Tile Basics and Discovery Farms Tile Findings

Eric Cooley
UW Discovery Farms

Why Tile?

- Maintain water table at proper level for healthiest plant growth.
- Keep soil voids free of excess water, which permits air flow and allows important biological processes to take place in soil.
- Minimize inefficient equipment operation caused by wet areas.

Credit: John Panuska

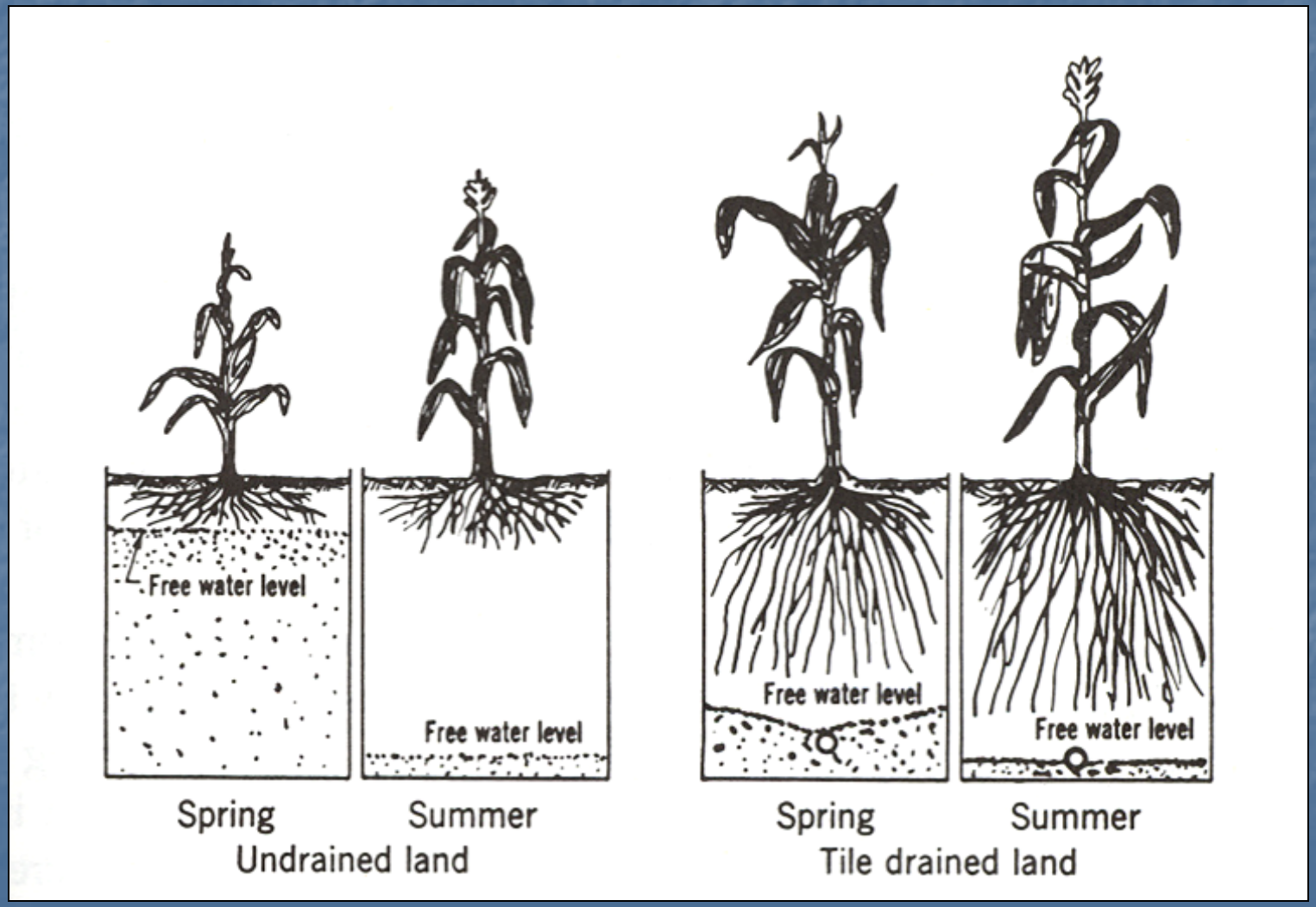
Benefits of Subsurface Drainage

- ✓ Increase crop yields and field access.
- ✓ Conserve topsoil by reducing runoff.
- ✓ Raises soil temperature

  Dry soil is warmer than wet soil. It takes 5 times as much heat to raise an equal volume of water 1° as it does to raise an equal volume of soil 1°.

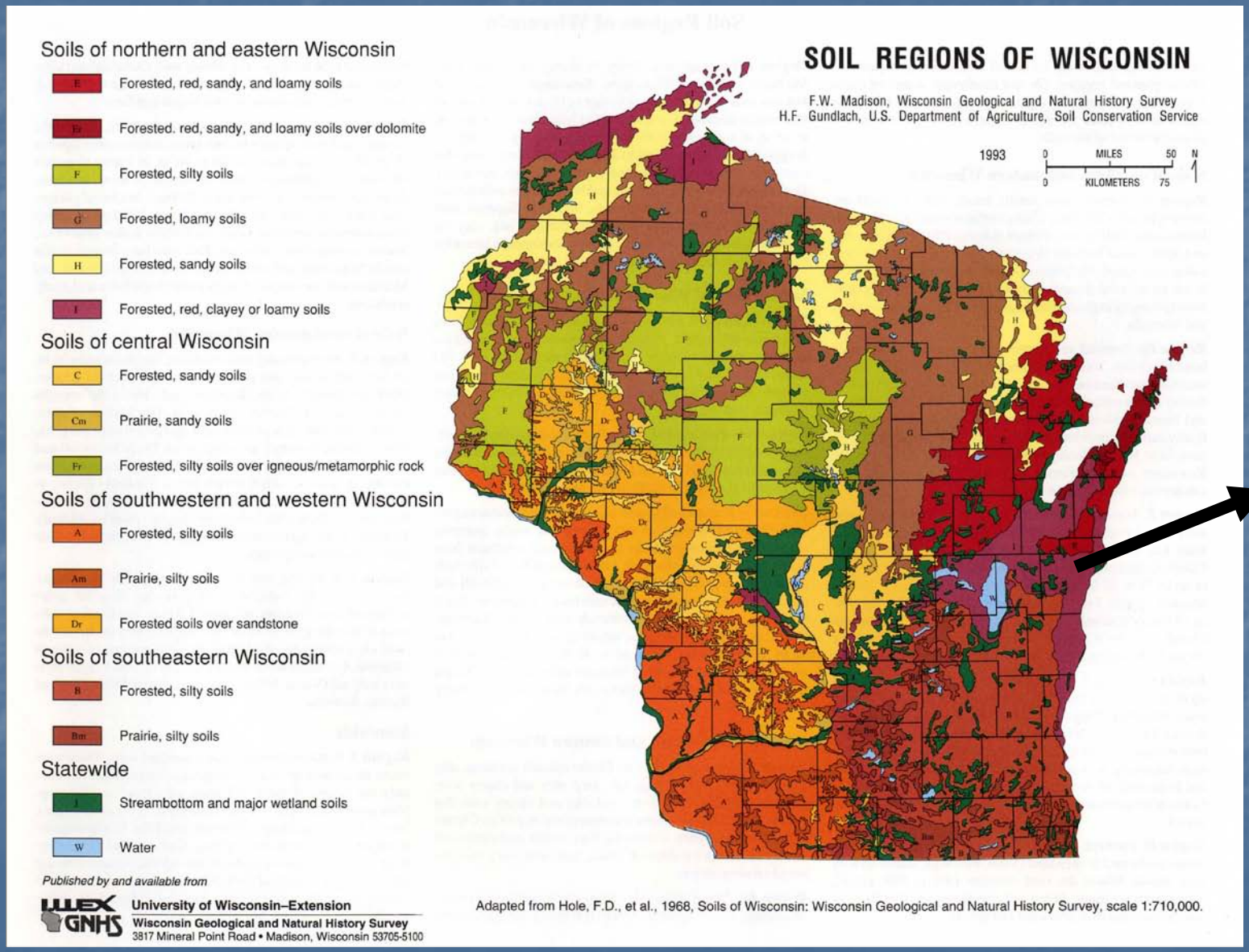
Credit: John Panuska

Improve root development



Credit: John Panuska

What Soils are Tiled and Why?

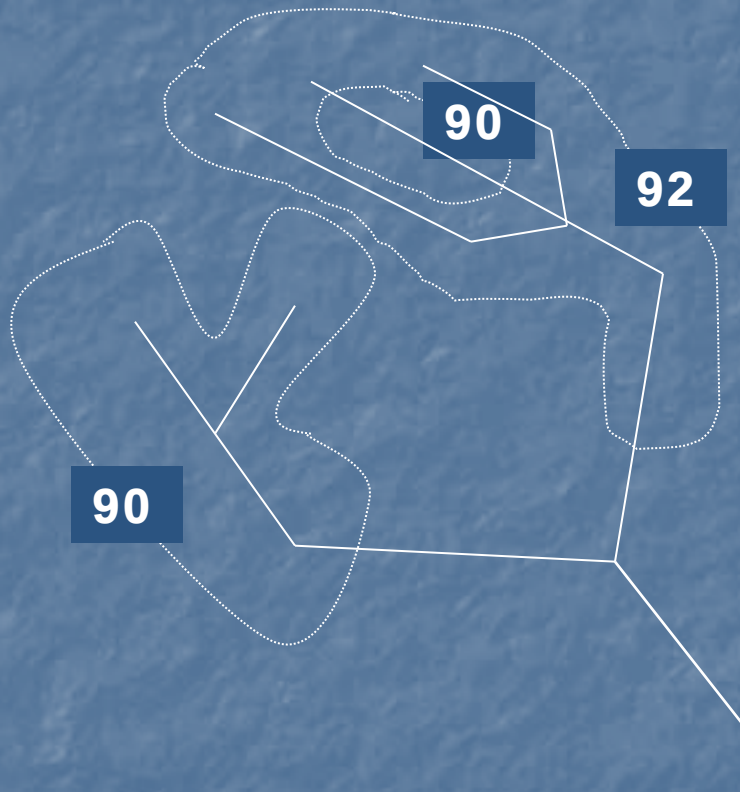


What Soils are Tiled and Why?

- Coarse textured glacial till that resides below the fine textured loess surface
- Dense, tightly-packed glacial till overlain by coarse textured soil
- Low areas in the landscape that accumulate water / closed depressions
  - Mineral soils
  - Organic soils
- Springs, soil inclusions, sand lenses, etc.

Natural or Random

- Follow natural depressions.
- Used frequently in “pot hole” landscapes to drain isolated depressions.



Credit: John Panuska

Tile Line Research in Wisconsin

- Limited research has been done throughout the United States
- Research done in other states not applicable to Wisconsin soils:
  - Slope and type of tiled soils
  - Tile installation patterns
  - Tile line flow periods

Tile Line Assumptions

- Infiltrating water should be attenuated and delayed compared to surface water:
  - Concentrations of phosphorus and sediment should be low because of “filtering” effect
  - Nitrate should be most common form of nitrogen do to mobility in soil
- Tile lines should not flow under frozen soil conditions

Discovery Tile Research Farms

Kewaunee County

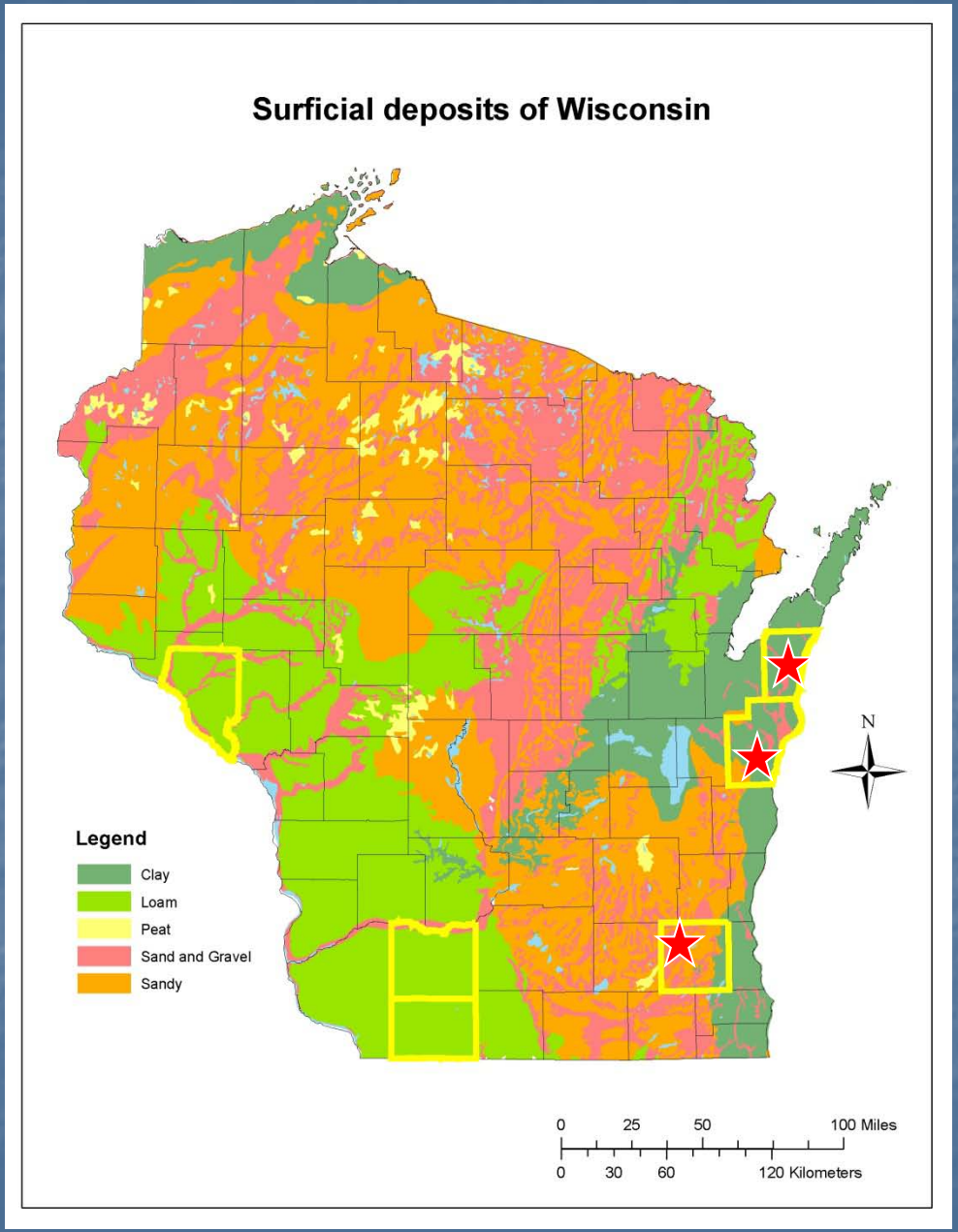
- Two tile line sites

Manitowoc County

- One tile line site

Waukesha County

- Two tile line sites

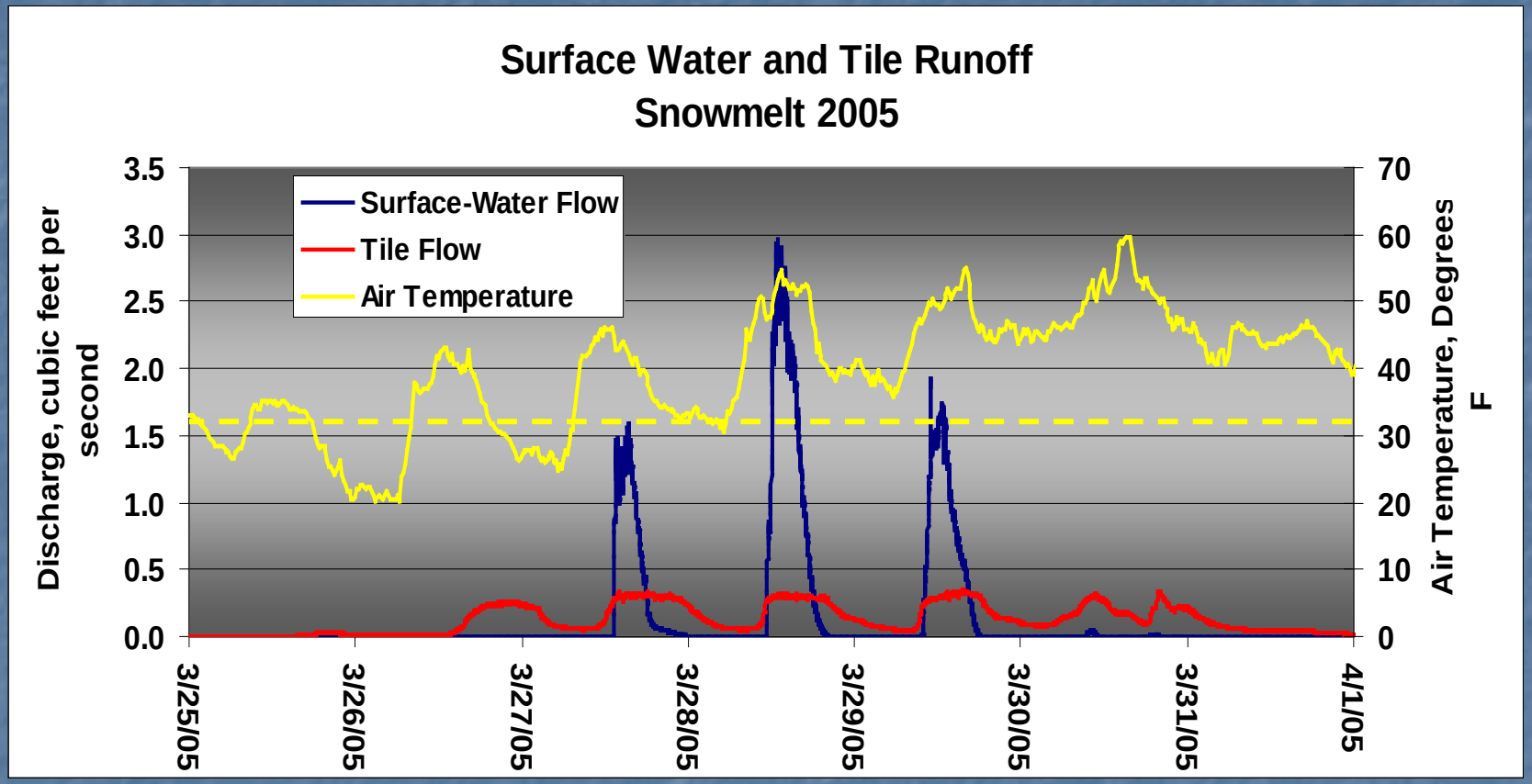


Tile line water monitoring

Tile line water monitoring

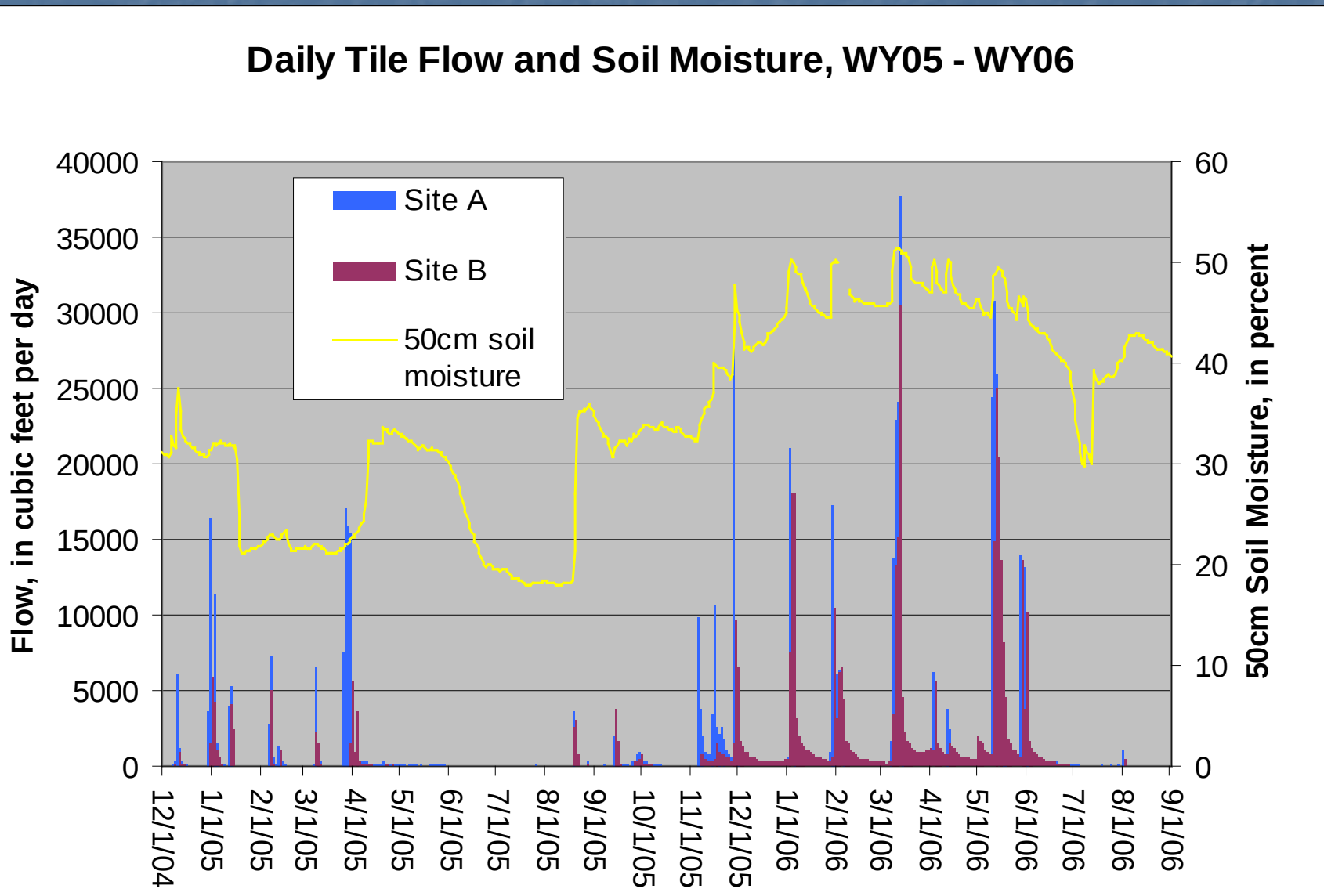
Tile monitoring equipment

Surface and Tile Runoff Under Snowmelt Conditions

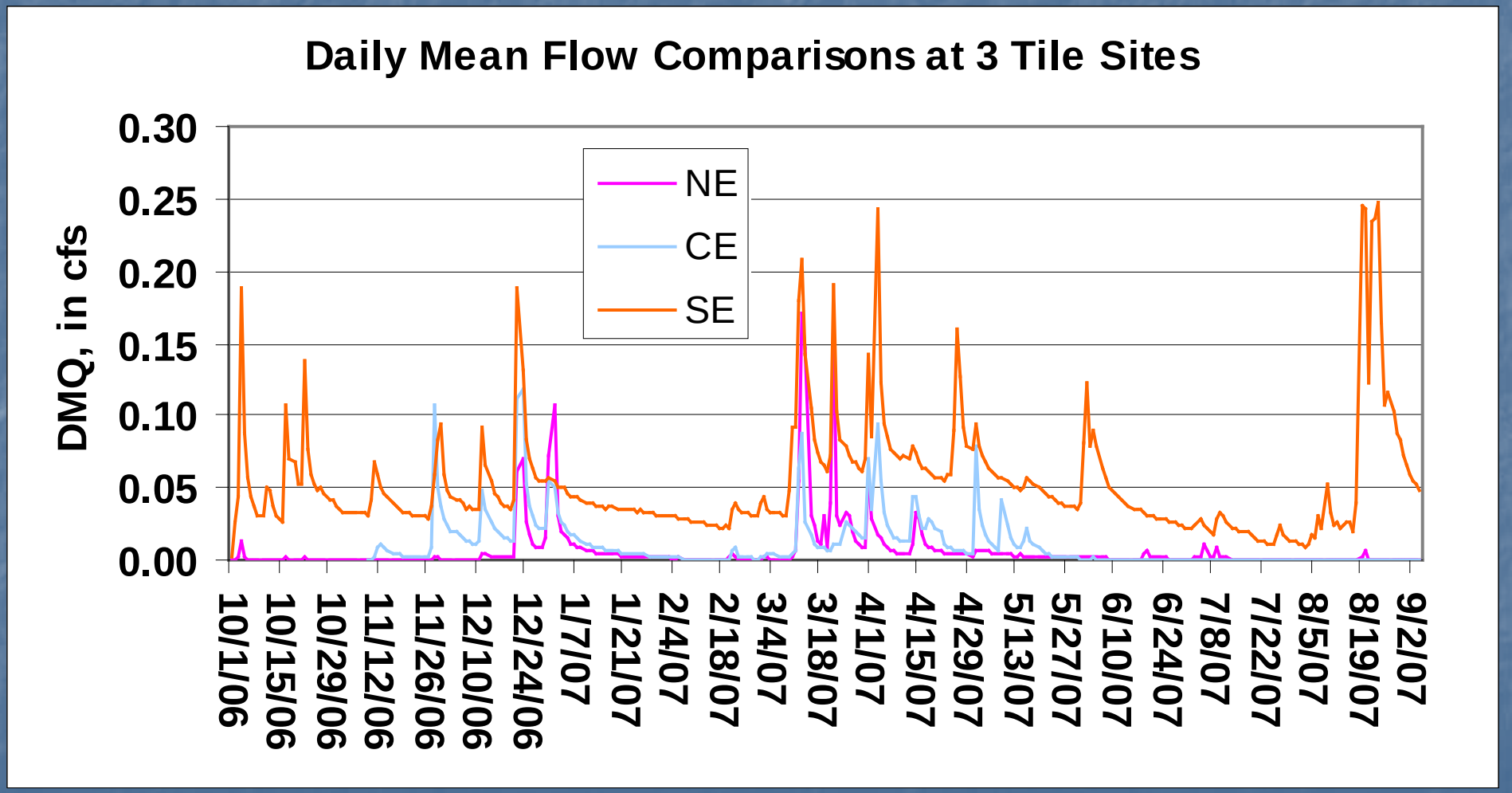


- Tile flow began before surface flow
- Relative volumes of water flowing in surface and tile were similar for this snowmelt period

Tile flow periods



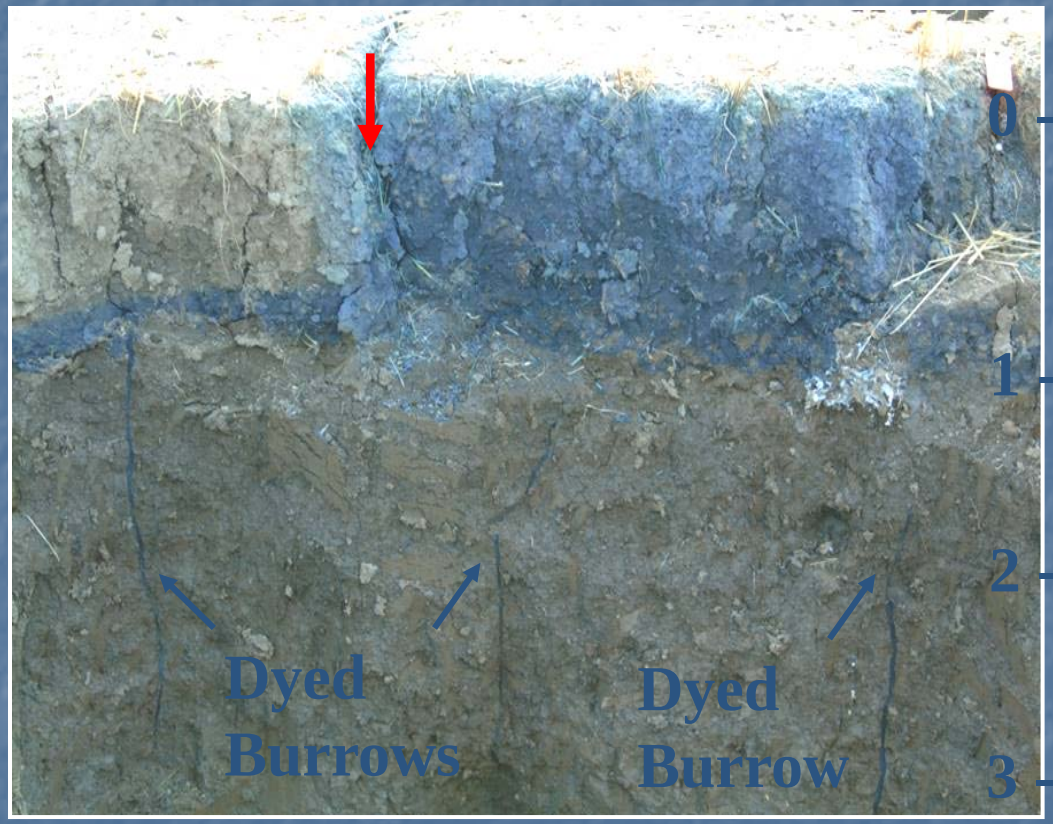
Tile flow patterns



Environmental Risks of Tiles
- Macropores -

Preferential flow

- Earthworm burrows
- Root channels
- Shrinkage cracks
- Structural porosity

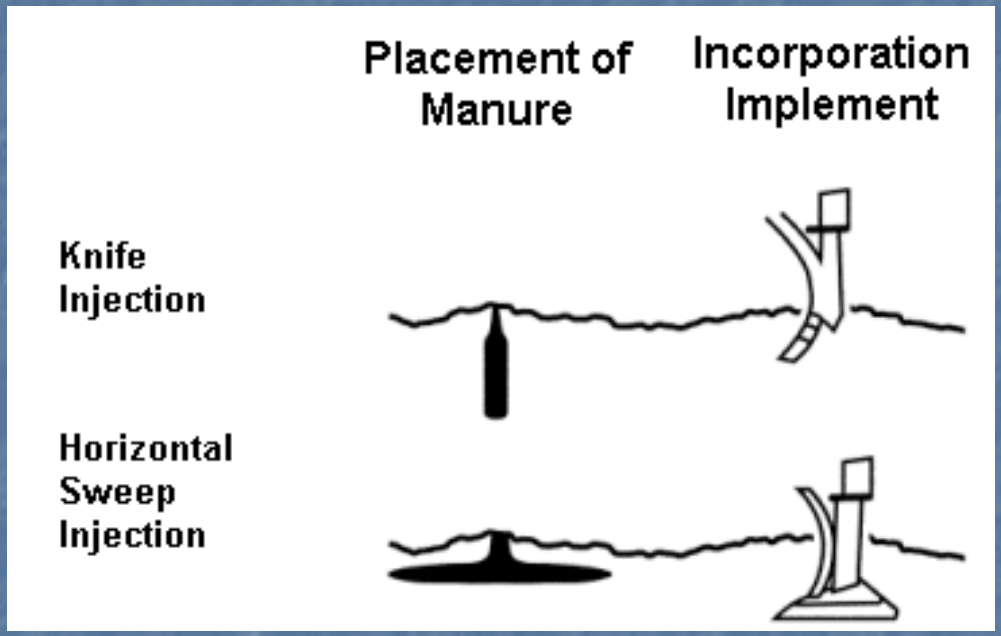


Credit: John Panuska

Factors Influencing Manure Contamination of Tile Lines

- Consistency of manure:
  - 0-2% solids: high risk
  - 2-5% solids: moderate risk
  - > 5% solids: low risk
- Application rate
- Tillage / manure incorporation
- Soil moisture content / frozen soils
- Tiles flowing

Manure Application Over Tile Line



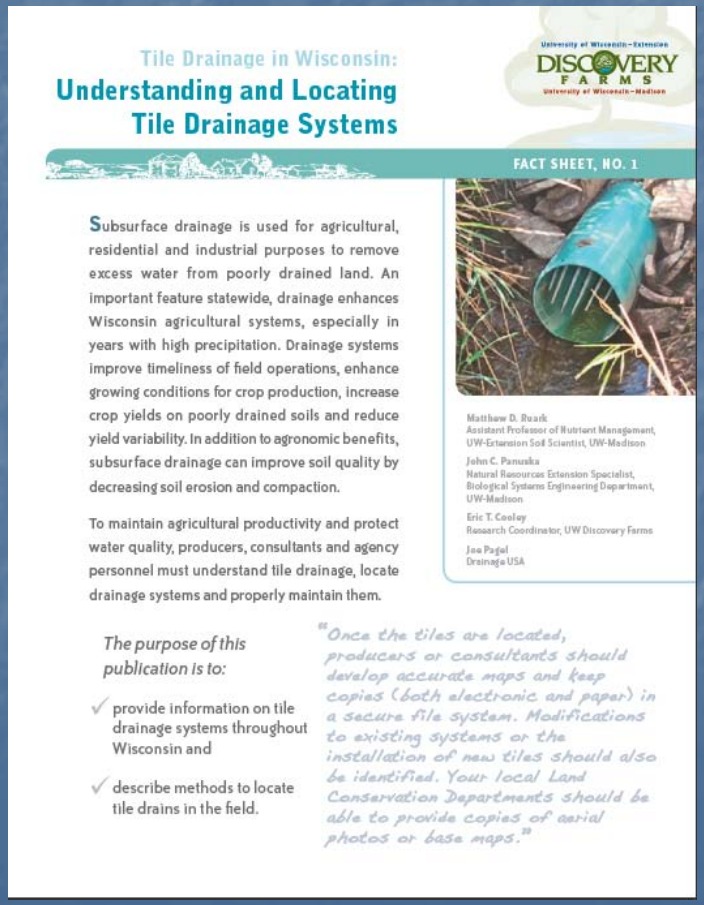
Source: *University of Nebraska, Institute of Agriculture and Natural Resources*

What are Discovery Farms next steps?

- Improve our understanding of tile drainage
- Development of risk assessments during potential surface-water & tile runoff periods
- Determination of when best management decision (BMP) should be utilized/maintained
- Knowledge of when to expect to see surface-water/tile losses

New website!

www.uwdiscoveryfarms.org



Tile Drainage in Wisconsin:

Understanding and Locating Tile Drainage Systems

University of Wisconsin–Extension DISCOVERY FARMS University of Wisconsin–Madison

FACT SHEET, NO. 1

Subsurface drainage is used for agricultural, residential and industrial purposes to remove excess water from poorly drained land. An important feature statewide, drainage enhances Wisconsin agricultural systems, especially in years with high precipitation. Drainage systems improve timeliness of field operations, enhance growing conditions for crop production, increase crop yields on poorly drained soils and reduce yield variability. In addition to agronomic benefits, subsurface drainage can improve soil quality by decreasing soil erosion and compaction.

To maintain agricultural productivity and protect water quality, producers, consultants and agency personnel must understand tile drainage, locate drainage systems and properly maintain them.

Matthew D. Ruark
Assistant Professor of Nutrient Management, UW-Extension Soil Scientist, UW-Madison

John C. Panuska
Natural Resources Extension Specialist, Biological Systems Engineering Department, UW-Madison

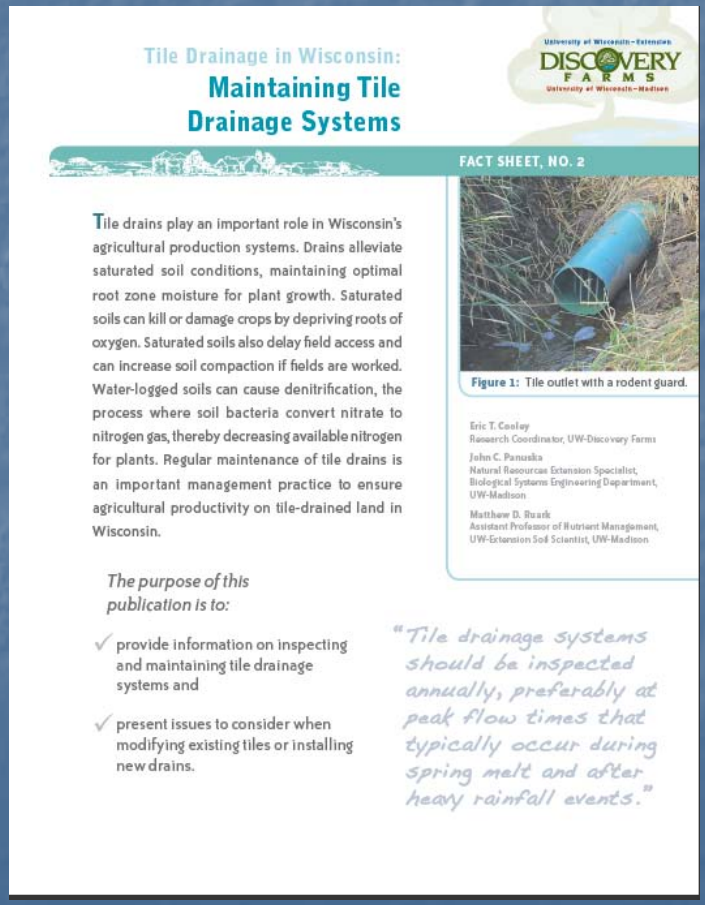
Eric T. Cooley
Research Coordinator, UW Discovery Farms

Joe Pagel
Drainage USA

The purpose of this publication is to:

- ✓ provide information on tile drainage systems throughout Wisconsin and
- ✓ describe methods to locate tile drains in the field.

"Once the tiles are located, producers or consultants should develop accurate maps and keep copies (both electronic and paper) in a secure file system. Modifications to existing systems or the installation of new tiles should also be identified. Your local Land Conservation Departments should be able to provide copies of aerial photos or base maps."



Tile Drainage in Wisconsin:

Maintaining Tile Drainage Systems

University of Wisconsin–Extension DISCOVERY FARMS University of Wisconsin–Madison

FACT SHEET, NO. 2

Tile drains play an important role in Wisconsin's agricultural production systems. Drains alleviate saturated soil conditions, maintaining optimal root zone moisture for plant growth. Saturated soils can kill or damage crops by depriving roots of oxygen. Saturated soils also delay field access and can increase soil compaction if fields are worked. Water-logged soils can cause denitrification, the process where soil bacteria convert nitrate to nitrogen gas, thereby decreasing available nitrogen for plants. Regular maintenance of tile drains is an important management practice to ensure agricultural productivity on tile-drained land in Wisconsin.

Figure 1: Tile outlet with a rodent guard.

Eric T. Cooley
Research Coordinator, UW-Discovery Farms

John C. Panuska
Natural Resources Extension Specialist, Biological Systems Engineering Department, UW-Madison

Matthew D. Ruark
Assistant Professor of Nutrient Management, UW-Extension Soil Scientist, UW-Madison

The purpose of this publication is to:

- ✓ provide information on inspecting and maintaining tile drainage systems and
- ✓ present issues to consider when modifying existing tiles or installing new drains.

"Tile drainage systems should be inspected annually, preferably at peak flow times that typically occur during spring melt and after heavy rainfall events."