



Nitrogen Loss Comparison in Surface Runoff vs. Tile Flow in Wisconsin Tiled Landscapes

Eric Cooley
Research Coordinator
UW Discovery Farms

What Are Discovery Farms?

The Discovery Farms Program will develop **on-farm** and related **research** to determine the **economic and environmental effects** of Best Management Practices on a diverse group of Wisconsin farms;



Discovery Farms Tile Research

A - Kewaunee County

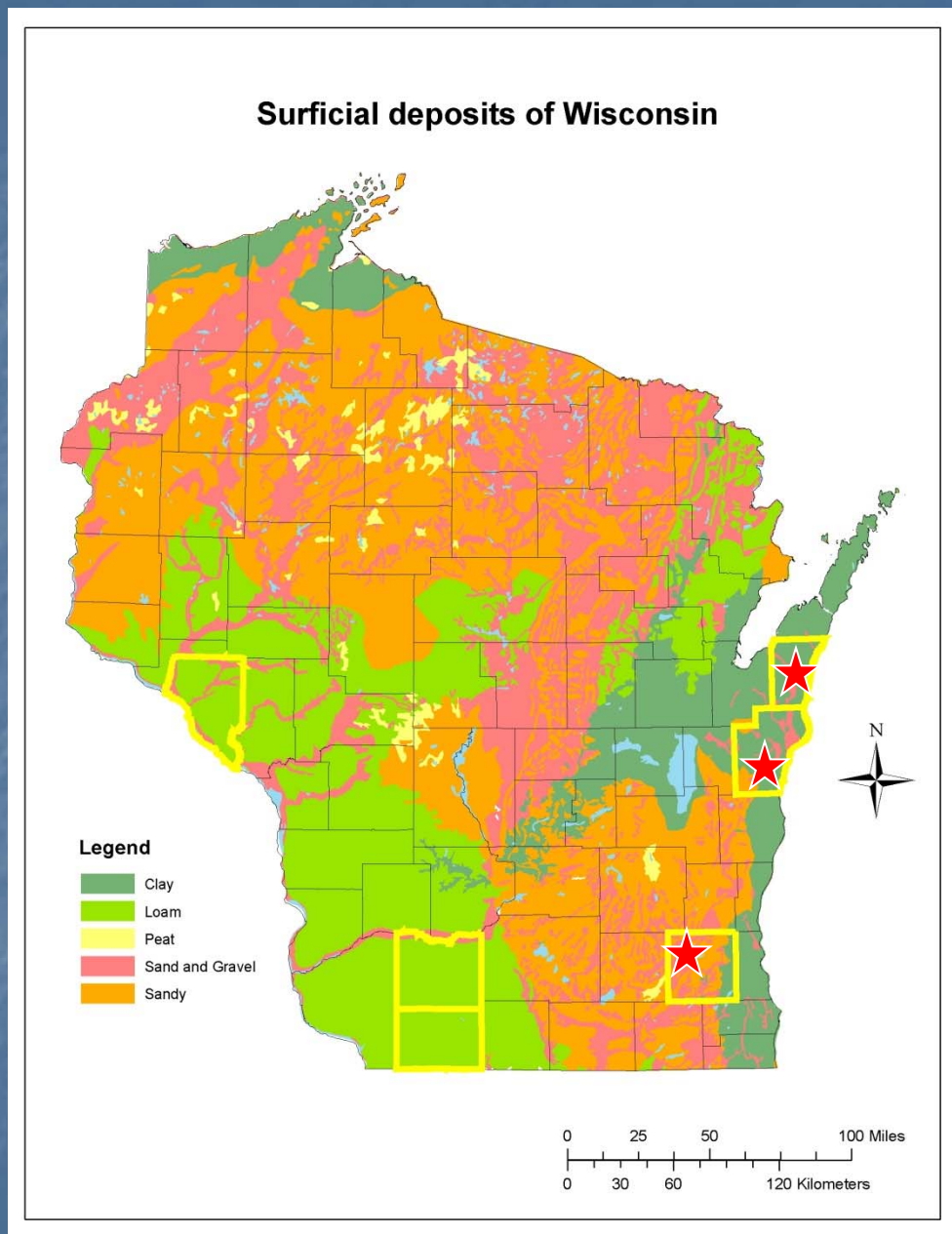
- Two tile line sites
(2004 – 2009)

B - Manitowoc County

- Two tile line sites
(2004 – 2007, 2007 – 2011)

C - Waukesha County

- Two tile line sites
(2004 – 2009)



Tile line water monitoring



Tile line water monitoring



Surface runoff monitoring

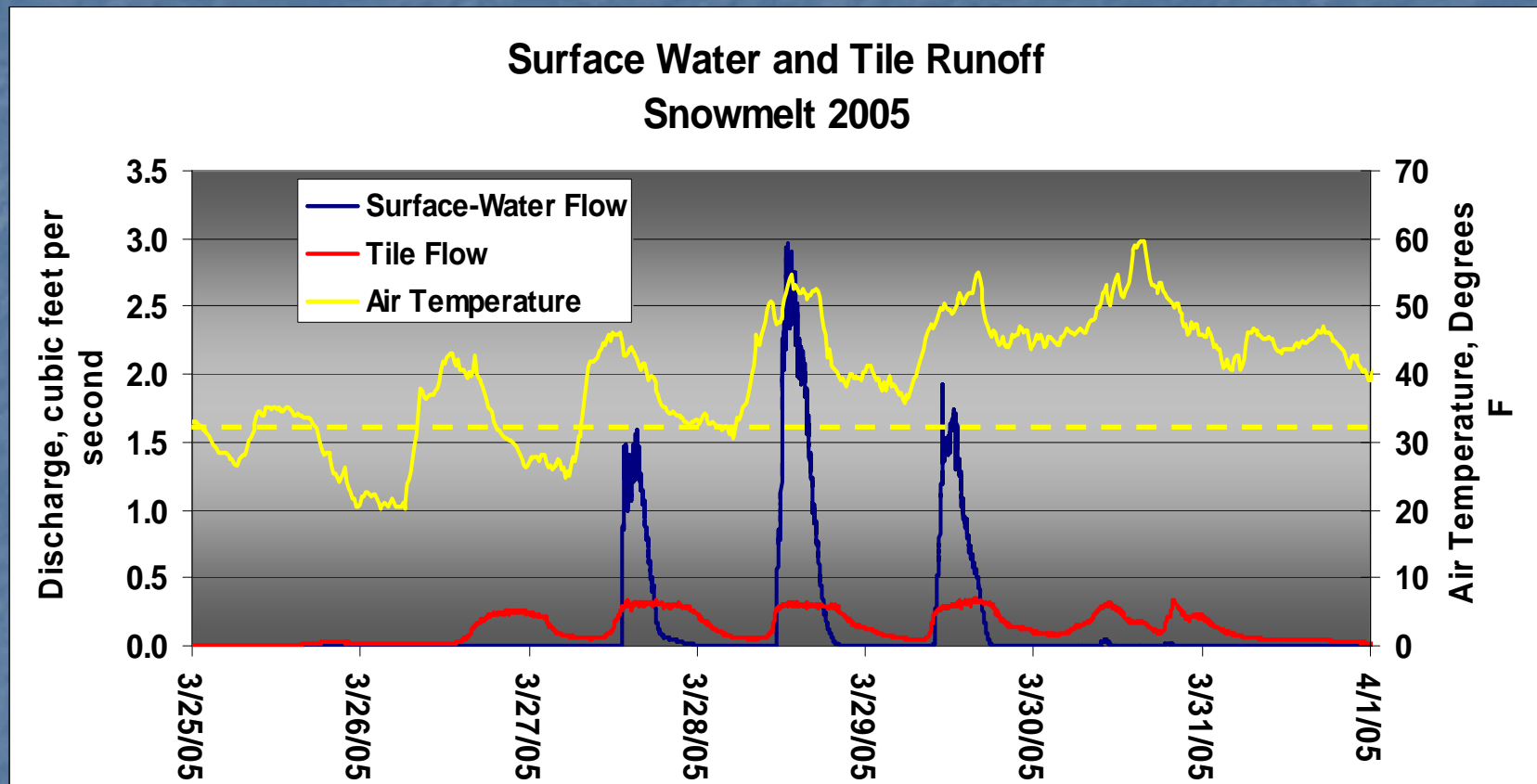


Monitoring equipment



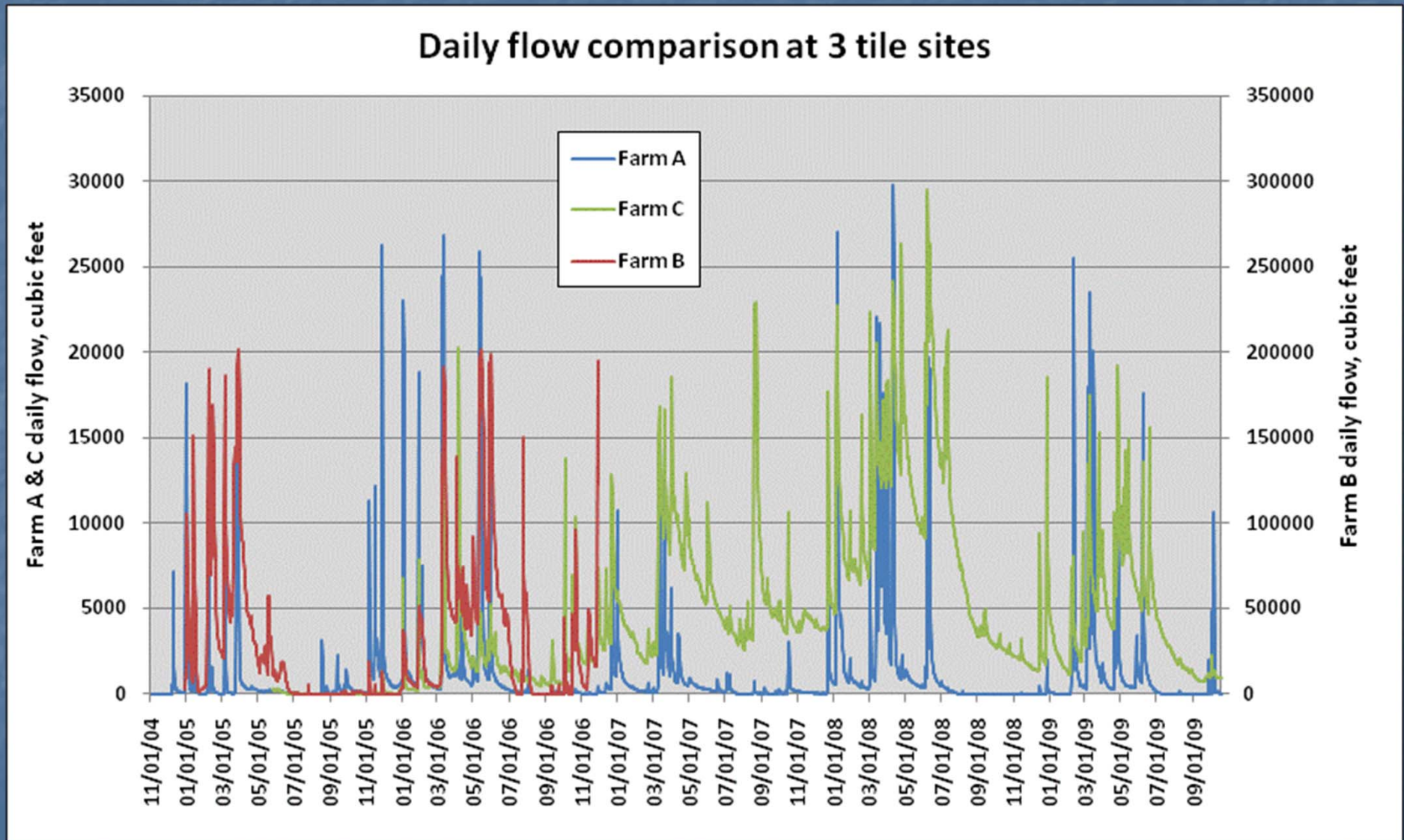
6/30/2004 2:11pm

Surface and Tile Runoff Under Snowmelt Conditions

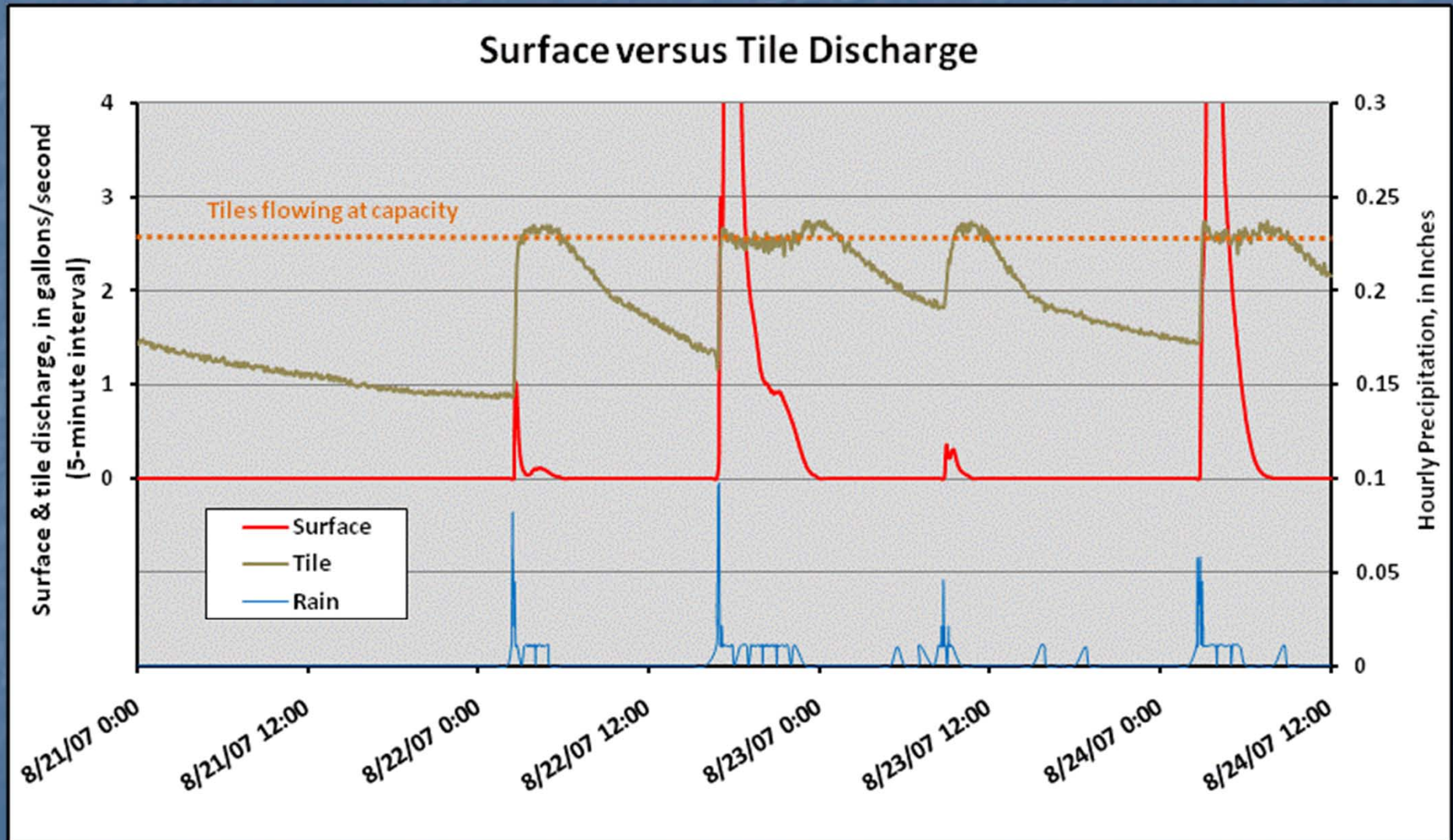


- Tile flow began before surface flow
- Relative volumes of water flowing in surface and tile were similar for this snowmelt period

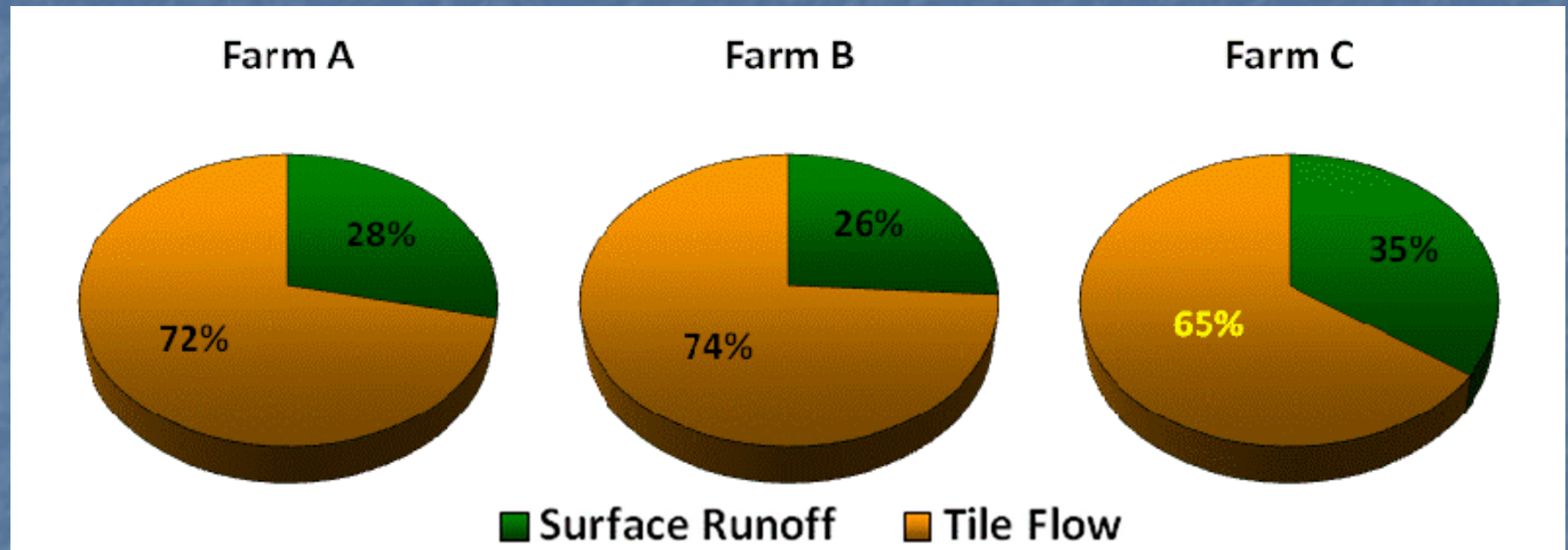
Tile flow periods



Efficiency of tile water removal



Water Budget



Percentage of total precipitation leaving the landscape as surface water

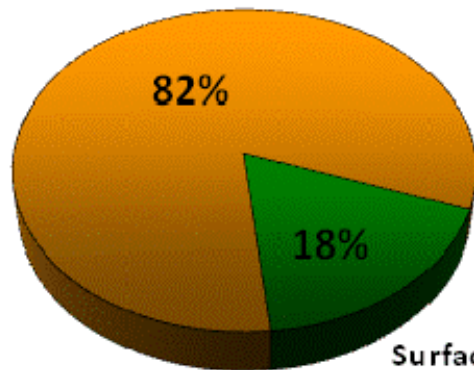
	<u>Farm A</u>	<u>Farm B</u>	<u>Farm C</u>
Surface runoff	10%	6%	9%
Tile flow	24%	16%	16%

Surface & tile nitrogen loss

■ Surface Runoff
■ Tile Flow

Farm A

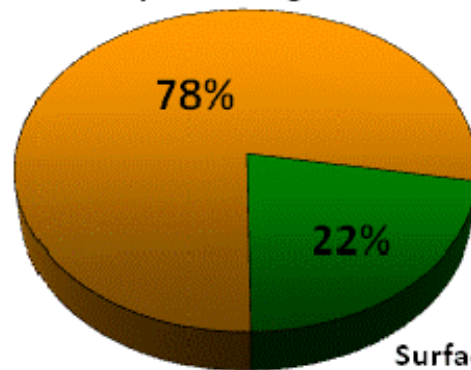
Tile:
62 lbs/acre/year average



Surface:
13 lbs/acre/year average

Farm B

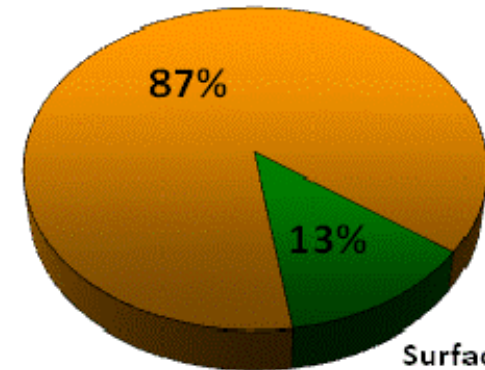
Tile:
10 lbs/acre/year average



Surface:
3 lbs/acre/year average

Farm C

Tile:
34 lbs/acre/year average



Surface:
5 lbs/acre/year average

Surface & tile loss timing

Total Nitrogen

	Surface		Tile	
	<u>Frozen</u>	<u>Non-frozen</u>	<u>Frozen</u>	<u>Non-frozen</u>
Farm A	57%	43%	52%	48%
Farm B	42%	58%	46%	54%
Farm C	16%	84%	24%	76%

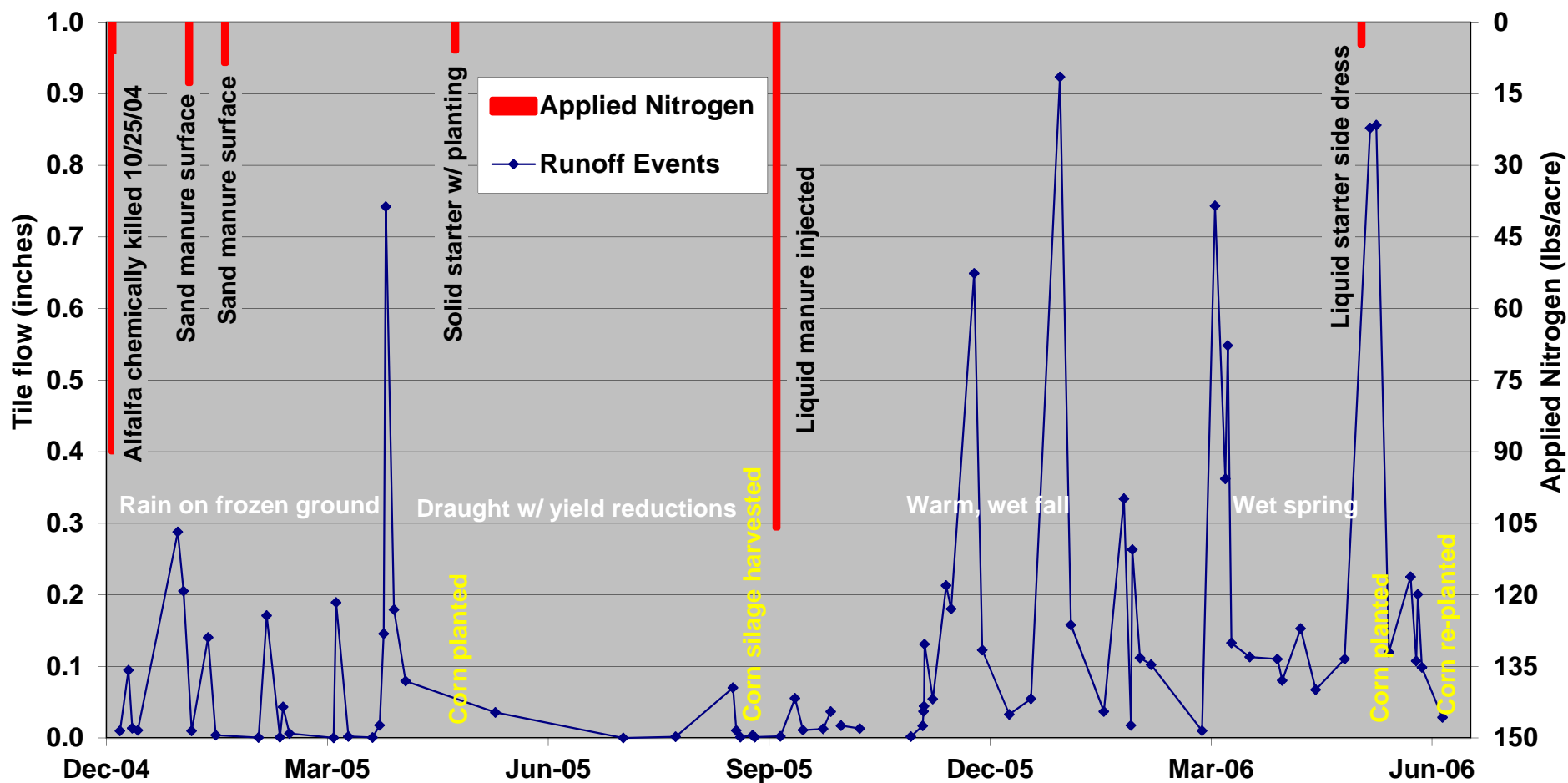
Surface & tile loss speciation

Nitrogen Speciation

	Surface			Tile		
	<u>Nitrate</u>	<u>Ammonium</u>	<u>Organic</u>	<u>Nitrate</u>	<u>Ammonium</u>	<u>Organic</u>
Farm A	45%	18%	37%	93%	2%	5%
Farm B	20%	38%	41%	50%	18%	32%
Farm C	22%	17%	61%	94%	1%	5%

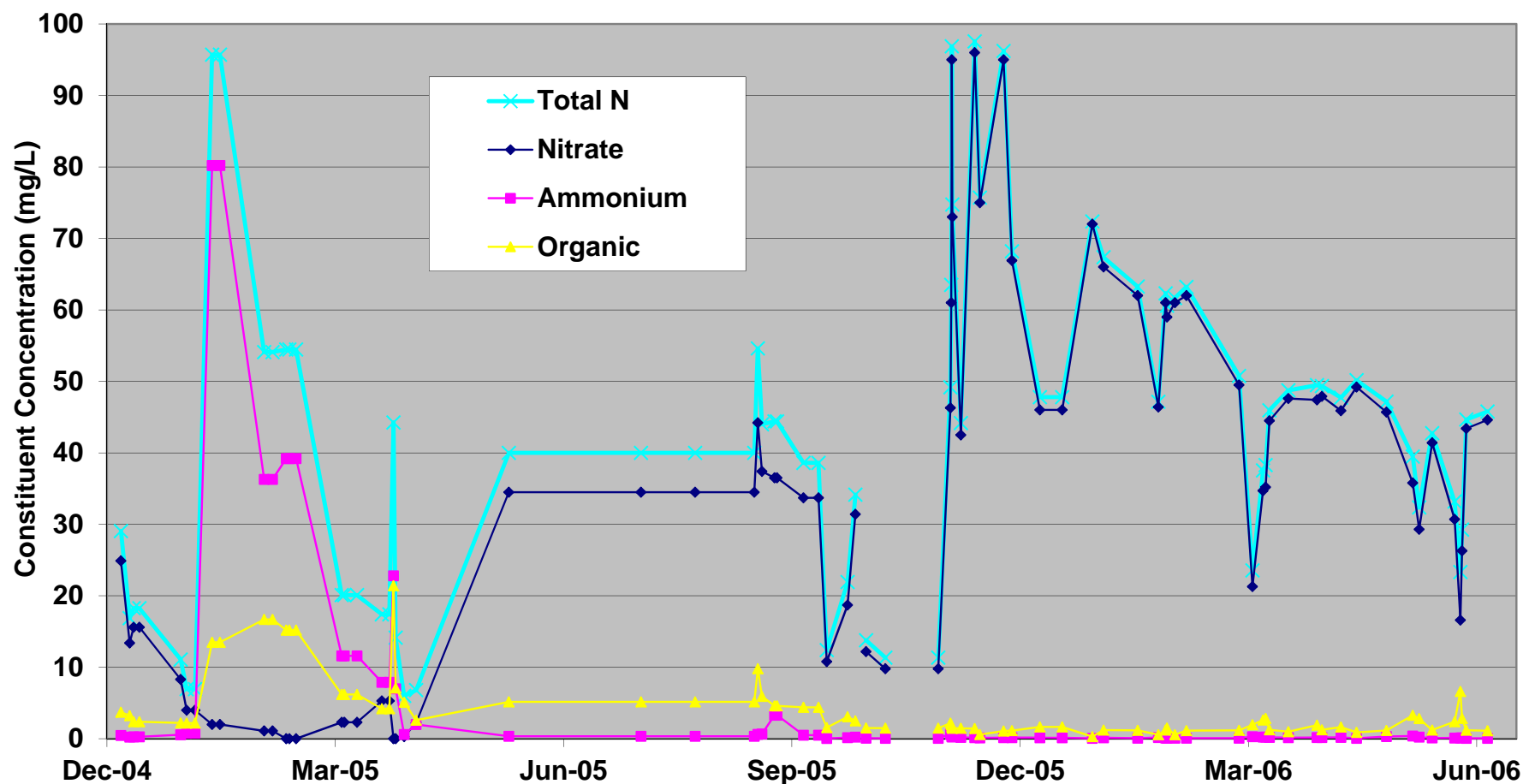
The "Perfect Storm" tile nitrogen losses

Tile flow events, nitrogen applications and cropping history



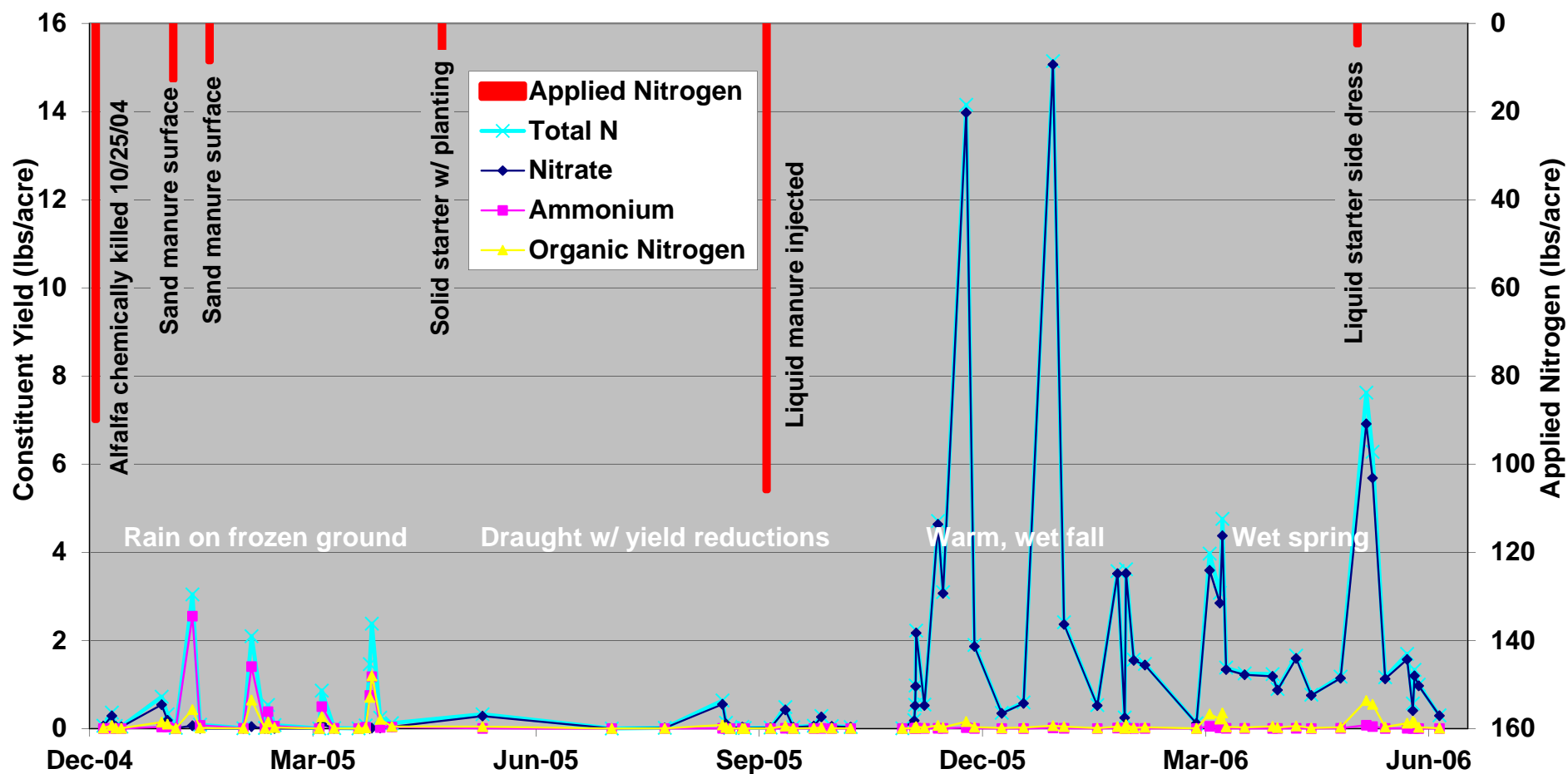
The “Perfect Storm” tile nitrogen losses

Tile nitrogen concentrations in various forms



The "Perfect Storm" tile nitrogen losses

Tile nitrogen yield in various forms



The “Perfect Storm” tile nitrogen losses

	Tile			Surface		
Total (lbs/acre)	WY05	WY06	WY07	WY05	WY06	WY07
Total Nitrogen	14.6	99.0	35.0	19.5	10.7	3.7
Nitrate	3.2	95.1	34.0	0.2	4.3	2.3
Ammonium	7.1	0.4	<0.1	13.8	0.4	<0.1
Organic Nitrogen	4.3	3.6	0.9	5.5	6.0	1.3

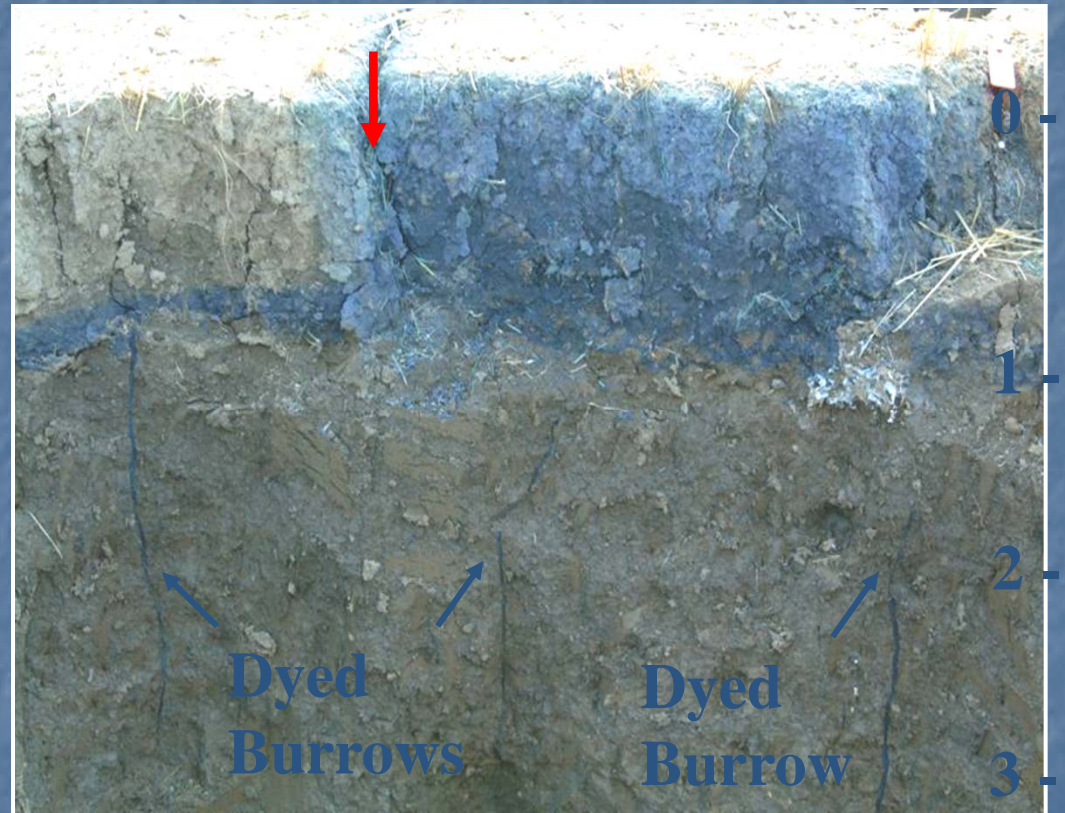
WY = Water Year (October 1 through September 30)

Environmental Risks of Tiles

- Macropores -

Preferential flow

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



Soil drying and crack formation

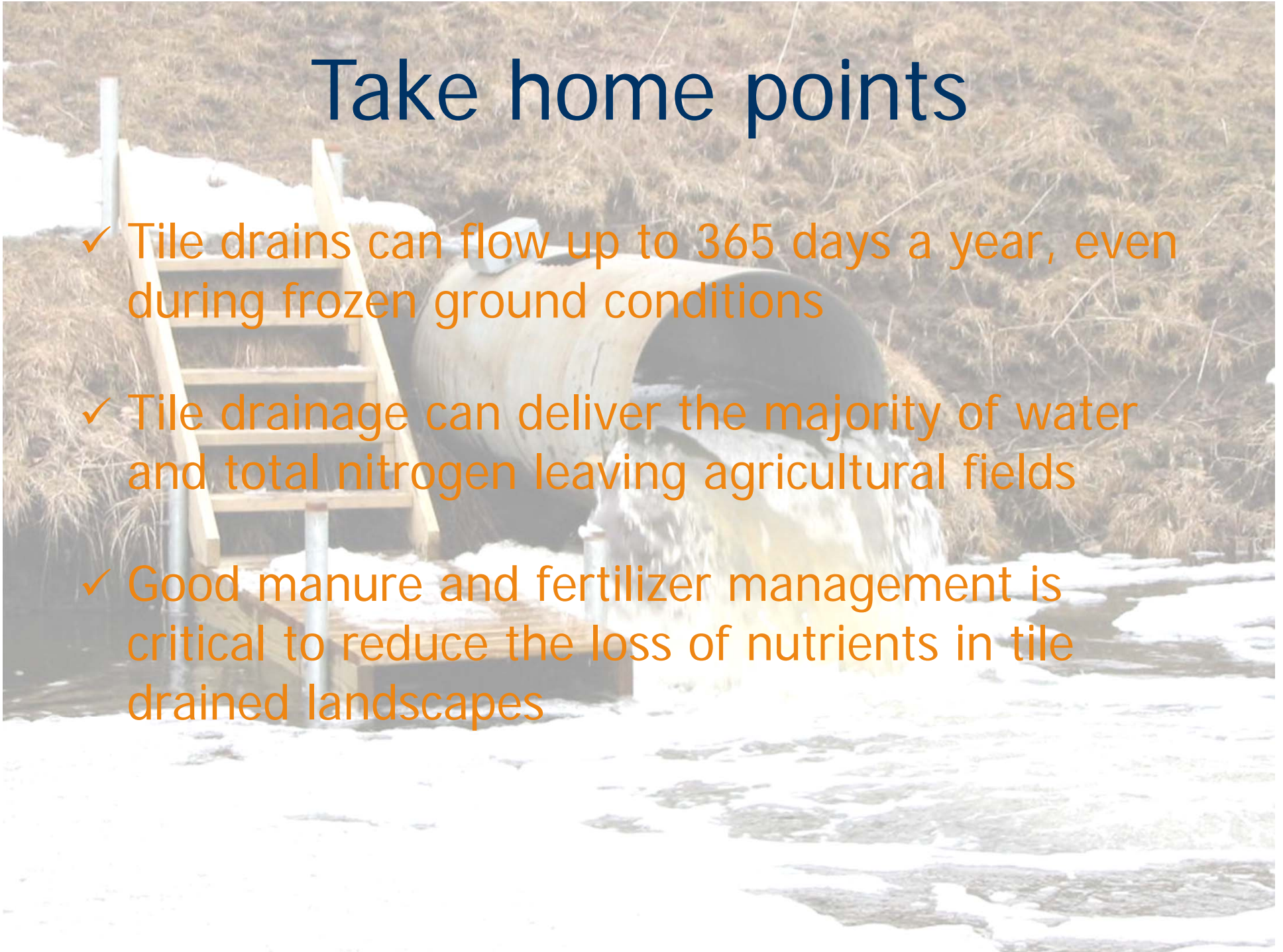


Factors Influencing Manure Contamination of Tile Lines

- 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 / tiles flowing
- Frozen soils

Take home points

- ✓ Tile drains can flow up to 365 days a year, even during frozen ground conditions
- ✓ Tile drainage can deliver the majority of water and total nitrogen leaving agricultural fields
- ✓ Good manure and fertilizer management is critical to reduce the loss of nutrients in tile drained landscapes



Updated website!

www.uwdiscoveryfarms.org