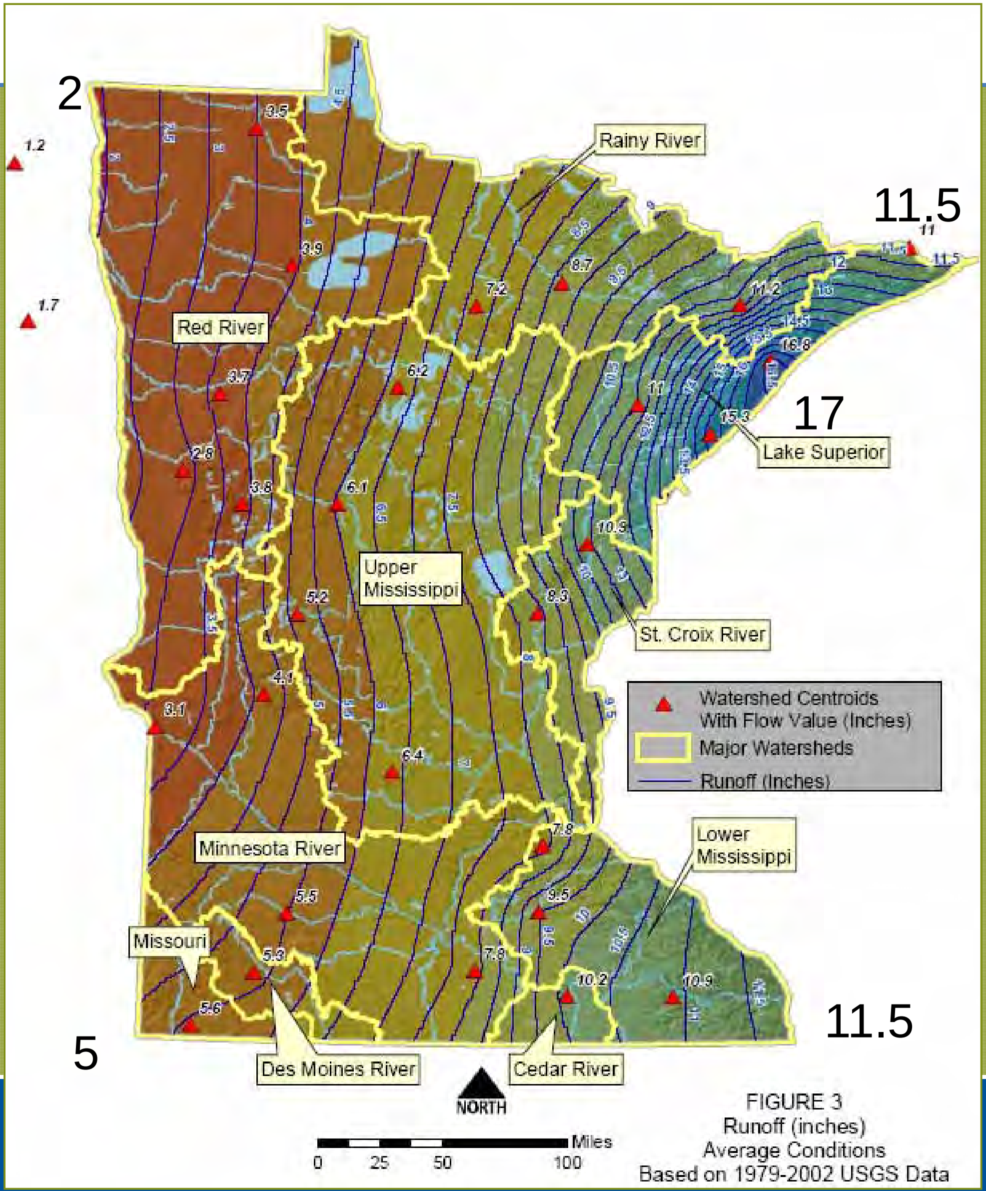
Three Common Volume Control Methodologies

1. Retain runoff volume on-site equal to one inch of runoff from proposed impervious surface

Retention Volume = 1 inch X Impervious Area

SIMPLE!!

Average Annual Runoff Variability in MN



Three Common Volume Control Methodologies

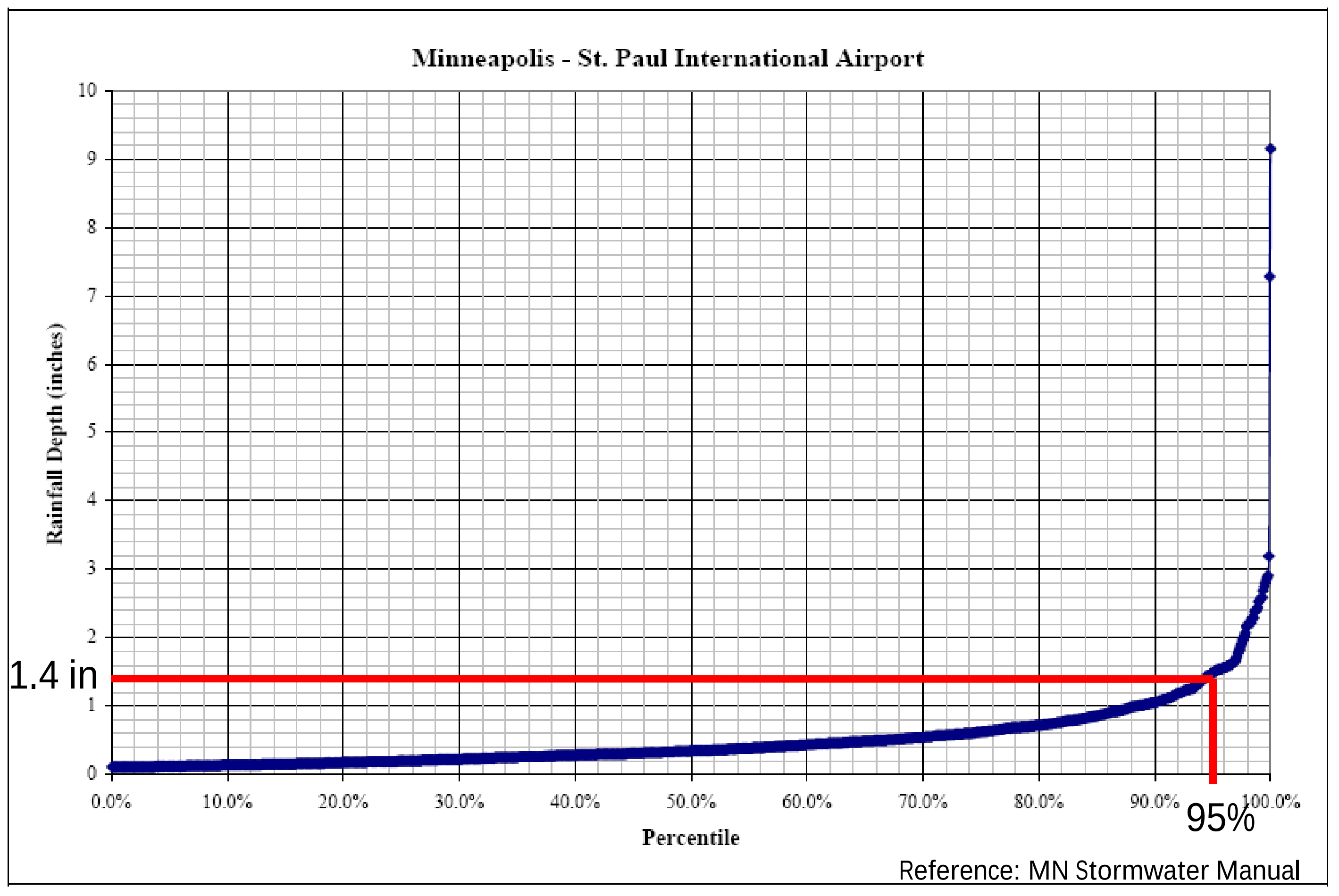
2. Retain the post-construction runoff volume on site for the 95th percentile storm (1.4 inches in Minneapolis).

- Use CN method to calculate runoff volume from pervious and impervious areas

+

- No Pre-settlement calculation required

95th Percentile Storm ~ 1.4 inches



Three Common Volume Control Methodologies

3. Limit post-construction runoff from a 1-, 2-, and 5-year 24-hour design storm to a volume equal to or less than the pre-settlement condition.

Return Frequency	Twin Cities Rainfall Depth 24-hour Storm Event (TP-40)
1-year	2.3 in.
2-year	2.8 in.
5-year	3.5 in.

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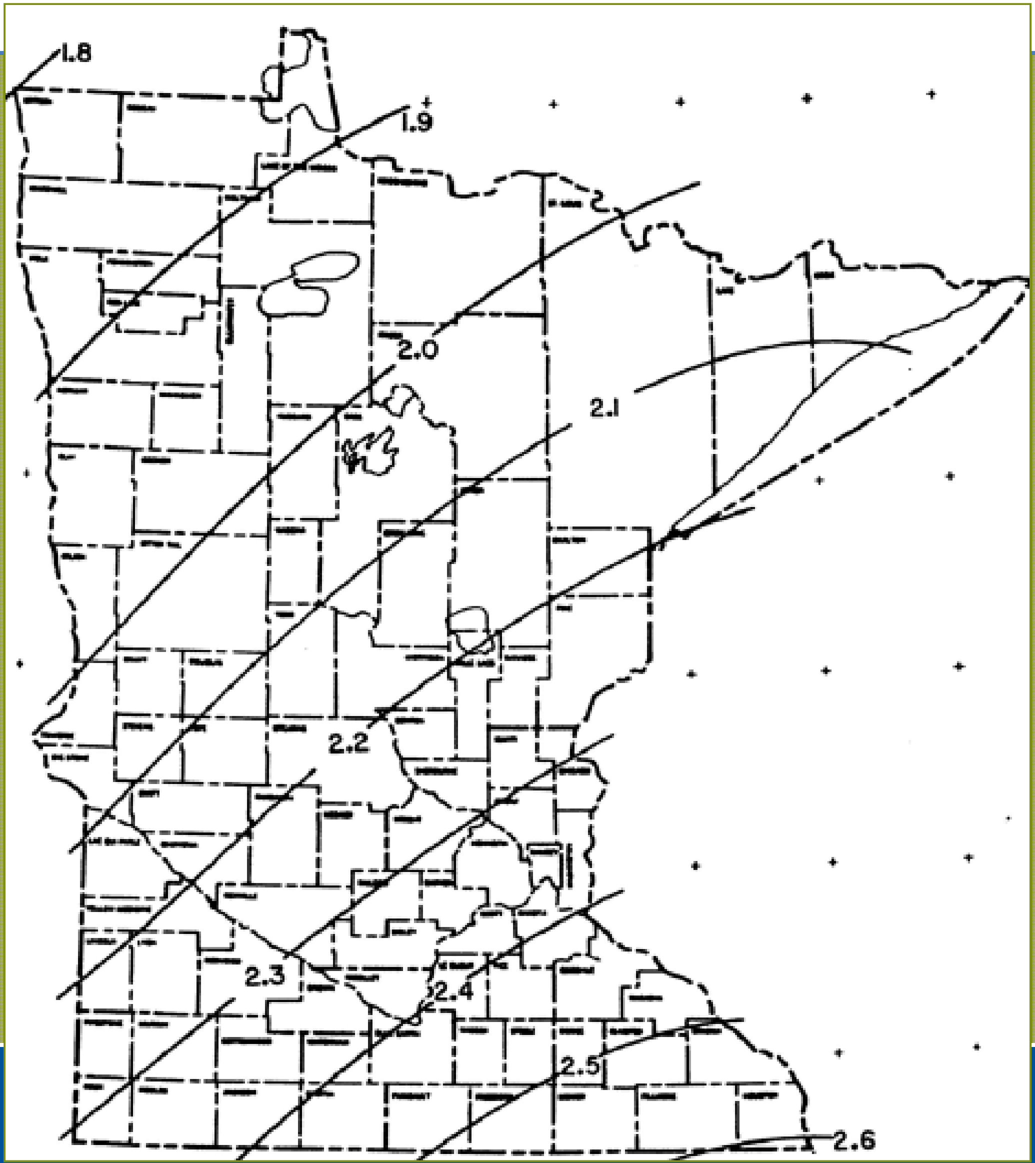
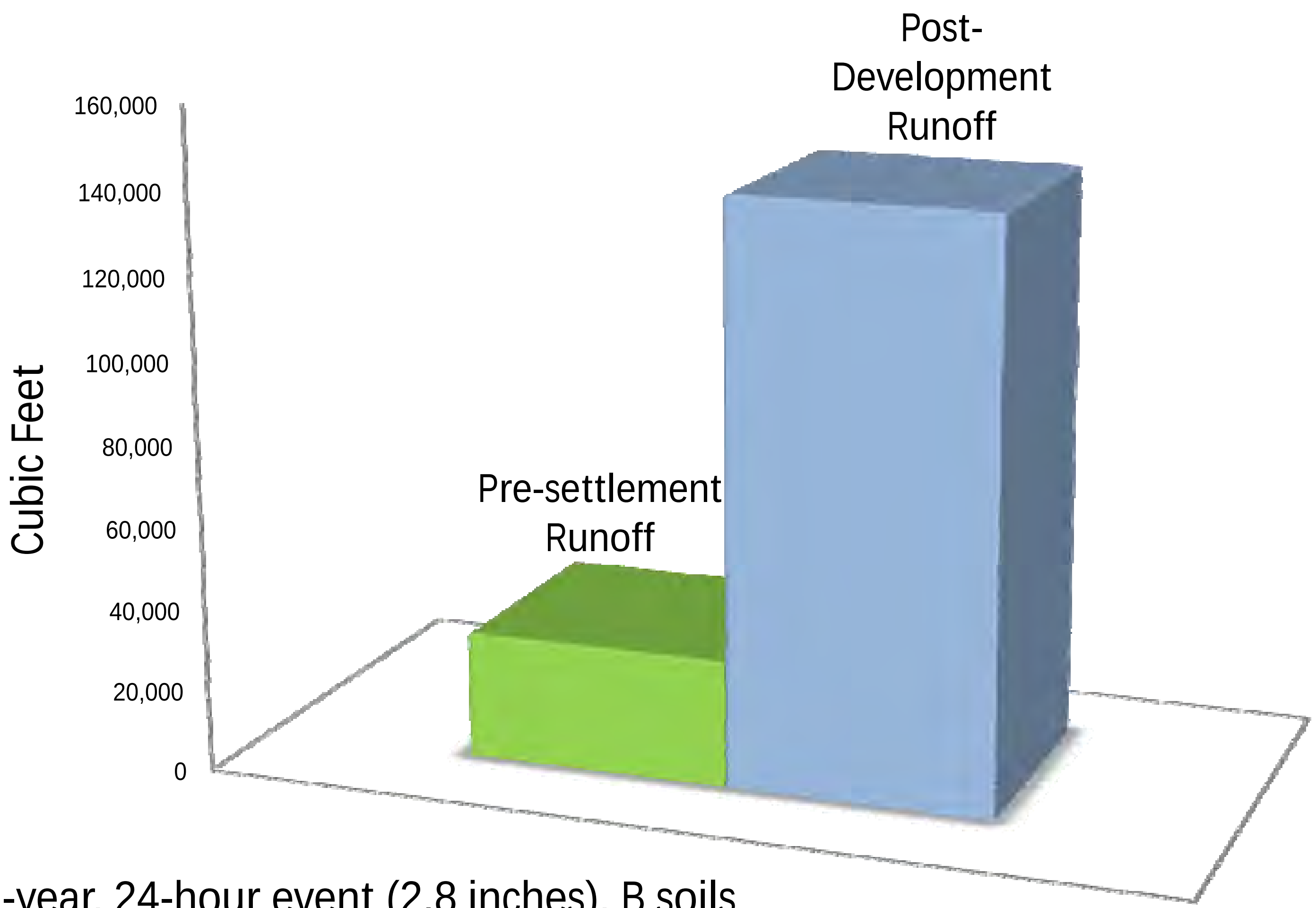
Variability in 1-year, 24-hour Rainfall in MN

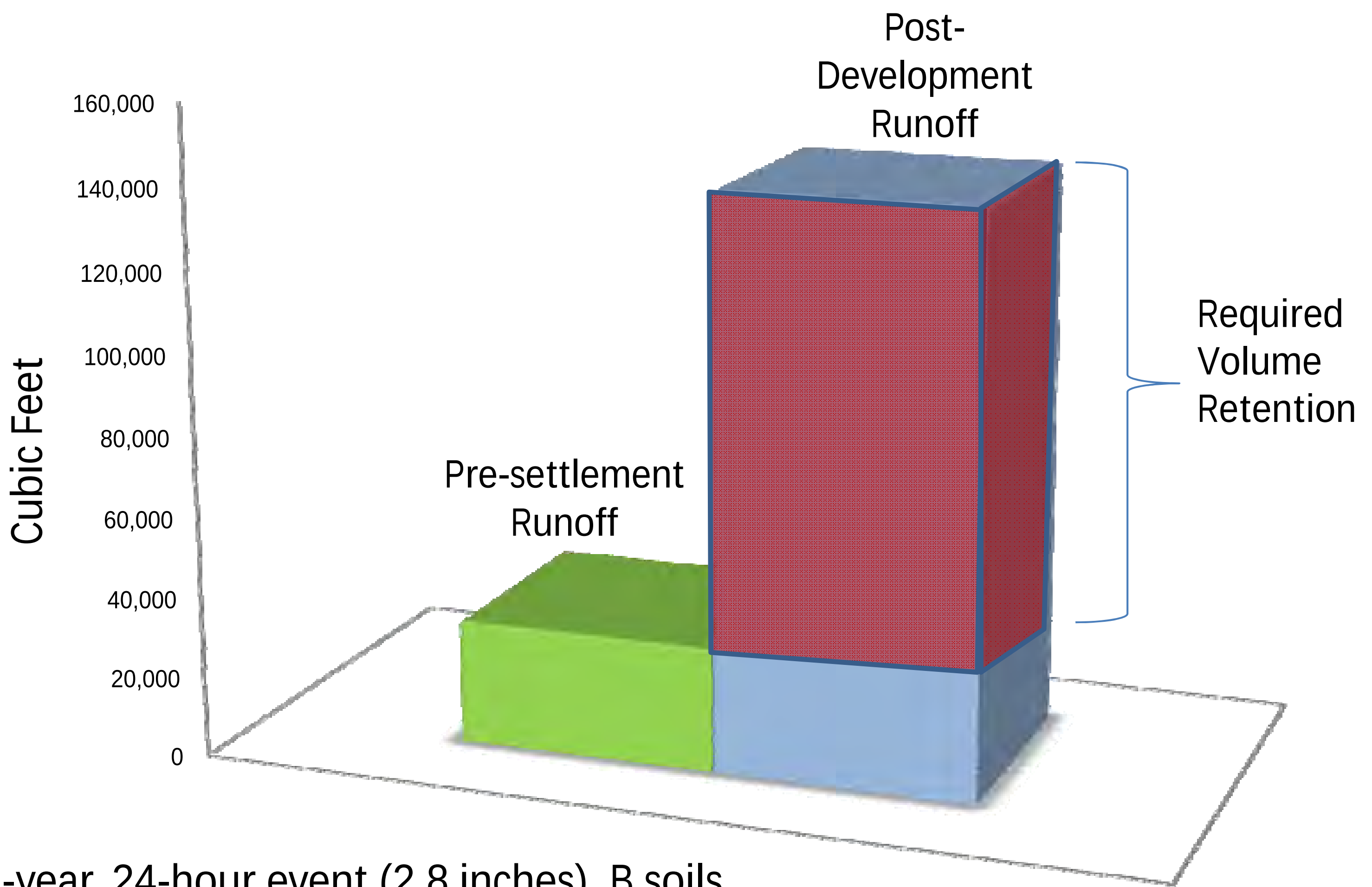


Three Common Volume Control Methodologies



2-year, 24-hour event (2.8 inches), B soils

Three Common Volume Control Methodologies



2-year, 24-hour event (2.8 inches), B soils

Volume Retention Analysis for Two Development Scenarios

Scenario #1:
40-acre Residential Site
30% Impervious

Scenario #2:
10-acre Commercial Site
80% Impervious

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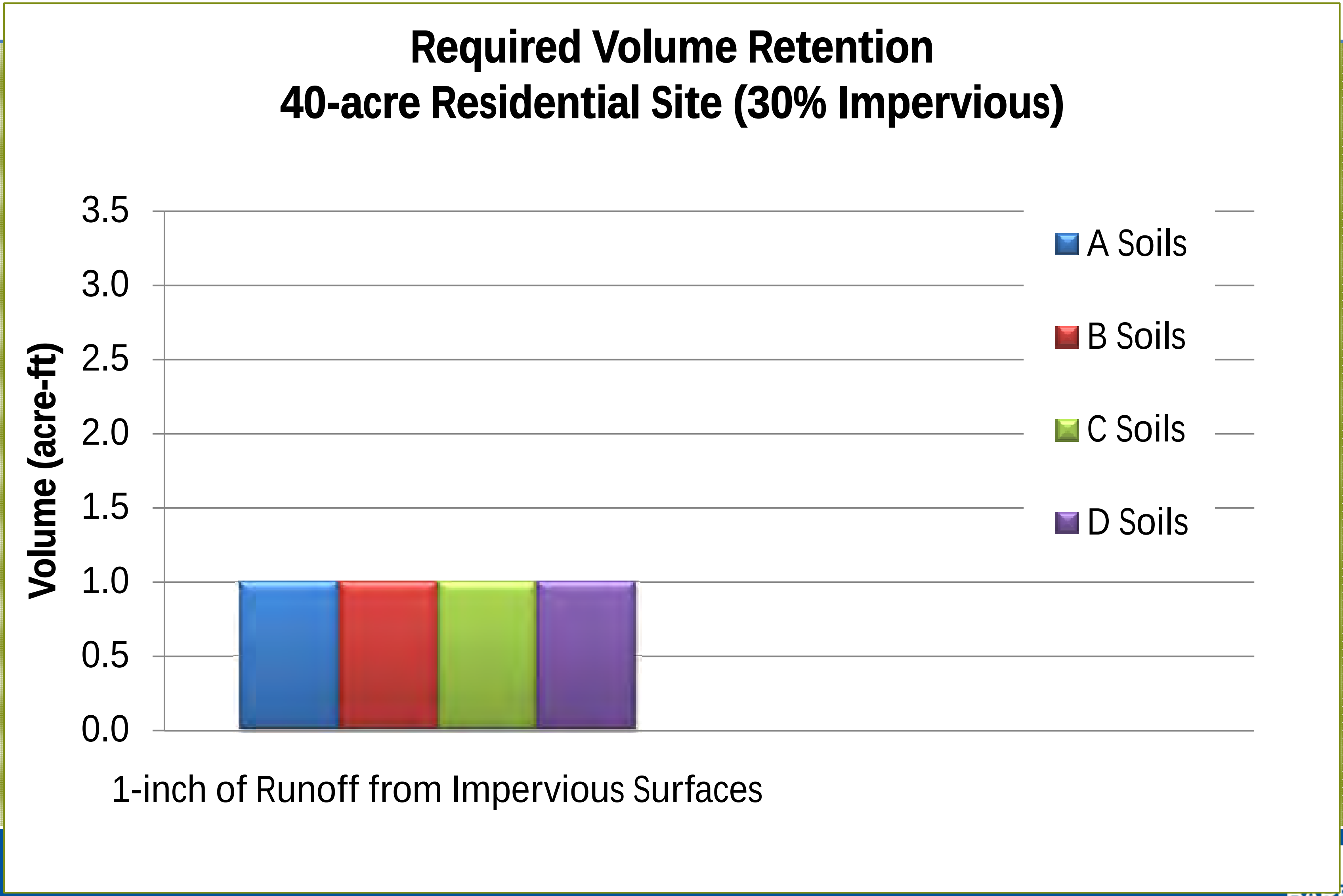
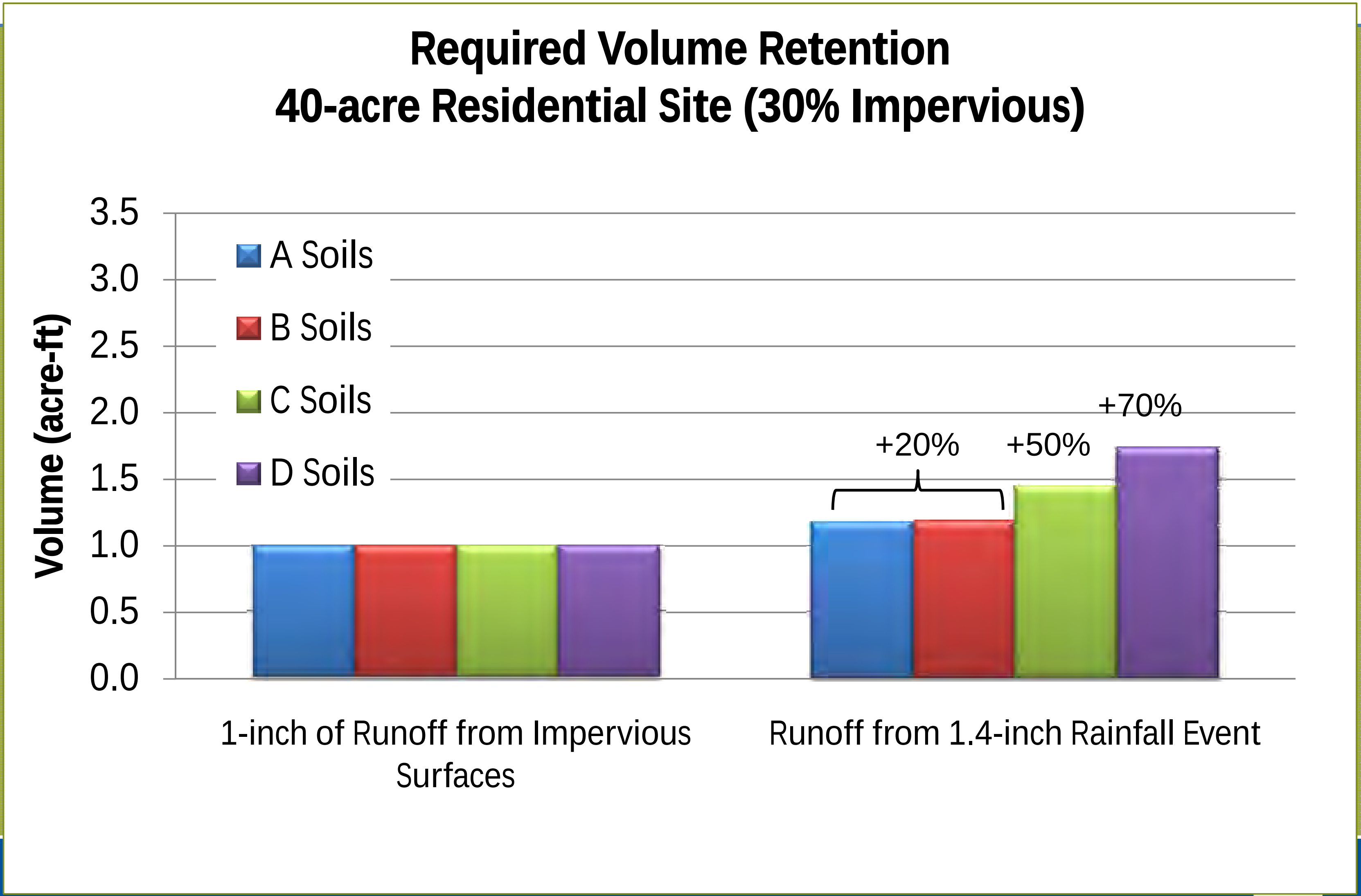
1-inch of Runoff from Impervious Surfaces



Retain Runoff from 95th Percentile Storm



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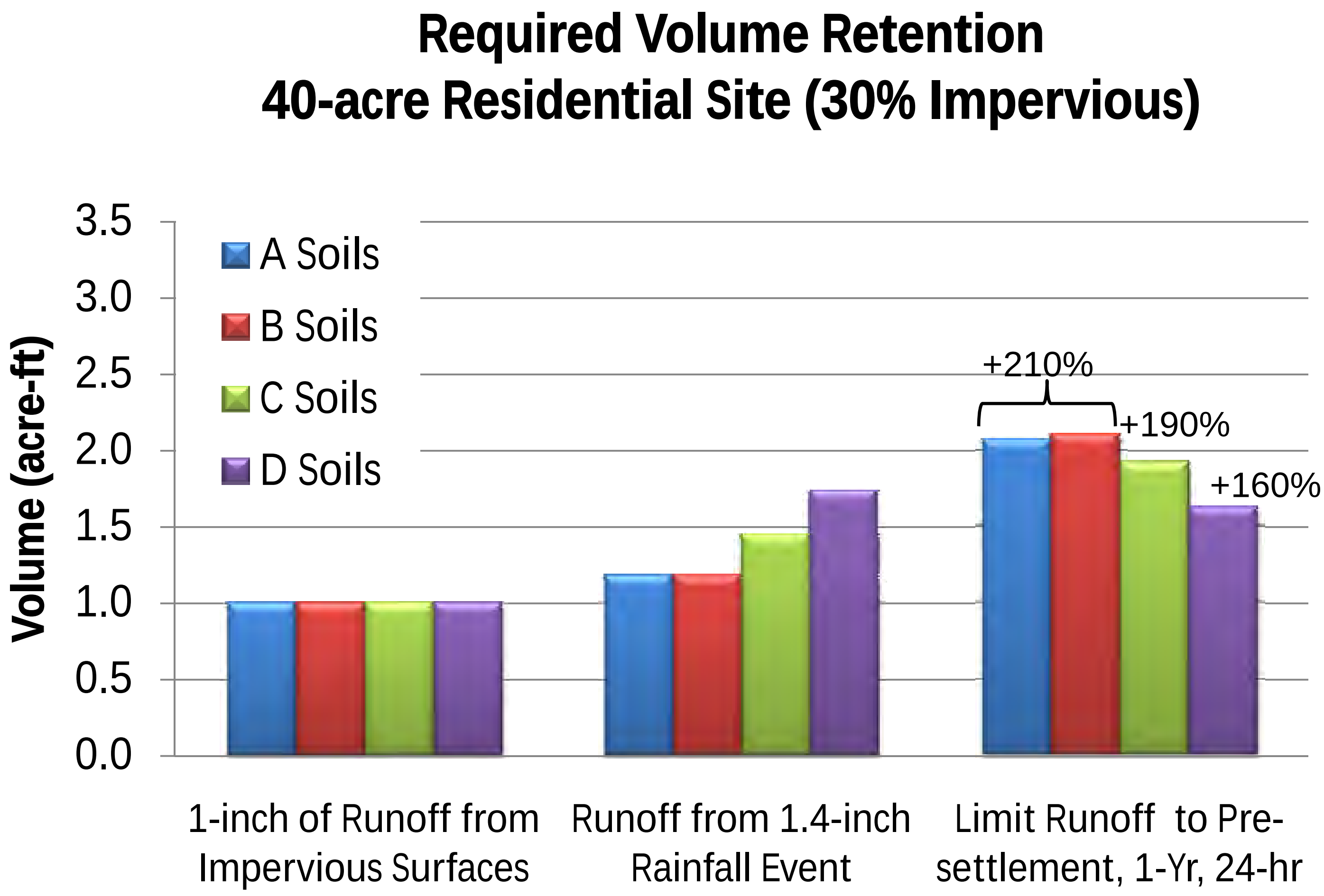
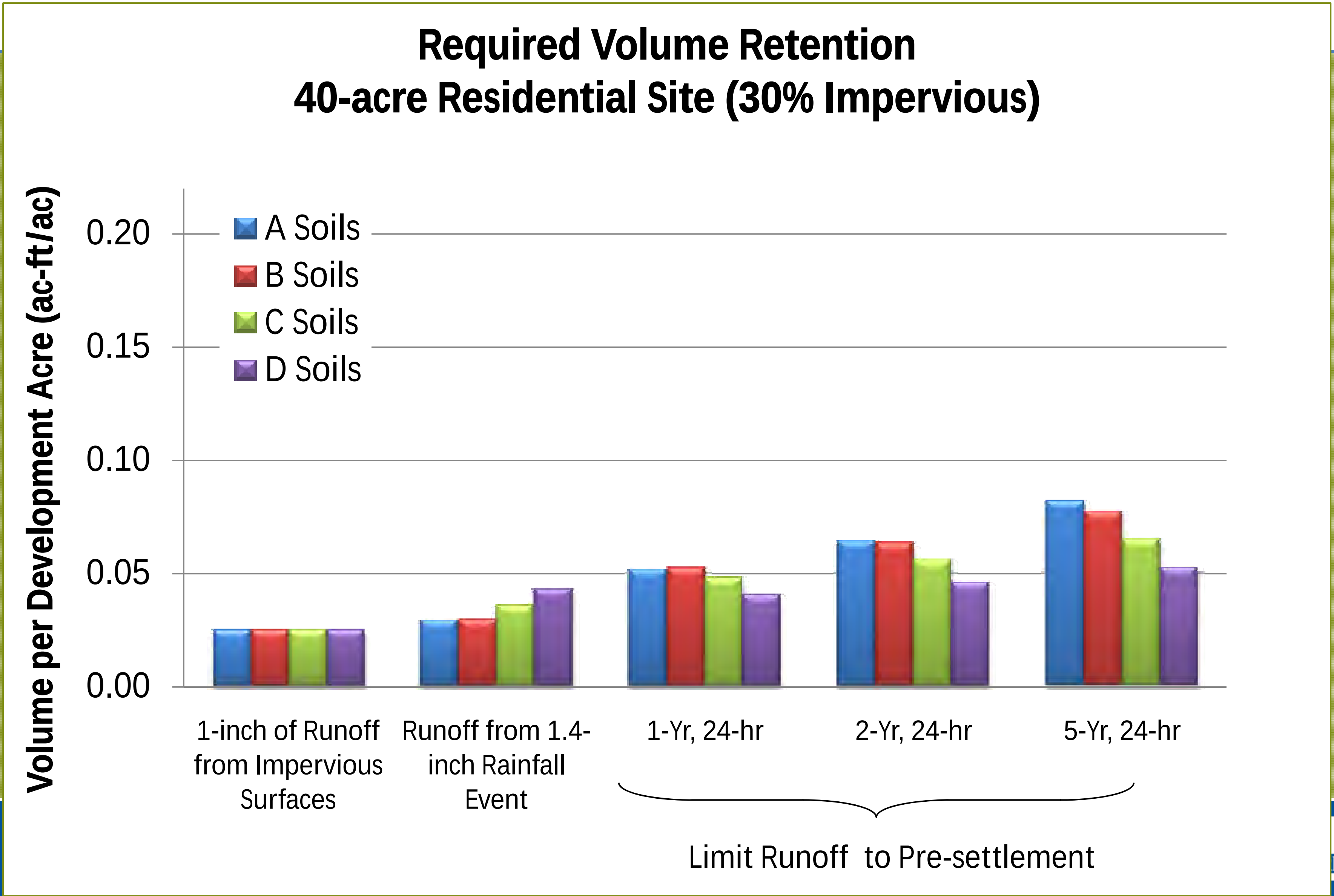
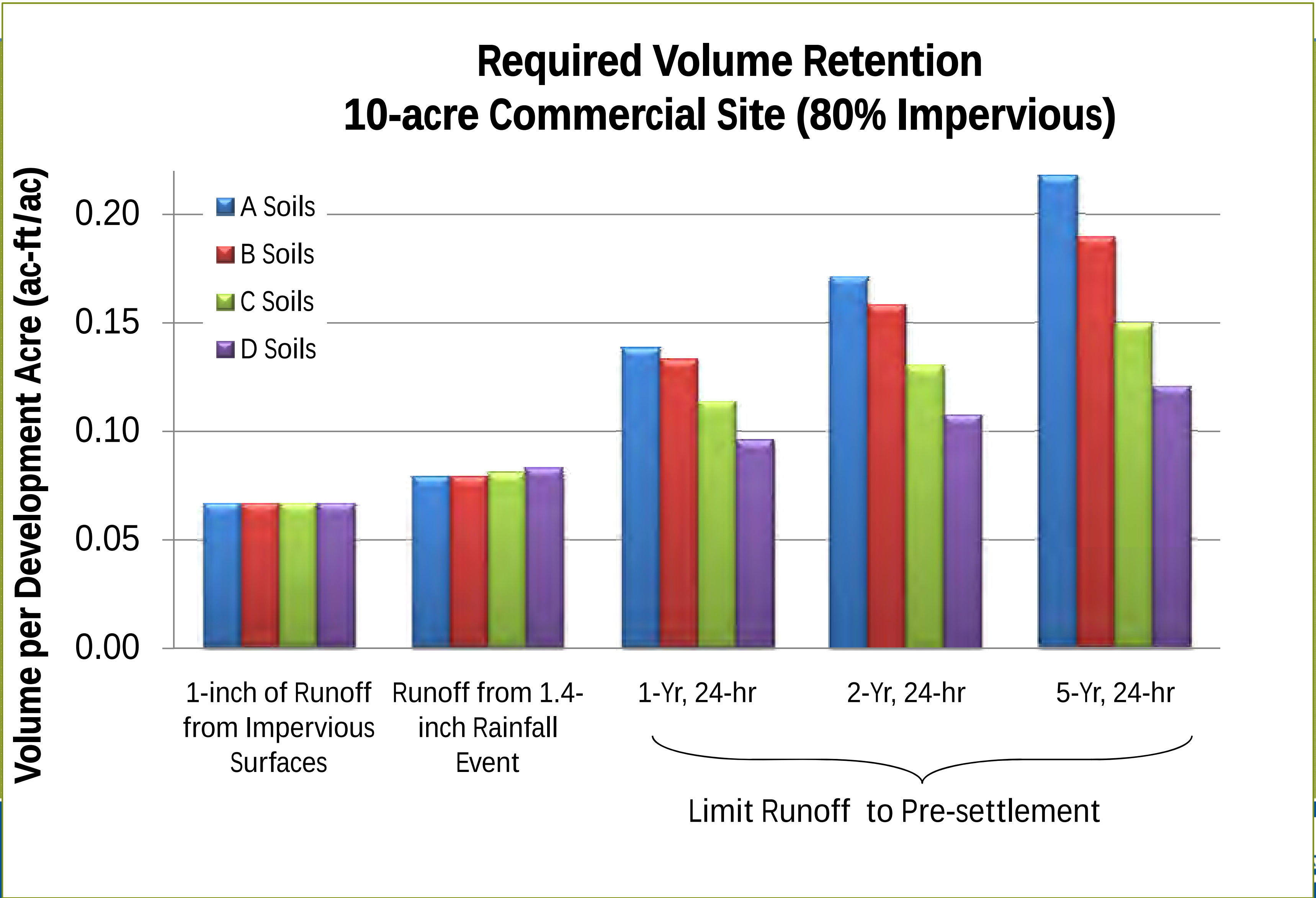
Limit Runoff to Pre-settlement (1-yr, 24-hr)



Volume Retention Analysis- Residential Site



Volume Retention Analysis- Commercial Site



How to evaluate the volume control methodologies?

- Feasibility
  - ✓ Land Footprint
  - ✓ Cost

- % Rainfall Captured

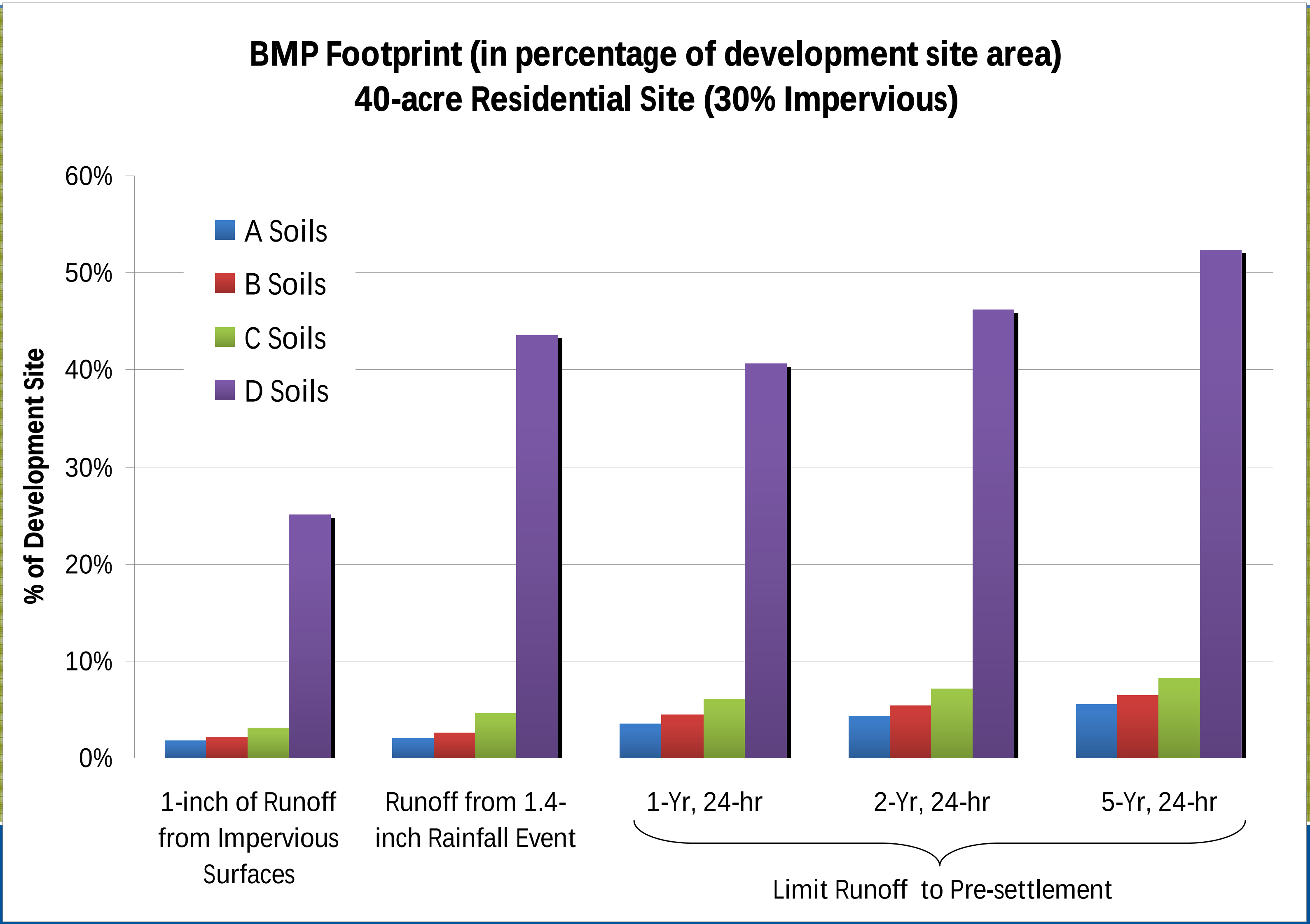
- **Does it MIMIC NATURAL HYDROLOGY??**

Comparison of BMP Land "Footprints"

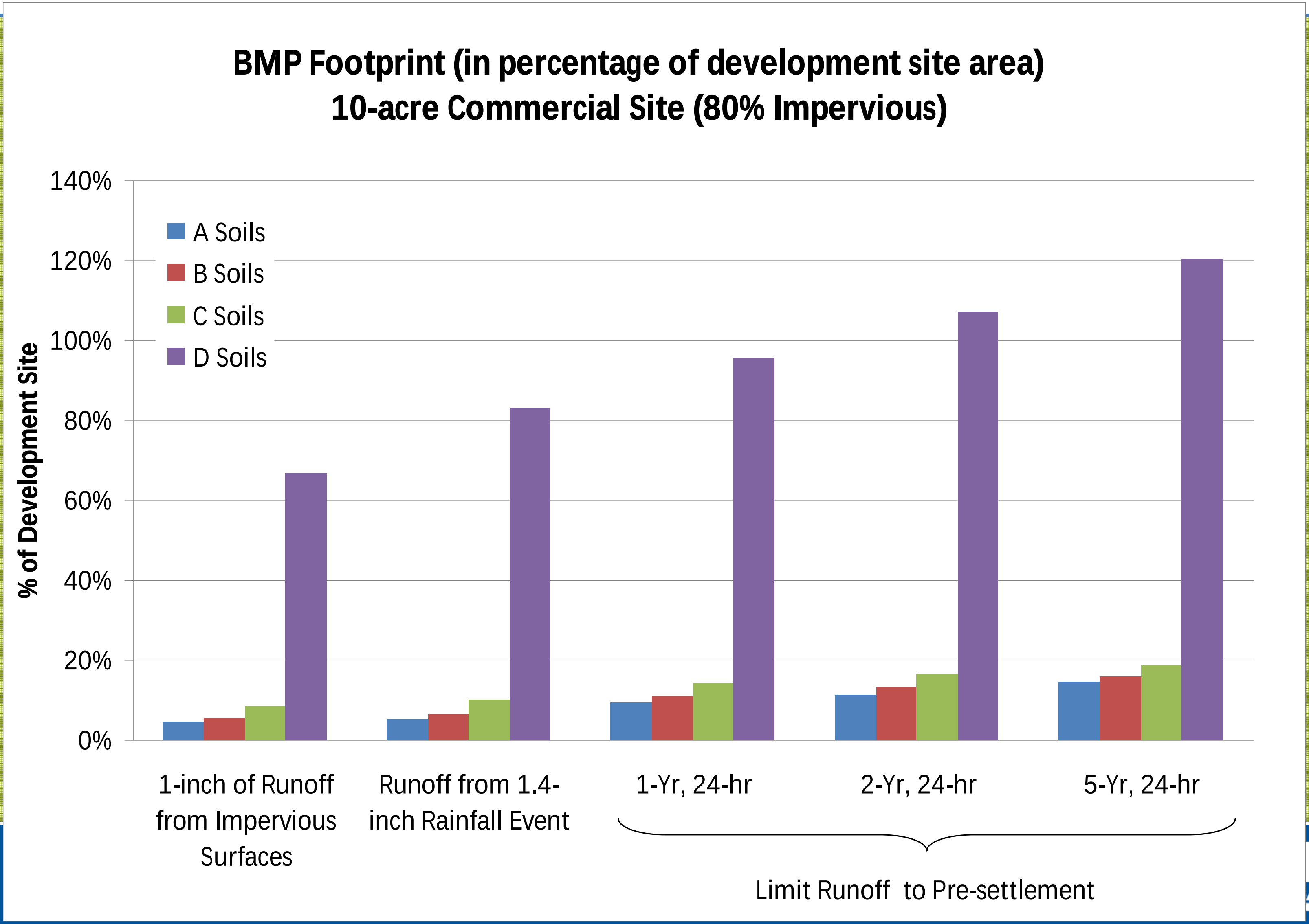
- "Footprint" = area required for BMP implementation
- Footprint estimated using bioretention basin to achieve volume control
- Sized to drain in 48 hours

Soil Type	Infiltration Rate (in/hr)	Max Depth of Basin (ft)
A	0.8	1.5
B	0.3	1.2
C	0.2	0.8
D	0.03	0.1

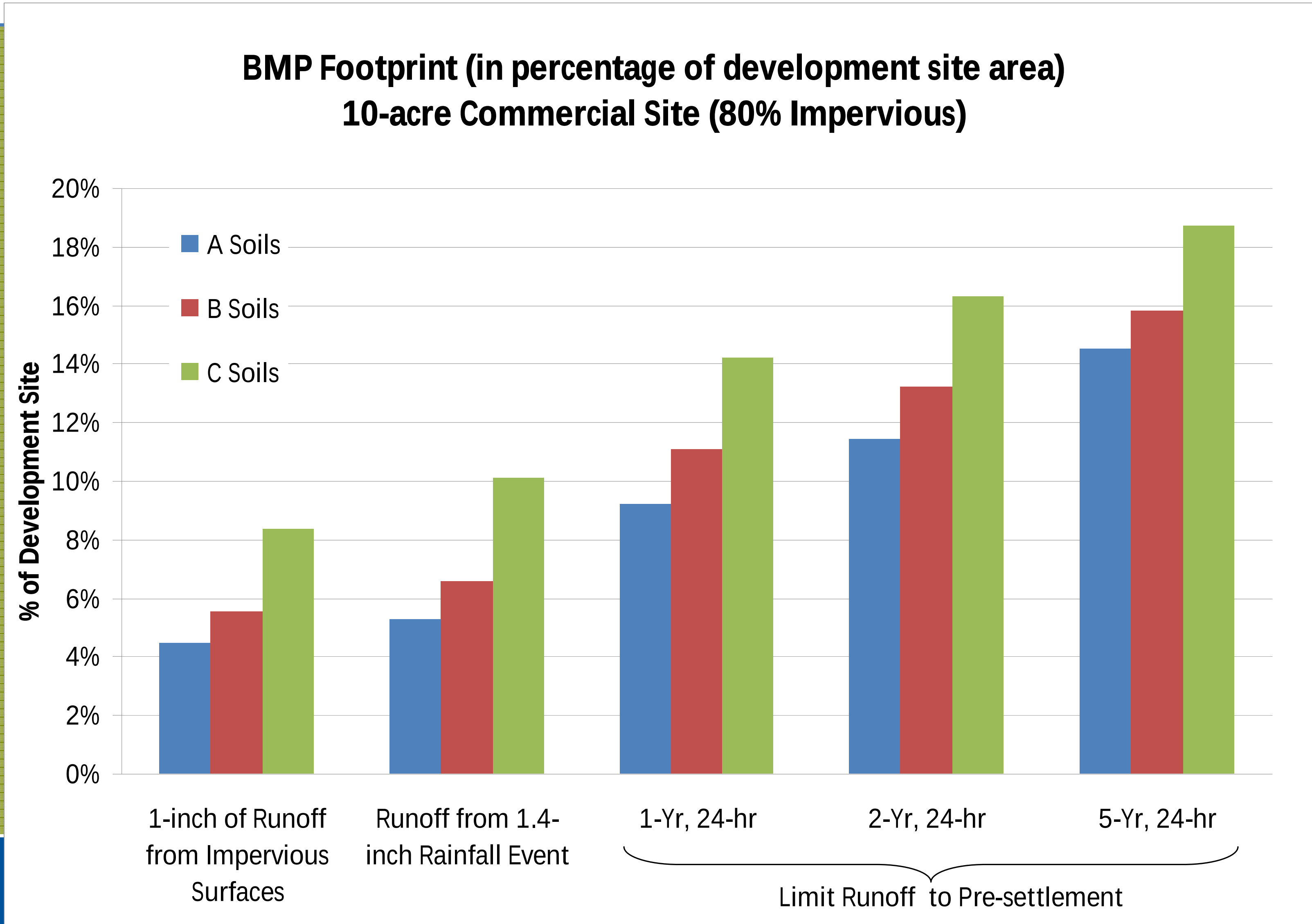
BMP Footprint Comparison- Residential Site



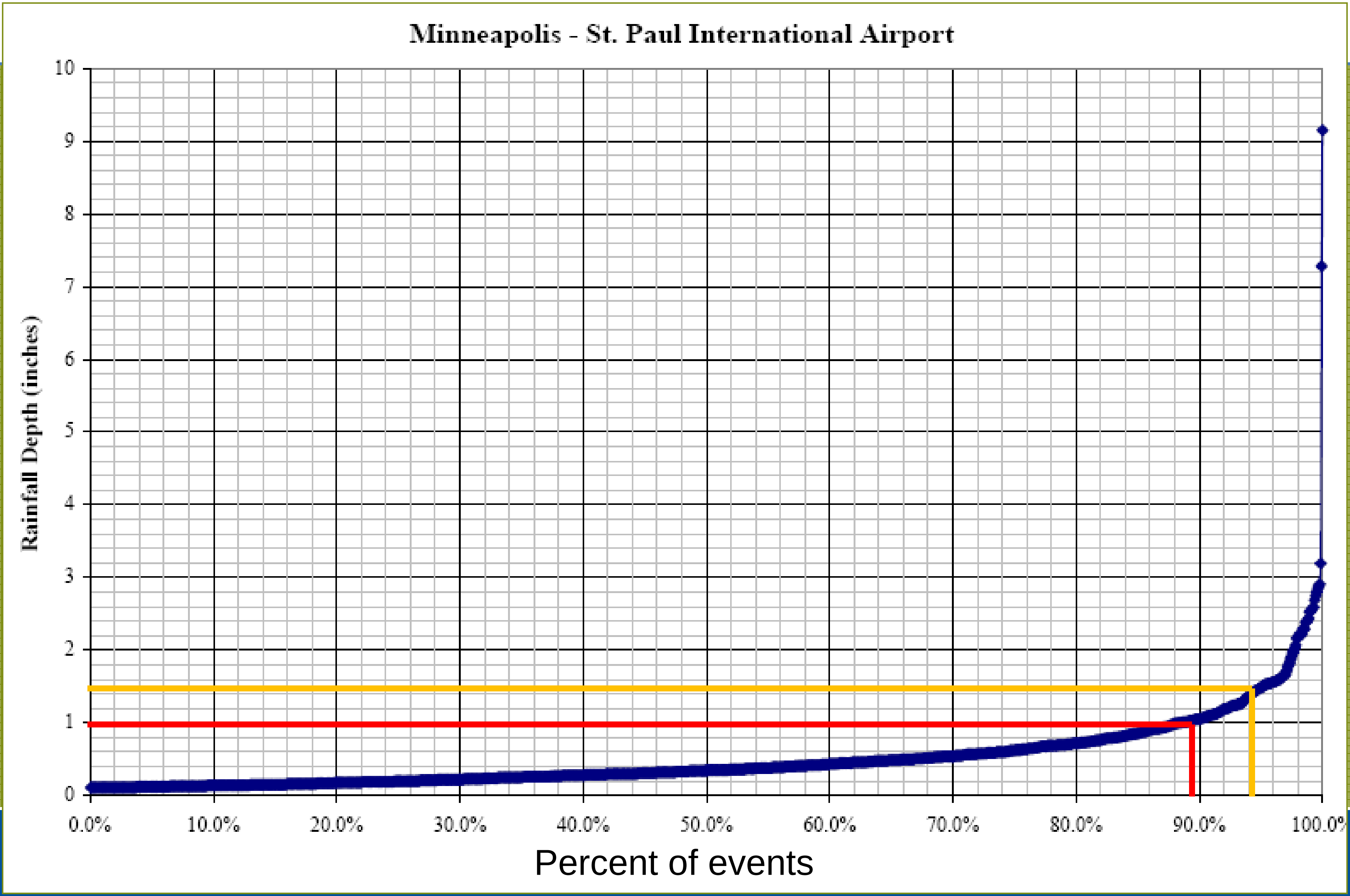
BMP Footprint Comparison- Commercial Site



BMP Footprint Comparison- Commercial Site



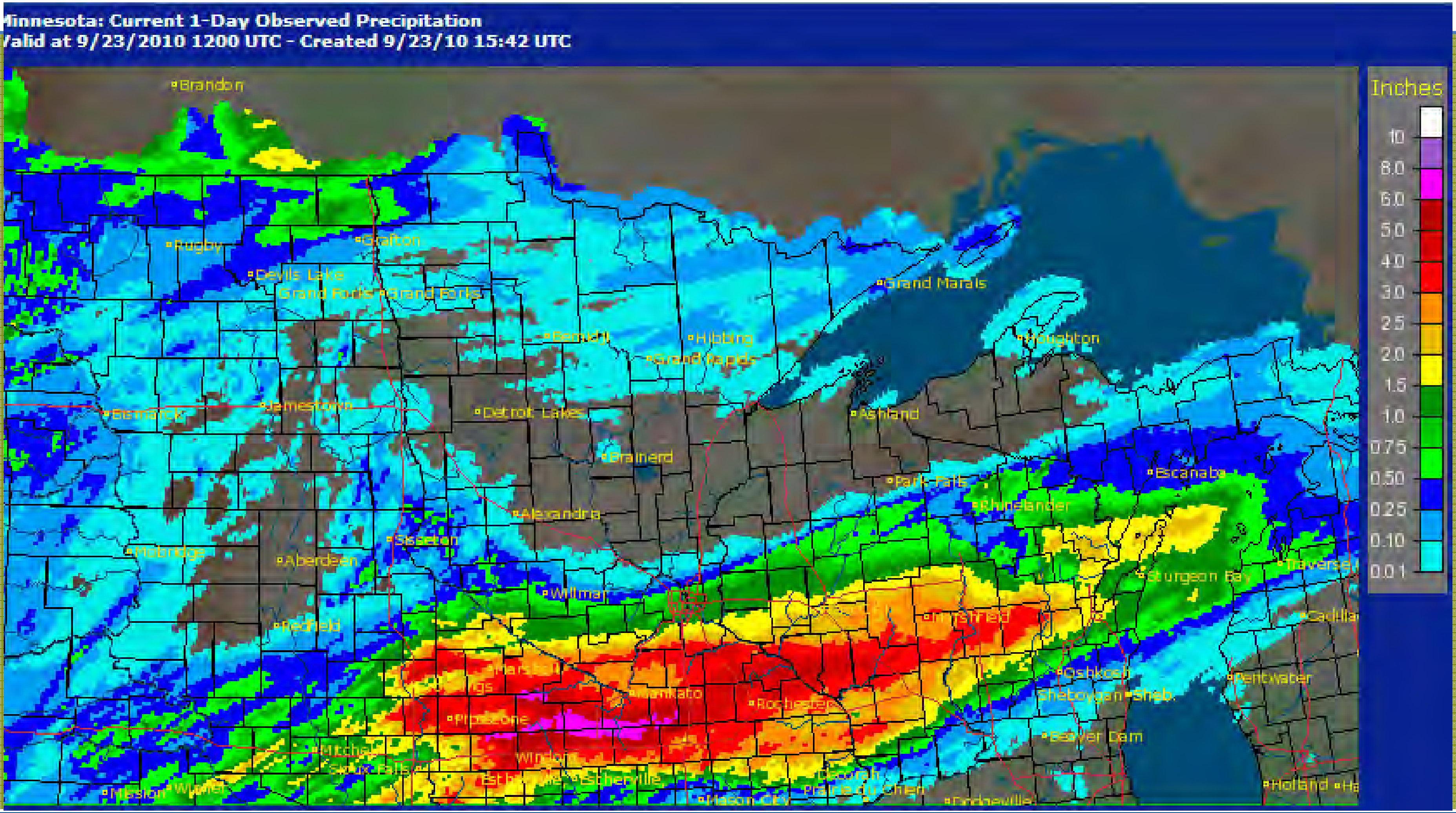
% Rainfall Captured



Assess Mimicry of Natural Hydrology

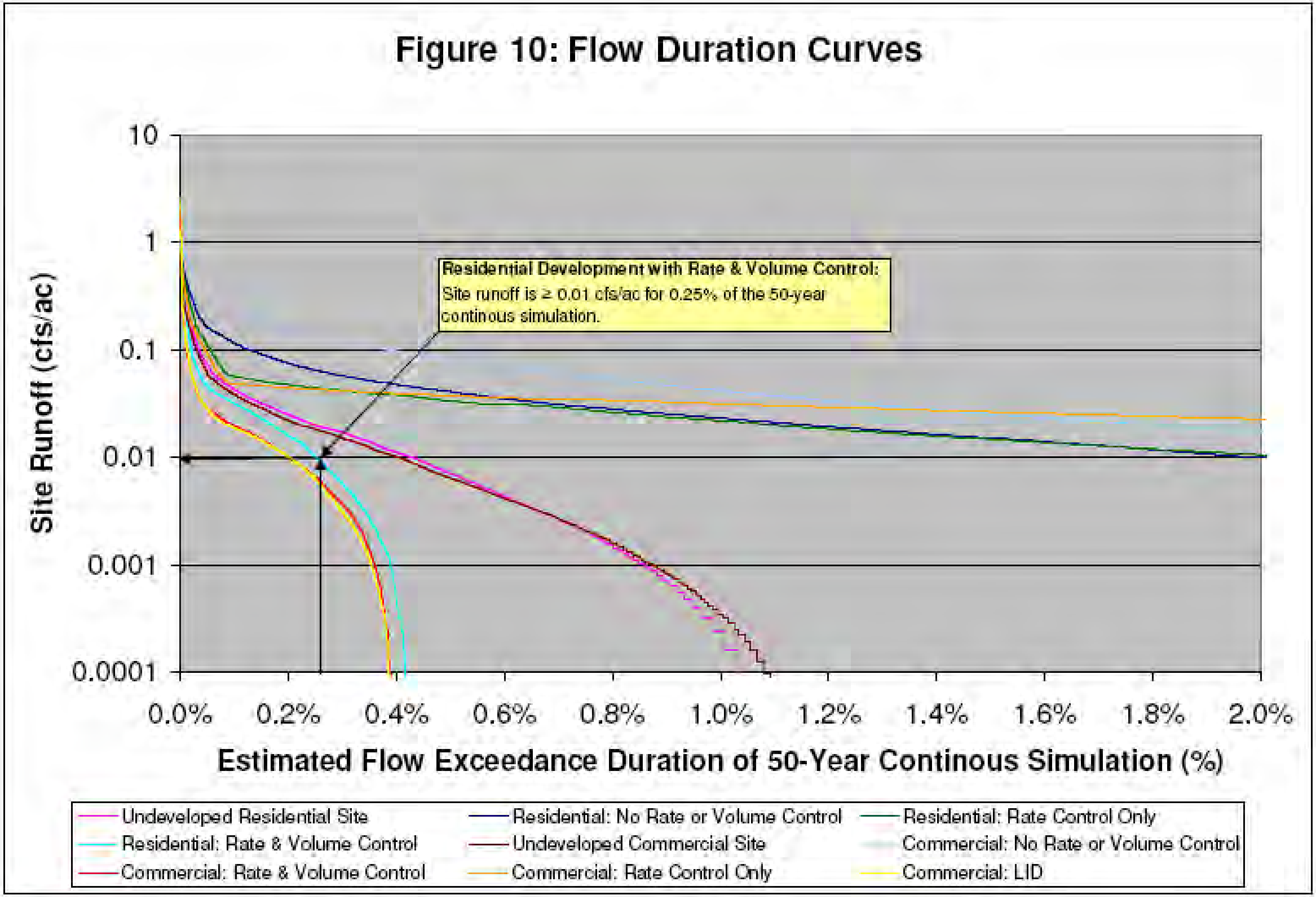
- Develop long-term continuous simulation model to estimate average annual pre-settlement runoff
- Use model to evaluate how volume control standards mimic pre-settlement runoff
- Useful tool for answering complex questions

Questions?



innesota: Current 1-Day Observed Precipitation
alid at 9/23/2010 1200 UTC - Created 9/23/10 15:42 UTC
Inches
10
8.0
6.0
5.0
4.0
3.0
2.5
2.0
1.5
1.0
0.75
0.50
0.25
0.10
0.01
Brandon
Rugby
Grafton
Devils Lake
Grand Forks
Grand Forks
Bemidji
Hibbing
Grand Rapids
Grand Marais
Houghton
Bismarck
Jamestown
Detroit Lakes
Ashland
Brainerd
Escanaba
Park Falls
Rhinelander
Alexandria
Sisseton
Mobridge
Aberdeen
Sturgeon Bay
Willmar
Redfield
Mankato
Rochester
Pipestone
Oshkosh
Sheboygan
Beaver Dam
Windom
Estherville
Sioux Falls
Prairie du Chien
Mason City
Holland

Flow Duration Curve



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Historic Annual Average Precipitation