Collaborative Edge-of-Field Research to protect Michigan Water Quality

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History of Drainage

- First comprehensive drain law of Michigan was passed in 1839. (Miller and Simons 1918)
- U.S. Swamp Land Acts of 1849 and 1850 provided federal funding

CONSTRUCTION OF OPEN DRAIN, THREE FEET BOTTOM WIDTH, FOUR FEET DEEP WITH BOARD SCRAPER AND TEAM

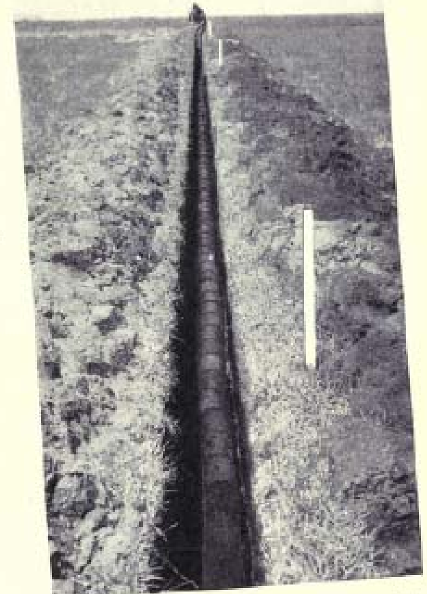
Drainage in Michigan. Miller and Simons (1918)

Installing

Digging the second spading.

Digging the third spading to put the tile good and deep.

Laying the tile.



The ditch should be straight, without any twists or crooks in the line of tile.

Tile Drainage. James King (1918)

MSU Farms

- August 1955

MSU Farms

- August 1955

PICTURE CAPTION

Picture Title: TILING DEMONSTRATION ILLUSTRATING METHOD OF TOPSOIL FILLING OF TRENCH AFTER BLINDING OF DRAIN TILE.

Date Taken: AUG. 1955 Negative No: 13898-80

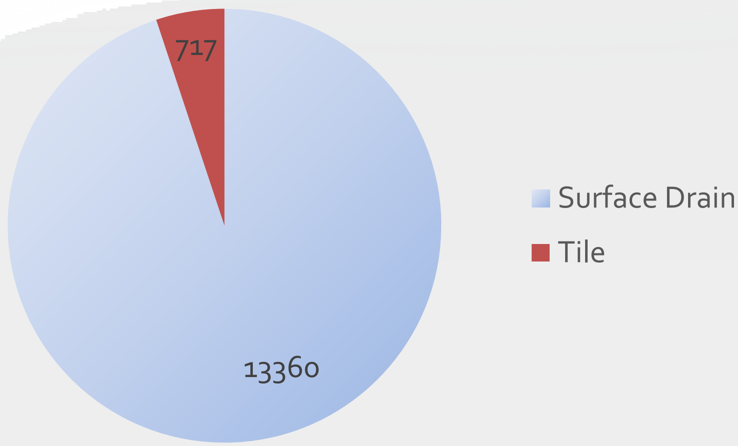
Explanation: THE CRAWLER TRACTOR IS AN ALLIS-CHALMERS HD-5 DIESEL, EQUIPPED WITH A GAR WOOD ANGLEDOZER BLADE, AND OPERATED BY MR. HENRY COMPTON, CONTRACTOR, AND DIRECTOR OF THE MICHIGAN FARM TRENCHERS ASSOCIATION. AT THE RIGHT OF THE TRENCH WITH ARMBAND IS ROLAND GROSS, PRES. OF MFTA.

TILING DEMONSTRATION AREA, M.S.U. FARMS, CENTENNIAL OF FARM MECHANIZATION.

Michigan Drainage (miles installed)

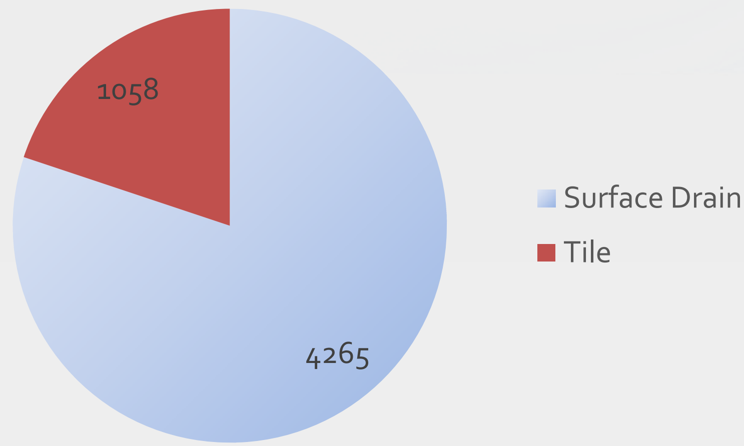
1898 to 1912 (15 years)

58 miles of tile per year



1913 to 1917 (5 years)

212 miles of tile per year



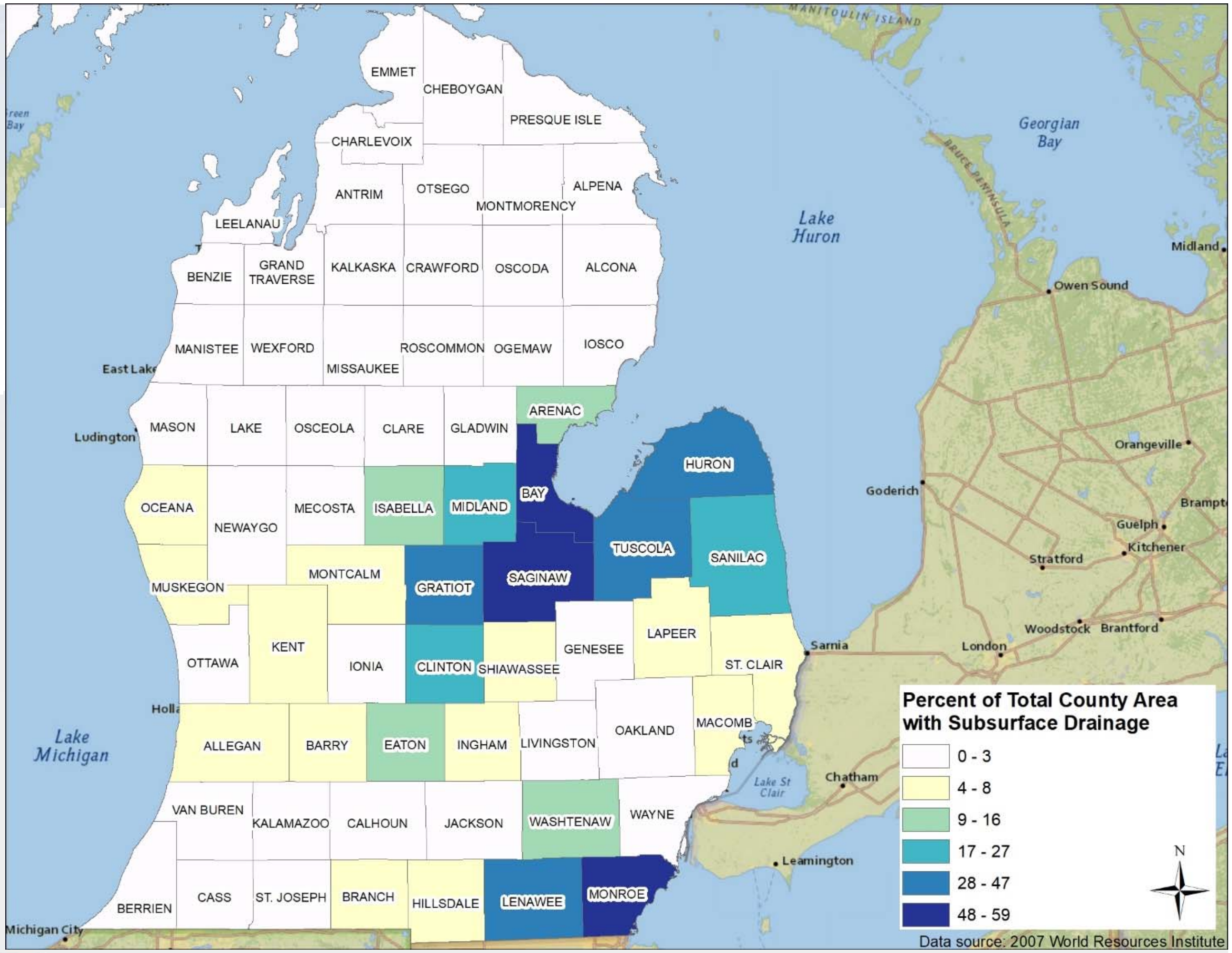
Data from "Drainage in Michigan" by Miller and Simons (1918)

LP Michigan

- 2.3 million acres Agricultural subsurface drainage

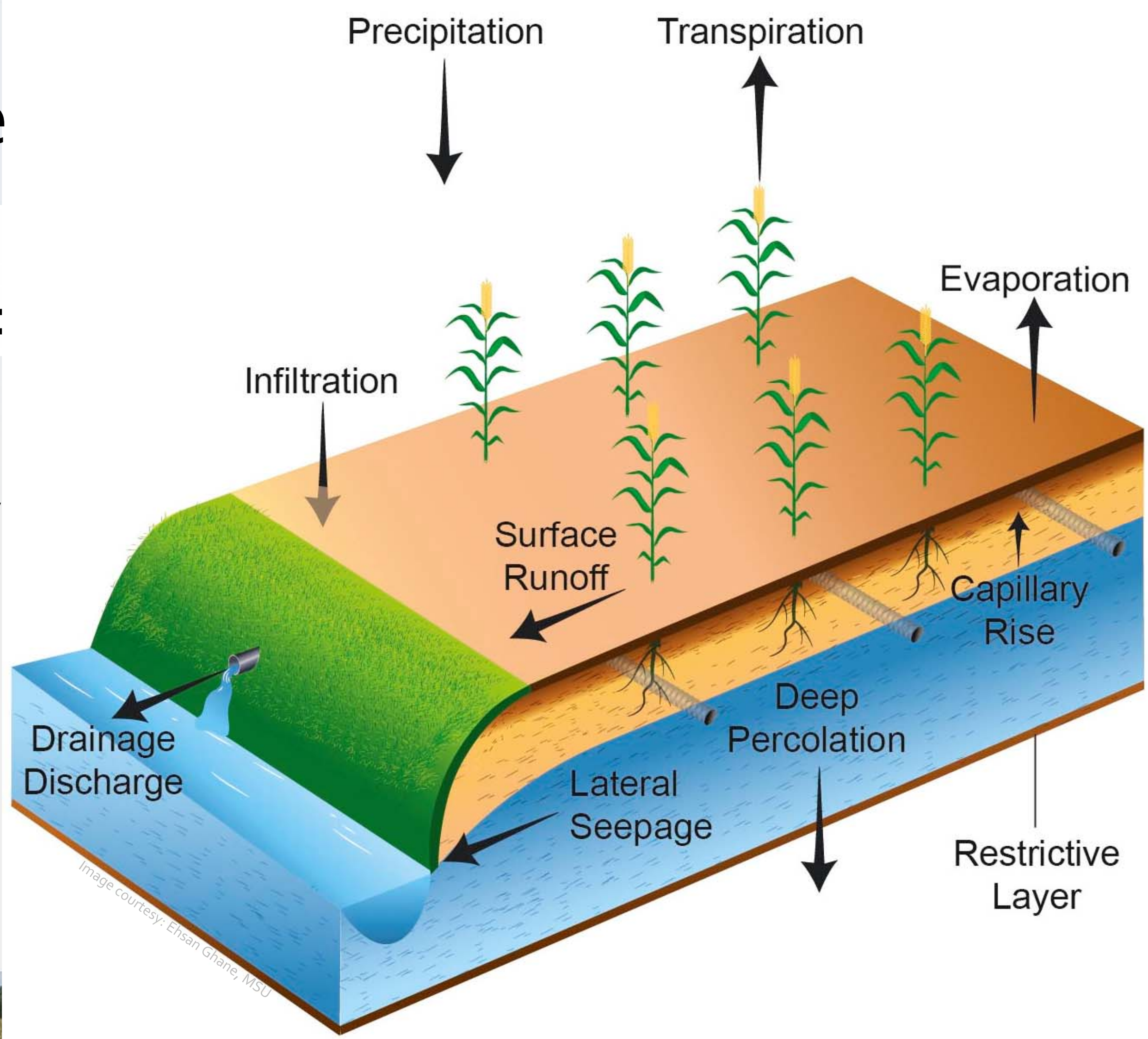
- 29% total cropland is drained

2007 estimate



Drainage Water Cycle

- Nutrient loss pathways:
  - Surface runoff
  - Subsurface drainage flow



Finding: Soluble Reactive Phosphorus

- From early 2000s soluble reactive P loads into Western Lake Erie has increased dramatically.
- Majority of the SRP load increase was due to
  - increased P availability in the field.
  - increased transport efficiency.
- Increase in reduced tillage (lower erosion).
- Increased drainage, closer lateral spacing. (Jarvie and colleagues 2017)

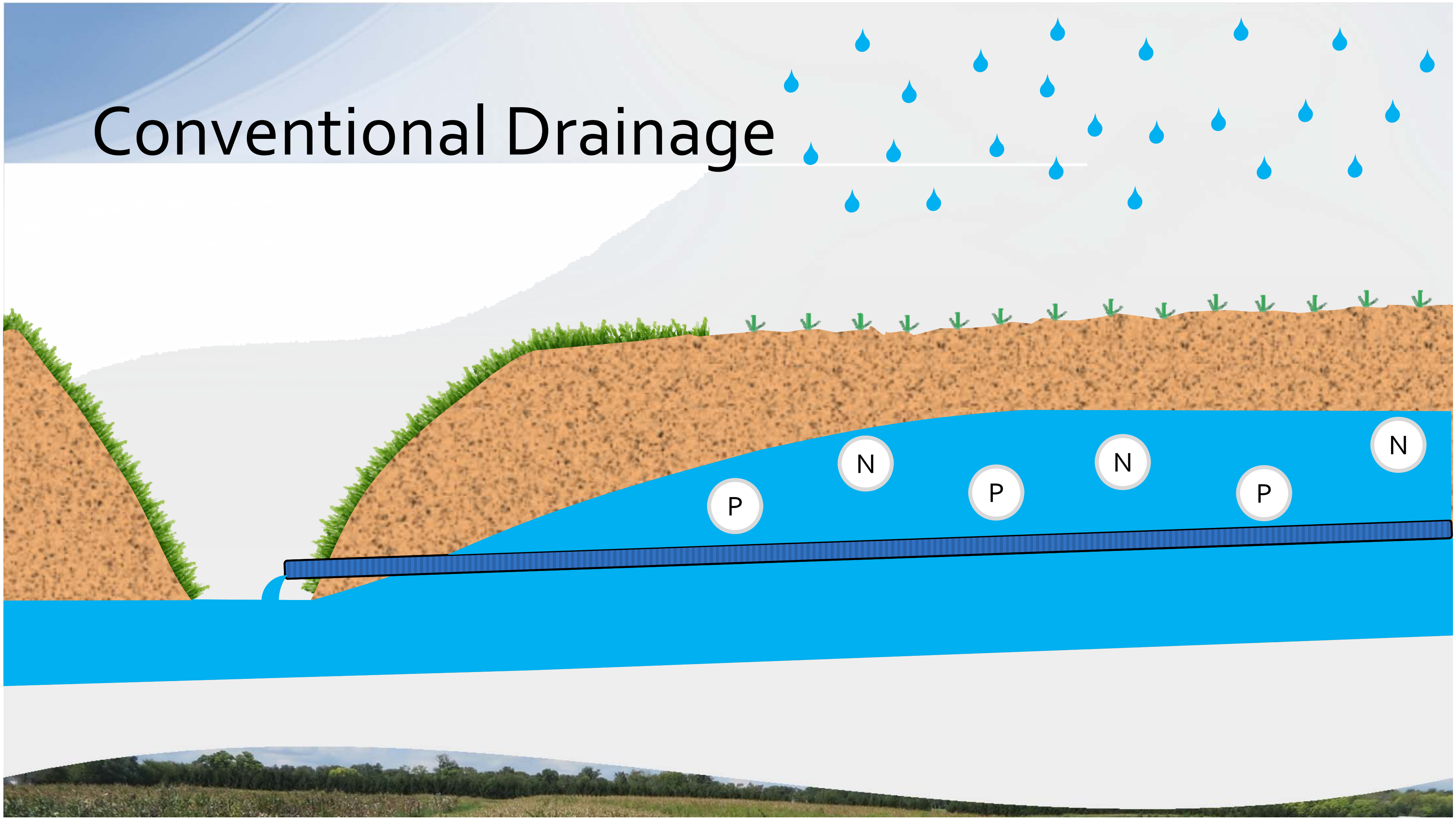
Soluble Reactive Phosphorus Variation

- No significant (meaningful) variation in SRP concentration across seasons.
- Majority of SRP load was lost during non-growing season, winter and early spring. (Pease and colleagues 2017)

What is Controlled Drainage?

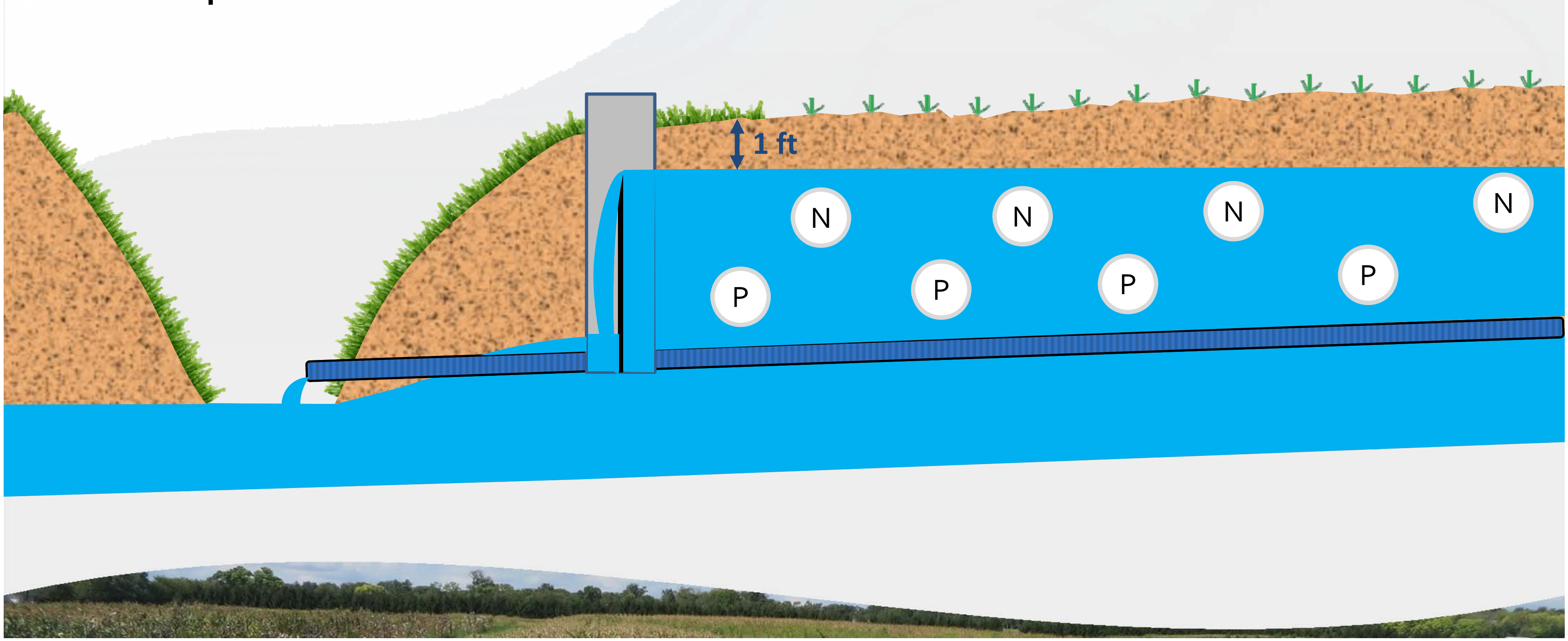
- Managing the outlet level of the drainage system
  - Purpose is to reduce nutrient delivery to surface water
- Works for both Nitrogen and Phosphorus

Conventional Drainage

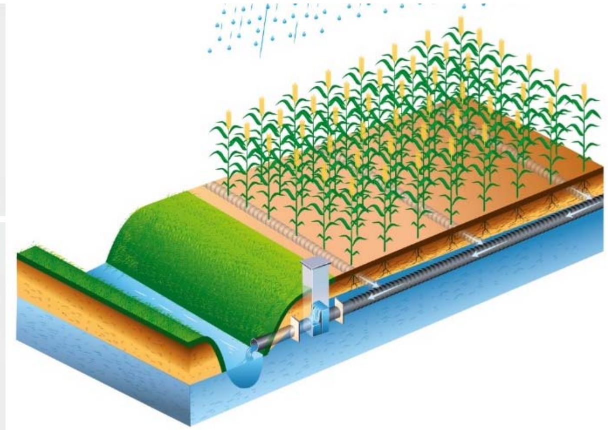


Controlled Drainage

After Harvest and fall field operations

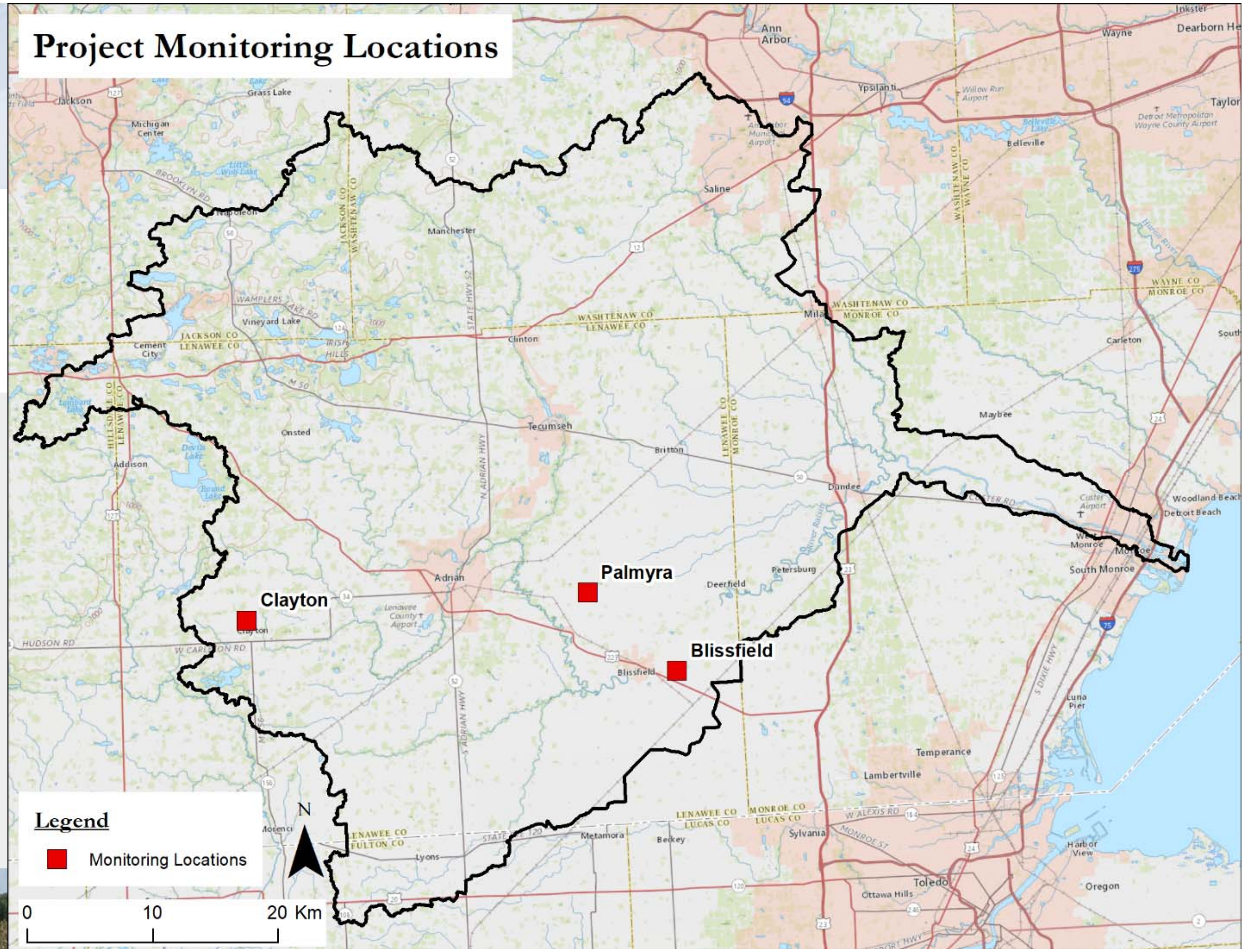


Why controlled drainage?



- No land is taken out of production
- Low maintenance and requires management
- Reduces nutrient loss (Ross and colleagues 2016)
  - Average nitrate load is 48%
  - Average soluble Reactive P load reduction is 57% (scarce: only 2 studies).
- Potential to improves crop yield with proper management and timely rainfall

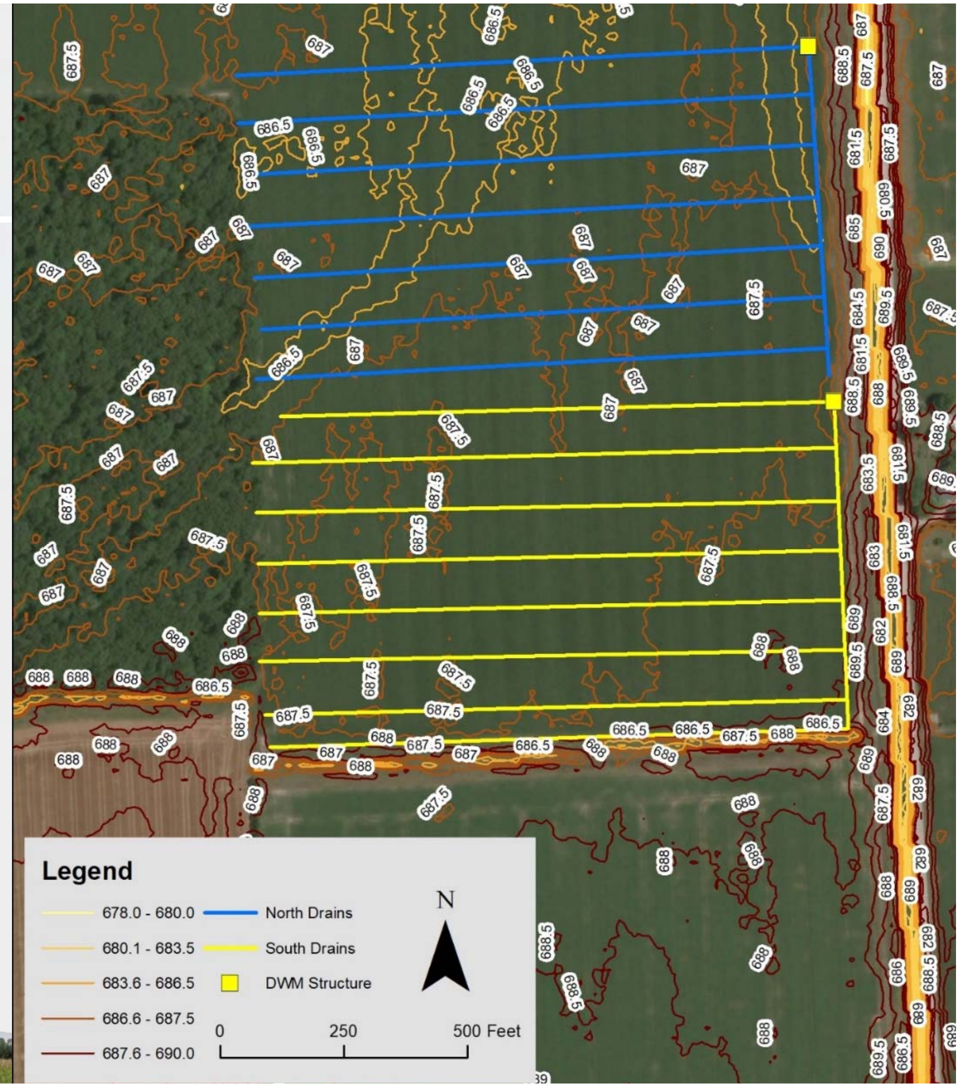
Sites



Project Monitoring Locations
Palmyra
Clayton
Blissfield
Legend
Monitoring Locations
0
10
20 Km
N

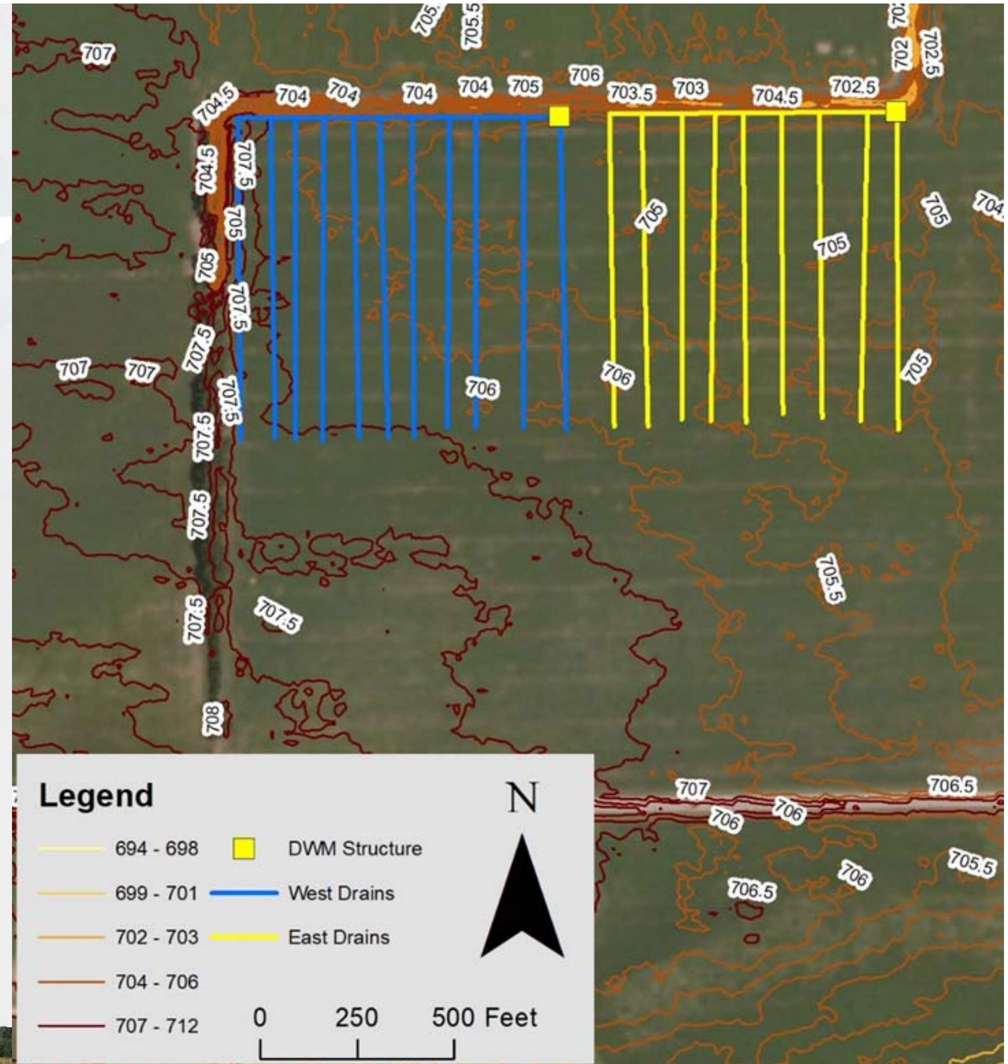
MI: Blissfield Site

- Evaluate Controlled Drain
- P concentration over time
  - Non-growing season
  - Growing season

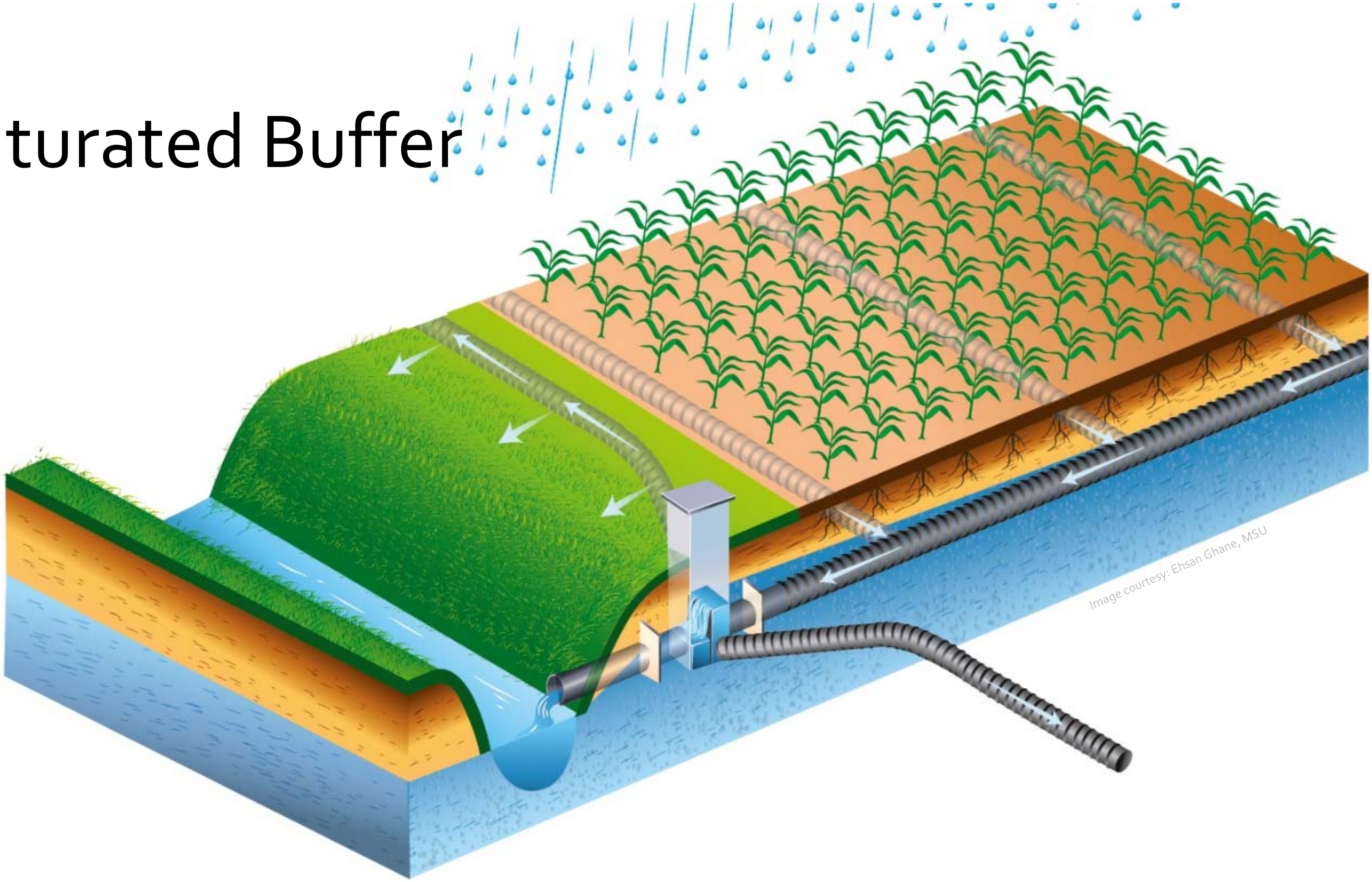


MI: Palmyra Site

- Evaluate Controlled Drain
- P concentration over time
  - Non-growing season
  - Growing season

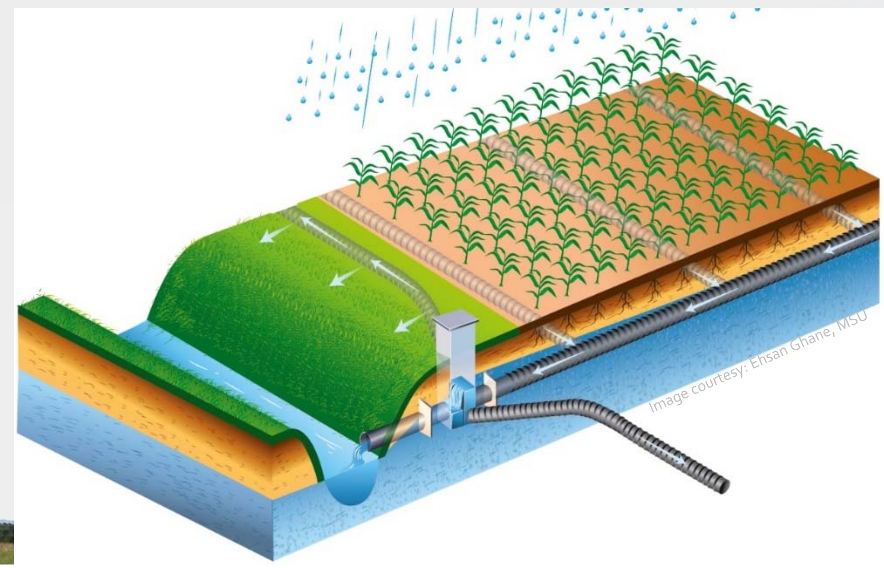


Saturated Buffer

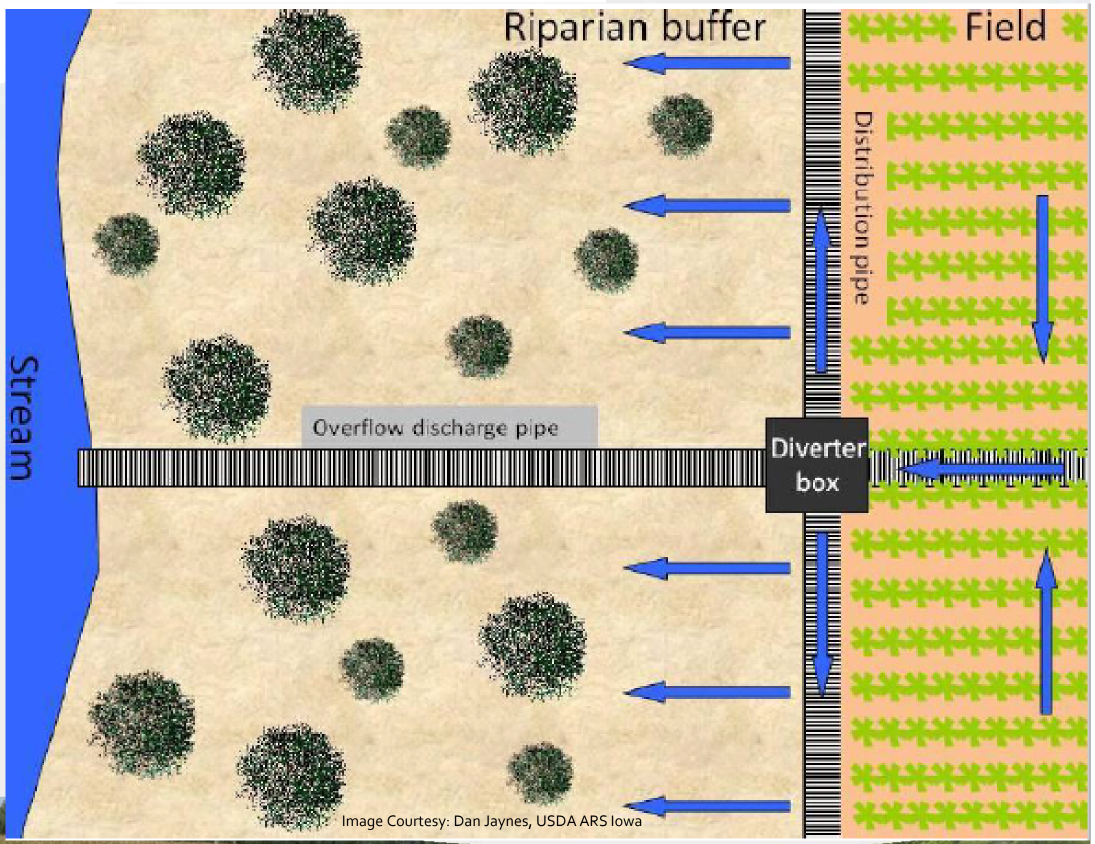


Saturated Buffer

- Main purpose is to reduce nutrient delivery
- Targets NO_3^-
  - Potentially P
- Built-in controlled drainage

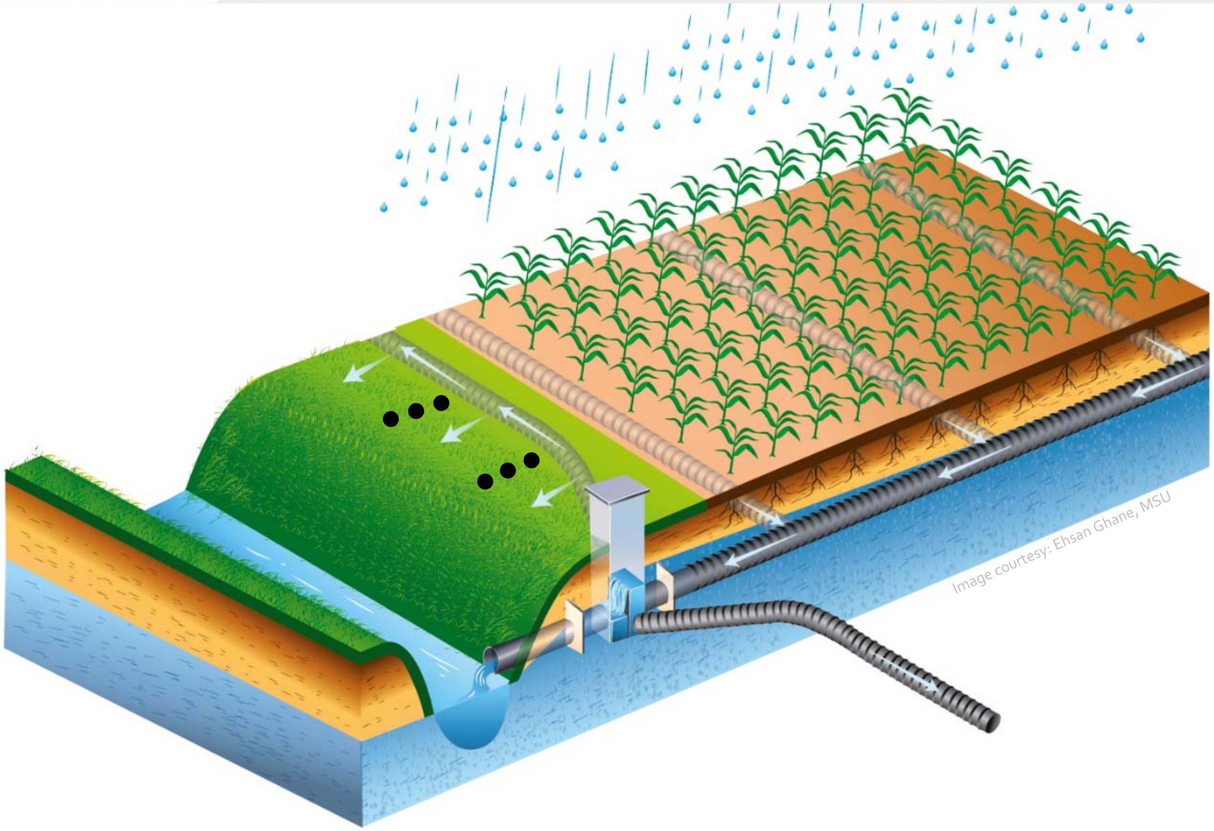


Top view of a Saturated Buffer



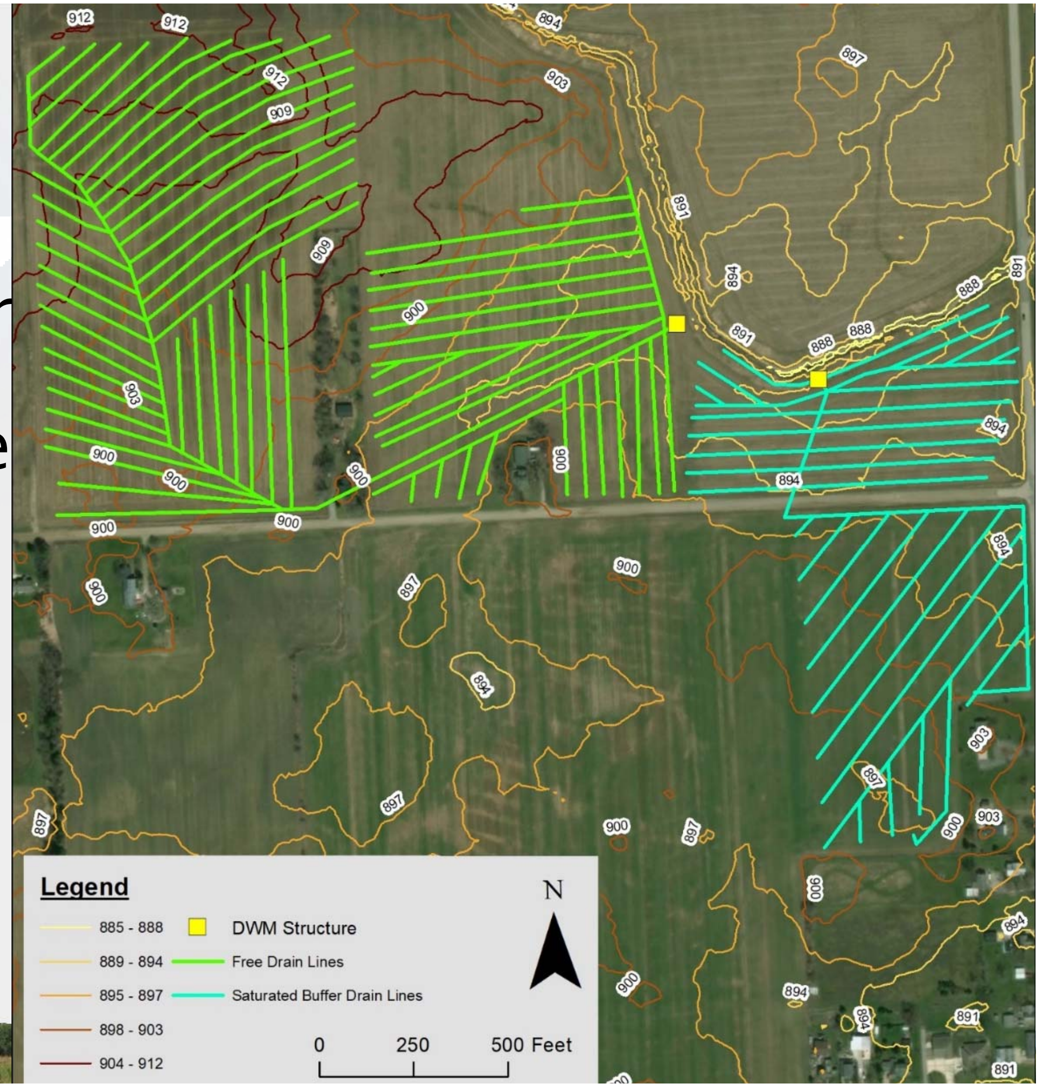
Saturated Buffer Sampling

- Transects of observation wells



MI: Clayton SB Site

- Evaluate Saturated Buffer
- P concentration over time
  - Non-growing season
  - Growing season



Project Goals

- Controlled drainage nutrient load reduction (primarily P)
- Crop yield benefit from controlled drainage
- Saturated buffer nutrient load reduction (primarily P)