Tile Drainage: Basics and Conservation Considerations

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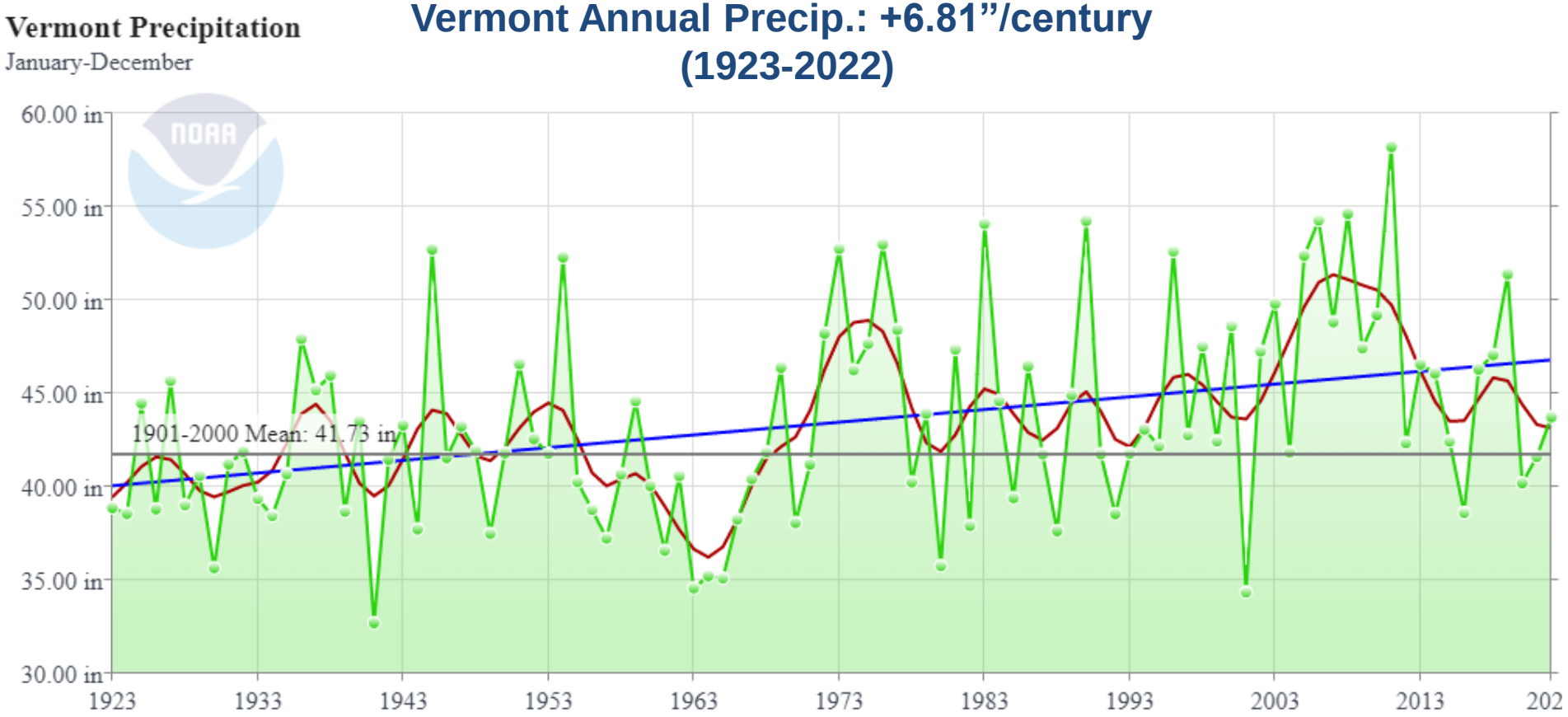
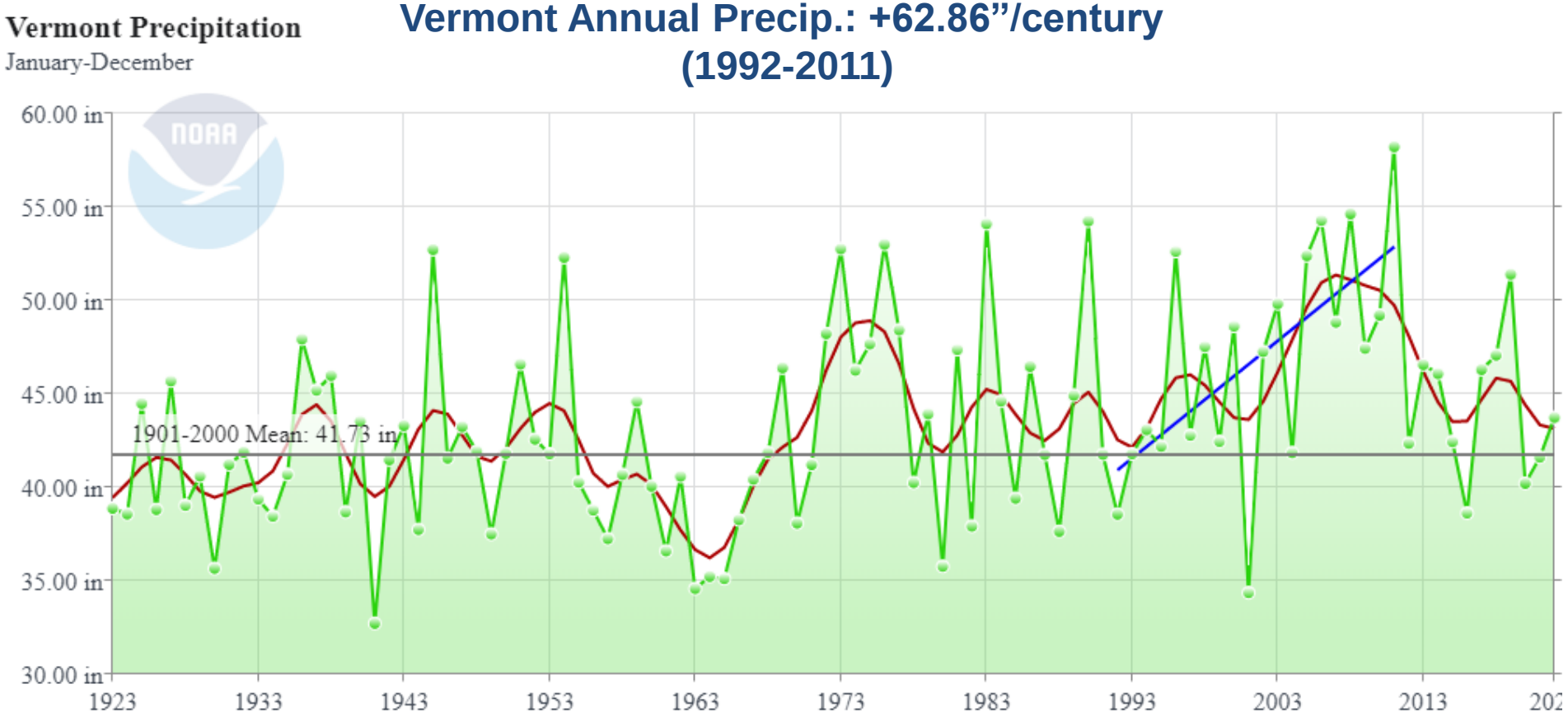
THE UNIVERSITY OF VERMONT EXTENSION

Image: Tom Cherveny, West-Central Tribune

Vermont Annual Precip.: +6.81”/century (1923-2022)



Vermont Annual Precip.: +62.86”/century (1992-2011)



2023: A year for the record books…

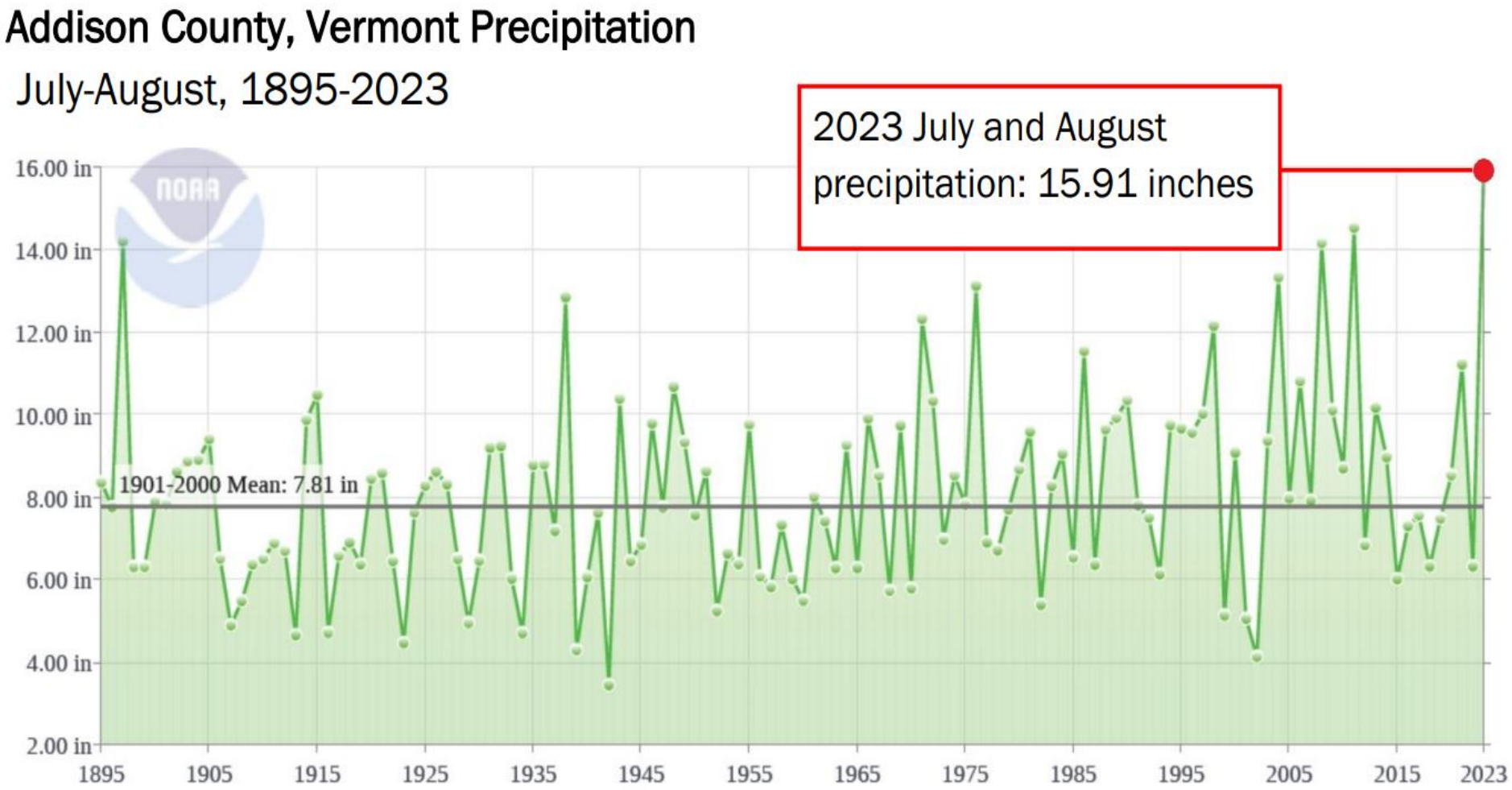
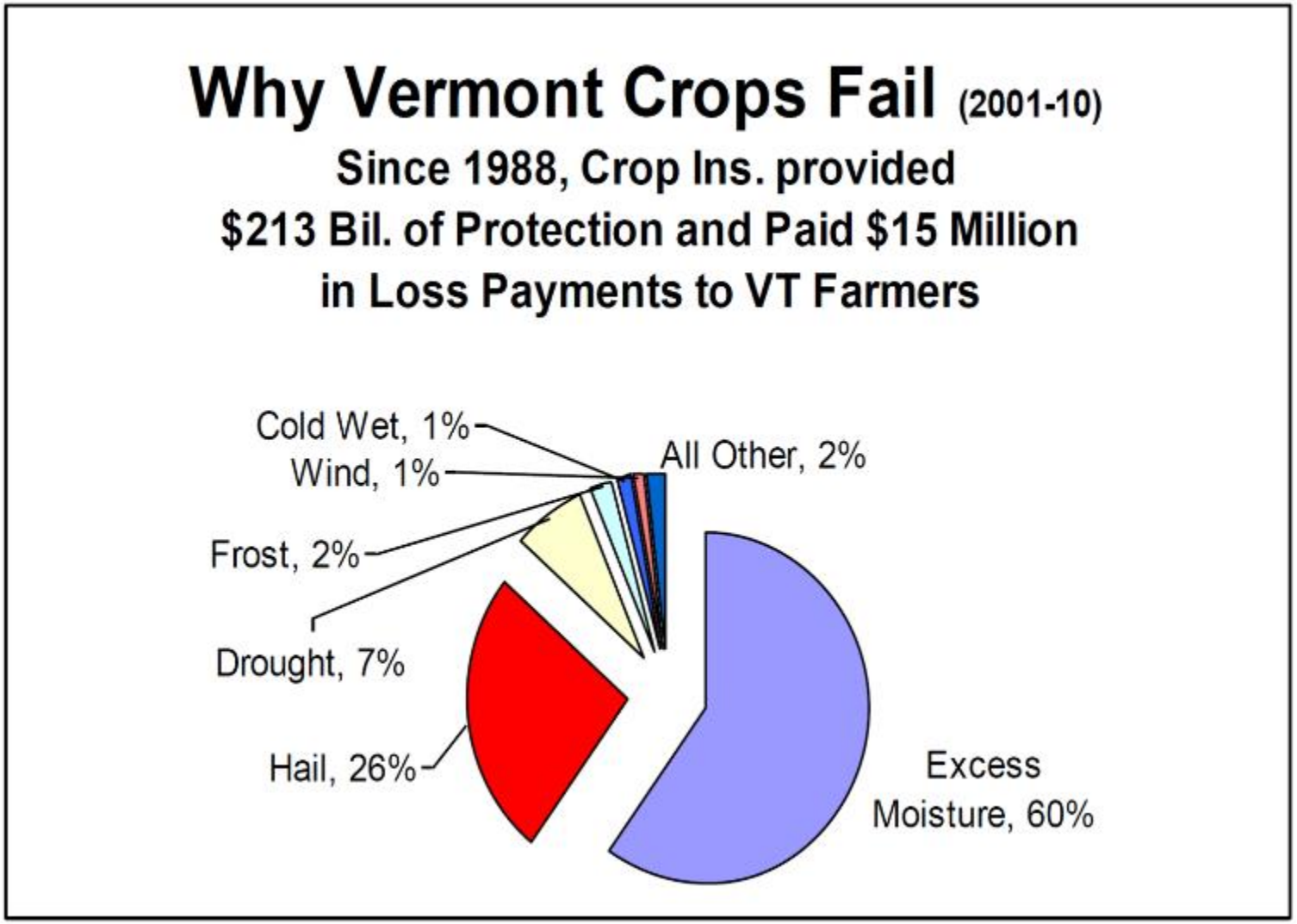
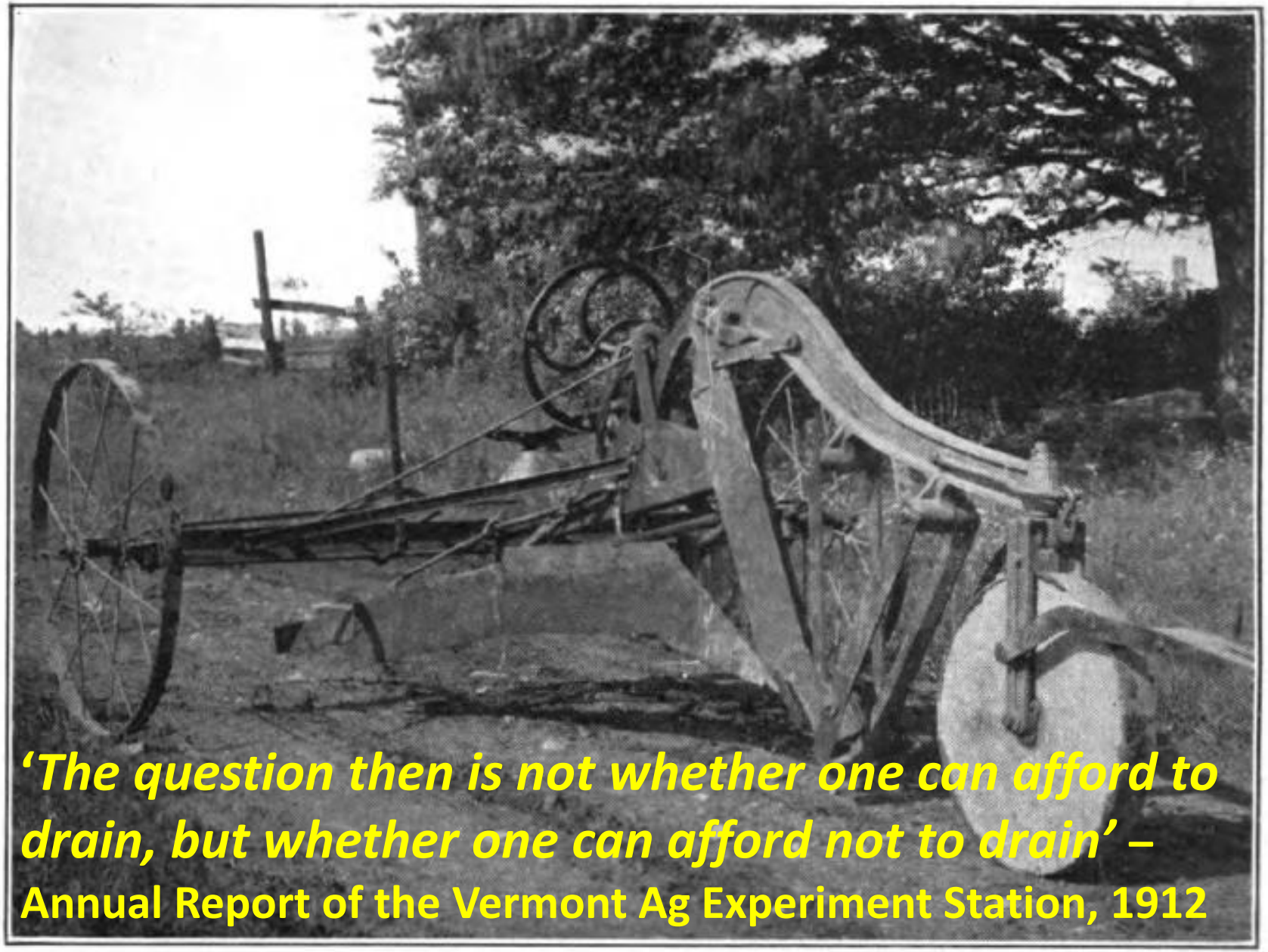


Figure 1 NOAA National Centers for Environmental Information.

Effects of Increased Precipitation are Clear



(RMA, 2012, https://www.uvm.edu/vtvegandberry/VVBGA%20Meeting%202012/RiskManagementCheckUp.pdf

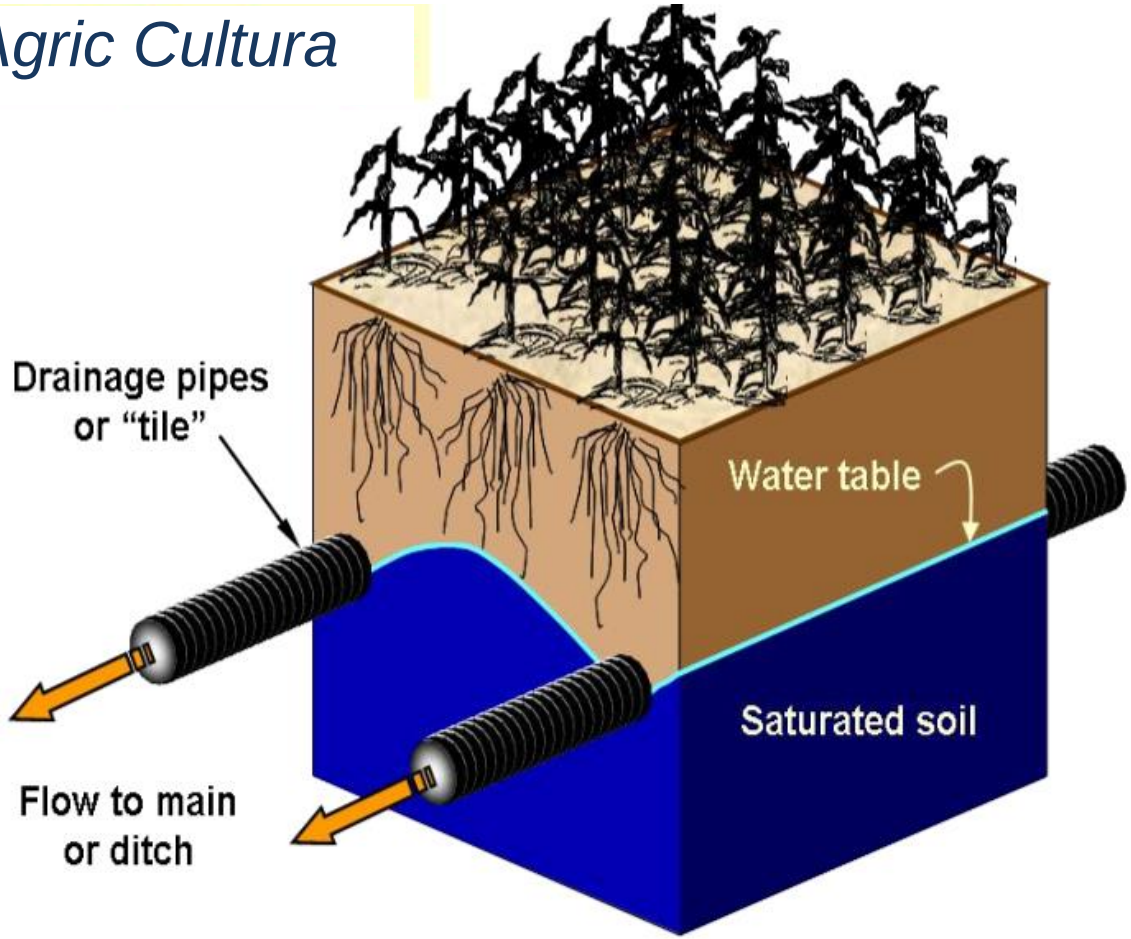


'The question then is not whether one can afford to drain, but whether one can afford not to drain' –
Annual Report of the Vermont Ag Experiment Station, 1912

PLATE III. Cyclone Ditcher, drawn by six horses. (Courtesy Hon. E. S. Brigham, St. Albans.)

Tile Drainage 101

- Artificial drainage first described by Cato in 200 BC in *De Agric Cultura*

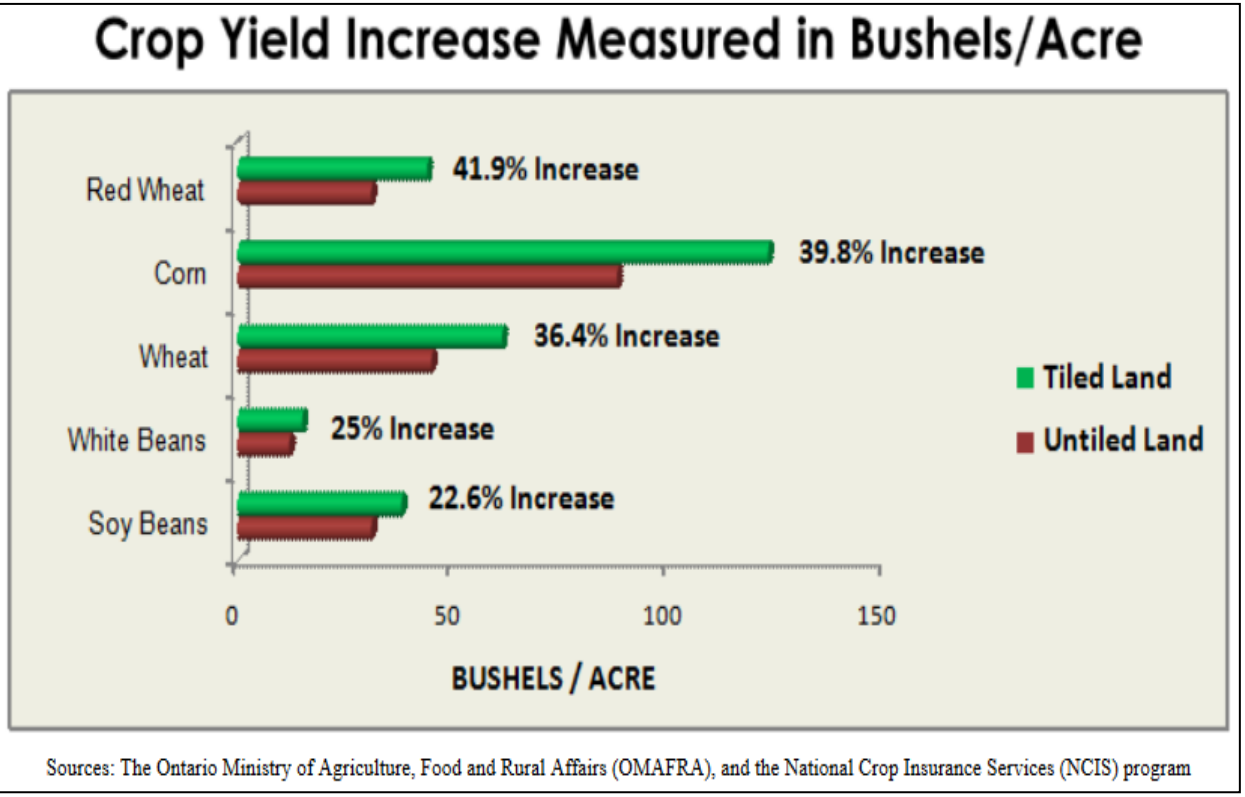


(Source: G. Sands, UMN)

Benefits of Drainage

1. **Improve crop production and less year-to-year variability**

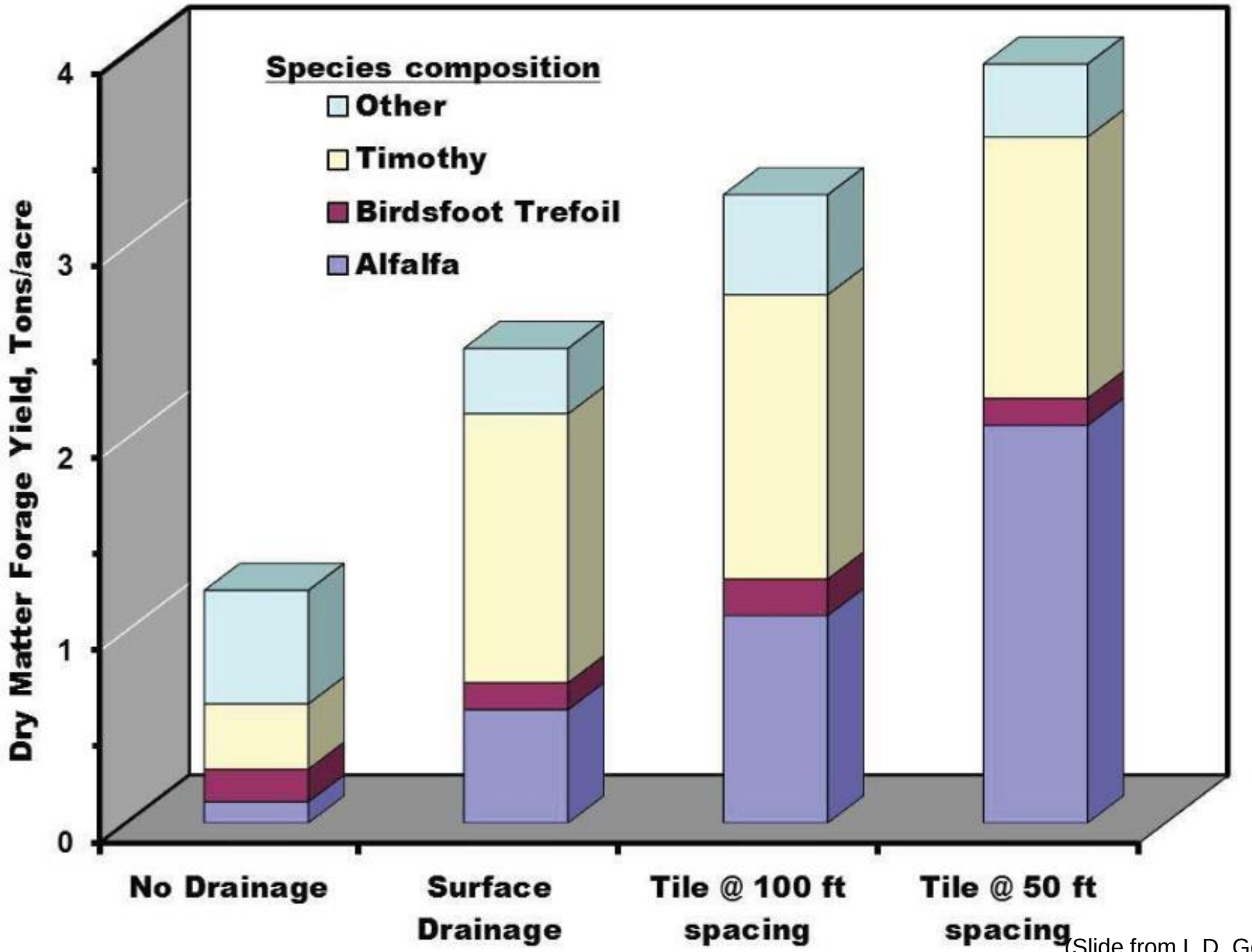
2. **Allows earlier and later field operations**



Sources: The Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA), and the National Crop Insurance Services (NCIS) program

Average of 30% yield increase in corn and soybeans due to drainage over 25 years in Ohio *(Reeder et al., 2011)*

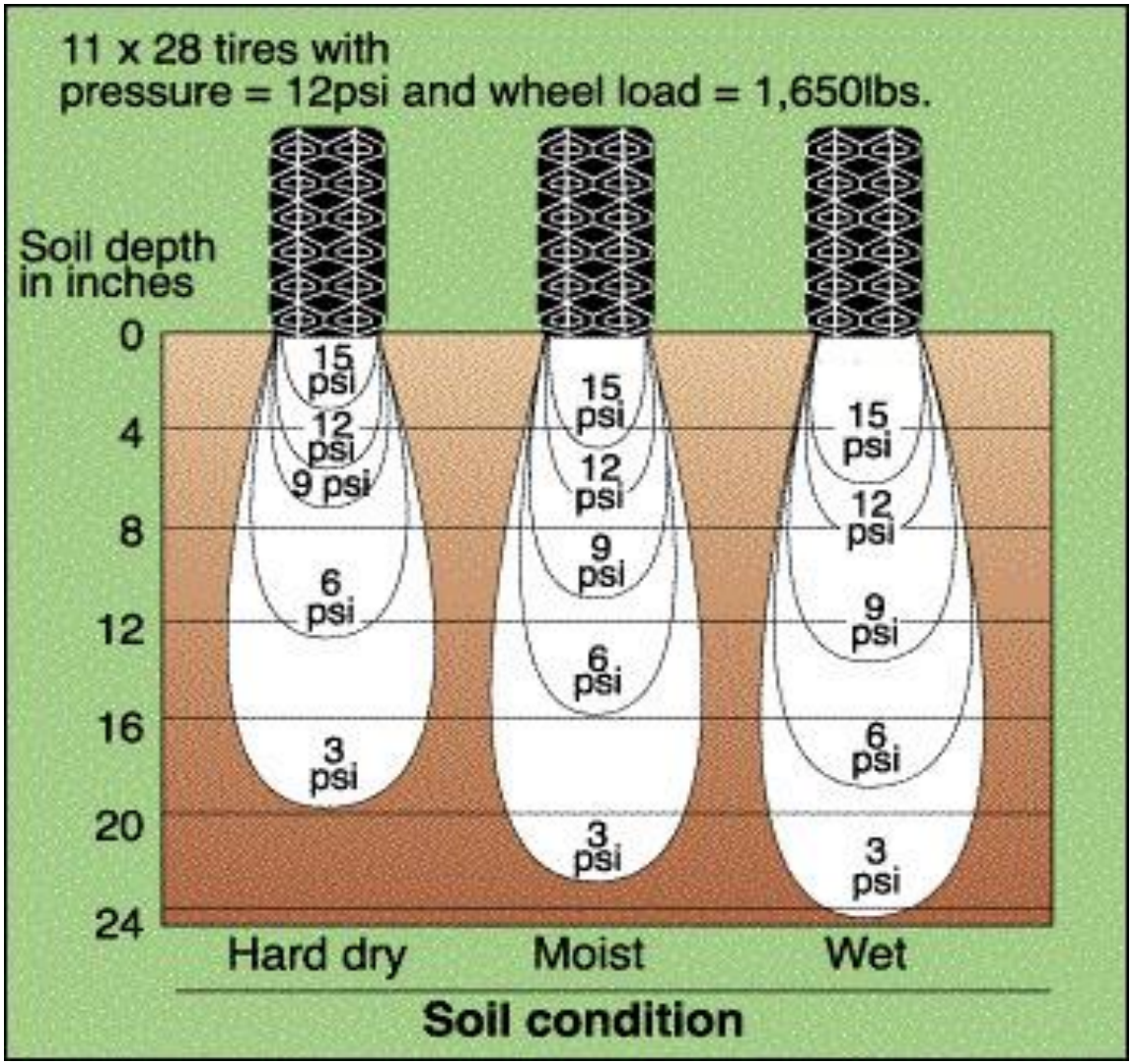
Forage Yield Response (4-Yr. Average)



(Slide from L.D. Geohring)

Reduce Compaction

Especially tough-to-remedy deep compaction

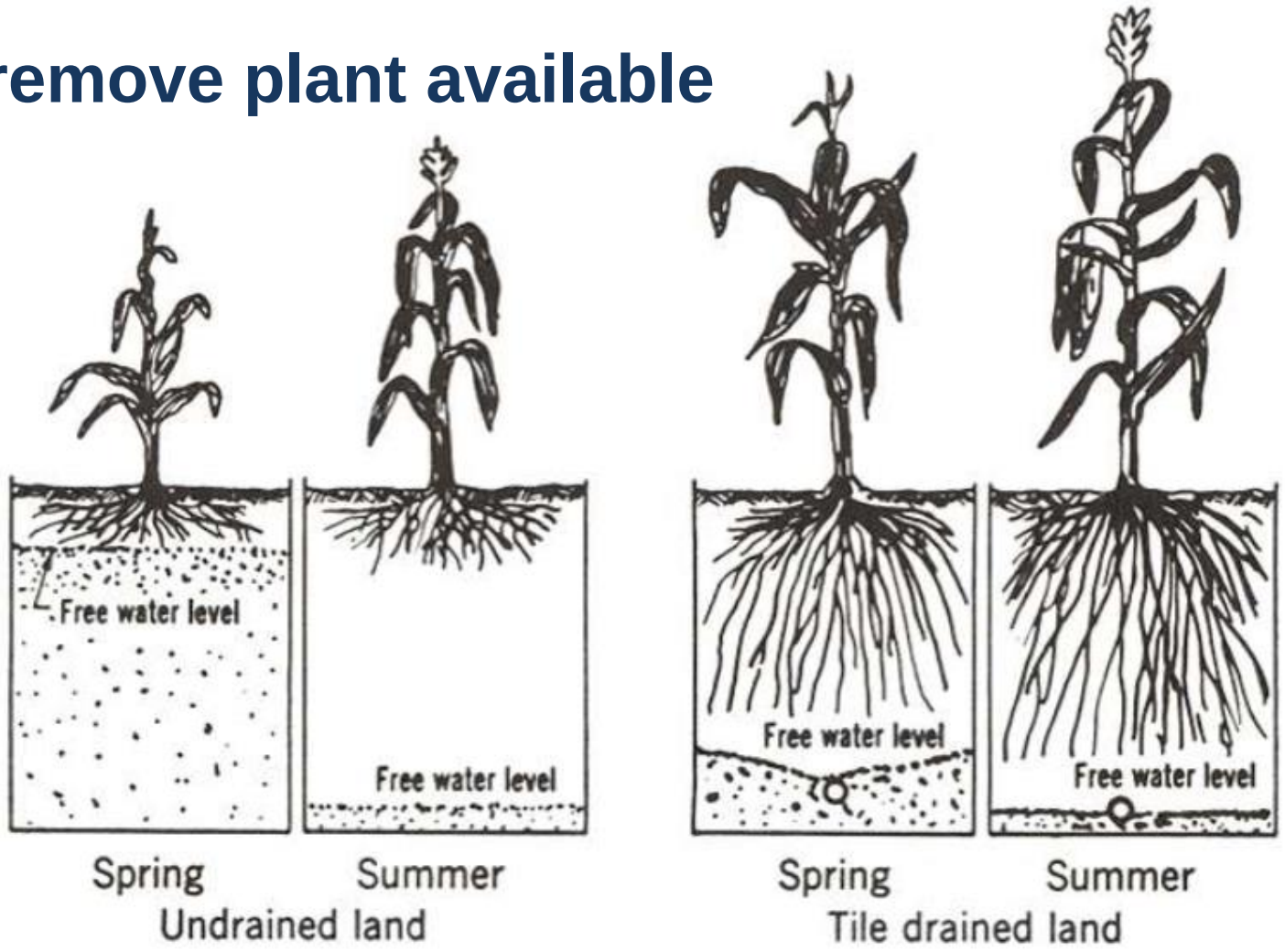


http://stormwater.pca.state.mn.us/index.php

extension.missouri.edu/explore/images/g01630art01.jpg

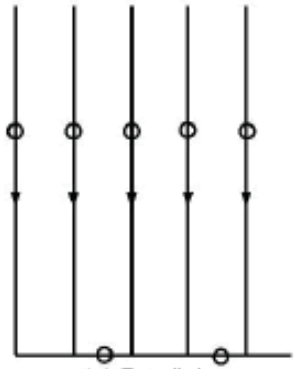
Wet years, and dry years

Does not remove plant available water

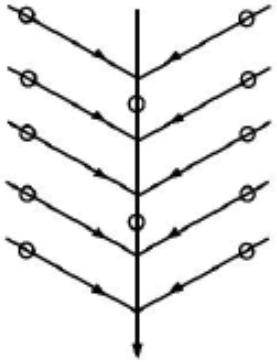


Tile Drainage 101

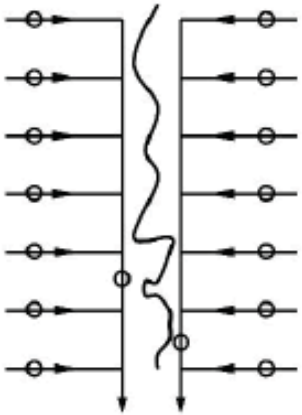
- Configurations of ‘laterals’ varies, but all feed ‘main’



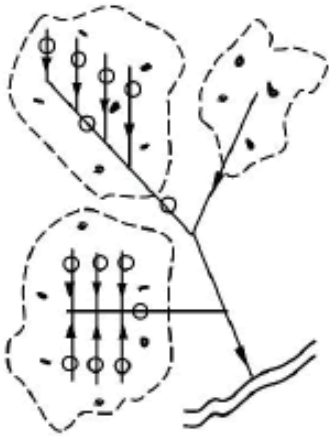
(a) Parallel



(b) Herringbone



(c) Double Main



(d) Random

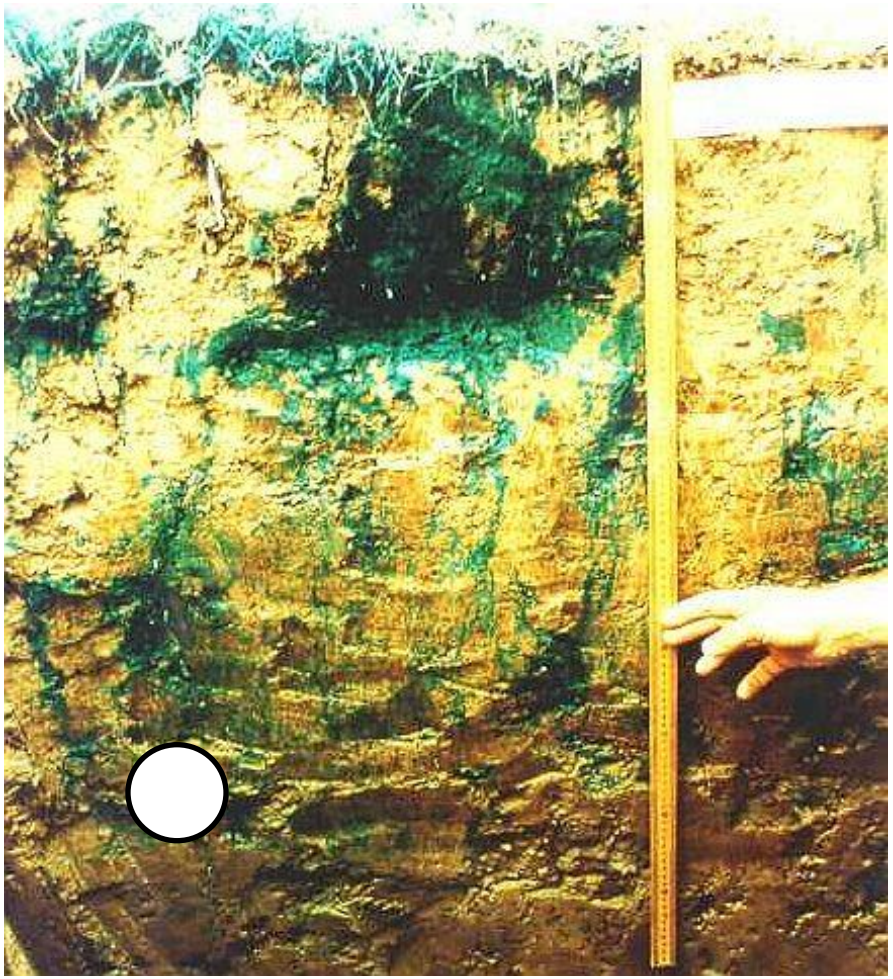
(extension.iastate.edu)

(omafra.gov.on.ca)

Tile Drainage Environmental Concerns

- **King et al. (2015) monitored eight tile outlets in central Ohio over an 8-yr period, and nearly half of the dissolved P and 40% of the total P load measured at the watershed outlet was attributed to runoff delivered by tile drains.**

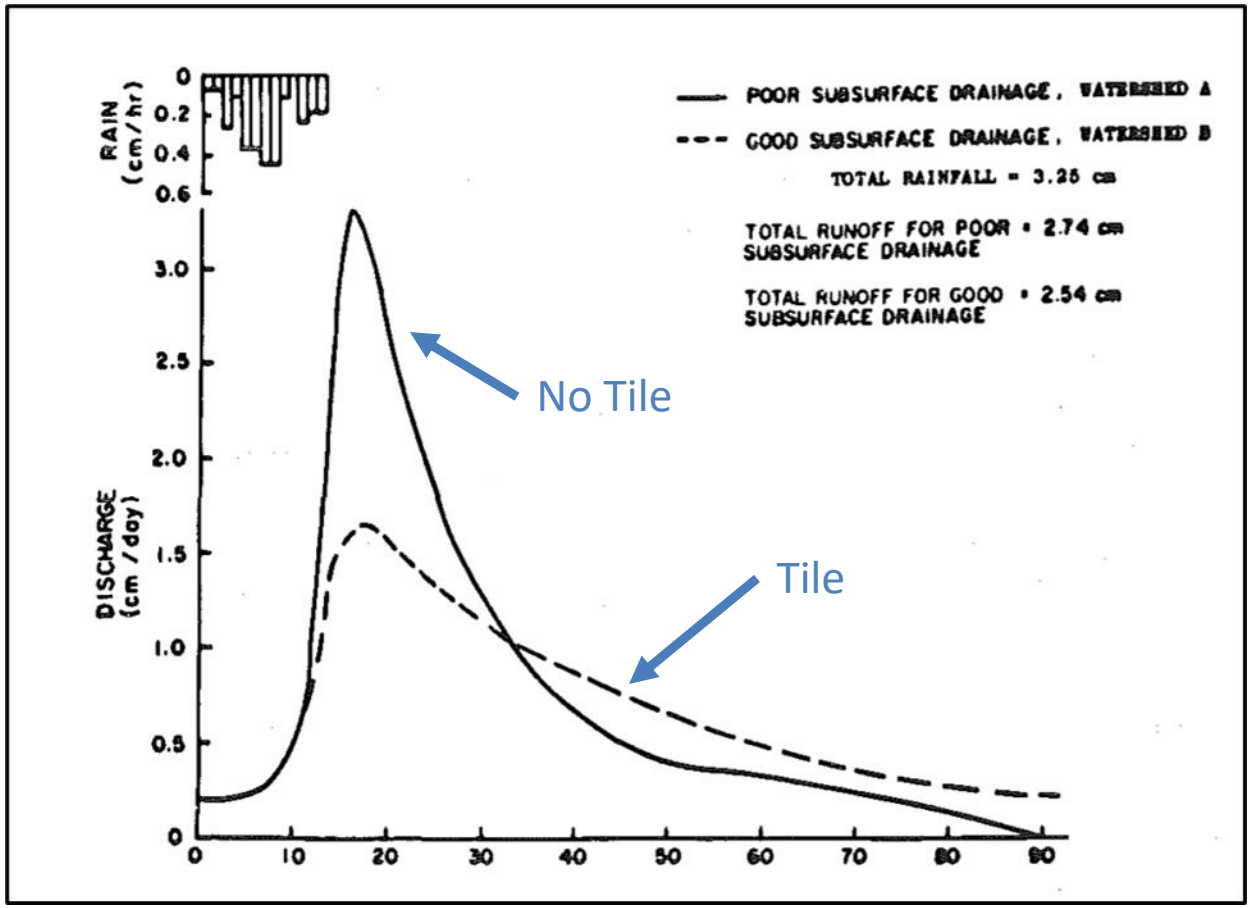
Preferential Flow



(Source: http://soilandwater.bee.cornell.edu)

Tile Drainage Hydrology: What the scientific literature says…

- **Skaggs and Broadhead (1982) found peak flows were reduced by 20% due to tile when soils were wet before a storm**
- **When soils were dry, tile reduced peak flows by up to 87%**
- **Robinson (1990) found a reduction of peak flows due to tile drainage specifically for clay-textured soils**
- **Increases overall watershed discharge volume by 10-20% (increases baseflow, between storms)**



(Gilliam and Skaggs, 1986)

Relationship Status: It's complicated…

- Tile drainage shown to decrease surface runoff and erosion (Skaggs et al., 1994)
- "All those gullies I used to see are gone now that I tiled my fields" – Vermont Farmer
- Improved yields mean more P is removed by crop…
- Tile drainage increases adoption levels of soil health BMPs (Darby, 2019)

DC Study: Total Phosphorus Loss (2020 & 2021)

- Dry conditions: 56% (2020) and 68% (2021) of typical precipitation

Table 1: Total Phosphorus Loss from Dead Creek Fields (lb/ac)

Field	2020			2021		
	Growing Season	Non-Growing	Total	Growing Season	Non-Growing	Total
DC-North	0.07	0.67	**0.74**	0.58	0.54	**1.12**
DC-South	0.42	0.28	**0.70**	0.39	0.28	**0.67**

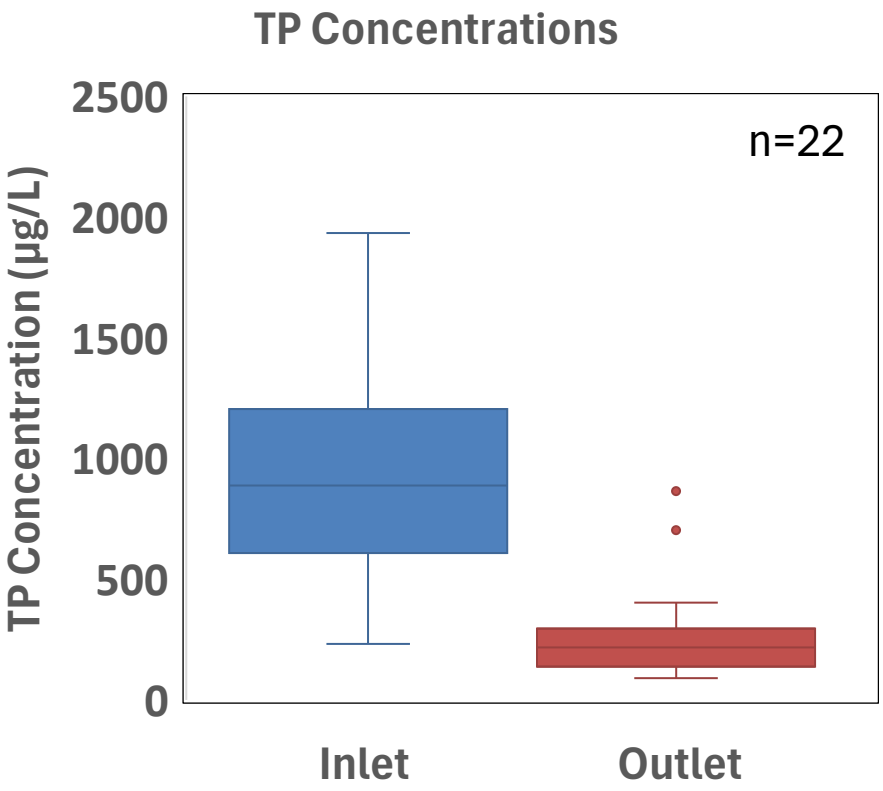
- TP loss was generally within ranges reported elsewhere in the country (**0.35 – 1.4 lb/ac/yr**) (King et al., 2015)
- Monitoring will continue and the effect of manure injection will be evaluated

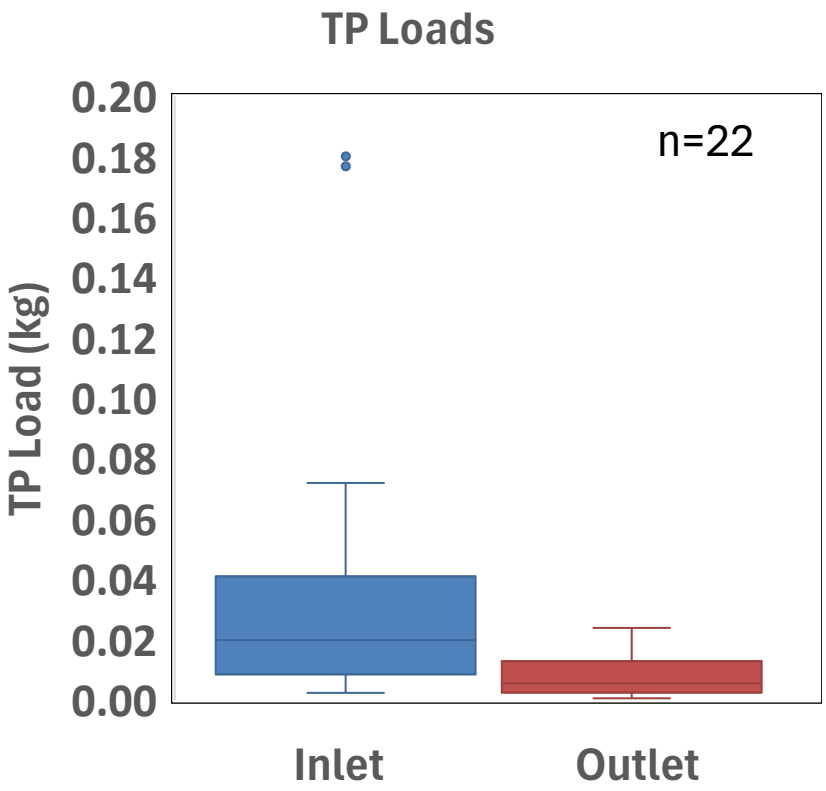
(Ruggiero, Faulkner, and Ross, 2022)

Tile Phosphorus Filters

- **Remove dissolved P**
- **Tile and Ditch filters**
- **Act like big water filters at edge-of-field**
- **Currently an NRCS-VT Interim Conservation Practice**

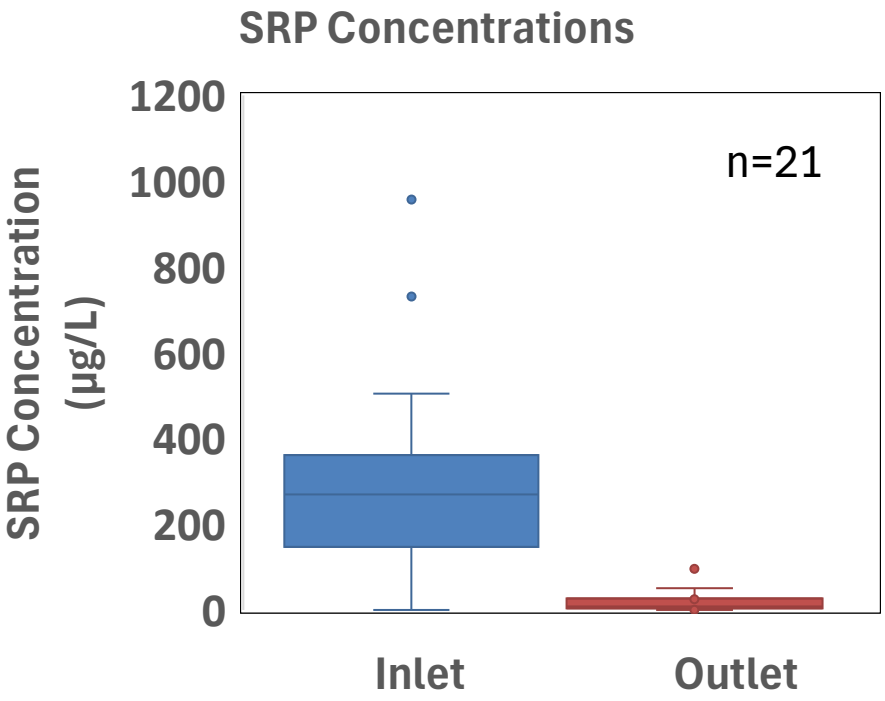
West Tile Performance: Total P

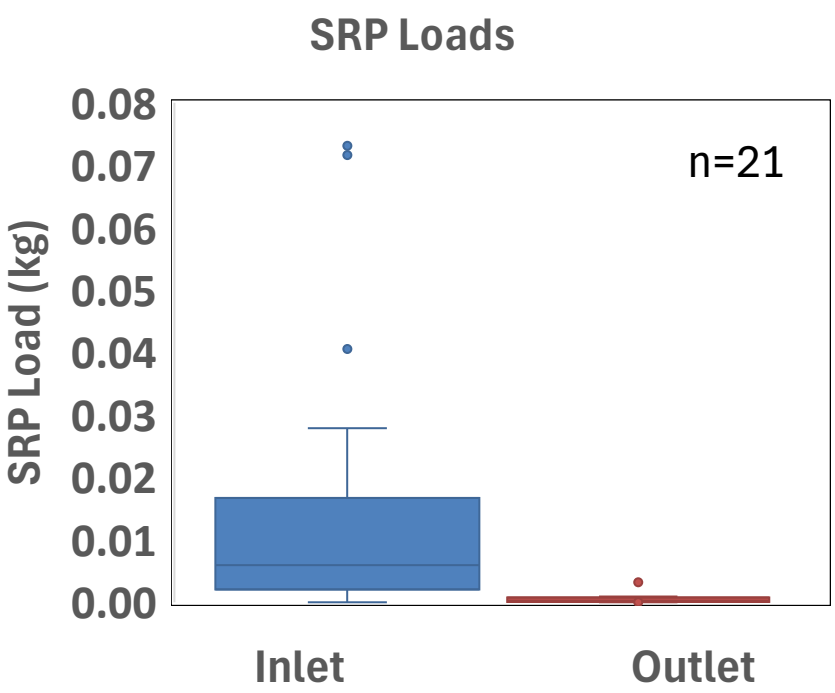




Cumulative Mass Removal: 80%
Average Mass Removal: 69%

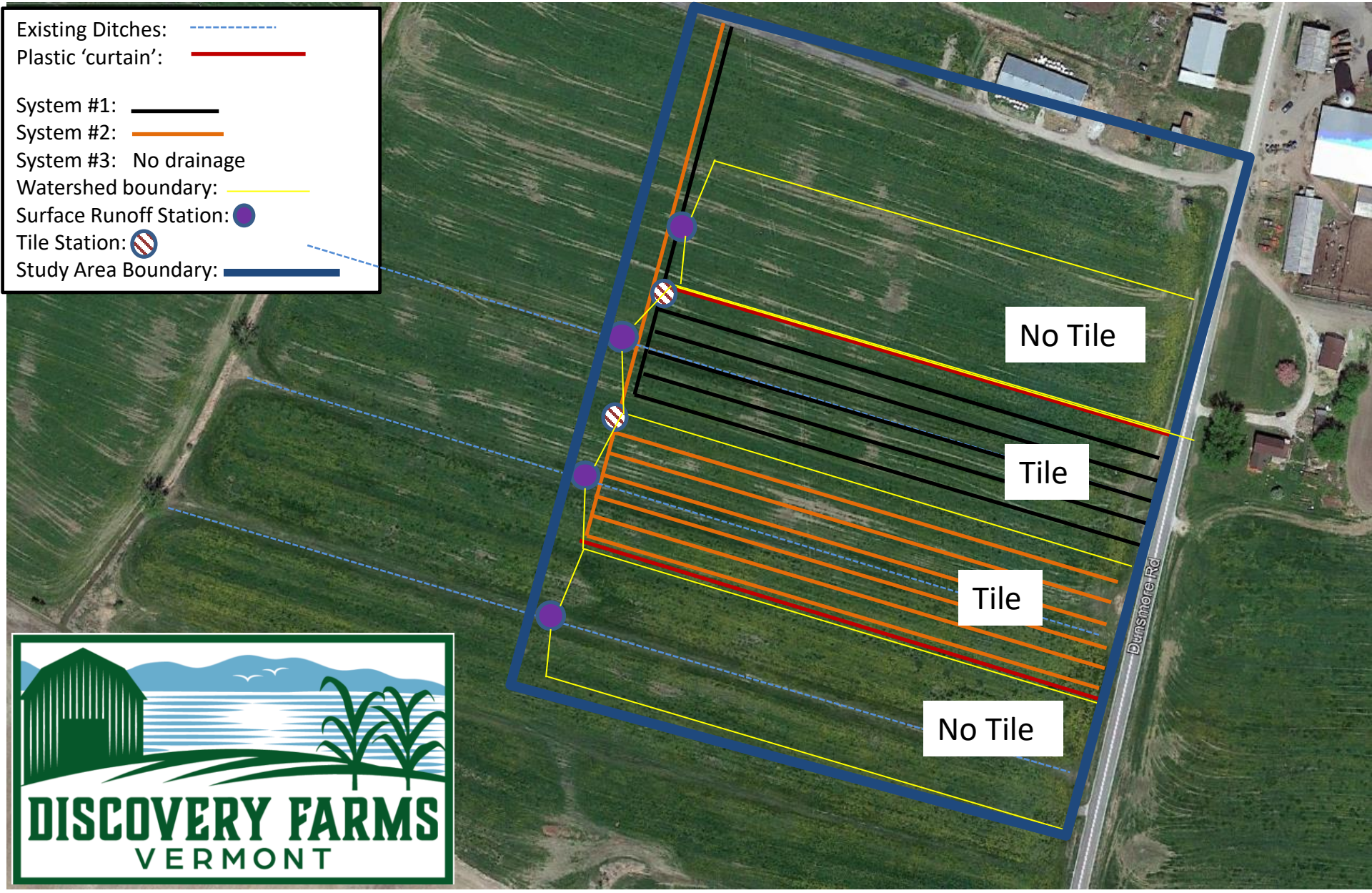
West Tile Performance: Soluble Reactive P





Cumulative Mass Removal: 95%
Average Mass Removal: 89%

Tile vs. No Tile: Discovery Farms, VT




Farm Business
Tile Shapes
PLEASE
DO NOT TOUCH TILE

Mike Weaver
DRAIN TILE MUSEUM
Home of John Johnston
"Father of Tile Drainage in America"