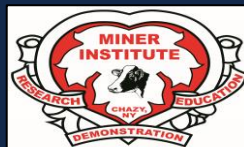


# WATER QUALITY MONITORING OF SURFACE RUNOFF AND TILE DRAINAGE ON DAIRY FARMS IN THE LAKE CHAMPLAIN BASIN

Presentation to the Vermont House Agriculture and Forestry Committee  
March 29, 2022

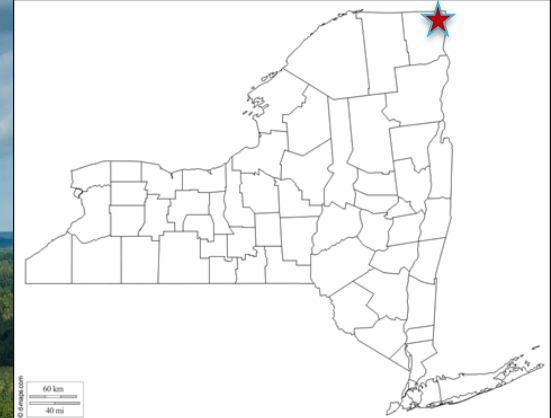
Laura Klaiber  
Research Scientist



The William H. Miner Agricultural Research Institute  
Chazy, NY



# Miner Institute, Chazy, NY

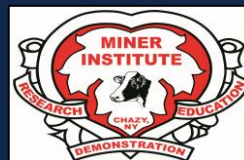
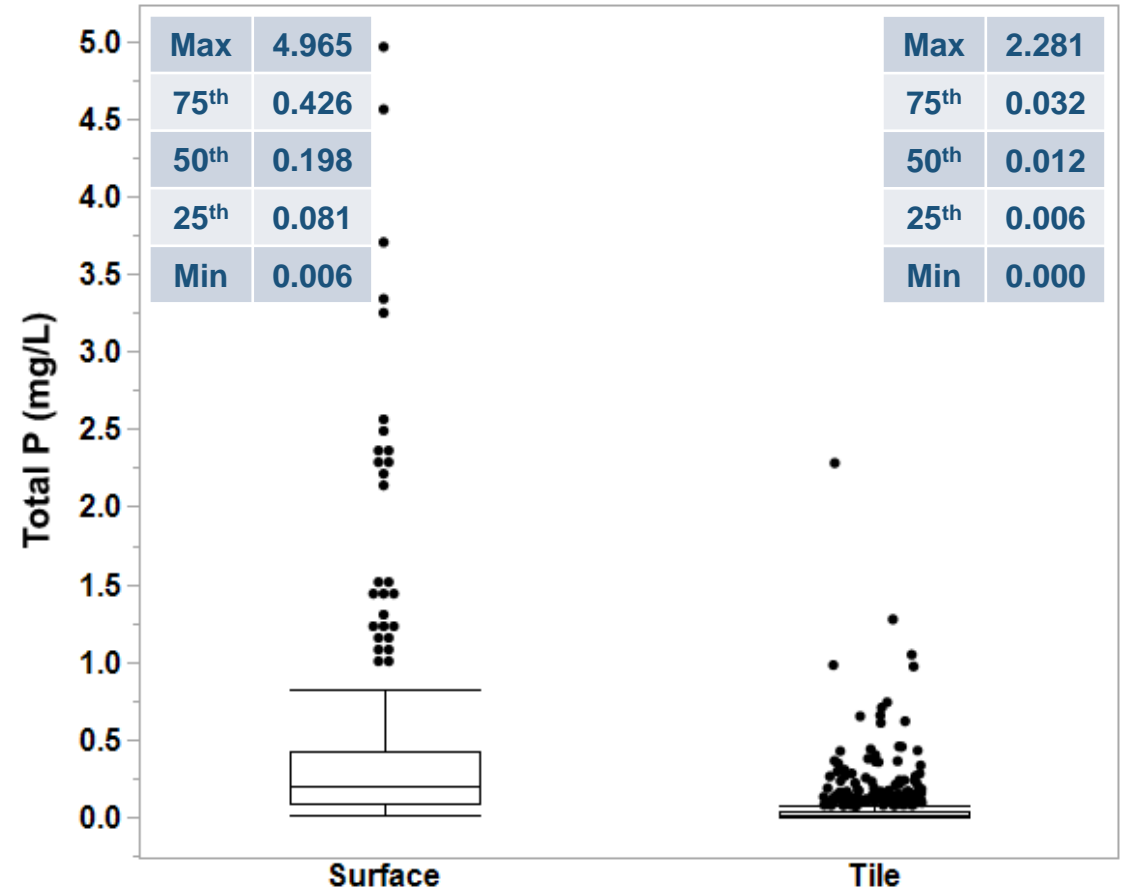
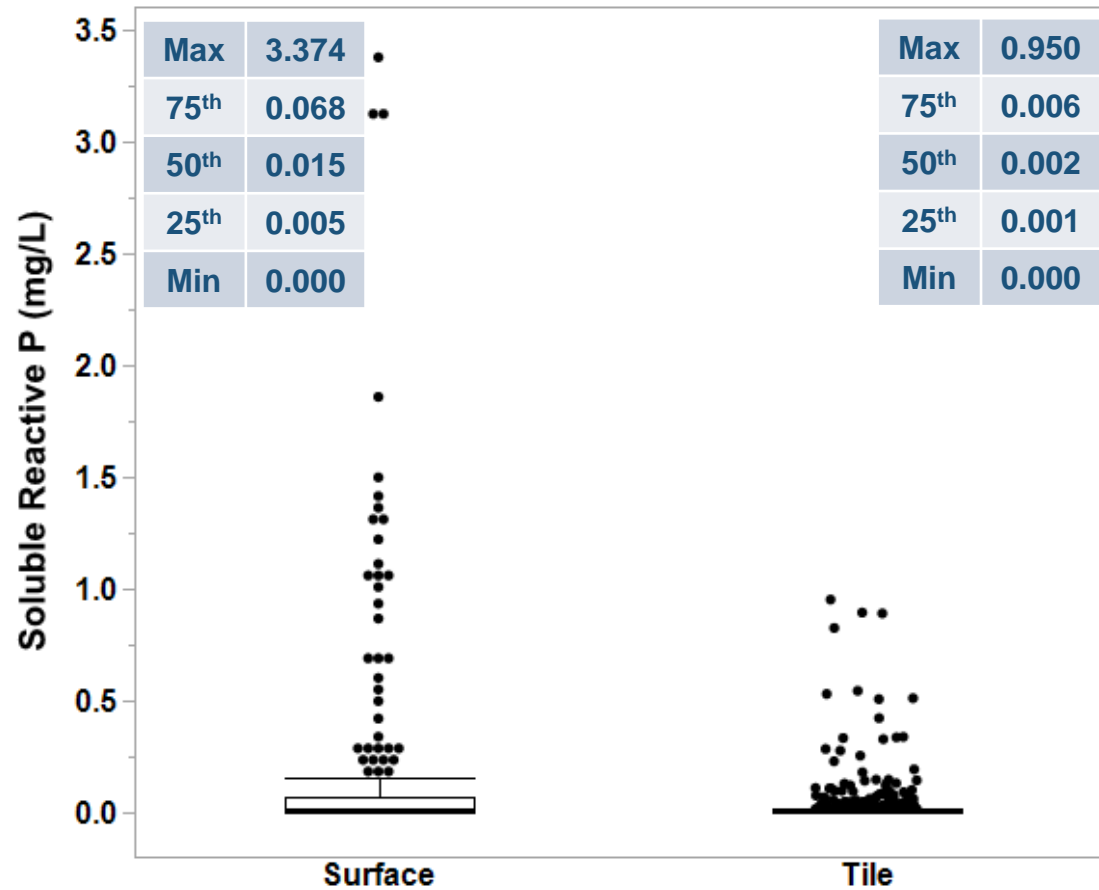


## Miner Institute Dairy Farm

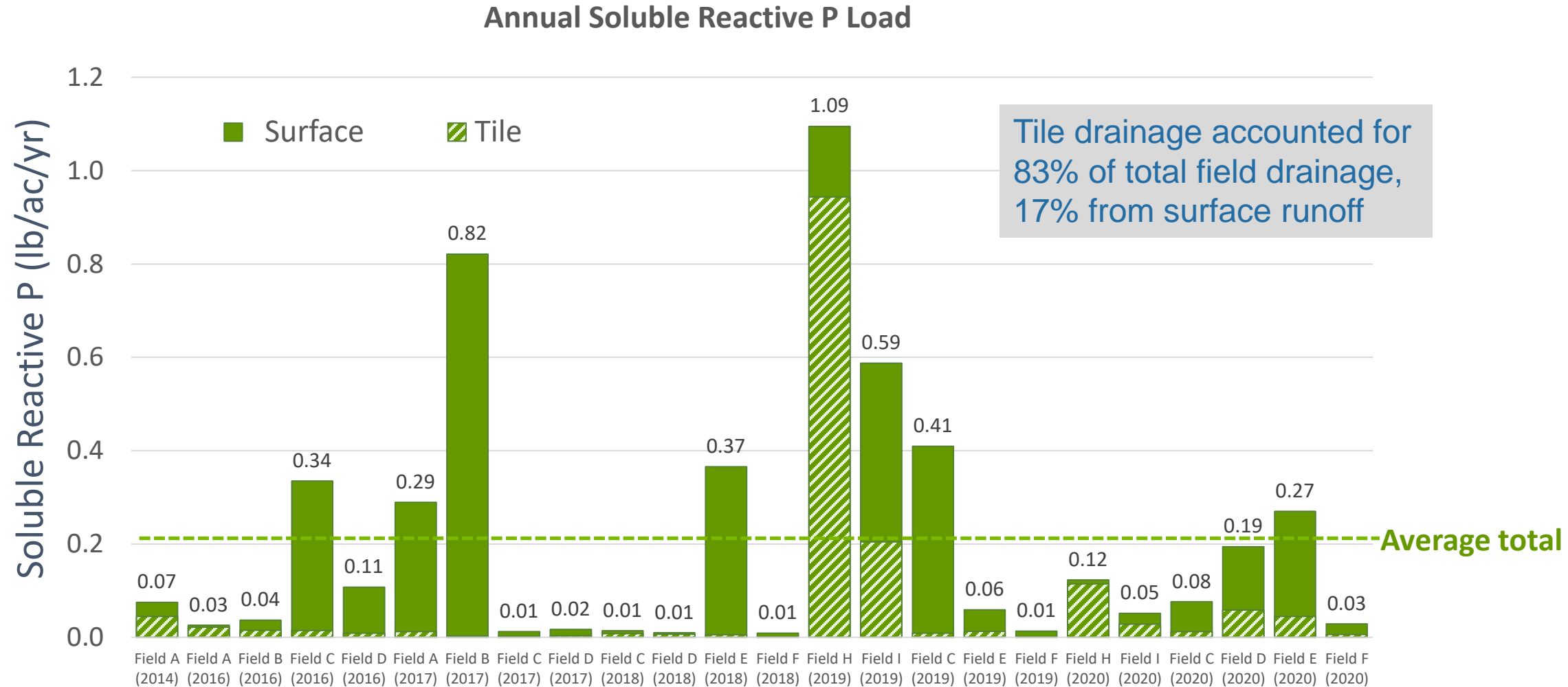
- 500 milking Holstein cows
- 1450 acres of cropland
  - alfalfa-grass/corn rotation

# Sample Concentrations (event composite samples) 2016-2020

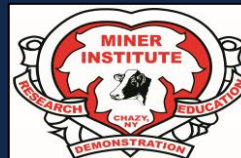
6 corn silage fields, annual manure applications, tillage  
240 surface runoff samples & 1102 tile drainage samples



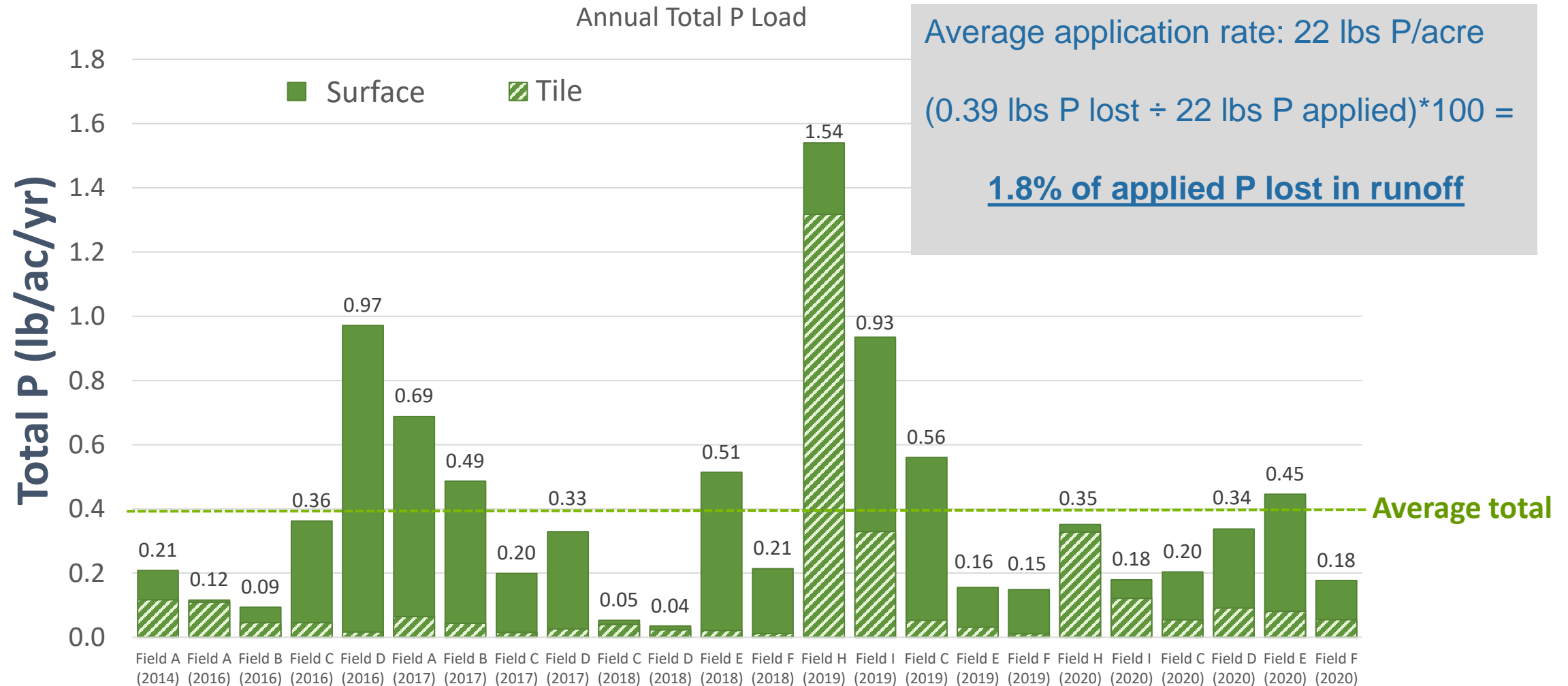
# Annual P Losses by Runoff Pathway (2014-2020)



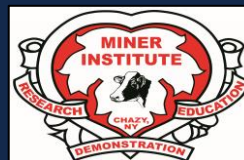
**Averages (mean): Tile = 0.07; Surface = 0.14; Total = 0.21 lb/acre/yr**



# Annual P Losses by Runoff Pathway (2014-2020)

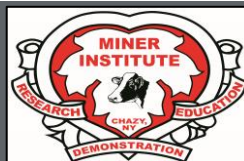
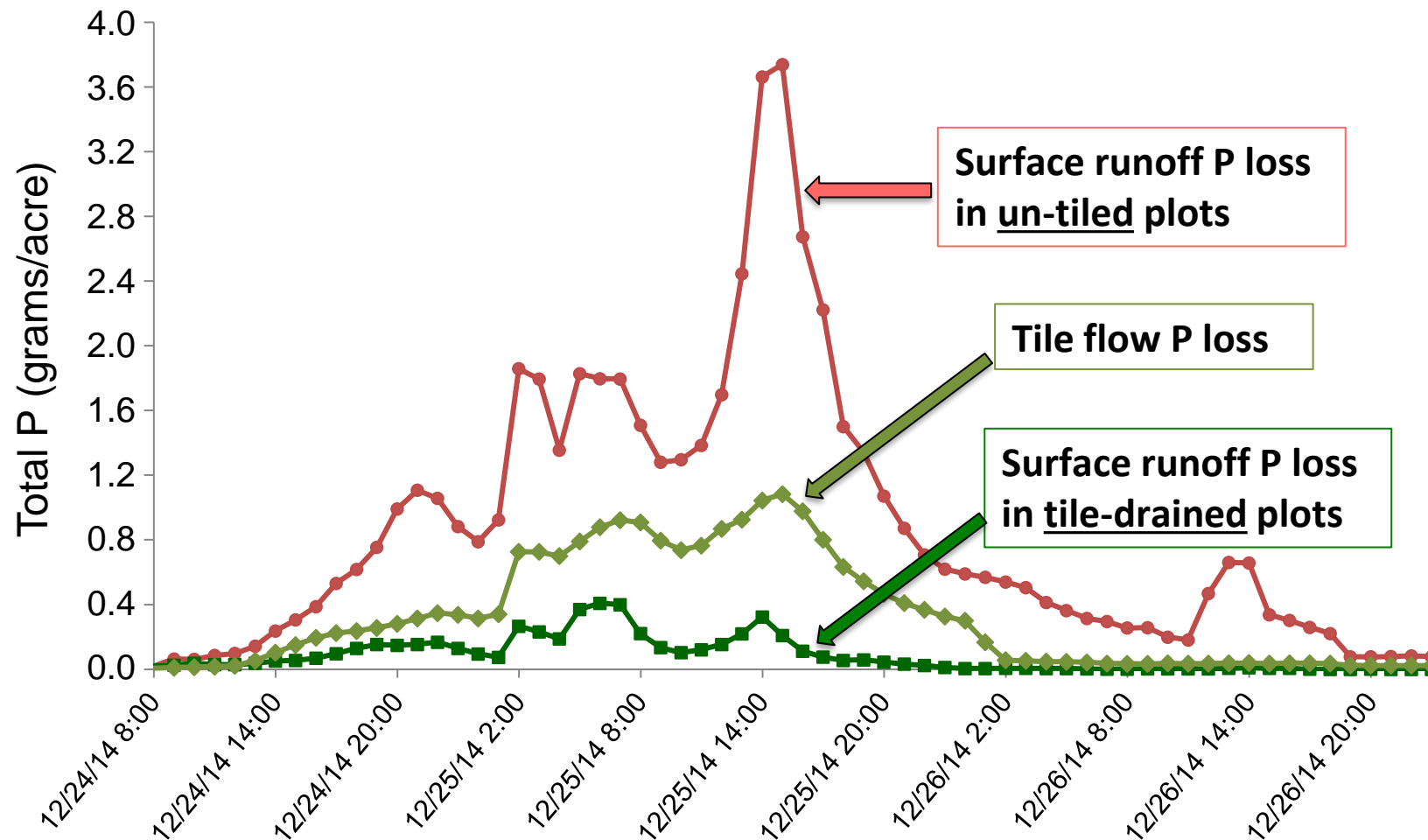


**Averages (mean): Tile = 0.13; Surface = 0.26; Total = 0.39 lb/acre/yr**



- 0.25-acre research corn plots
- 2 tile-drained, 2 un-tiled
- Surface runoff sampled from all, tile flows sampled in drained plots
- Hourly samples
- Manure applied 1 month prior
- 86% decrease in surface runoff in tiled plots
- 67% more total flow from tiled plots (tile was 91% of flow)
- Tiled plot loss = **0.06 lb/acre**
- Un-tiled plot loss = **0.12 lb/acre**

## Tiled vs. Un-tiled Plots: Snowmelt Runoff Event



# Take-home Messages

- Majority of P loss occurring in surface runoff due to higher P concentrations
- Losses overall represent very small fraction of applied P
- Majority of P loss occurs during a very short window of time (often during nongrowing season: snowmelt/large storms when limited time between application and runoff)
- Must pay attention to known risk factors (surface runoff & tile drainage):
  - Surface-applied manure w/ no incorporation
  - Manure application timing relative to weather events
  - High levels of P already in the soil (legacy P)
  - *Tiles only*: Macropores (heavier clay soils, no-till)
- Current projects: impacts of controlled tile drainage (complete in spring 2022), no-till (in-progress)
- Future goals: cover crops, manure injection (corn and grass)



**Questions?**  
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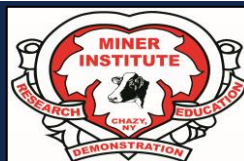
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Natural Resources Conservation Service



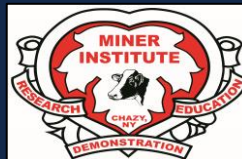
# Surface Runoff Sampling and Analysis



- Earthen berms around perimeter of field
- Surrounded by ditches to exclude outside water
- All surface runoff routed to single outlet at field edge

Pre-calibrated fiberglass H-flume  
Water height = flow rate

- ❖ Flow-proportional composite sampling: 5 acre field = sample/3,200 gal of flow (640 gal for every acre)
- ❖ Miner Institute laboratory analysis: Soluble reactive P (SRP), total P, nitrate, ammonium, total N, total suspended solids (TSS; aka sediment)



# Surface Runoff Sampling and Analysis



Autosampler



16-L sample container

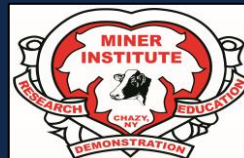


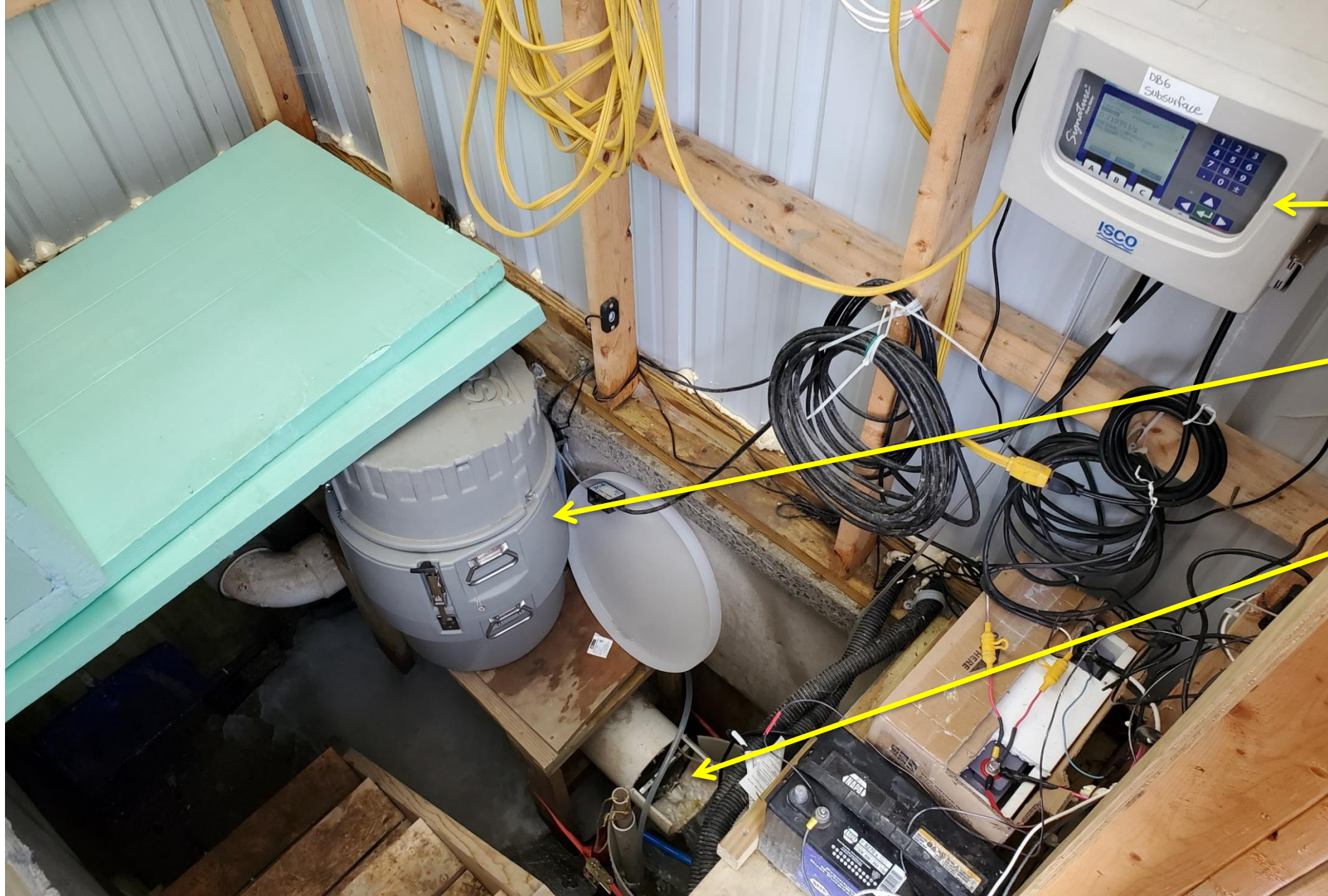
Ultrasonic water level sensor

Flow module (data interface, storage)

Sample intake line

- ❖ Flow-proportional composite sampling: 5 acre field = sample/3,200 gal of flow
- ❖ Miner Institute laboratory analysis: Soluble reactive P (SRP), total P, nitrate, ammonium, total N, total suspended solids (TSS; aka sediment)





Flow meter

Autosampler

Tile outlet

- ❖ Flow-proportional composite sampling: 5 acre field = sample/3,200 gal of flow
- ❖ Miner Institute laboratory analysis: Soluble reactive P (SRP), total P, nitrate, ammonium, total N, total suspended solids (TSS: aka sediment)

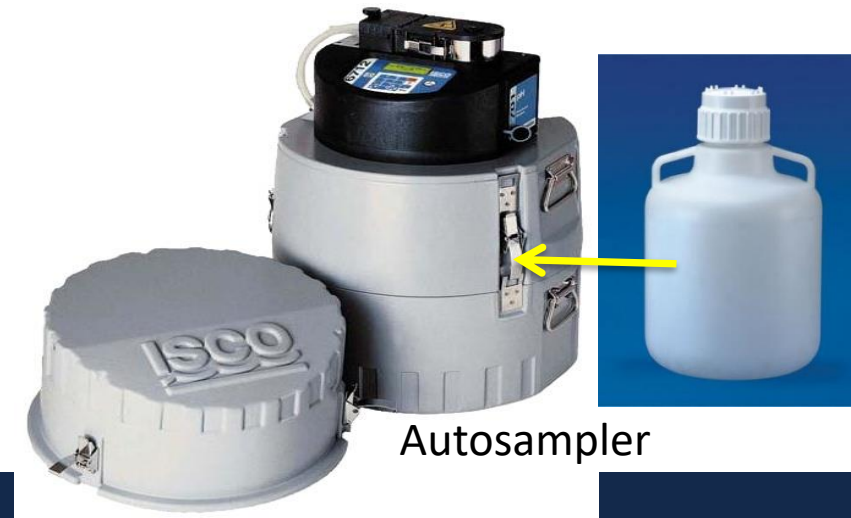


Bubbler tube:  
Resistance = flow

Thel-Mar Weir



Flow meter (data  
interface, storage)



Autosampler

