



# Red River Basin Tile Drainage Study

Briefing Paper #2: Water Management Options for Subsurface Drainage

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**BASIN TECHNICAL AND SCIENTIFIC ADVISORY  
COMMITTEE (BTSAC)**

AVAILABLE @:

**[WWW.RRBBDIN.ORG](http://WWW.RRBBDIN.ORG)**

# Red River Basin Decision Information Network: [www.rrbdin.org](http://www.rrbdin.org)

The screenshot shows the homepage of the Red River Basin Decision Information Network. At the top, there is a search bar and a navigation menu with links for Home, About, News, Resources, Projects, Tools, and Contact Us. Below the navigation is a large banner image of a river flowing through a wooded area. The main content area is divided into several sections: 'Featured Tool', 'Featured Project', 'Organizations', 'Additional Tools', 'More Projects', and 'News & Events'. The 'Featured Project' section is highlighted with a yellow circle. It describes the Basin Technical and Scientific Advisory Committee (BTSAC) - Tile Drainage Study, which was commissioned by the Red River Retention Authority (RRRA) to determine the impacts of agricultural drainage on peak flows. The 'Organizations' section lists several partner organizations, including FM River Keepers, International Water Institute, MN Red River Watershed Management Board, ND Red River Joint Water Resources District, Red River Basin Commission, Red River Retention Authority, and US Army Corps of Engineers. The 'News & Events' section lists recent news items, such as the Obama Administration approving a diversion project and a spring flood threat increase. The footer contains the International Water Institute logo and contact information, along with a disclaimer that the site is made possible by partners including the International Water Institute, U.S. Army Corps of Engineers, and North Dakota State University.

**Red River Basin Decision Information Network**  
Shared Tools for Regional Problem Solving

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**Featured Tool**  
Regional Drought Decision Support System  
The Regional Drought Decision Support System (RDDSS) for the Red River of the North Basin (Red River Basin) is the vision of the International Water Institute (IWI) and collaborators. The intent of the RDDSS is to allow a user to obtain  
[VIEW TOOL](#) [MORE INFO](#)

**Featured Project**  
Basin Technical and Scientific Advisory Committee (BTSAC) – Tile Drainage Study  
The Red River Retention Authority (RRRA) commissioned the International Water Institute with establishing an objective and scientific process to determine the impacts of agricultural drainage (tile drainage) on peak flows. The International Water Institute established a Basin Technical and Scientific  
[MORE INFO](#)

**Organizations**  
FM River Keepers  
International Water Institute  
MN Red River Watershed Management Board  
ND Red River Joint Water Resources District  
Red River Basin Commission  
Red River Retention Authority  
US Army Corps of Engineers

**Additional Tools**

- River Watch Water Quality Database
- Regional Drought Decision Support System
- LiDAR Portal
- Flood Forecast Display Tool

**More Projects**

- North Ottawa Flood Damage Reduction Project
- Basin Technical and Scientific Advisory Committee (BTSAC) – Tile Drainage Study
- Long Term Flood Solutions (LTFS)
- Regional Drought Decision Support System
- Project Planning Tool (Phase 6)

**News & Events**  
3/31/12 - Obama Administration Approves Diversion Project  
3/3/12 - Spring Flood Threat Increased  
2/28/12 - Freshwater Society Hosting Precision Conservation Conference

**International Water Institute**  
Supporting Flood Research and Watershed Education  
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This site is made possible in part by the following partners: International Water Institute, U.S. Army Corps of Engineers, and North Dakota State University, Extension Service



- International Flood Mitigation Initiative (IFMI) 2000
- 501c3 Non-Profit Organization
- International (US and CA) Management Board
- Mission:
  - *Provide a forum for research, public education, training, and information dissemination relating to flood damage reduction and natural resource protection and enhancement in the Red River Basin*

# Presentation Overview

## 1. Study Origins

- Basin Technical and Science Advisory Committee

## 2. Soil Science/Tile Drainage

## 3. Briefing Paper #1

- Conclusions/Statements

## 4. Briefing Paper #2\*

- Conclusions/Options

# Study Origins

- 2009 Red River of the North Flood
- ND Red River Joint Water Resources District & MN Red River Watershed Management Board (Joint Drainage Committee)
  - *What are the impacts of agricultural drainage on peak watershed flows?*
  - *How should agricultural drainage systems be designed to maximize benefits while minimizing adverse impacts?*
- ND and MN Joint Boards formed 
- Directed the International Water Institute to establish objective process to address questions - BTSAC

# BTSAC MEMBERSHIP

Stakeholder	Representative	Stakeholder	Representative
MN Red River Watershed Management Board	Charlie Anderson	ND Red River Joint Water Resources Board	Kurt Lynse
City of Fargo, ND	Mark Bittner	US Geological Survey	Rochelle Nustad
MN Red River Watershed Management Board	Nate Dalager	ND Natural Resources Conservation Service	Dennis Reep
US Fish and Wildlife Service	Josh Eash	ND State Water Commission	Bill Schuh
International Water Institute	Charles Fritz	MN Department of Agriculture	Rob Sip
ND Red River Joint Water Resources Board	Randy Gjestvang	MN Department of Natural Resources	Jim Solstad
MN Natural Resources Conservation Service	Dave Jones	MN Red River Watershed Management Board	Dan Thul
US Army Corps of Engineers	Scott Jutila	MN Center for Environmental Advocacy	Henry VanOffelen
MN Board of Soil and Water Resources	Al Kean	City of Moorhead, MN	Bob Zimmerman

# BRIEFING PAPER(S)

- STUDY GOAL

- Understand Subsurface Drainage Systems Impacts on Watershed and Basin hydrology
  - Develop Management Recommendations
    - Maximize Benefits/Minimize Impacts
- 

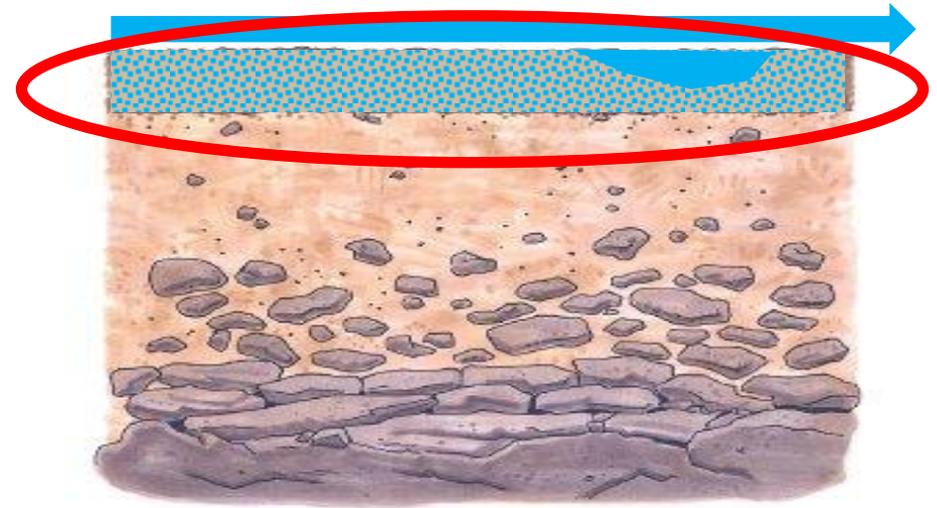
- Audience:



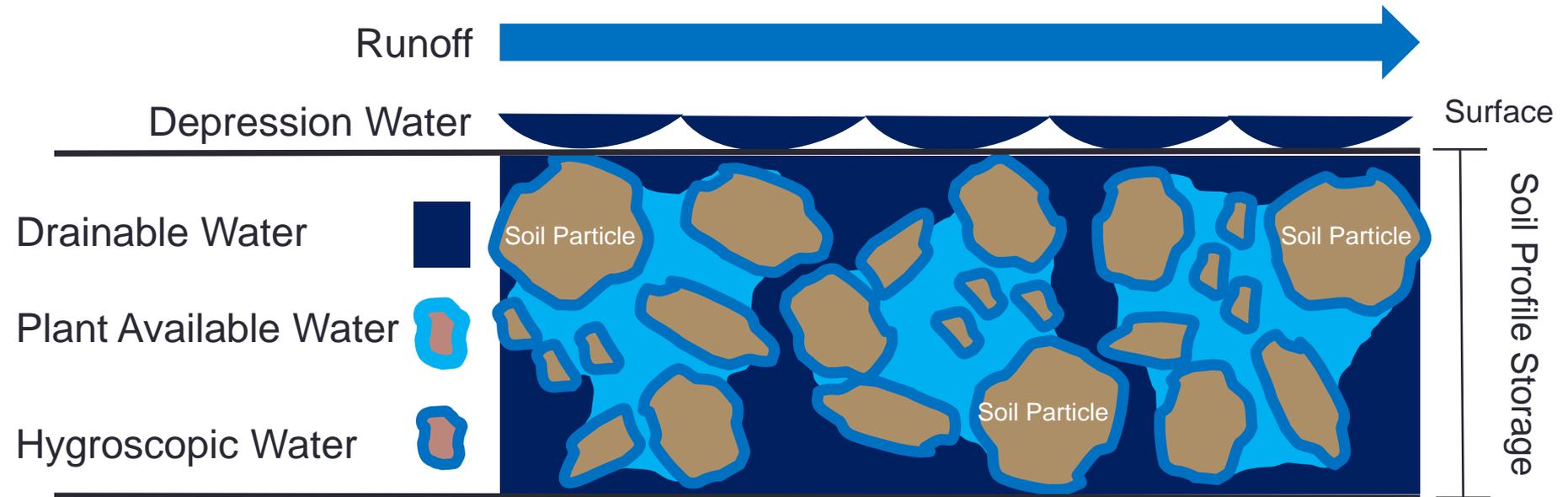
- MN - Red River Watershed Management Board
  - Member Watershed Districts
- ND - Red River Joint Water Resources District
  - Member Water Resources Districts

# GENERAL PROCESS

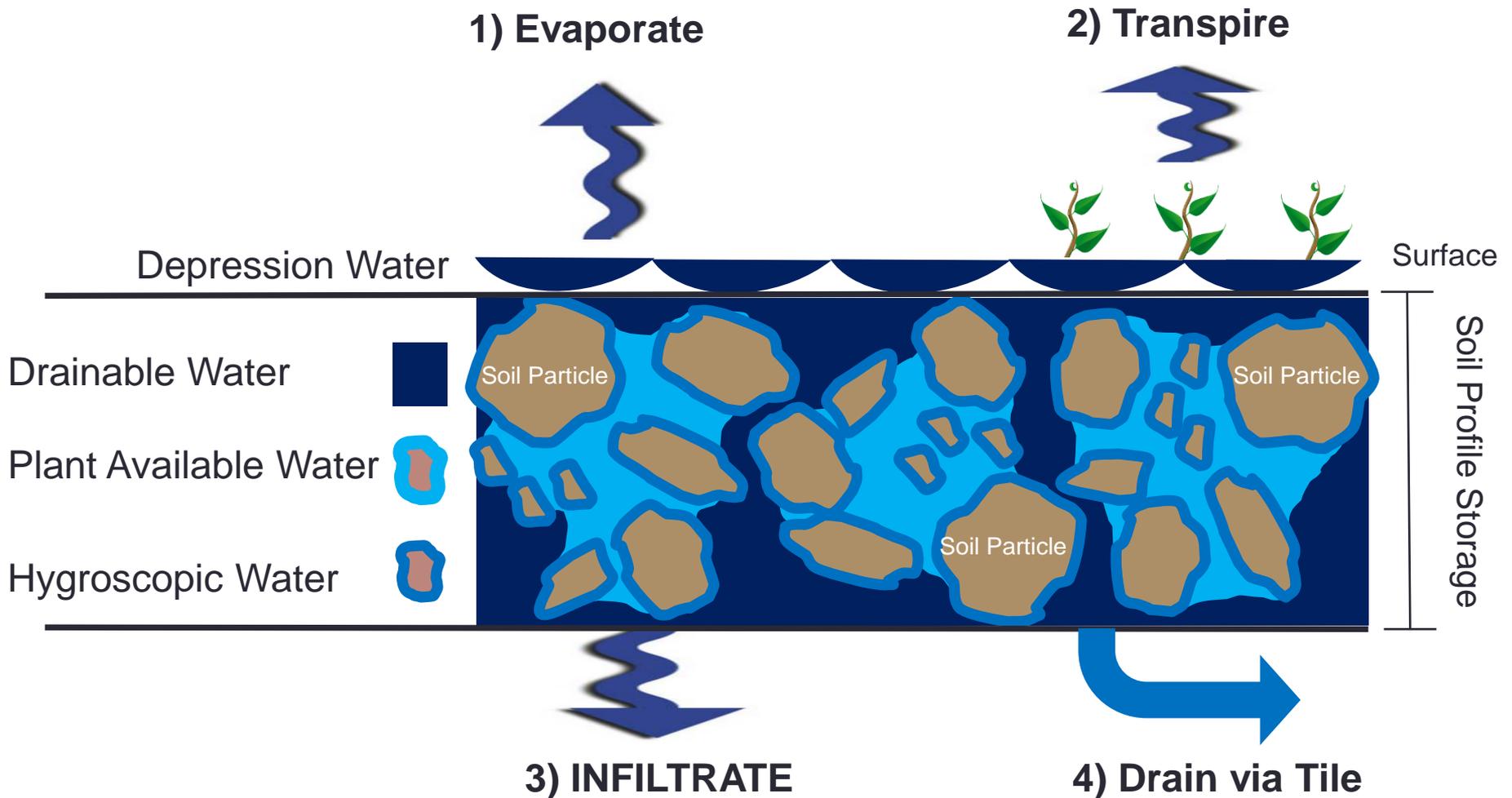
- Rainfall or Snowmelt begins...
  - If not already full, water fills depressions and soil profile
- Excess Water – Surface Runoff
- Fate of Soil Profile and Surface Depression Water?



# Partitioning of Soil and Surface Water



# Fate of Soil and Surface Water:



# Water Storage

- **Retention** – Storing water for extended periods of time (weeks or months) for alternate uses. Sometimes referred to as a “permanent” reservoir or that portion of the reservoir pool that is considered permanent.
  
- **Detention** - Storing water for a limited period of time (hours or days). Sometimes referred to as a “dry” pond or that portion of water in a reservoir that can be quickly and easily removed.

Wetland - detention



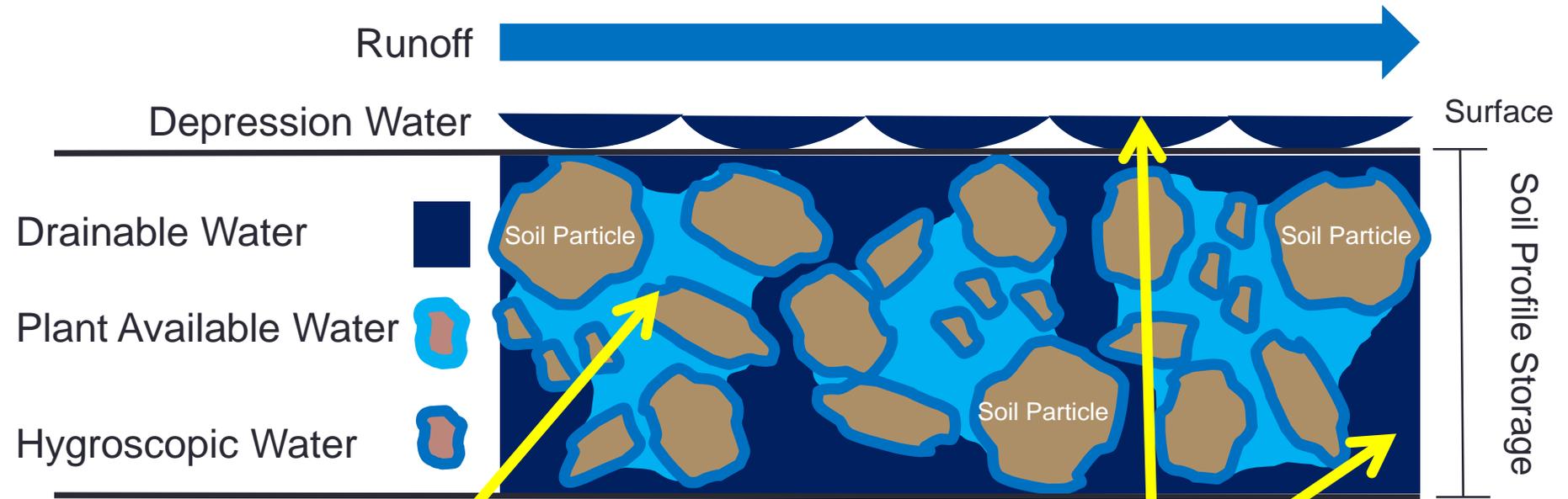
Wetland - retention



Maple River Dam - detention



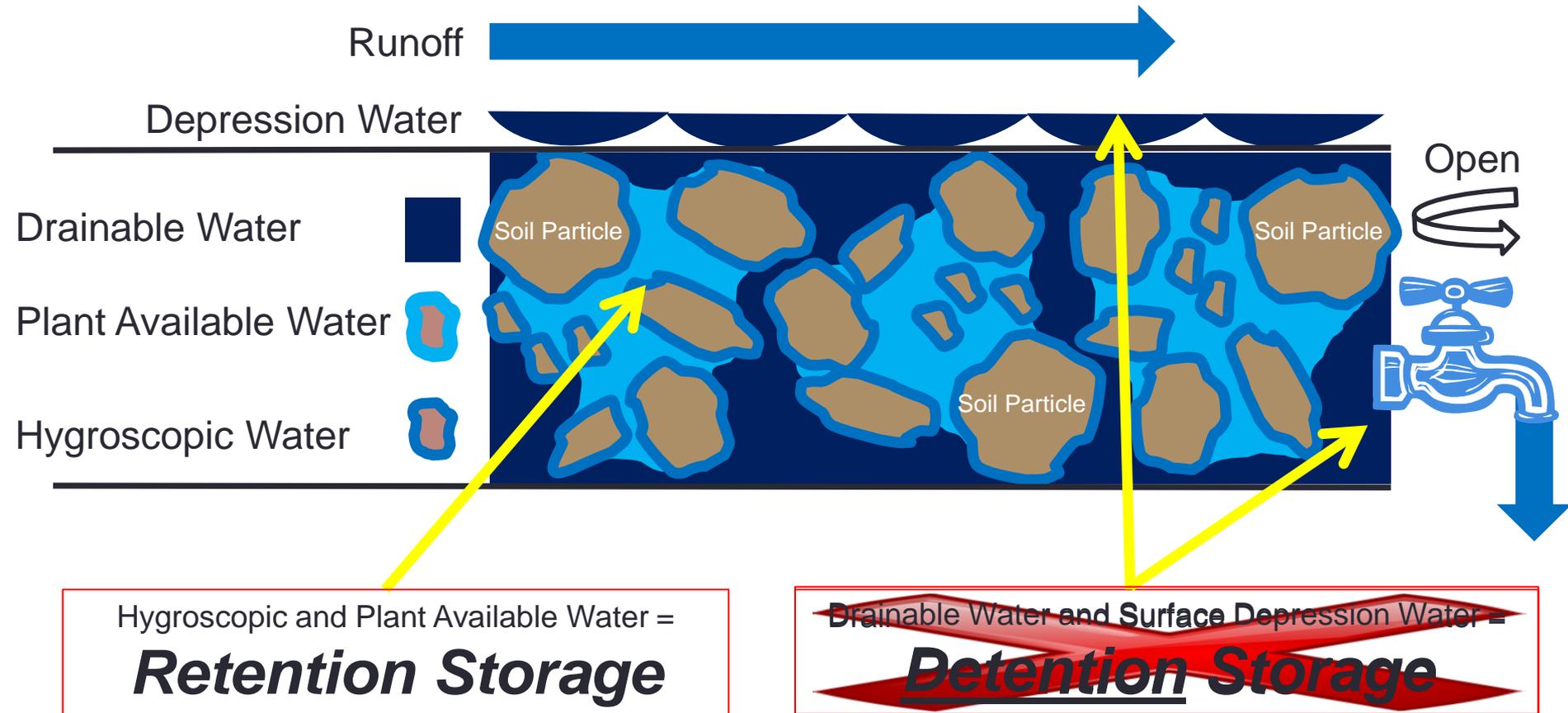
# No Subsurface Drainage



Hygroscopic and Plant Available Water =  
***Retention Storage***

Drainable Water and Surface Depression Water =  
***Retention Storage***

# With Subsurface Drainage



# REVIEW (**Briefing Paper #1**): Impacts of Agricultural Drainage (Subsurface) on Watershed Peak Flows

- Available literature and hydrologic modeling  
Subsurface Drained **FIELDS**:
  - Attenuate outflows
    - Decrease Peak Flow
    - Delayed Discharge\*
  - Increase Water Yield
    - Predominately early spring and fall

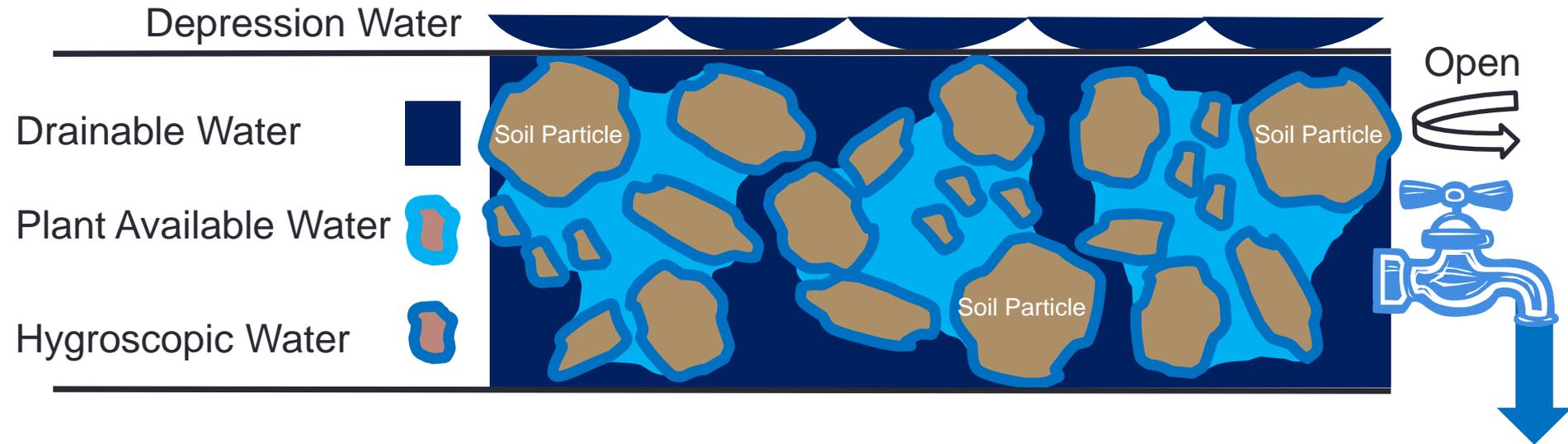
## TAKE HOME MESSAGE (Briefing Paper #1)

...“Any general statement implying that subsurface drainage decreases (or increases) flood peaks is strongly discouraged because it oversimplifies the complex processes involved.”...

# Briefing Paper #2 Conclusions:

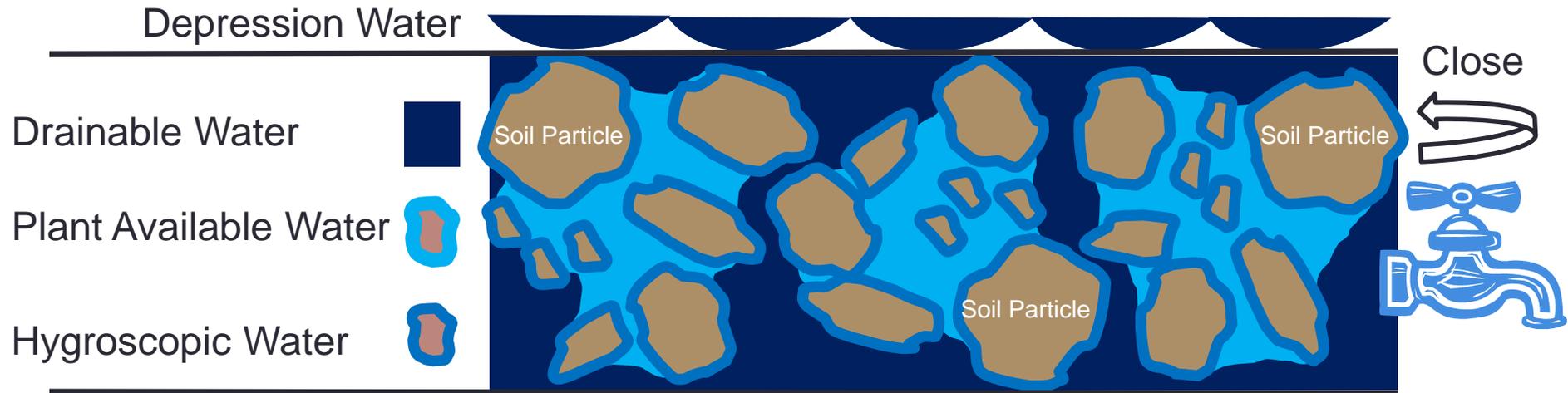
- ✓ *Situations do exist where adding uncontrolled subsurface drainage to areas of the landscape has the potential to increase flooding. This risk must be considered and evaluated in water management decision making.*
- ✓ *The inclusion and appropriate operation of control structures on existing and proposed subsurface drainage systems can maximize water storage potential and reduce flood flows.*

# Subsurface Drainage Management: FALL SEASON



- ✓ **If conditions allow**, subsurface drains can be opened to drain the soil profile and surface depression water in preparation for a spring flood event.

# Subsurface Drainage Management: SPRING (flood) SEASON



- ✓ **If conditions allow**, subsurface drains can be closed to store water during the spring flood event.

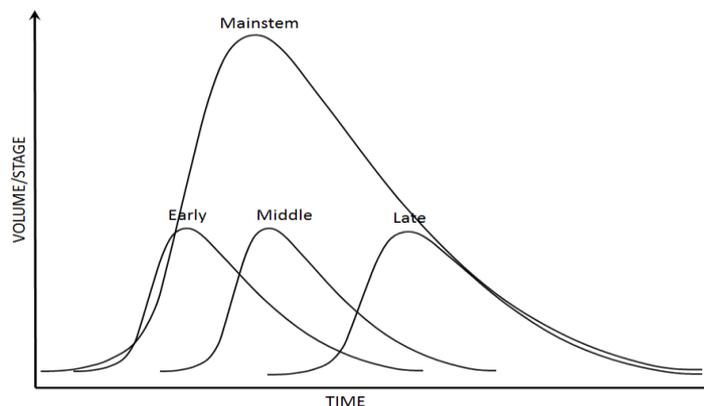
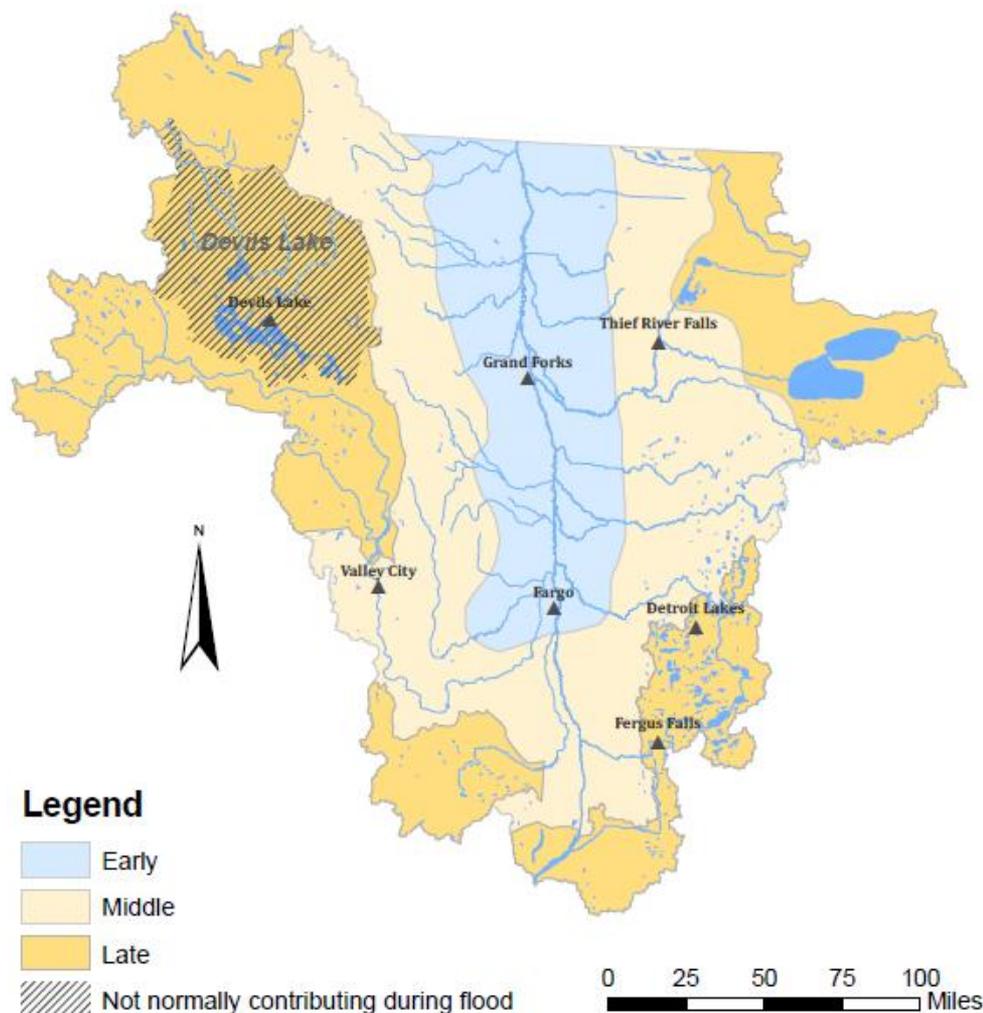
# Water Management Objectives

- Field/Producer
  - Optimal Crop Production
    - Remove water during wet periods (planting and harvesting)
    - Conserve water during droughts
- Watershed/Basin/Manager
  - Reduce flood flows (spring/summer events)
    - Minimize flood damages

# Options (permitting/management)

1. Field Outlet Control (preferred)
2. Water Storage Trading (preferred)
3. On or Off Site Storage
4. Culvert Sizing
5. Drainage Coefficient Limitations

# Early, Middle, and Late Water Concept



# Unmanaged Subsurface Drainage Effects

Effect	Early Water	Middle Water	Late Water
Increased Volume	(-)	(- -)	(-)
Delayed Peak	(-)	(- or +)	(+)
Decreased Peak	(+)	(+ +)	(+)

# Early, Middle, Late Region Considerations

Options	Early Water	Middle Water	Late Water
Preferred - Field Outlet Control	Reduce	Reduce	Reduce
Preferred - Control structure Credits/Bank	Reduce	Reduce	Reduce
Subsurface Drainage Coefficient Limits	Increase	Reduce	Reduce
Off/On-site Storage Option	Reduce*	Reduce	Reduce
Culvert Sizing	Increase	Reduce	Reduce

\*Assumes gated storage. Un-gated storage would increase potential in Early Water areas

# NEXT STEPS

- GSSHA Modeling Results
  - 6-8 months
  - Modify or Revise BP#2 Recommendations (if necessary)
- Water Storage Trading/Credit Program
  - Develop Concept
- Address other Technical Issues in Service to the RRRRA\*

*“Availability of good information lies at the heart of effective and equitable decision making”*

*(Allen and Kilvington 1999)*



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