Agricultural Nutrient Transport and Current BMP's

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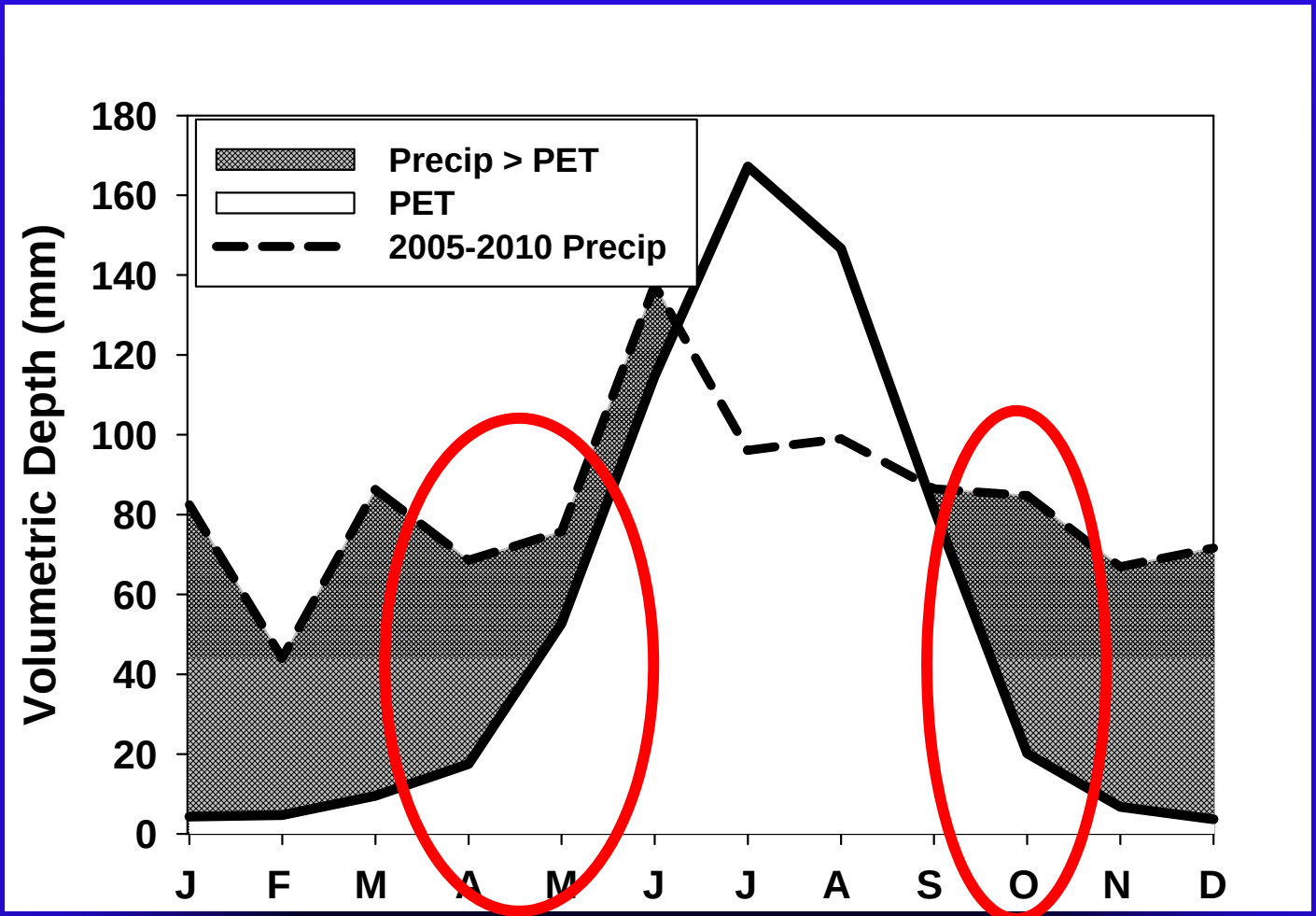


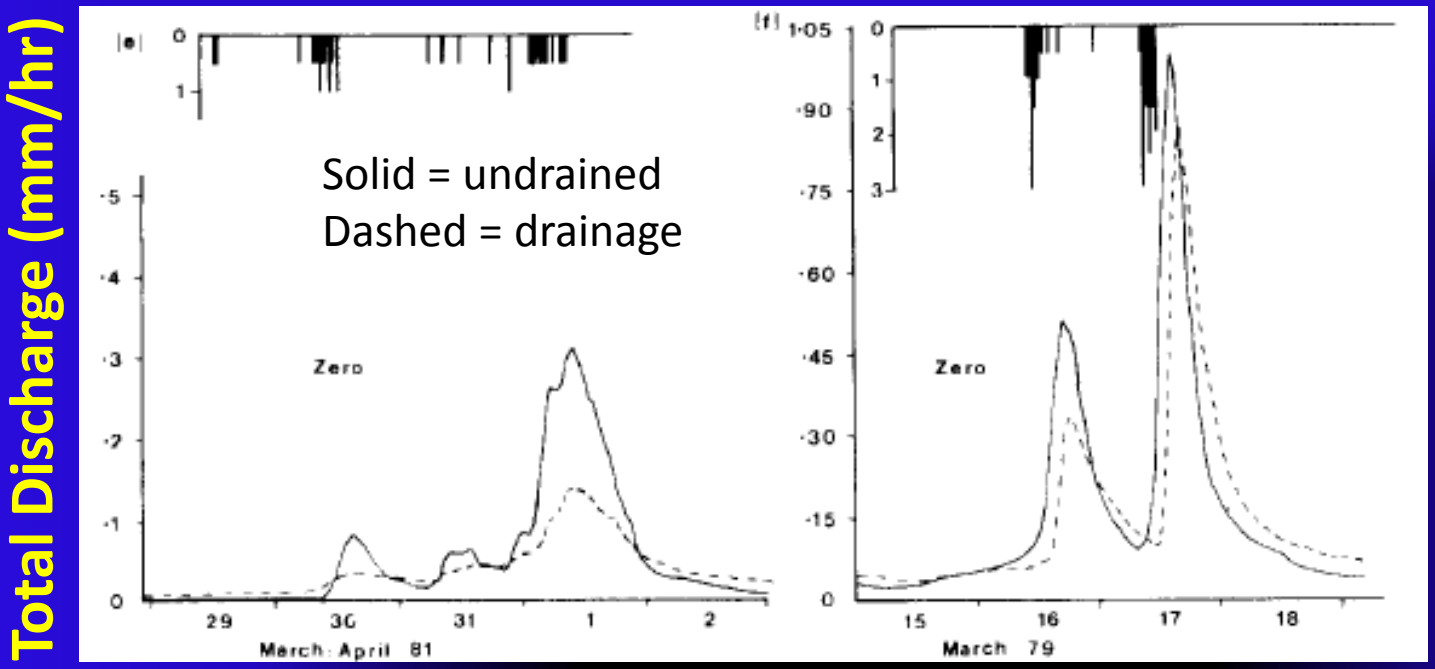
25% of cropland in US and Canada could not be farmed without tile drainage (Skaggs et al., 1994)

- soils with the greatest inherent production potential

Tile Drainage (Fausey et al., 1987):

- provides trafficable conditions for field operations
- promotes root development by preventing exposure of plants to excess water

Drainage vs No Drainage



(Robinson and Beven, 1983)

Sandusky, Ohio (Schwab et al., 1963)

Discharge from replicated 0.23 ha plots, Toledo silty clay (March to September)

Surface drained only (81 mm)

Surface and subsurface (88 mm)

Watershed Scale Assessment

Objective: Quantify contribution of tile drainage to watershed hydrology and water quality.

Location: Upper Big Walnut Creek watershed, central Ohio

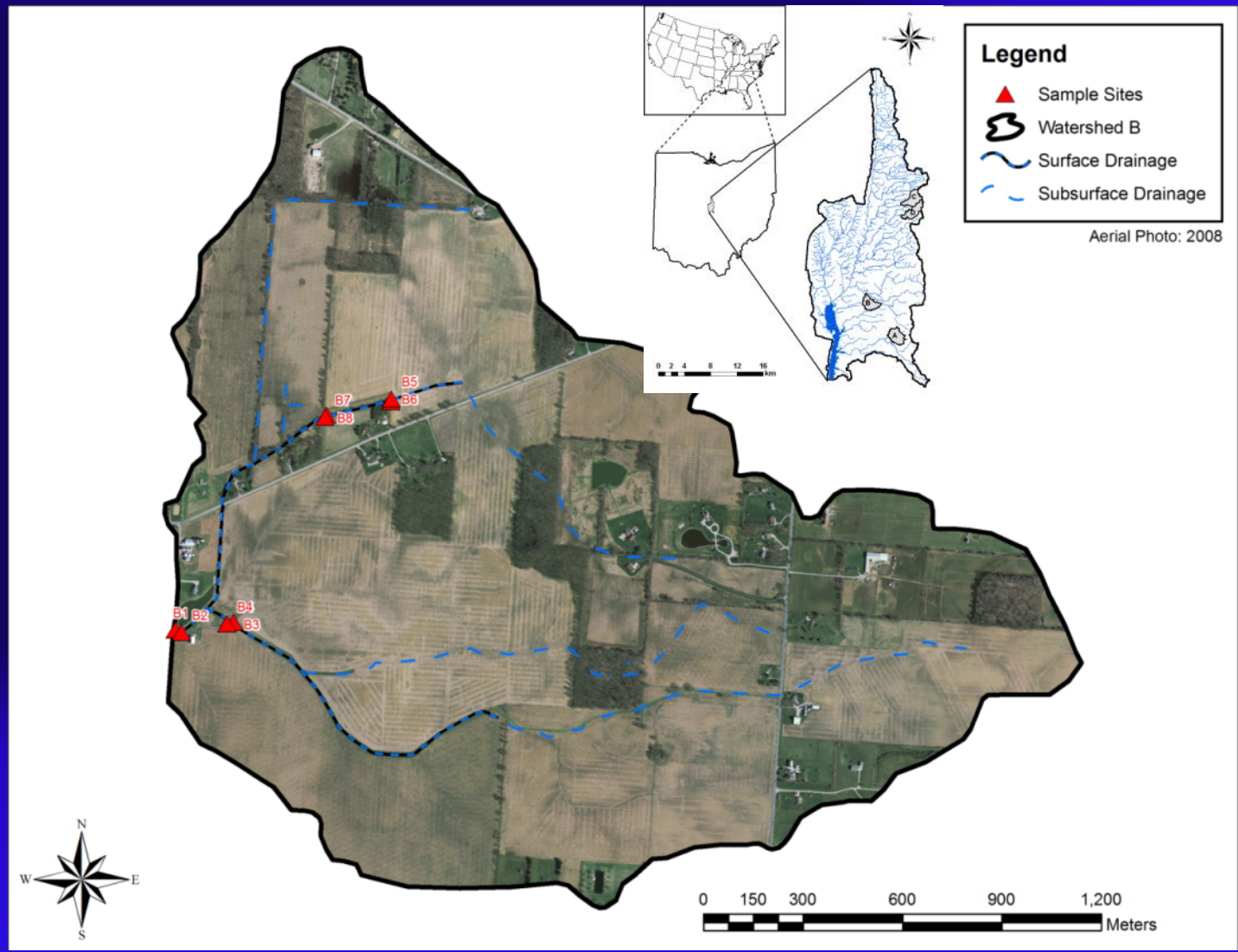
Drainage area: 389 ha

Soils: Bennington silt loam (52.9%); Pewamo clay loam (46.2%)

Land use: 73% ag, 6% woods, 21% farmstead

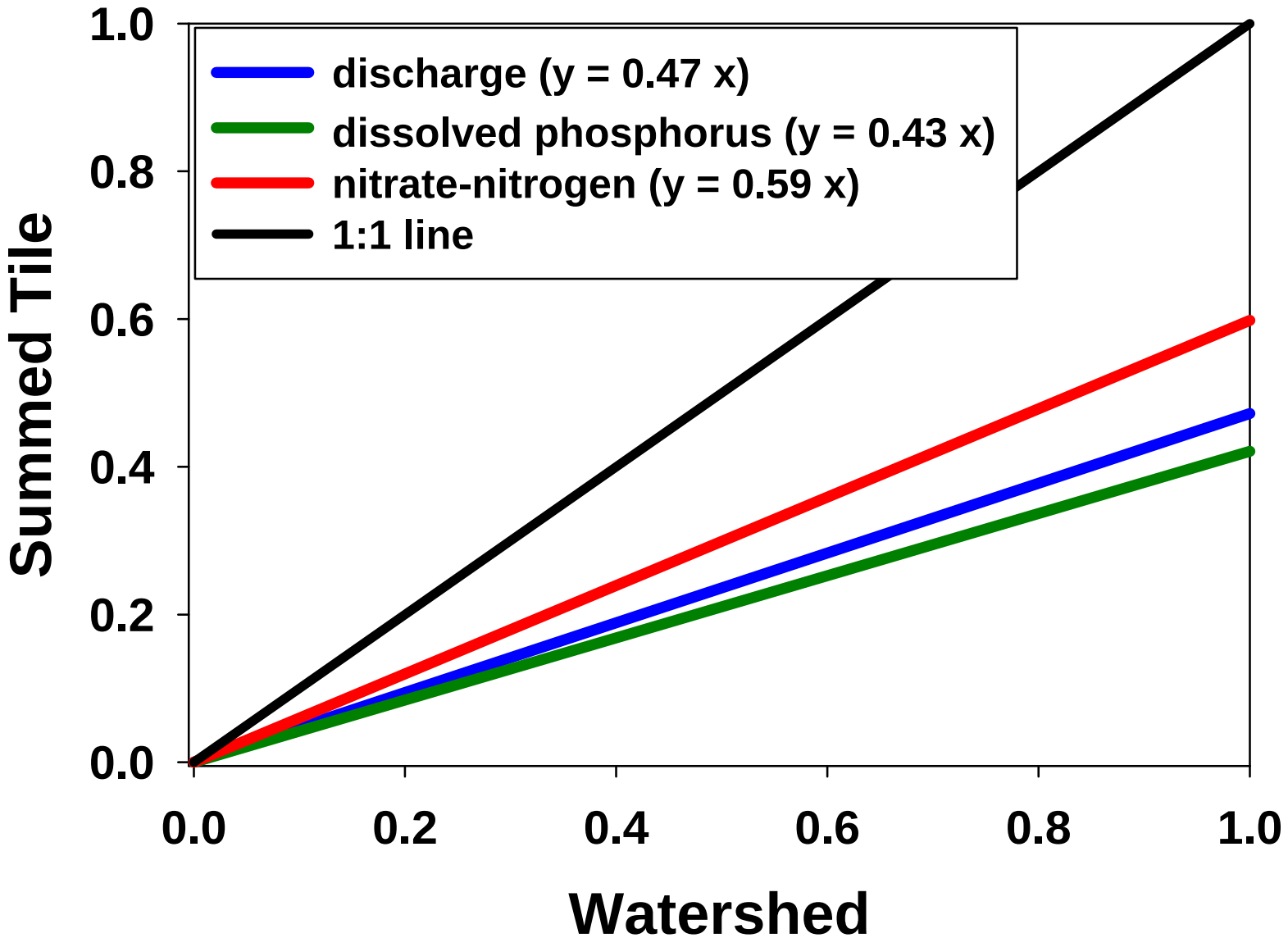
Cropping: C-S w/ rot. tillage

Drainage: 80% systematically tile drained



Sampling Methodology

- Flumes and weirs with automated sampling equipment
- Hydrology recorded on a 10 minute interval
- Samples taken every 6 hours and composited on a weekly basis



2005-2010 UBWC watershed

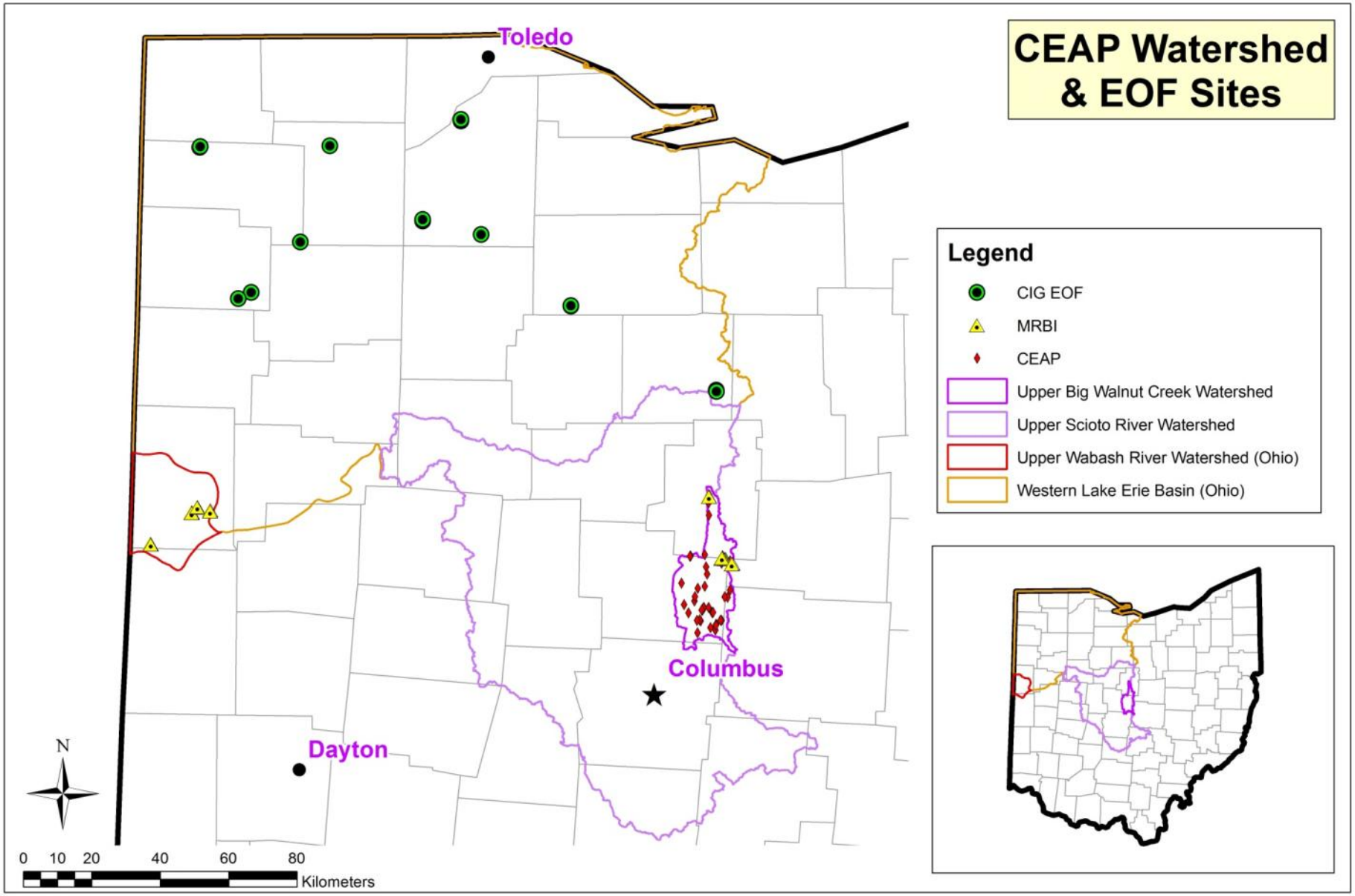
Edge-of-Field (EOF) Assessment

Objective:

1) Elucidate and quantify the surface and subsurface hydrology and water quality impacts of innovative conservation management practices
2) develop a suite of practices to address and mitigate offsite phosphorus delivery
3) Use edge-of-field data to enhance Ohio P-index and other quantitative models

Approach:

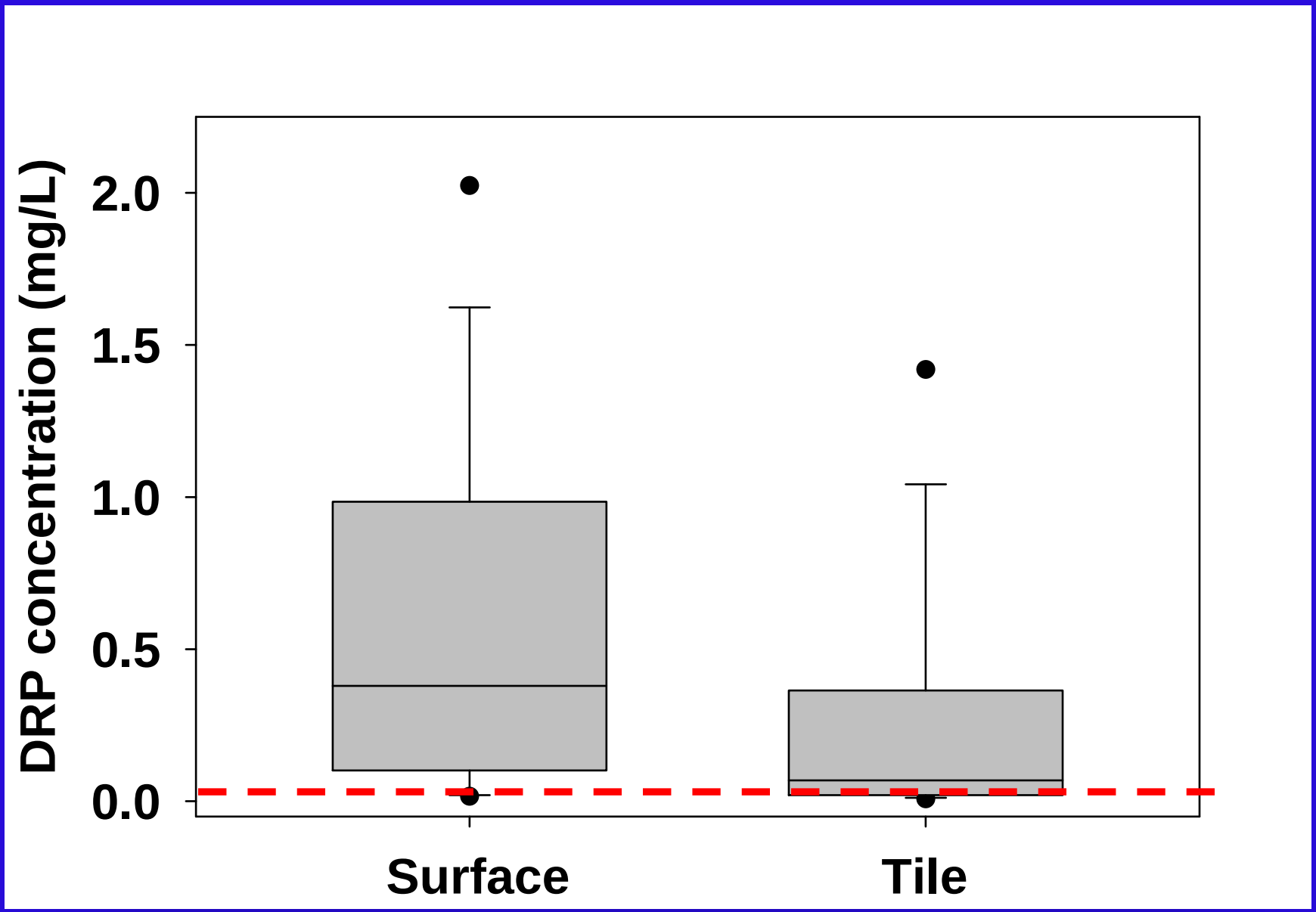
- Before/After Control Impact Design
- 32 fields (16 pair) representative of Ohio crop production agriculture (8 pair in WLEB, 4 pair in Upper Wabash, 4 pair in Upper Scioto)
  - Surface and subsurface combination when possible

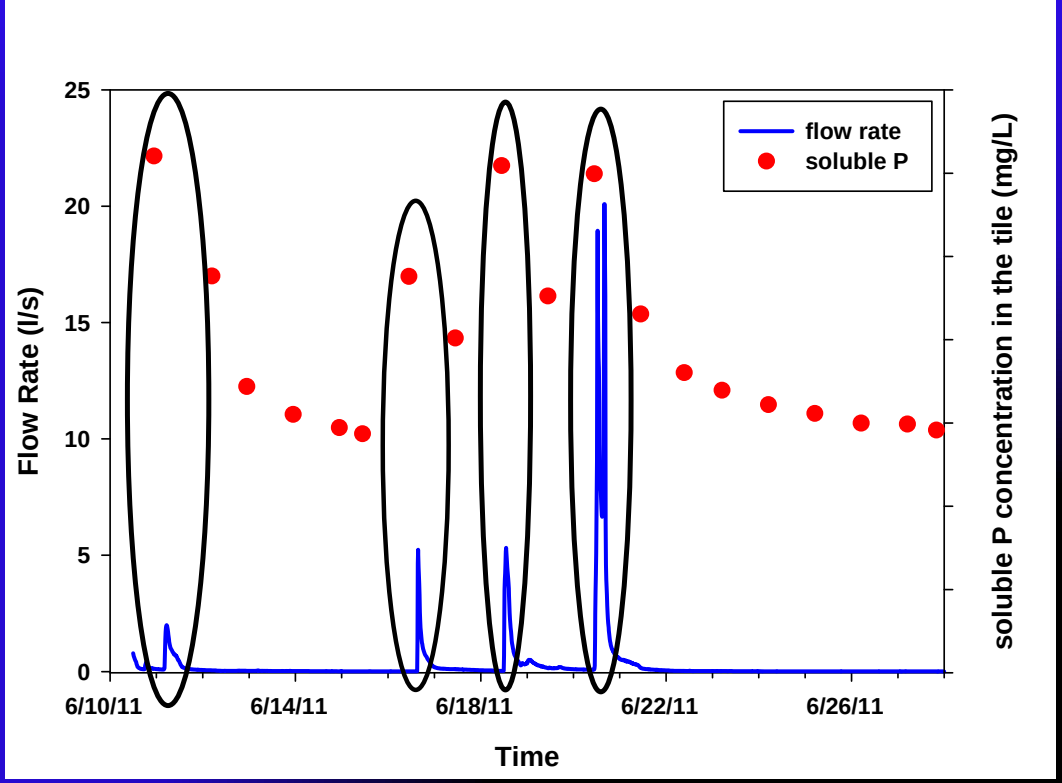

CEAP Watershed & EOF Sites
Toledo
Columbus
Dayton
N
0 10 20 40 60 80
Kilometers
Legend
CIG EOF
MRBI
CEAP
Upper Big Walnut Creek Watershed
Upper Scioto River Watershed
Upper Wabash River Watershed (Ohio)
Western Lake Erie Basin (Ohio)

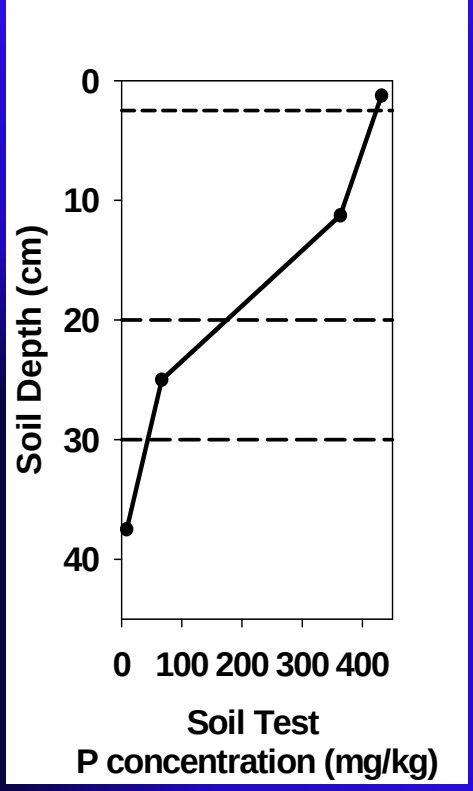






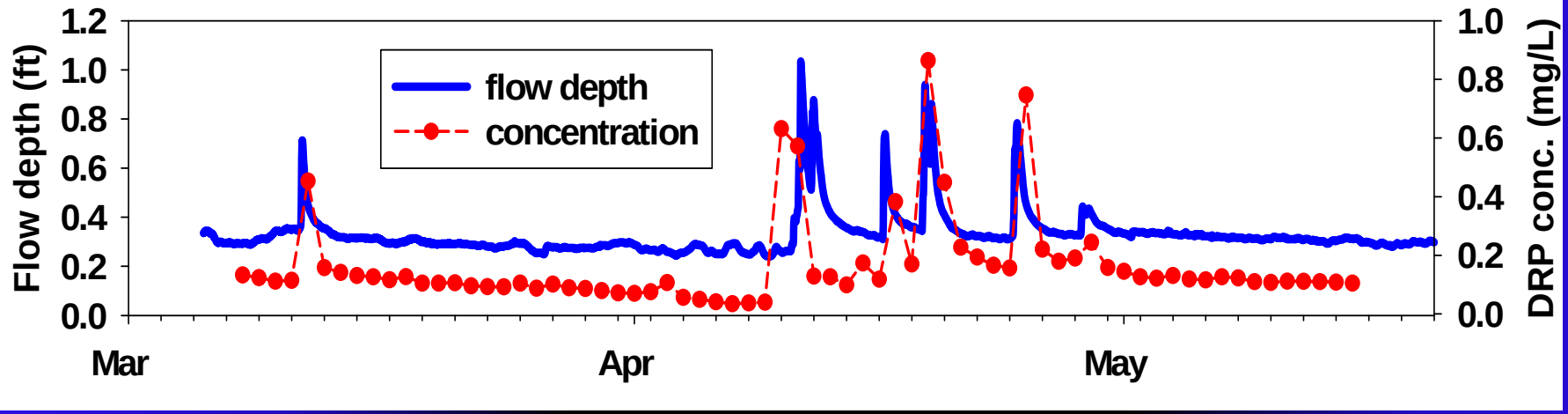


DRP concentration (mg/L)
2.0
1.5
1.0
0.5
0.0
Surface
Tile





Chemograph of soluble P concentration in tile flow and graph of Mehlich 3 STP from the same field

Positive correlation between peaks in concentrations and tile discharge indicate fast flow processes (preferential flow) and connection to surface sources



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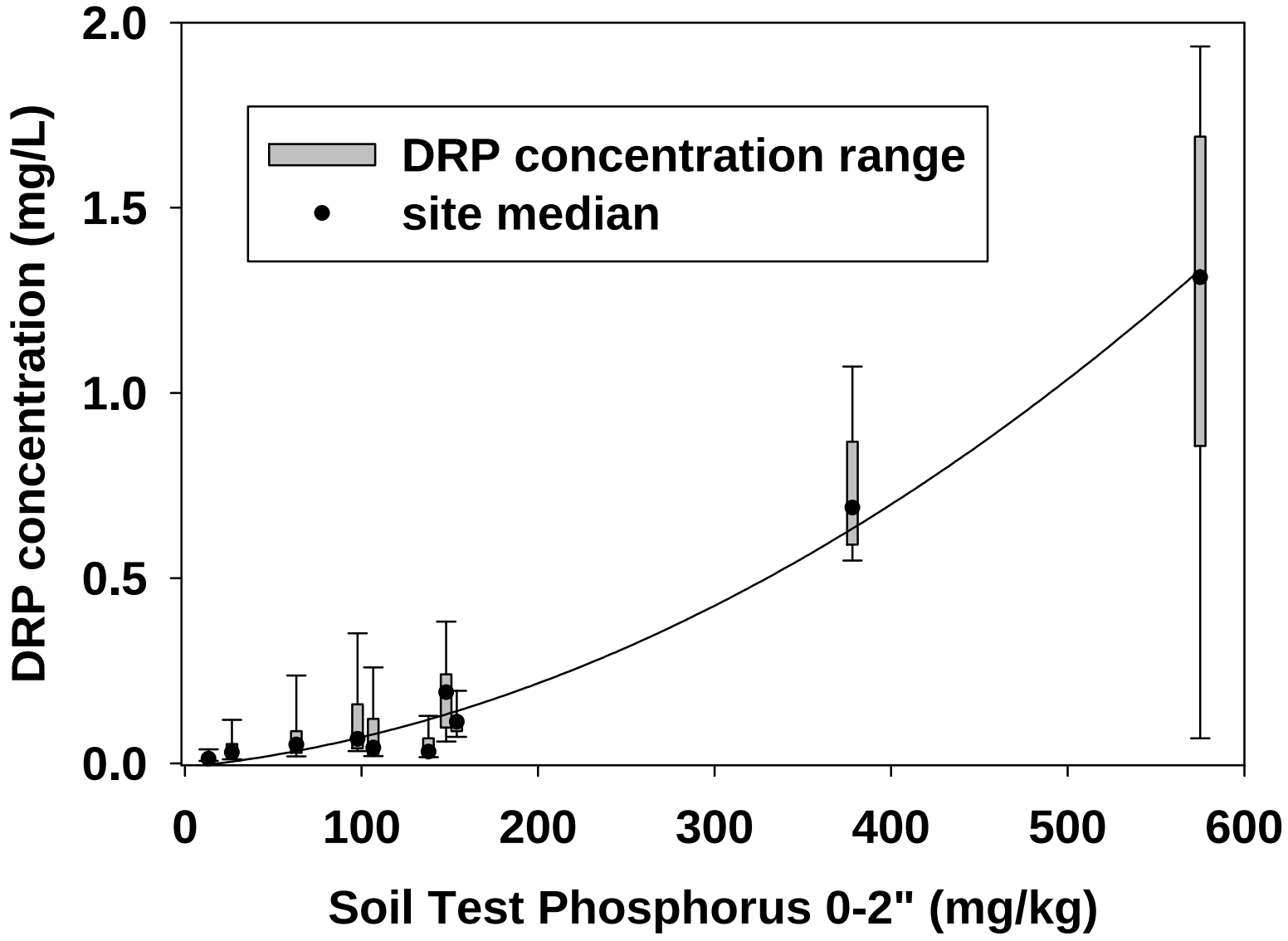
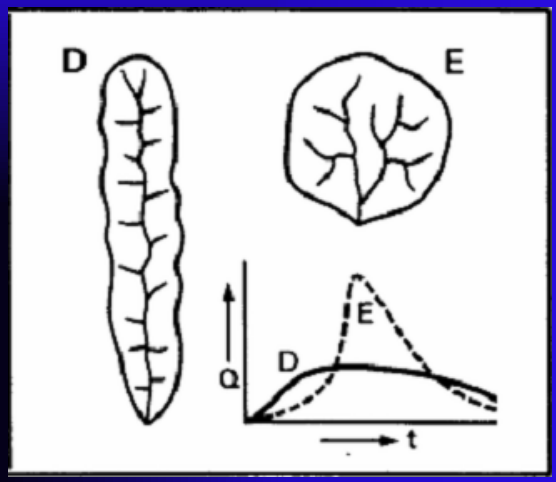


Relationship between soil test phosphorus and dissolved phosphorus concentration in tile discharge (UBWC and Upper Wabash watersheds)

BMPs and Mitigation Strategies

What Determines Watershed Condition and Response?
How Do We Measure and Monitor?
How Do Watersheds Function to Transport and Process Pollutants?

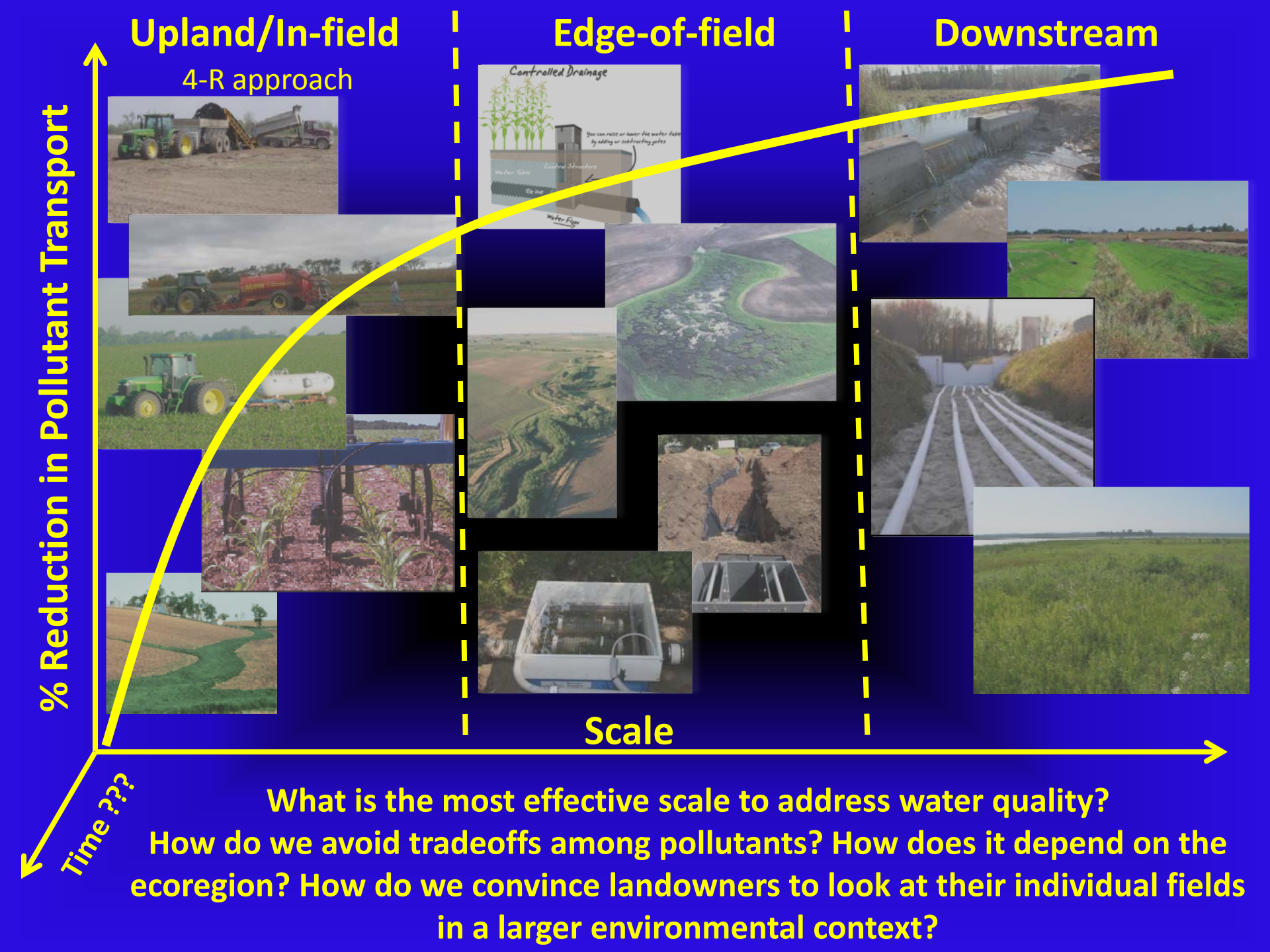


Uniqueness

- Landscape and geomorphology (drainage density, shape factors)
- Management
- Soils and geological deposits
- Climate
- Hydrologic alteration (drainage, impoundments)

Complexity

- Lag time
- Seasonality
- Land use change
- Riparian function and processes
- Interacting cycles of water, carbon, and nutrients


Upland/In-field
4-R approach
Edge-of-field
Controlled Drainage
Downstream
% Reduction in Pollutant Transport
Scale
Time ???
What is the most effective scale to address water quality?
How do we avoid tradeoffs among pollutants? How does it depend on the ecoregion? How do we convince landowners to look at their individual fields in a larger environmental context?

Strategies for Addressing Agricultural Induced Phosphorus Transport

Upland Management
- 4Rs
- Interruption of connection to surface

Structural Hydrologic Control
- Drainage water management
- blind inlets

Filtration
- End-of-tile and in-stream
- Enhanced bioreactors

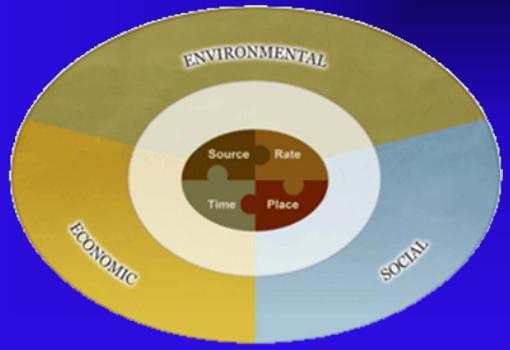
Edge-of-field
- Buffers
- wetlands

Ditch Design and Management
- Two stage, natural, and over-wide ditches
- Dredging
- Vegetated channels

Upland Management (4 Rs)

Potential Practices to Investigate

- Cover crops
- Banding vs broadcast
- Spring vs fall vs split application
- Incorporation (shallow vs deep injection
- Tillage vs no-till
- Tri state recommendation vs reduced rate
- Manure vs commercial fertilizers
- Controlled traffic and variable rate application
- Surface amendments (gypsum)
- Other (innovative ideas)



Why did it happen? What has changed?

- Change in weather patterns (amounts, intensity, timing) ?
- Increase in tile density (more surface connection/ macropores) ?
- Change in tillage approach (macropores) ?
- Herbicide monoculture (glyphosate) ?
- Less small grains in rotation ?
- GMOs ?
- Change in soil biology ?