MIDS Work Group Meeting
November 19, 2010

Review of Background Information and Preliminary Results of Performance Goals Evaluation

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:

- “Promote…LID”
- An approach “that mimic’s a site’s natural hydrology”
  - Mimic means to imitate. Does that mean match?
- “stormwater is managed on-site”
- “the rate and volume of predevelopment stormwater reaching receiving waters is unchanged”
- “based on native soil and vegetation”

Barr's First Tasks

- Provide Background and Foundation for Defining Performance Goals
  - Native vegetation
  - Soils
  - Precipitation
  - Abstractions
  - Infiltration
  - Curve Numbers
- Compare Native Hydrology to Common Performance Goals

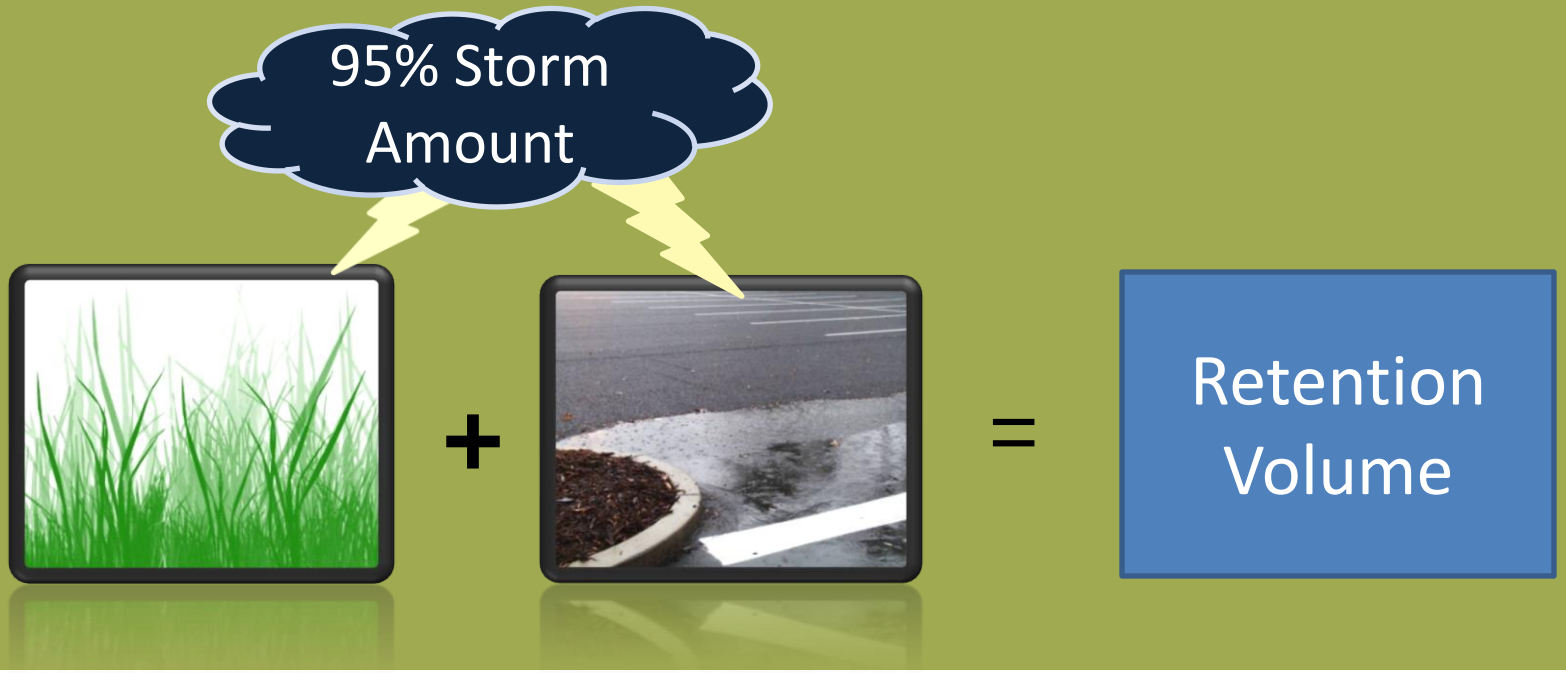
Three Common Volume Control Approaches

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

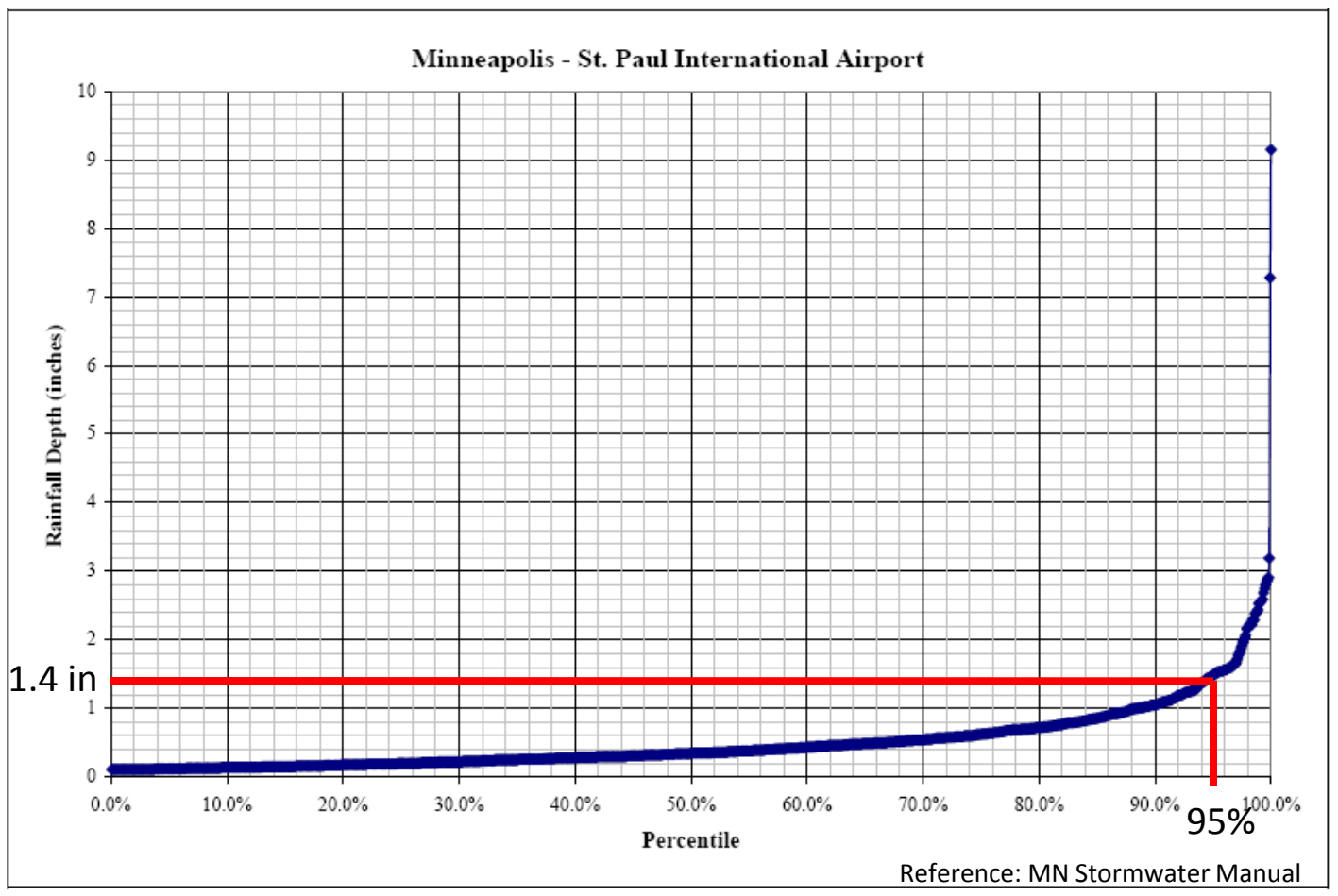
1 inch **X**  = Retention Volume

Three Common Volume Control Approaches

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



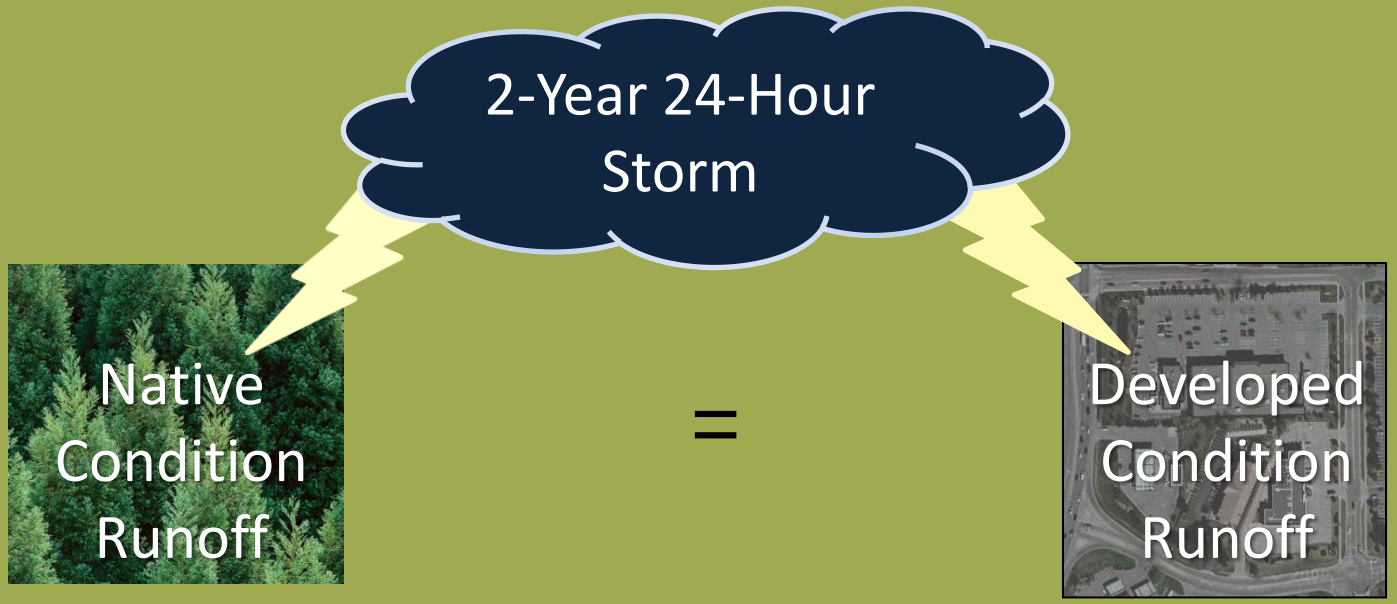
95th Percentile Storm ~ 1.4 inches at MSP



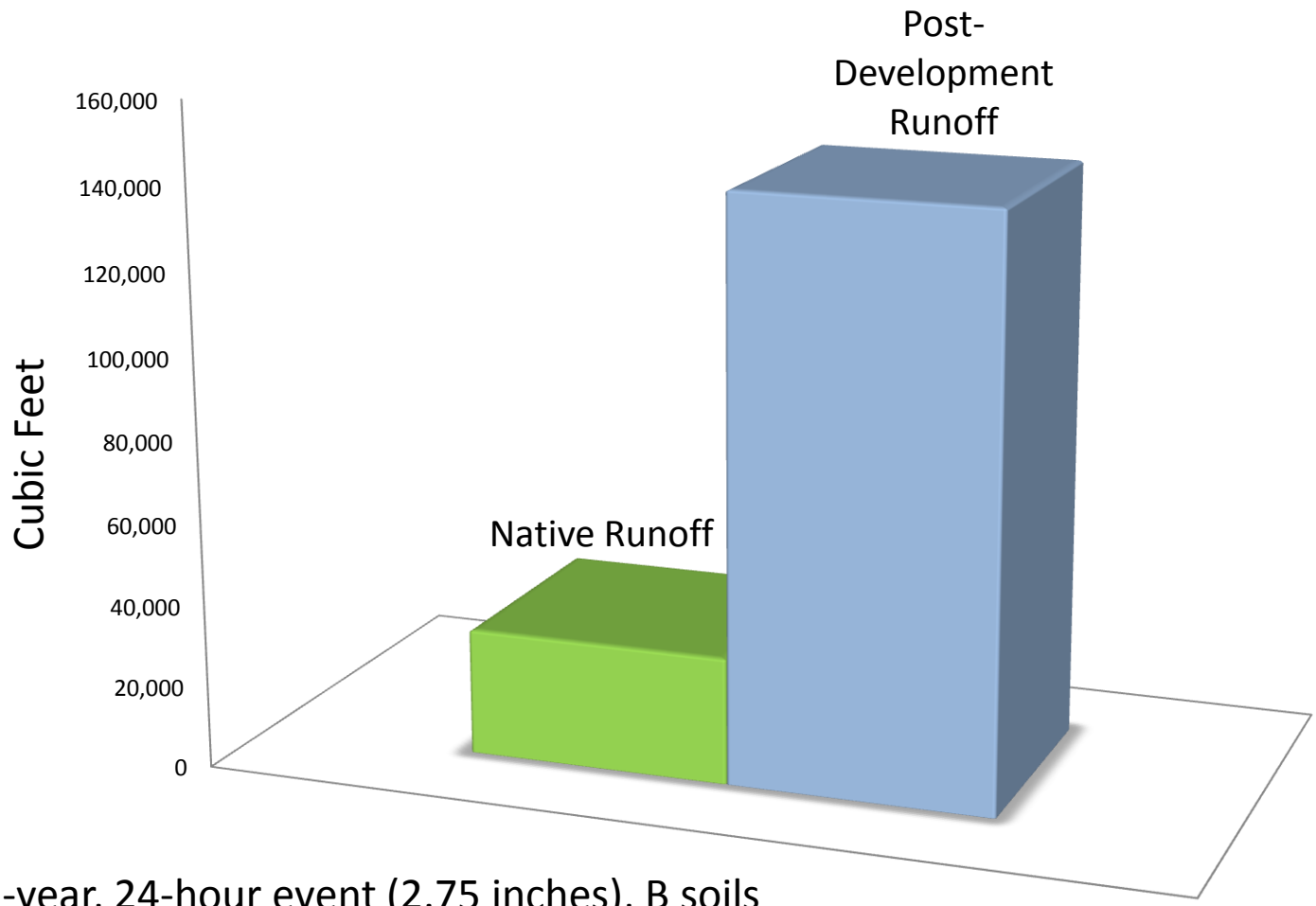
Reference: MN Stormwater Manual

Three Common Volume Control Approaches

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

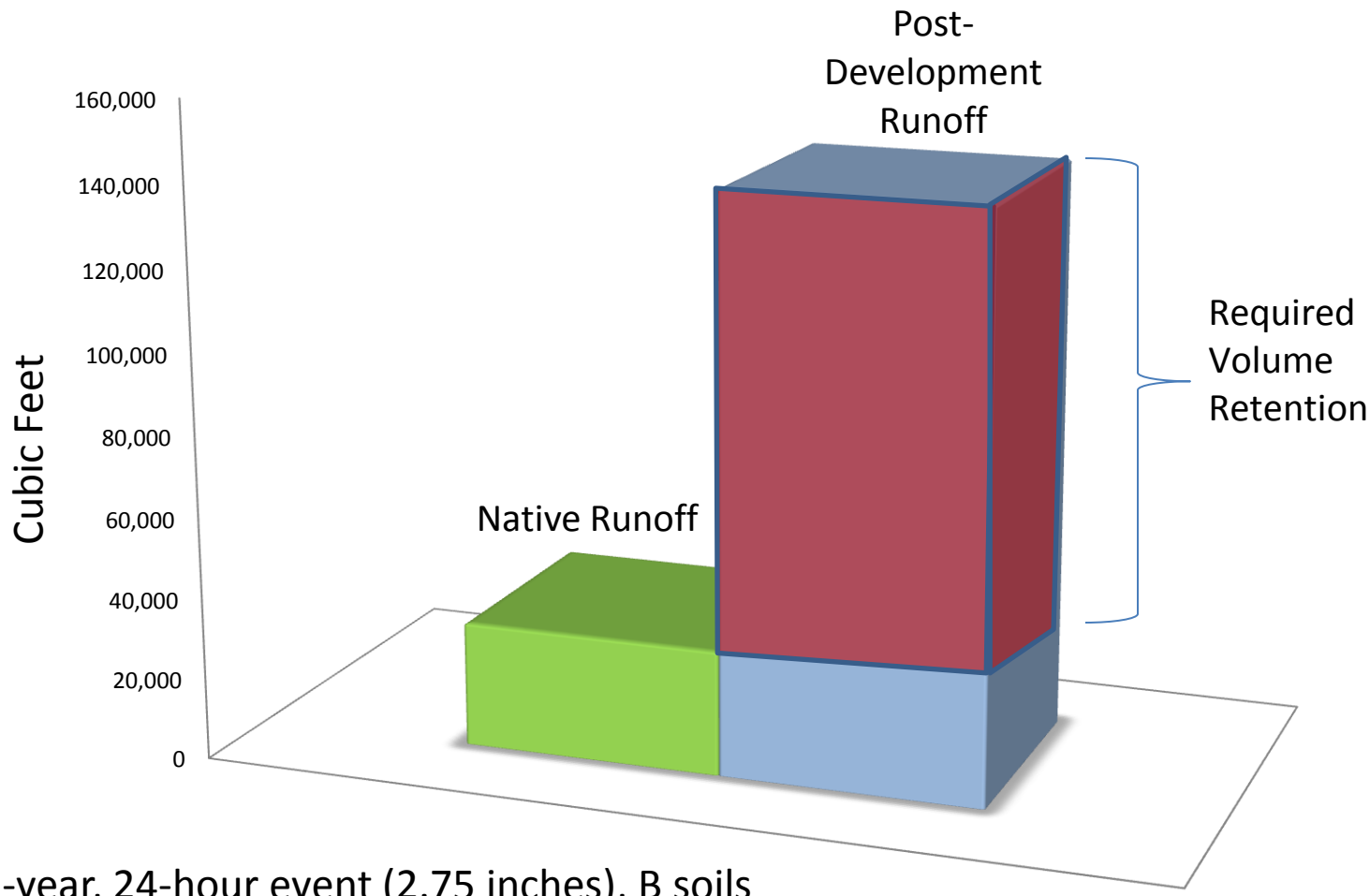


Matching Volume Control Approach



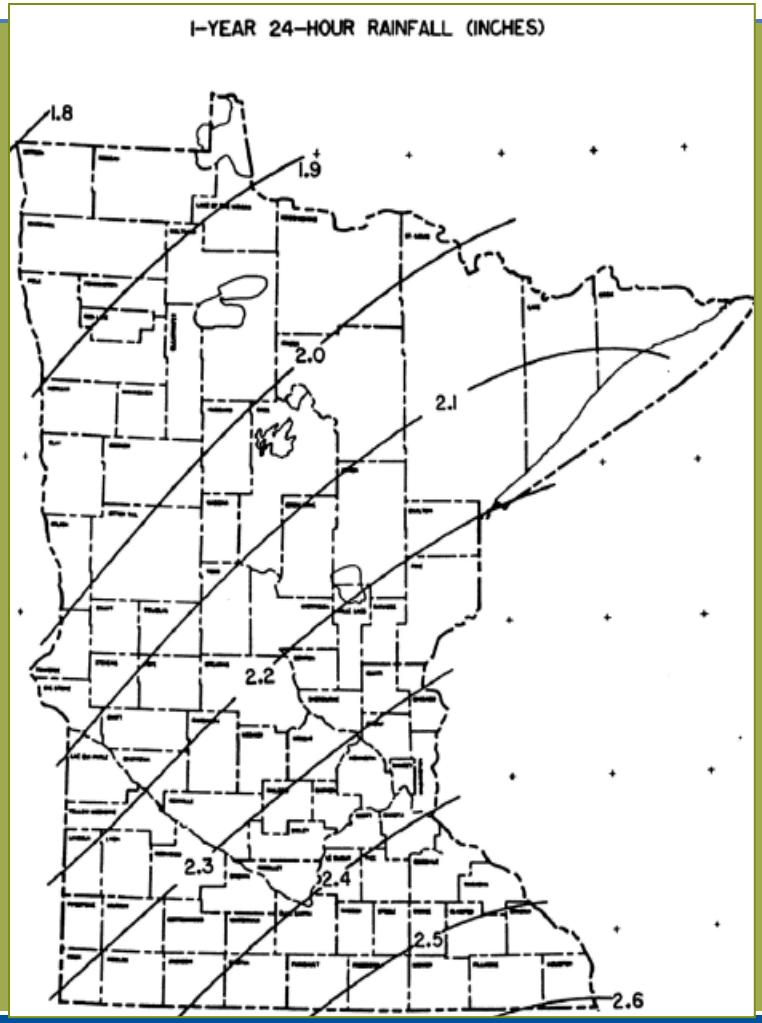
2-year, 24-hour event (2.75 inches), B soils

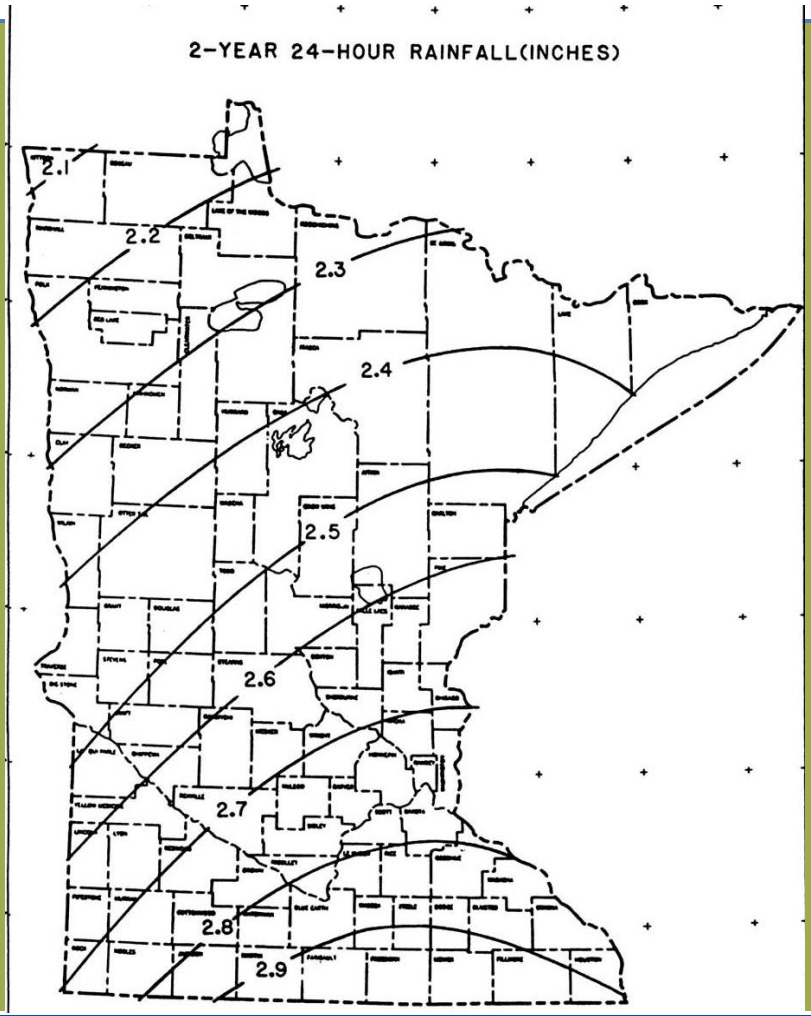
Matching Volume Control Approach



2-year, 24-hour event (2.75 inches), B soils

Variability in 1-Year and 2-Year, 24-Hour Rainfalls in Minnesota





Evaluation Criteria of Three Common Volume Control Approaches

Issue
Simple to calculate?
Open to subjectivity?
Provides incentive to reduce impervious surfaces?
Takes into account different MN regions?
Mimics native hydrology?

Evaluation Criteria of Three Common Volume Control Approaches

Issue	Approach 1 : 1 Inch off Impervious Surface	Approach 2: Retain 95% Storm	Approach 3A: Match 1-Year 24-Hour Volume	Approach 3B: Match 2-Year 24-Hour Volume
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Simple to calculate?	Very Simple	Simple	Moderately simple	
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Provides incentive to reduce impervious surfaces?				
Takes into account different MN regions?				
Mimics native hydrology?				

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Open to subjectivity?	No	Some, but values can be defined to reduce	More, but values can be defined to reduce	
Provides incentive to reduce impervious surfaces?	**Yes, the most of the 3**	**Yes, less incentive for sites on non-porous soils**	**Yes, less incentive for sites on non-porous soils**	
Takes into account different MN regions?				
Mimics native hydrology?				

Evaluation Criteria of Three Common Volume Control Approaches

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Takes into account different MN regions?	No, but could by varying 1”	Yes	Yes	
Mimics native hydrology?				

Evaluation Criteria of Three Common Volume Control Approaches

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Takes into account different MN regions?	No, but could by varying 1”	Yes	Yes	
Mimics native hydrology?	?	?	? Expected to come the closest	

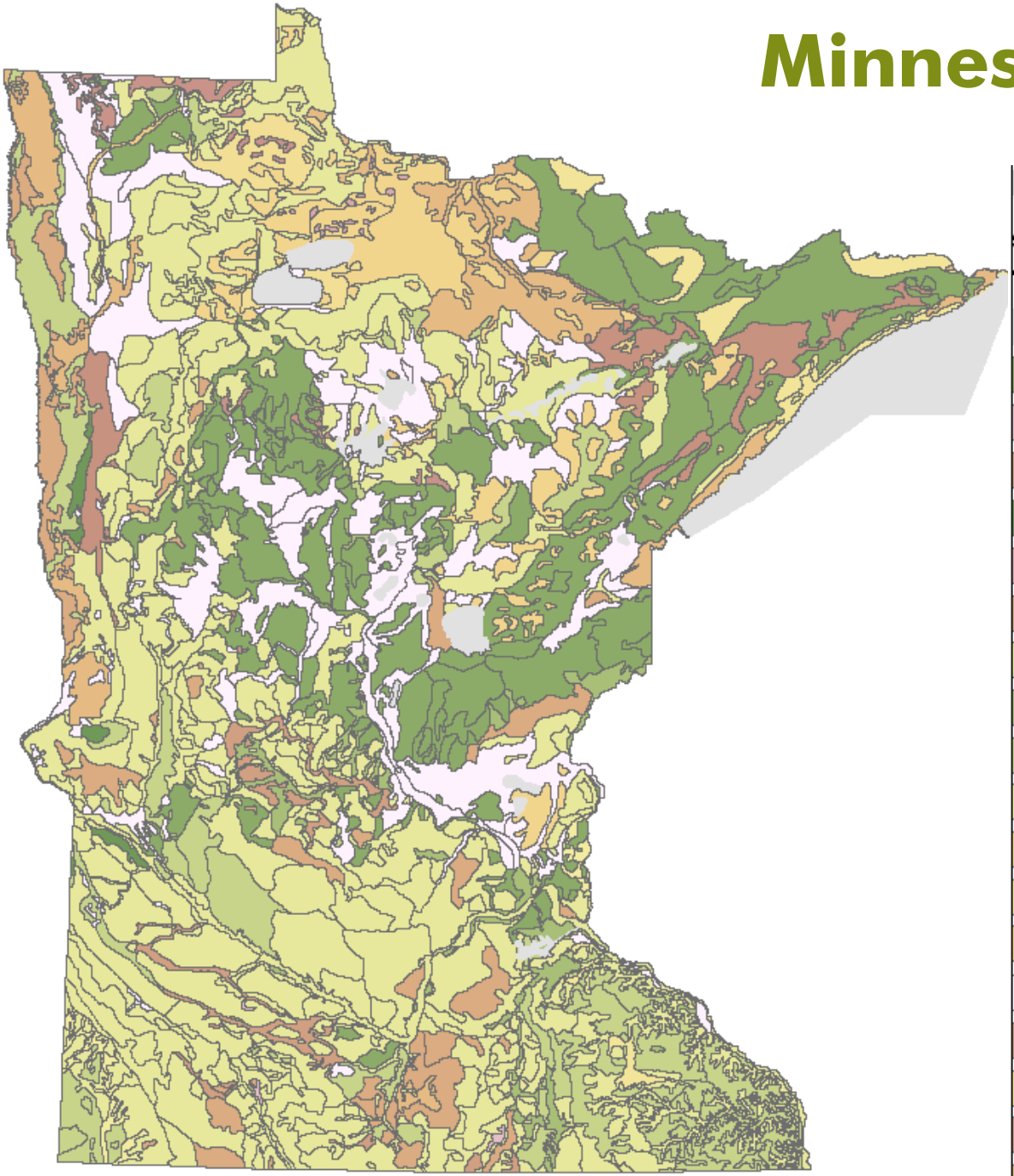
Assess Mimicry of Native Hydrology

- Develop long-term (35 years) continuous simulation model to estimate average annual native runoff
- Use model to evaluate how well volume control standards mimic native runoff

Hydrology Variables Throughout Minnesota

- Soils
- Precipitation
- Vegetation
- Abstractions (various processes which act to remove water from the incoming precipitation before it leaves the watershed as runoff, i.e., “losses”)

Minnesota Soils Vary



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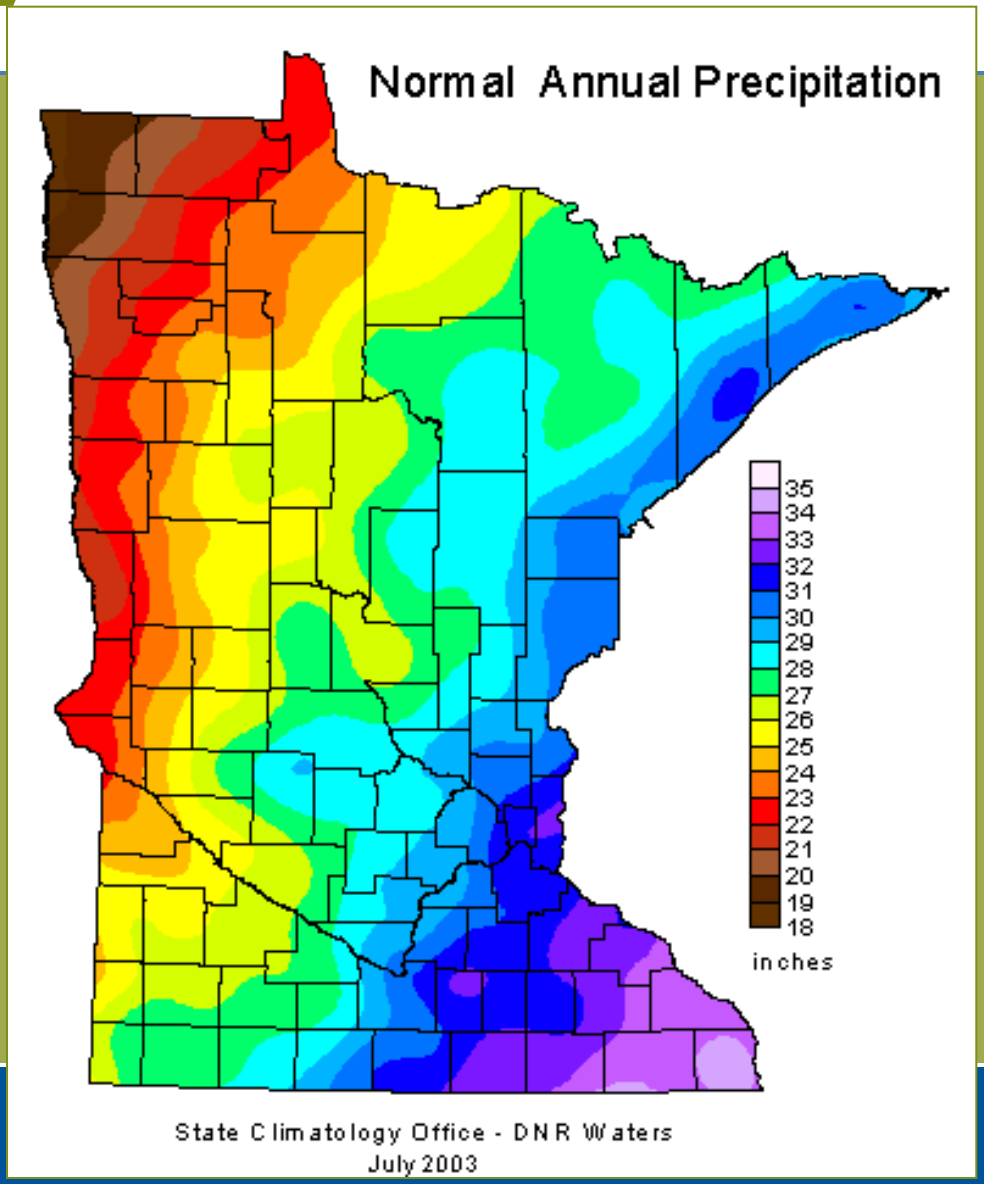
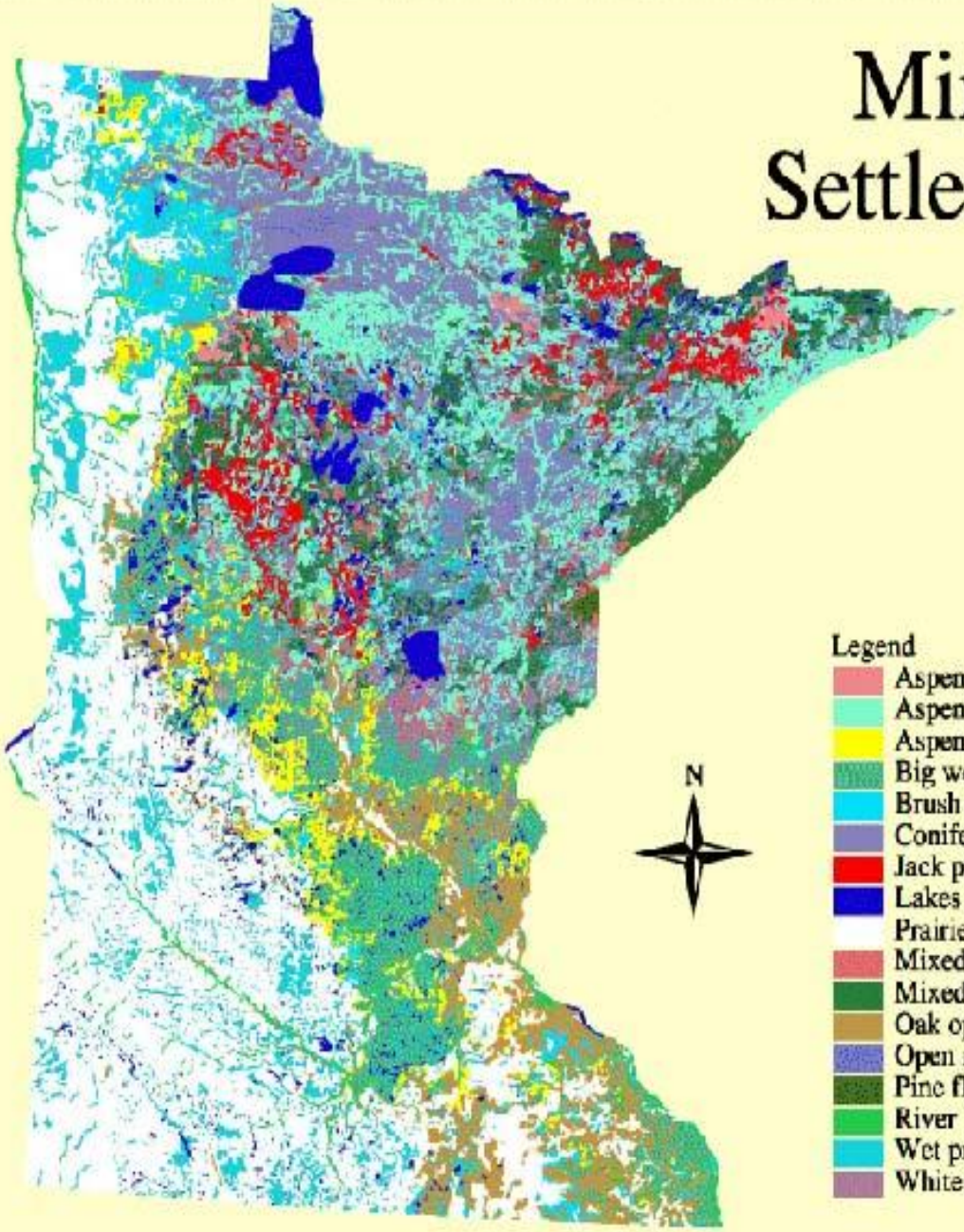
Normal Annual Precipitation Variability in Minnesota



Minnesota Early Settlement Vegetation



Scale
1:4000000

Miles
0 30 60 90 120

N

Legend
- Aspen-birch (eventually succeed to hardwoods)
- Aspen-birch (eventually succeed to conifers)
- Aspen-oak land
- Big woods - oaks, elm, basswood, ash, maple, etc.
- Brush prairie
- Conifer and bog swamps
- Jack pine barrens
- Lakes
- Prairie
- Mixed hardwood and pine
- Mixed white pine and Norway pine
- Oak opening and barrens
- Open muskeg
- Pine flats (hemlock, spruce, fir, cedar, & white pine
- River bottom forest
- Wet prairie
- White pine

Vegetative cover map was derived from notes and maps from General Land Office surveys conducted in Minnesota (1847-1907). Map was digitized by the Minnesota DNR

Great Lakes Ecological Assessment

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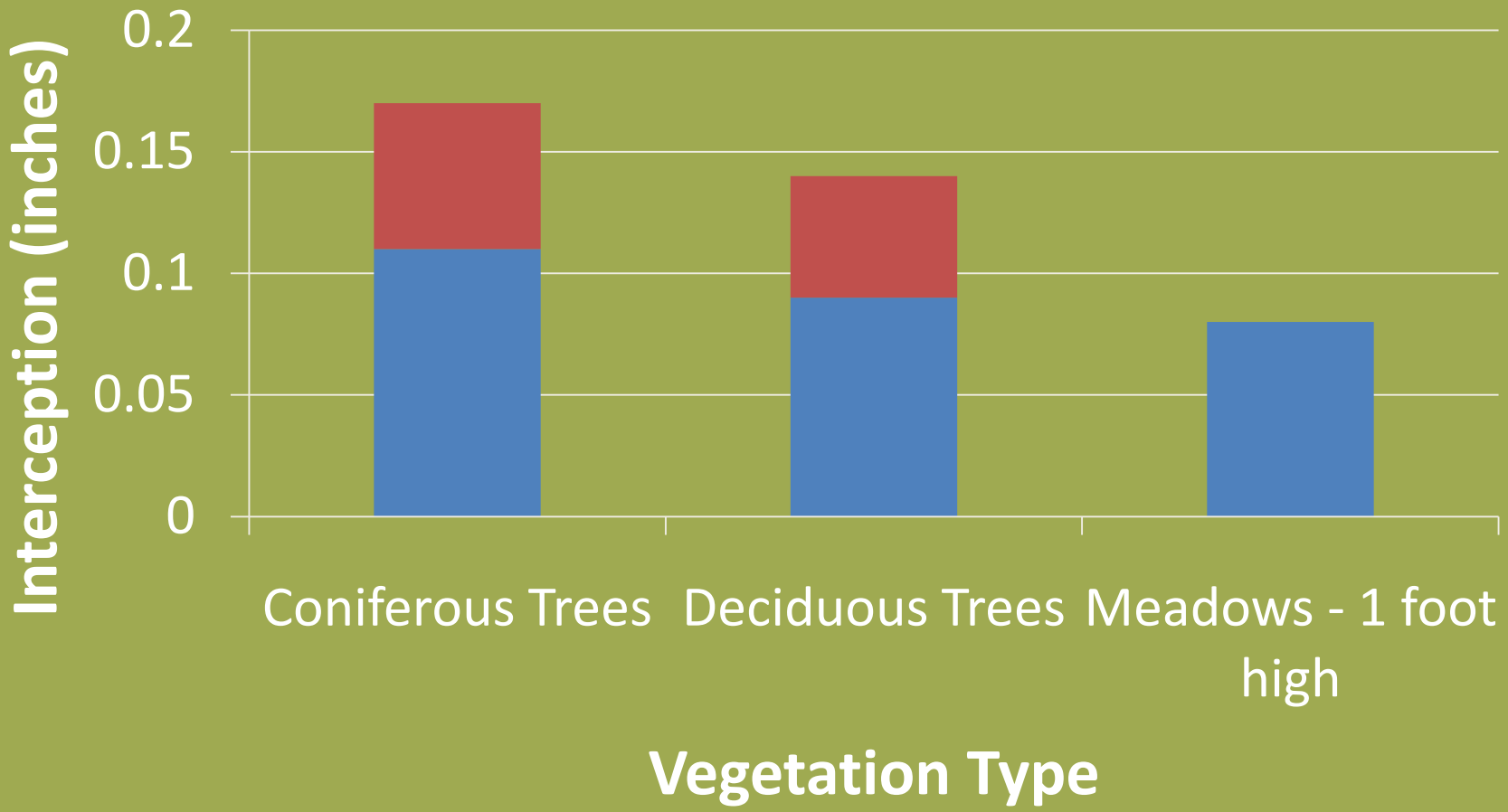
Abstractions – Interception:
Capturing precipitation on vegetation

- Variable:
  - Trees
    - Big vs. little
    - Species
    - Time of year
  - Prairie grass
    - Height
  - Developed land
    - Pavement
    - Row crops

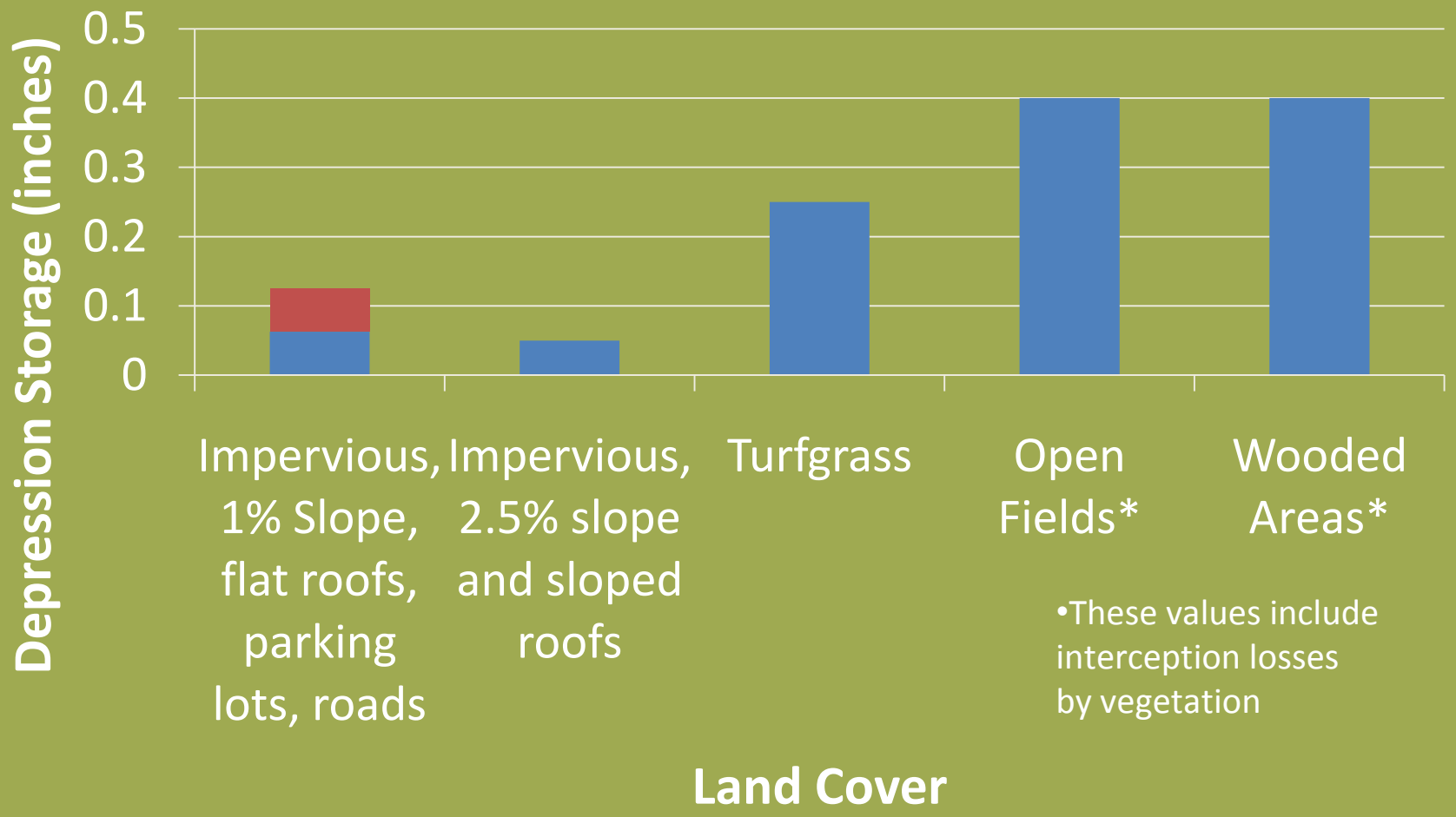
Interception Amounts for Selected Vegetation Types



Abstractions – Depression Storage:
Low points that store precipitation

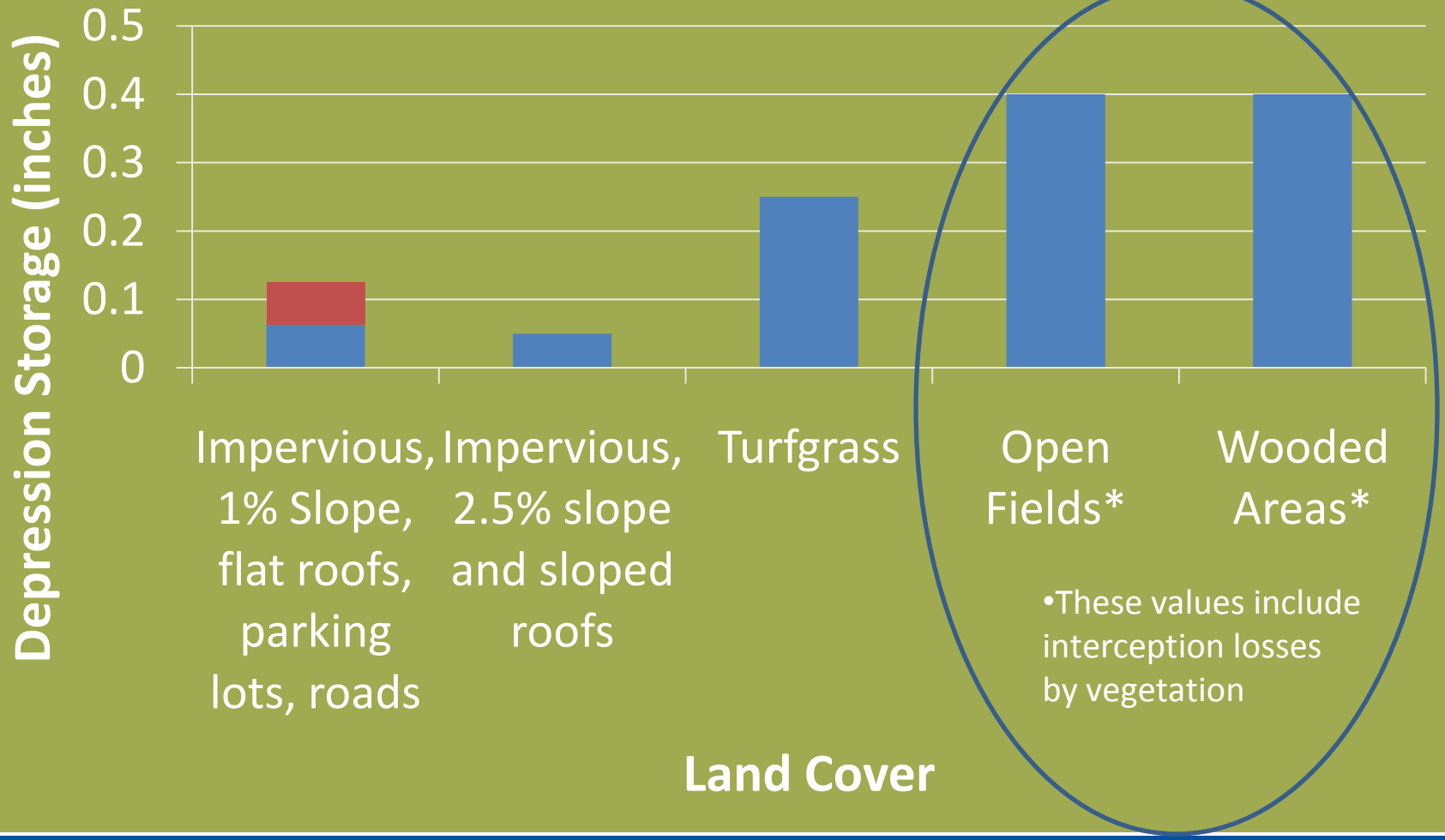
- Dependant on surface cover and slope

Depression Storage Amounts for Selected Land Covers



•These values include interception losses by vegetation

Depression Storage Amounts for Selected Land Covers



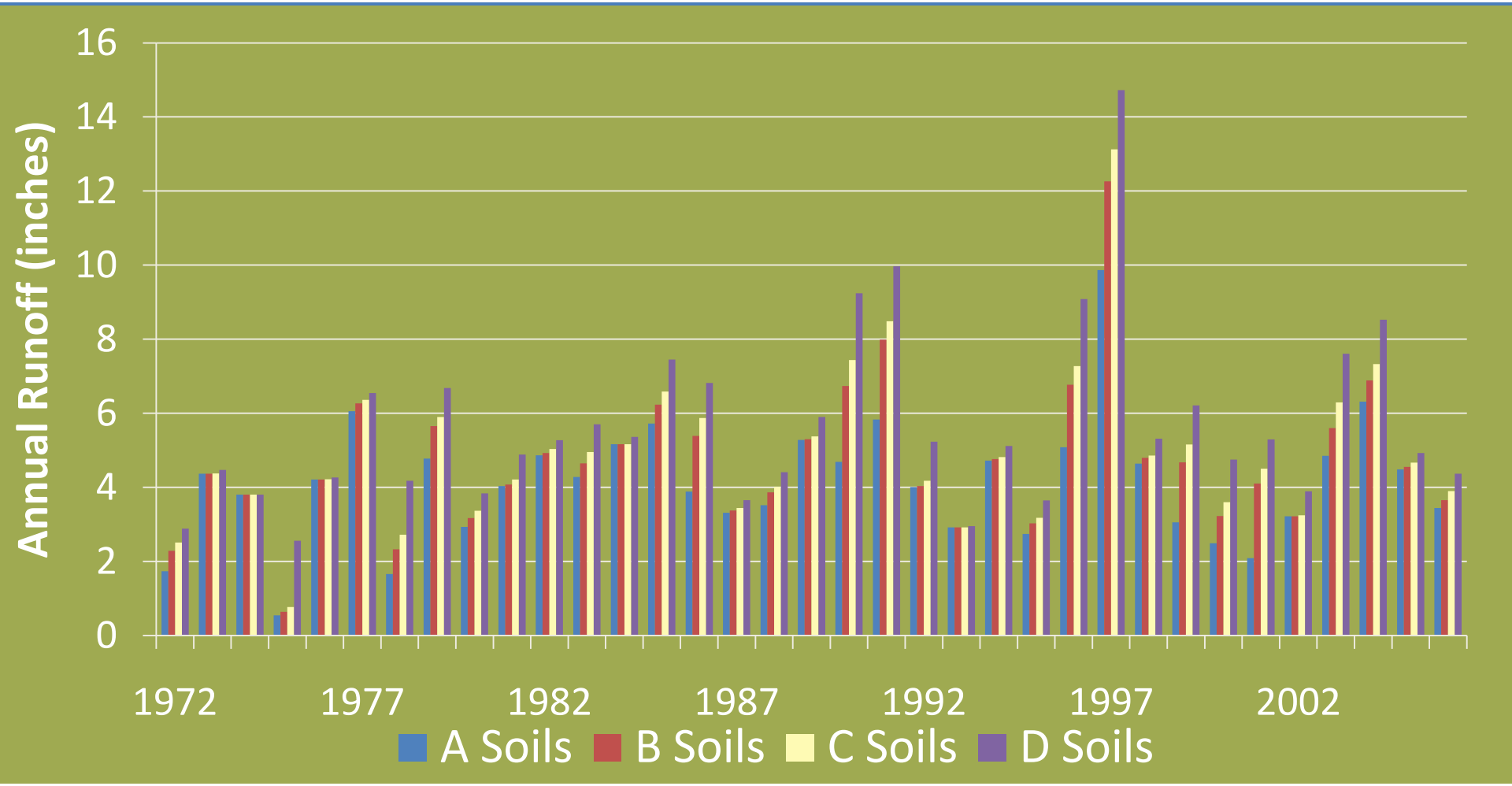
Model 10-Acre Site in Twin Cities Ecoregion

Condition	Hydrologic Soils Group			
	A	B	C	D
Native: 100% Deciduous Forest	X	X	X	X
Native: 100% Meadow	X	X	X	X
Developed: 20% Impervious Surface		X	X	
Developed: 50% Impervious Surface		X	X	
Developed: 80% Impervious Surface		X	X	

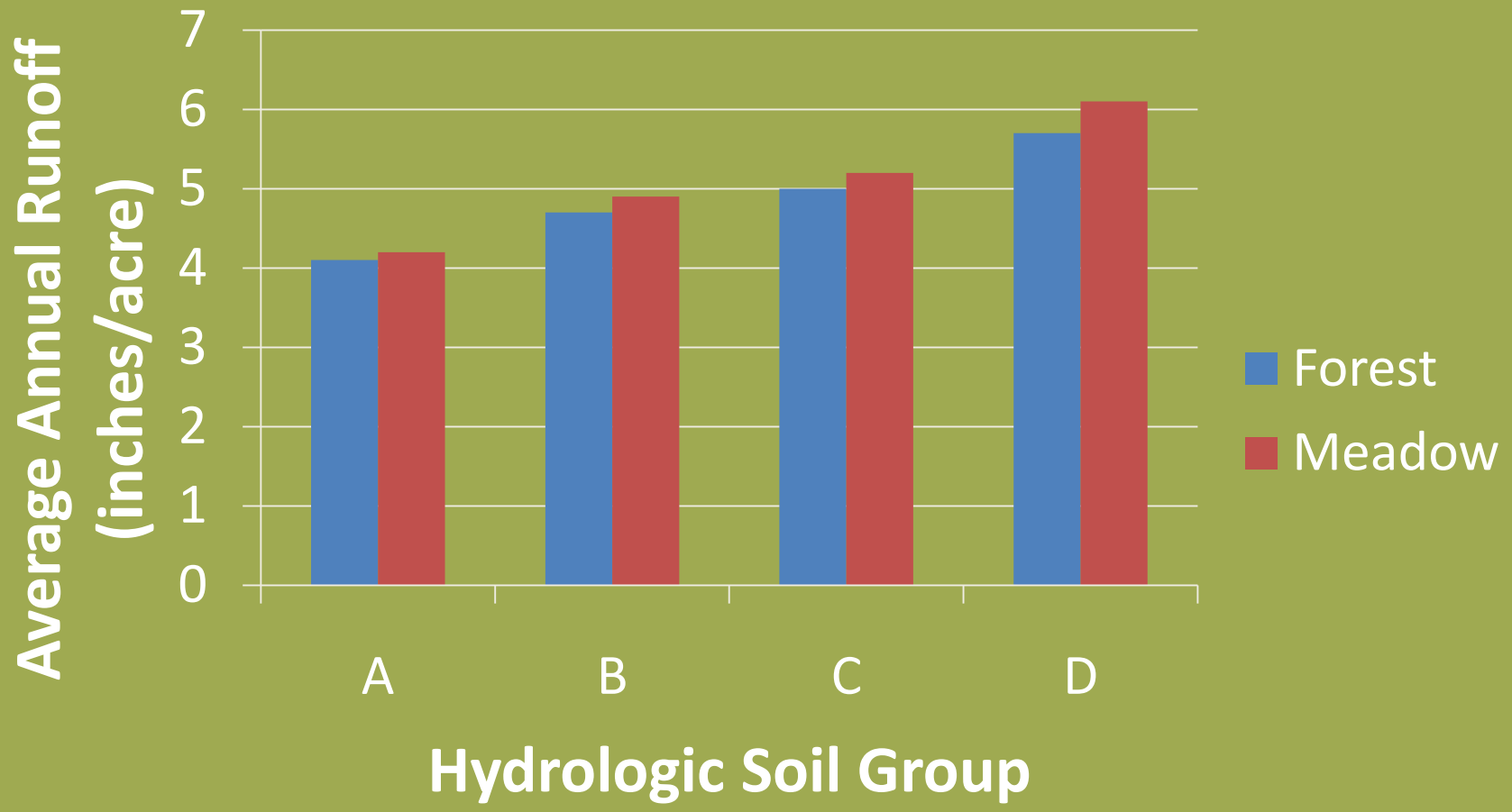
Native Conditions:

Stormwater Runoff Volume Leaving 10-Acre Site

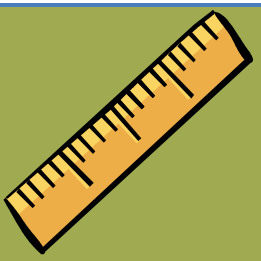
Forest



Native Conditions:
Stormwater Runoff Volume Leaving 10-Acre Site



Developed Site Volume Control Performance Goals Modeled



1. Retain a runoff volume equal to one inch times the proposed impervious surfaces

2. Retain the post-construction runoff volume on site for the 95th percentile storm

3. Match the native runoff volume for the
   a. 1-year 24-hour design storm
   b. 2-year 24-hour design storm

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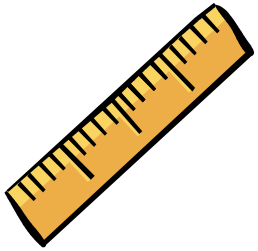
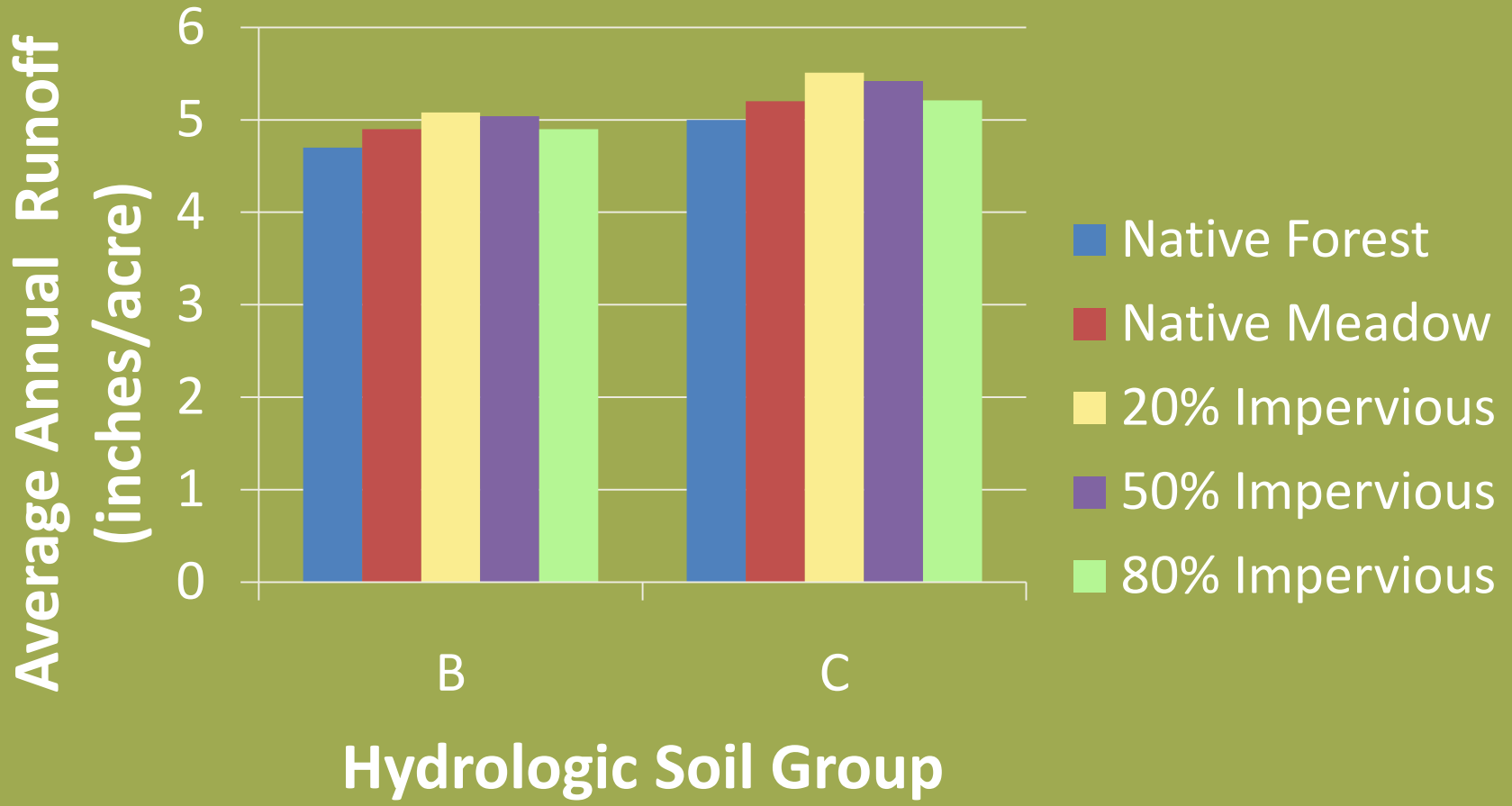
Developed Conditions:
Stormwater Runoff Volume Leaving 10-Acre Site

Volume Control =





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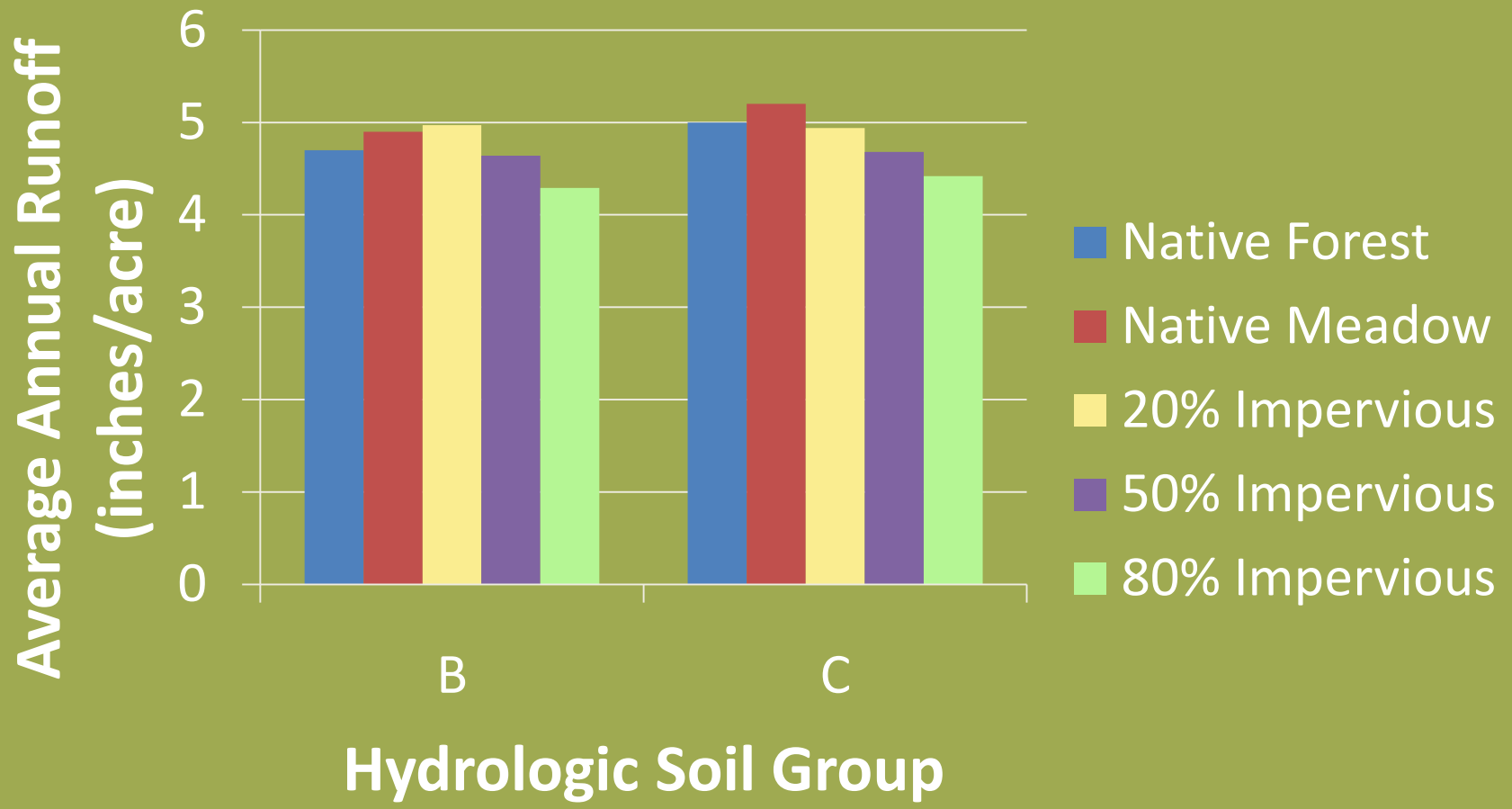
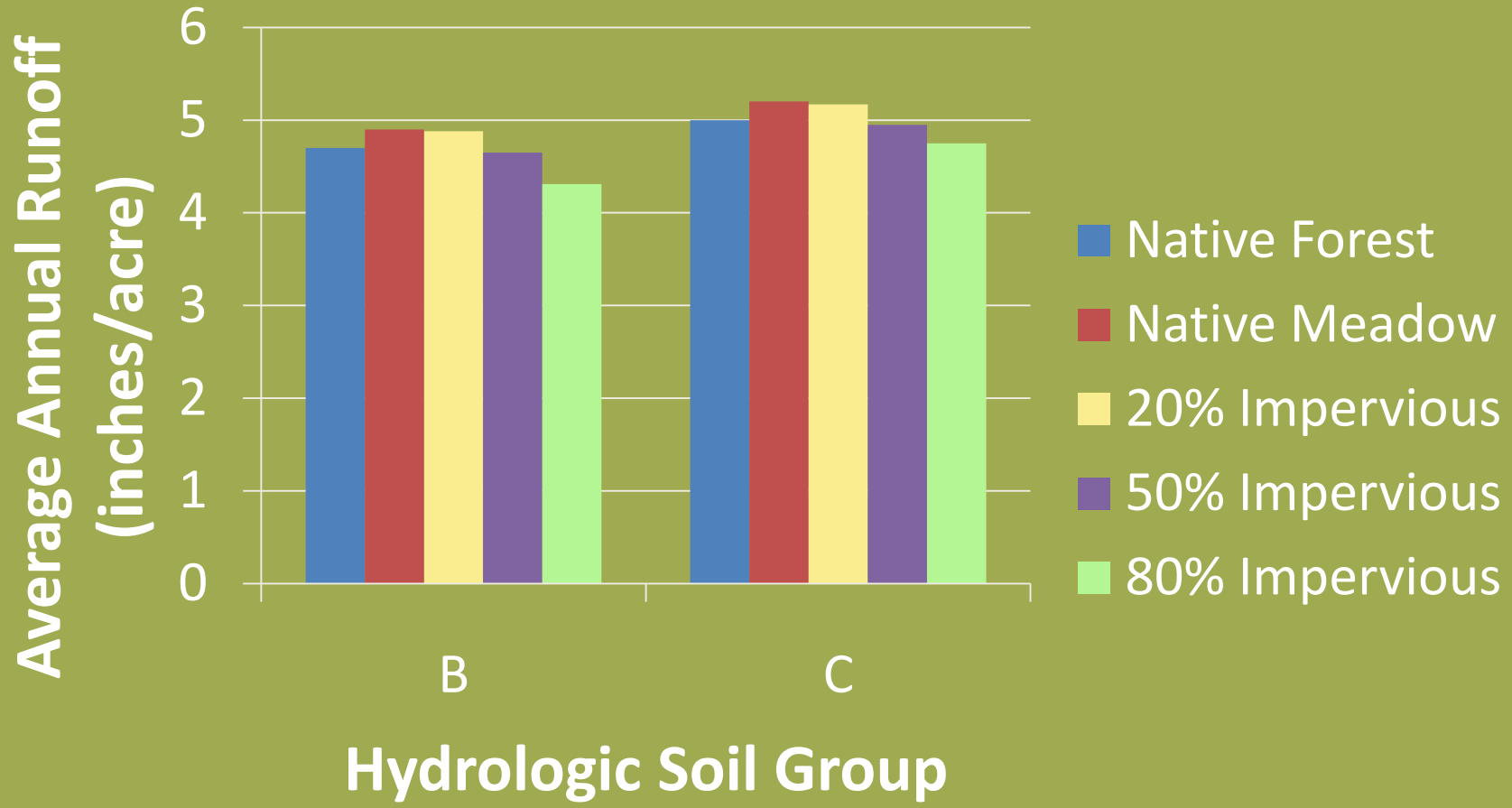
Developed Conditions:
Stormwater Runoff Volume Leaving 10-Acre Site

Volume Control = 95%



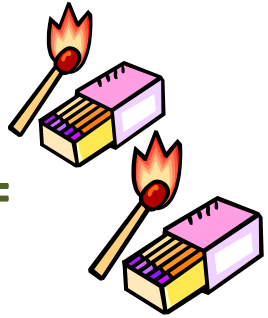
Developed Conditions:
Stormwater Runoff Volume Leaving 10-Acre Site

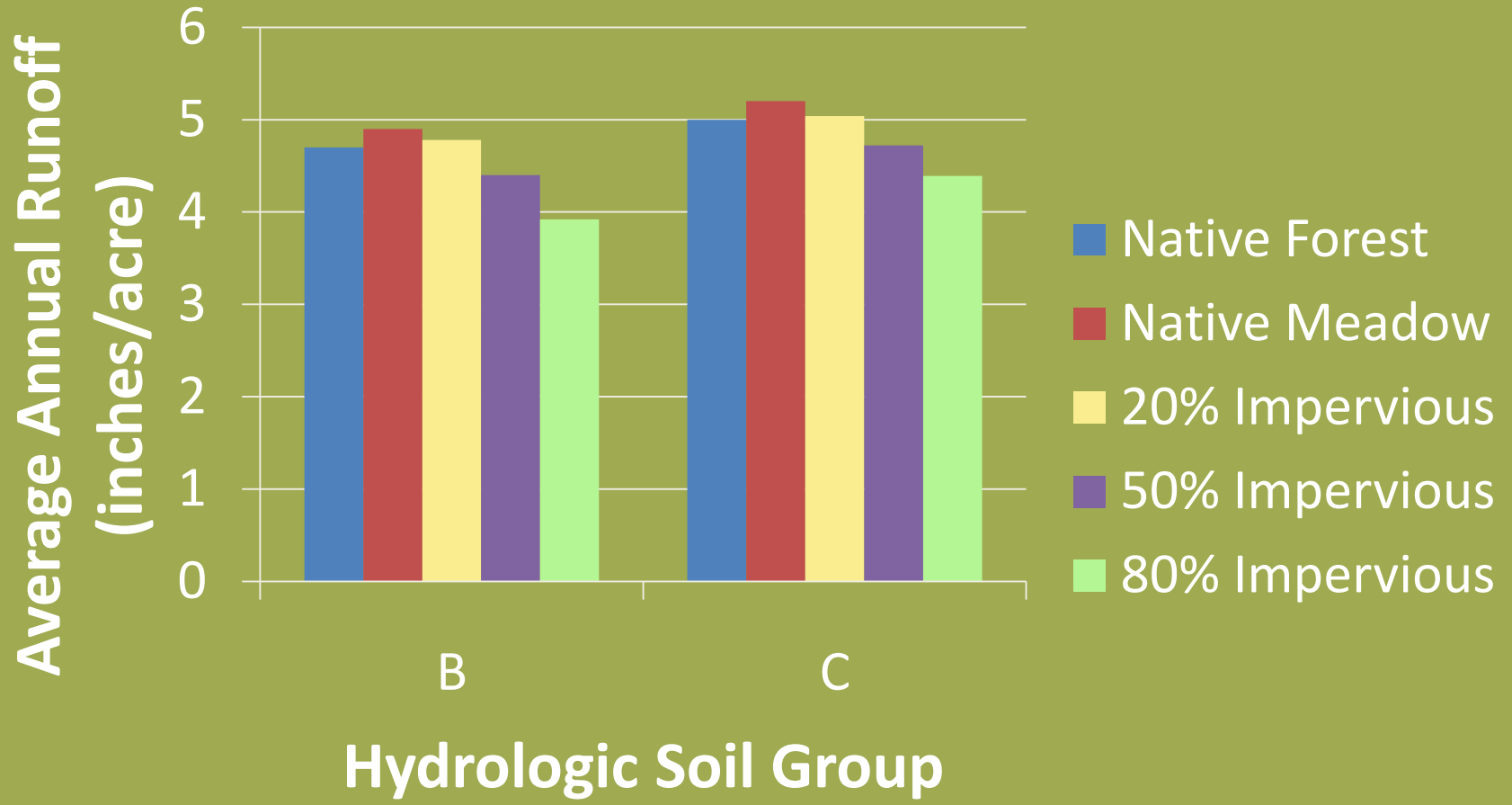
Volume Control =



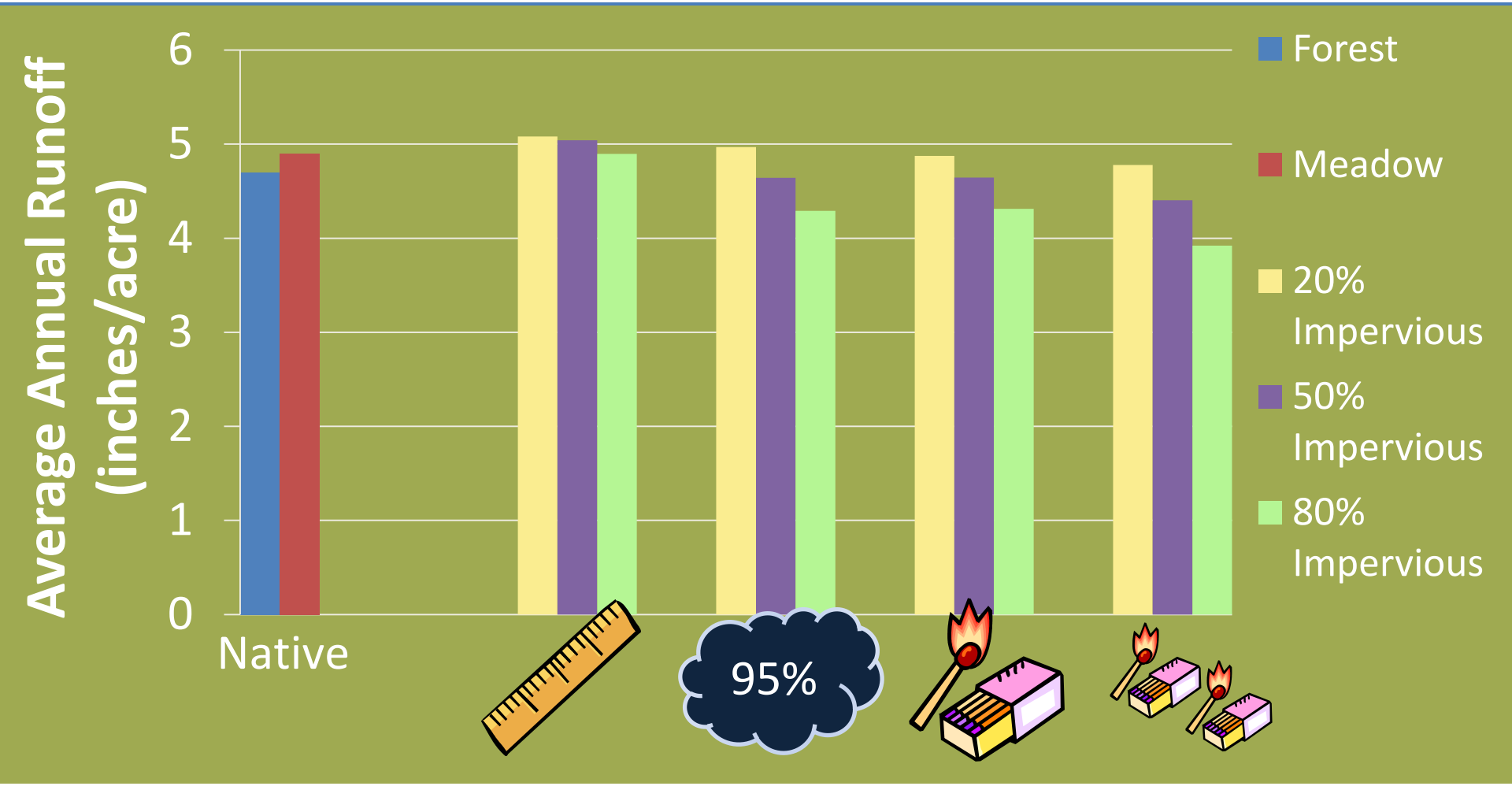
Developed Conditions:
Stormwater Runoff Volume Leaving 10-Acre Site

Volume Control =

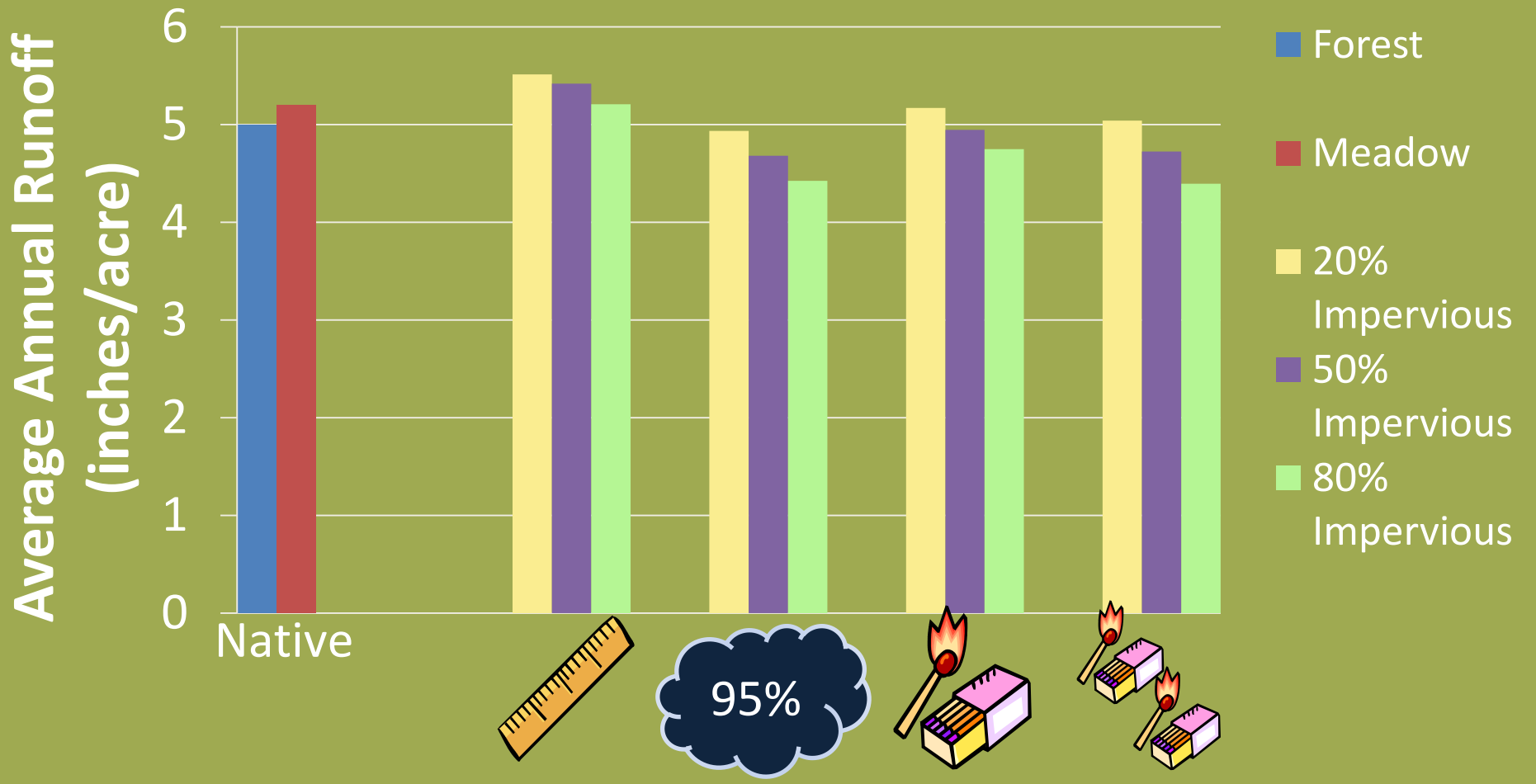




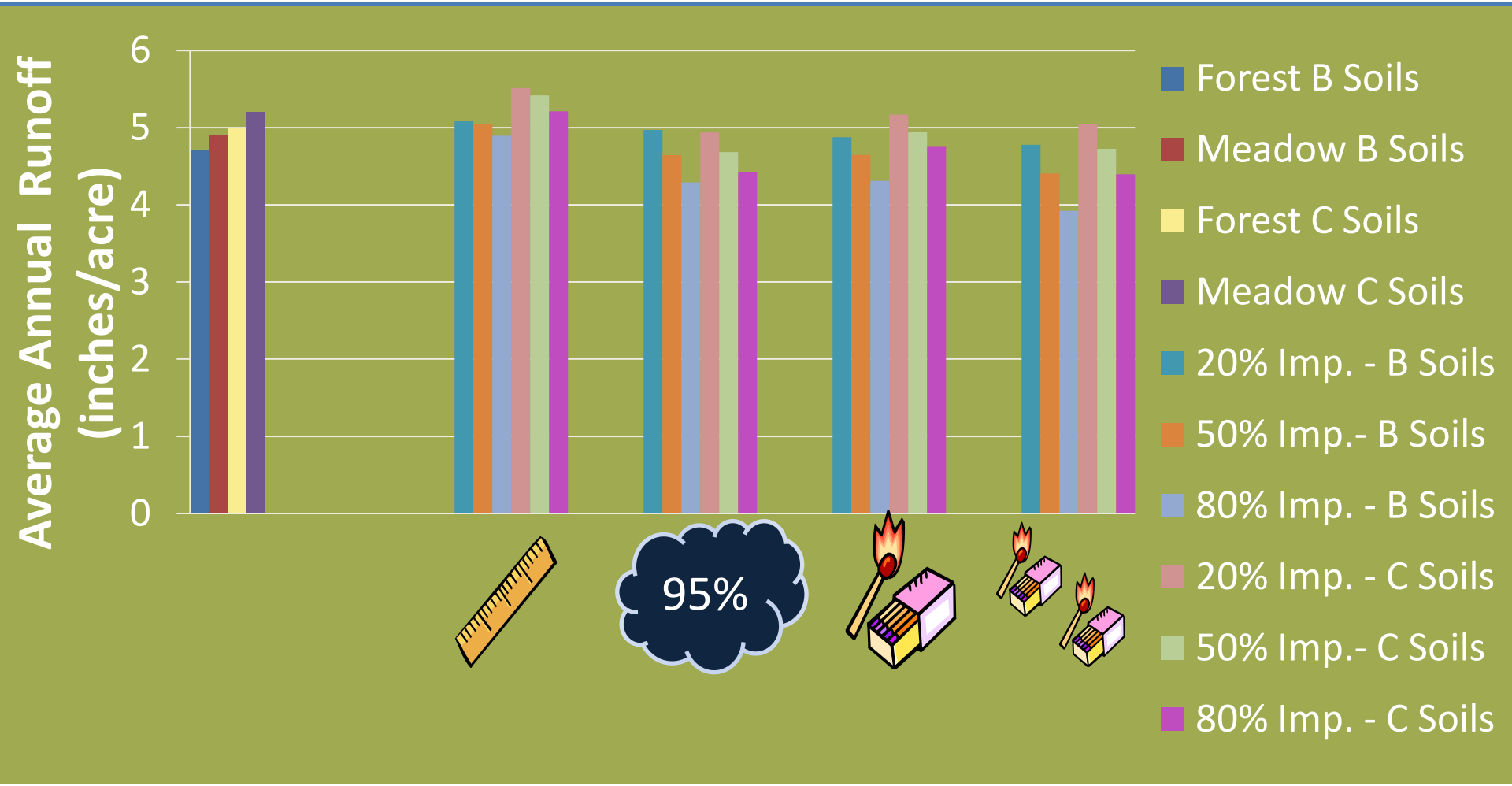
Comparison of Volume Controls:
Stormwater Runoff Volume Leaving 10-Acre Site with B Soils



Comparison of Volume Controls:
Stormwater Runoff Volume Leaving 10-Acre Site with C Soils

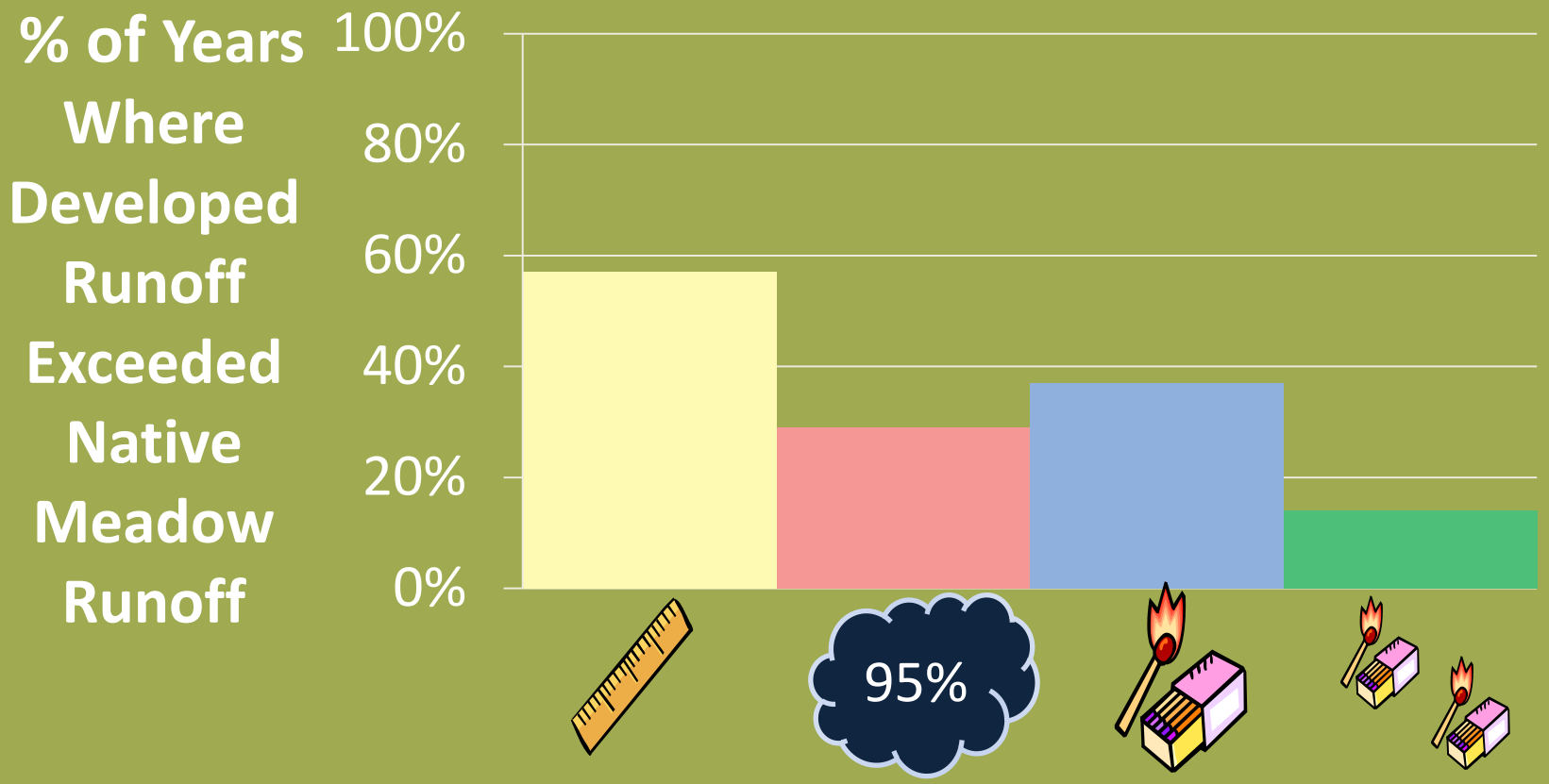


Comparison of All Volume Controls:
Stormwater Runoff Volume Leaving 10-Acre Site



Annual Variability of Performance Goals

B soils, 50% Impervious



Mimicry Evaluation Summary

Parameter	Approach 1 : 1 Inch off Impervious Surface	Approach 2: Retain 95% Storm	Approach 3A: Match 1-Year 24-Hour Volume	Approach 3B: Match 2-Year 24-Hour Volume
Is the 35-year average annual runoff volume equal to or less than the native annual runoff?				
What percentage of the 35 years modeled does approach exceed native forest/meadow runoff volume?				
How does the approach compare to others in removing pollutants?				

Mimicry Evaluation Summary

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Is the 35-year average annual runoff volume equal to or less than the native annual runoff?	• No • Is closer for higher impervious site • Could improve match with higher treatment (e.g. , 1.2”?)	• Almost always • Closely matches for low impervious • Provides more than needed volume reduction for high impervious	• Yes • Closely matches for low impervious • Provides more than needed volume reduction for high impervious	• Yes • Closely matches for low impervious • Provides more than needed volume reduction for high impervious

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Mimicry Evaluation Summary

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What percentage of the 35 years modeled does approach exceed native forest/meadow runoff volume?	Forest: 60-85% Meadow: 45-80%	Forest: 30-65% Meadow: 15-45%	Forest: 35-65% Meadow: 15-60%	Forest: 15-60% Meadow: 5-50%

Mimicry Evaluation Summary

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How does the approach compare to others in removing pollutants?	**Comparable**	**Comparable**	**Comparable**	**Comparable**

Decisions for Work Group

- How well should performance goal mimic native hydrology? Do their runoff volumes need to match?
- Which performance goal should be used?
  - What additional information does Work Group need?
    - Determine better value for 1” x impervious, e.g., 1.2” x impervious?
    - Performance on “A” soils?
    - Performance in different MN regions?

“Make everything as simple as possible, but not simpler.”

- Albert Einstein