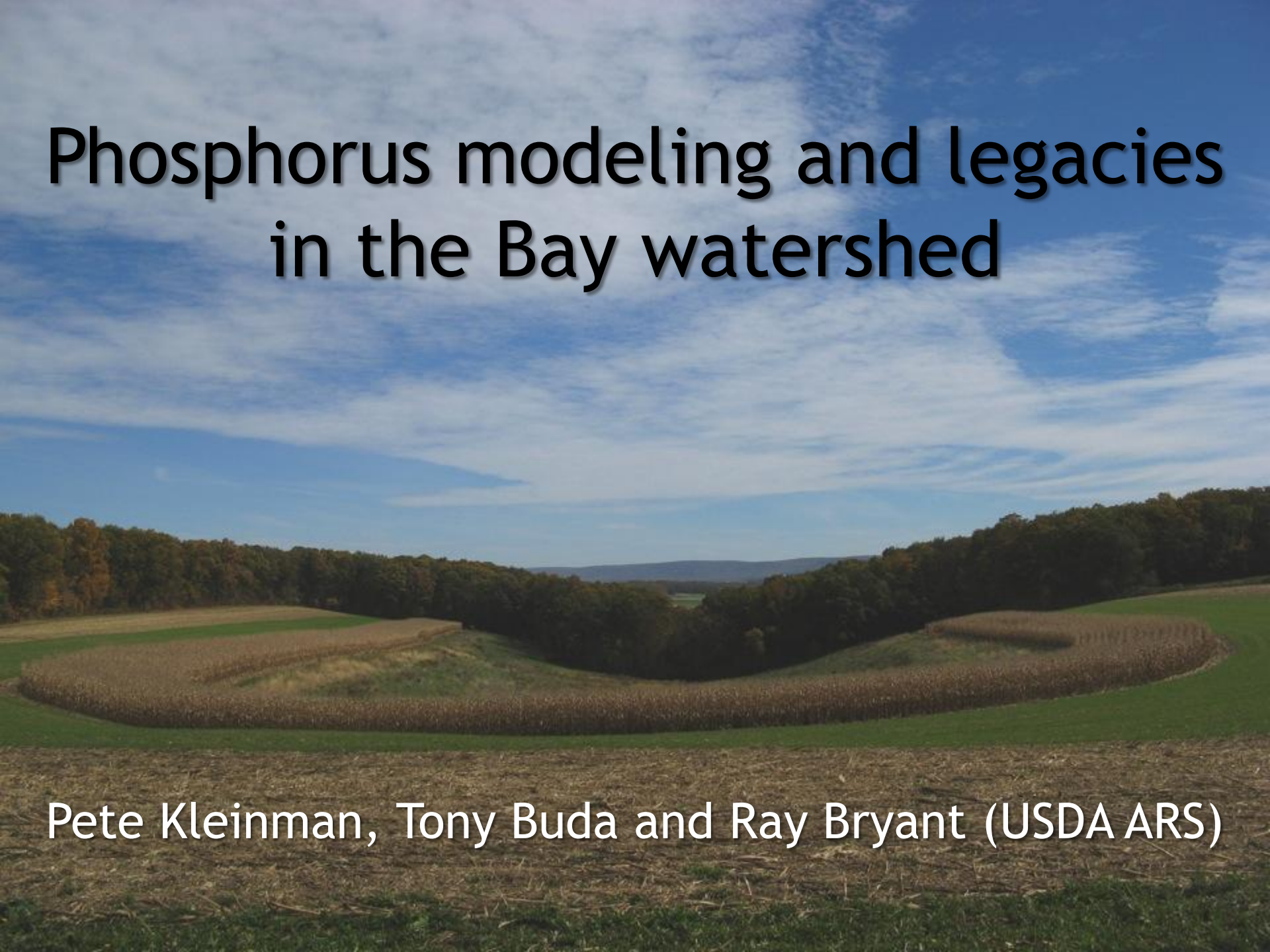
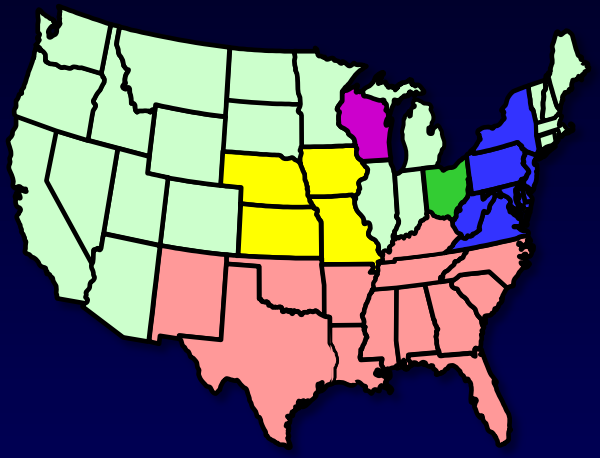
Phosphorus modeling and legacies in the Bay watershed



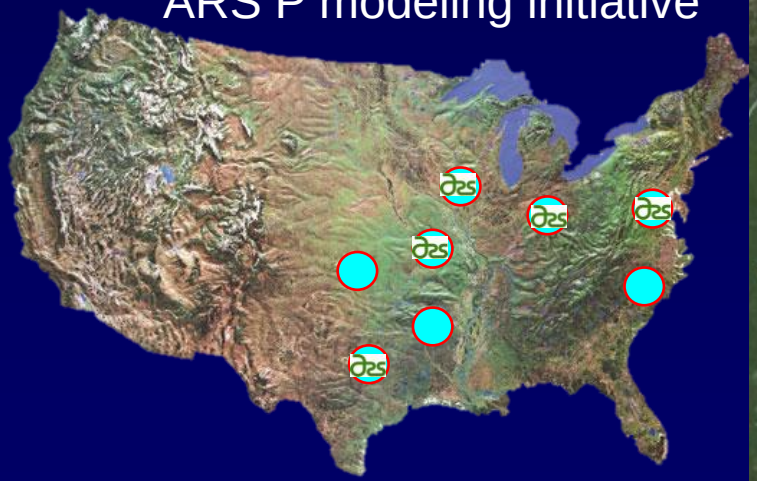
Pete Kleinman, Tony Buda and Ray Bryant (USDA ARS)

Responding to the revised NRCS nutrient management standard: Validating and refining the P Index

2012 NRCS Conservation Innovation Grants

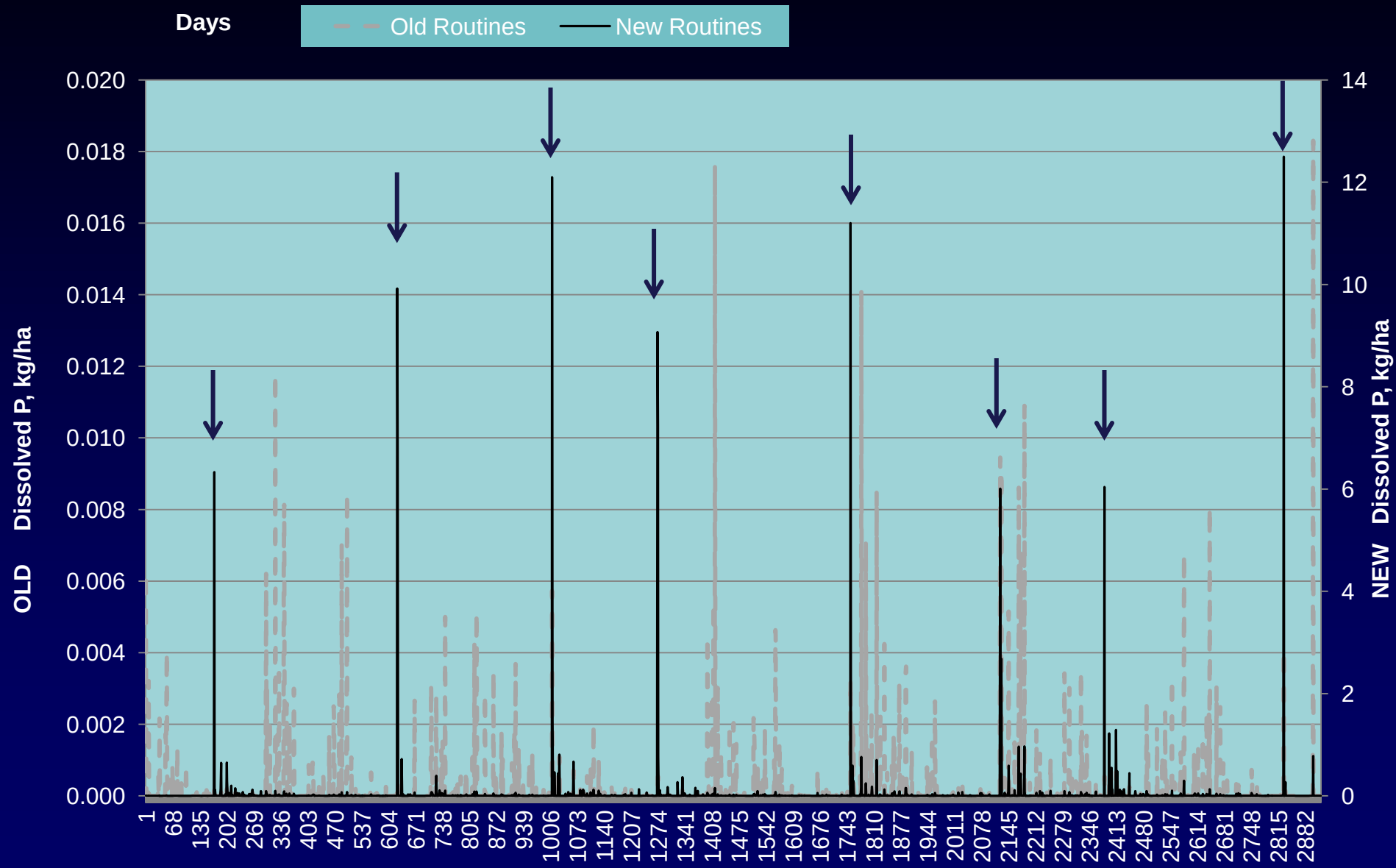


ARS P modeling initiative



PHYSIOGRAPHIC CONSITENCY
- IN VALIDATON
- IN P INDICES
- IN OUTCOMES

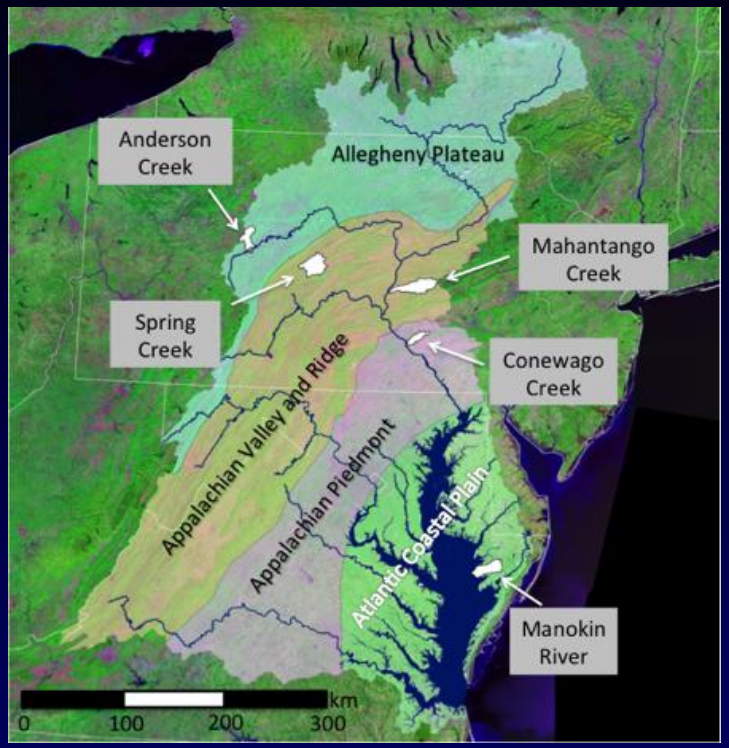
Changes to P routine in SWAT

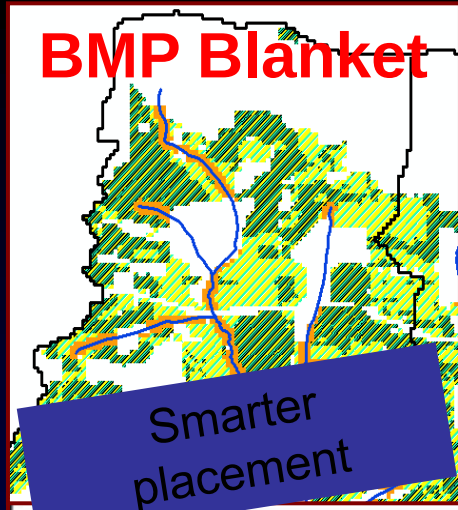


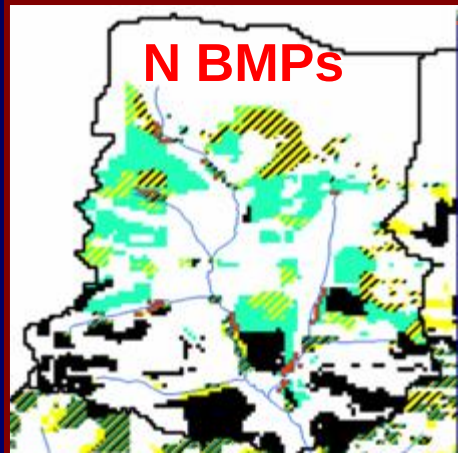
APLE run on a daily time step (from Vadas and White, USDA-ARS)

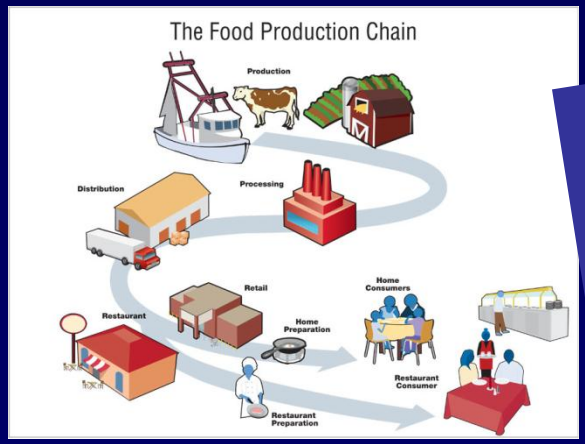
Center for Nutrient Solutions

USEPA funded









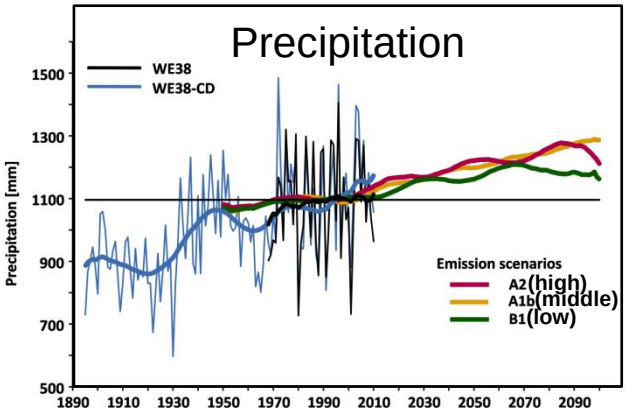
Overcoming market barriers to nutrient cycling

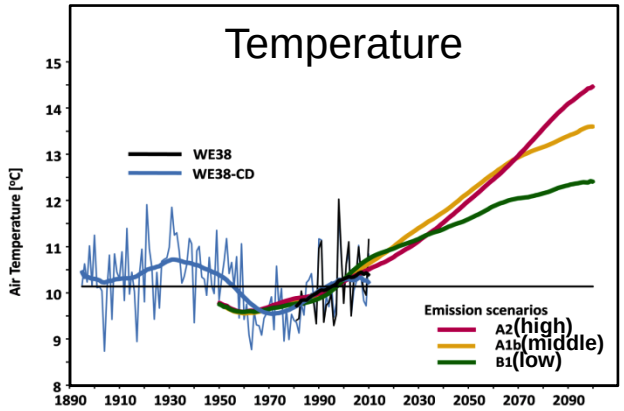
Courtesy Veith, USDA

USDA-ARS multi-location project :

Impacts of climate change on US agro-ecosystems

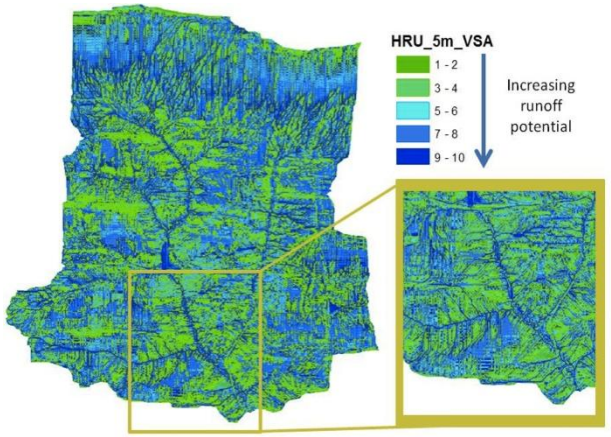
Phase 1: Detecting past trends in climate, hydrology and water quality



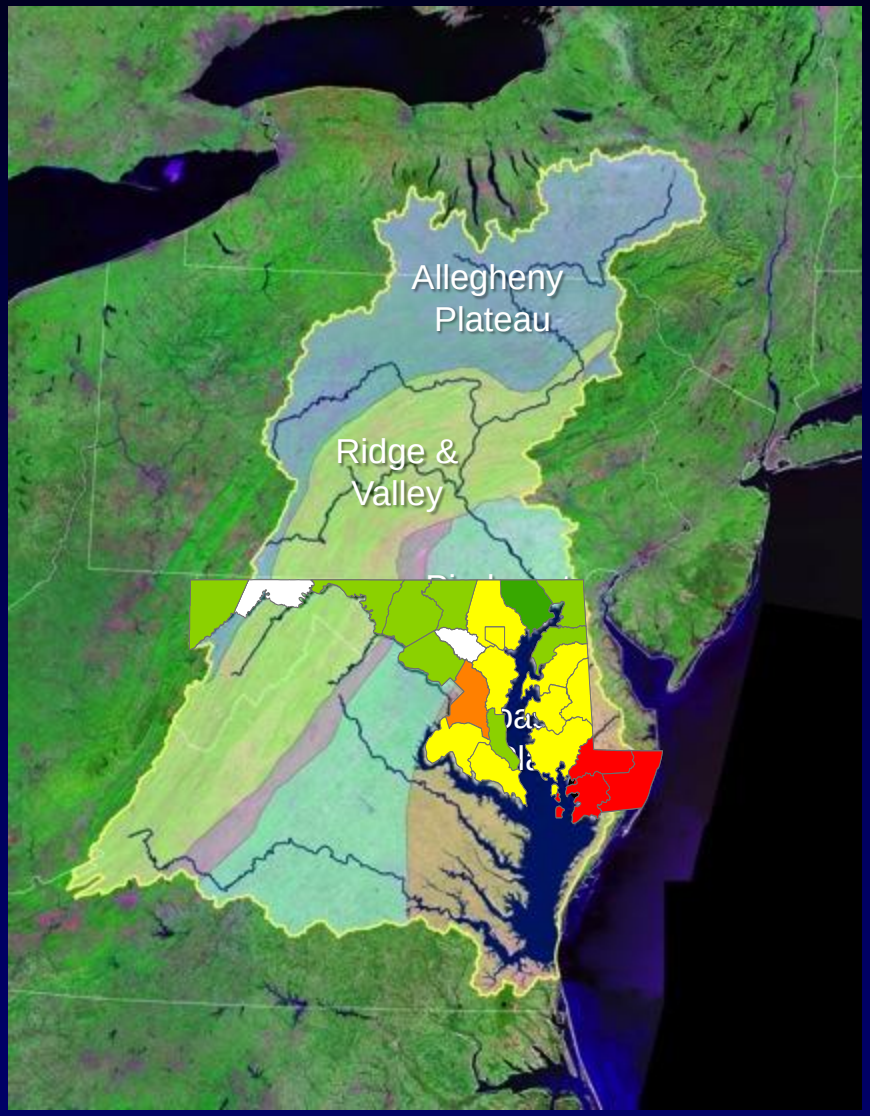


Garbrecht et al. (2013)

Phase 2: Modeling climate change impacts on hydrology and water quality



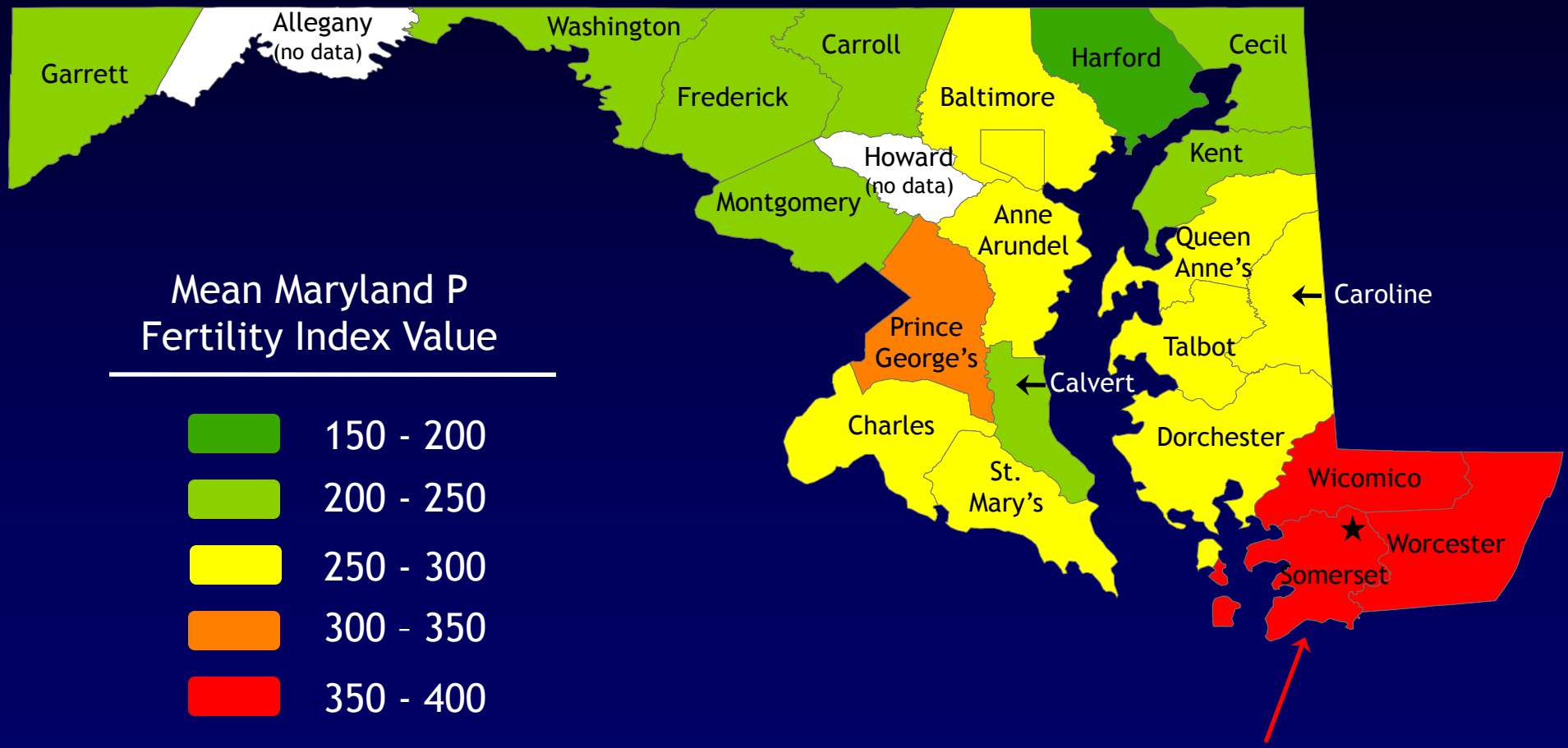
Living with legacy phosphorus: The “somewhat obvious” scenario



UMES Research Farm
Princess Anne, MD

Soil test P summary

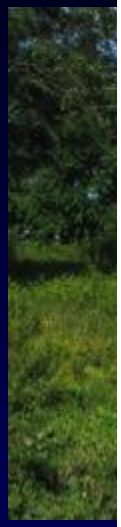
Restricted to fields where the Maryland P Index was run (FIV > 150 only)



Courtesy J. McGrath, Univ. Maryland

Manokin River Watershed

Manokin River Watershed



PENNSTATE

1855

(814) 863-0841 Fax (814) 863-4540
Agricultural Analytical Services Laboratory
The Pennsylvania State University
University Park PA 16802
http://www.aasl.psu.edu

SOIL TEST REPORT FOR:	ADDITIONAL COPY TO:
LOU SAPORITO USDA-ARS 3702 CURTIN RD UNIVERSITY PARK PA 16802	11/24/03 UMBS Sampling

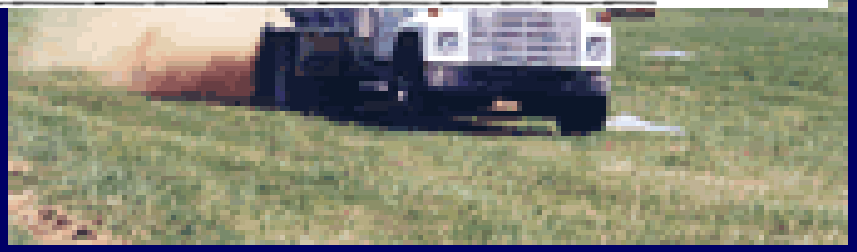
DATE	LAB #	SERIAL #	COUNTY	ACRES	ASCS ID	FIELD ID	SOIL
01/19/2004	S03-17635	113568	Centre			1 SIGMA	

SOIL NUTRIENT LEVELS			Below Optimum	Optimum	Above Optimum
[1]Soil pH	6.0				
[2]Phosphorus (P)	535	ppm			
[2]Potassium (K)	449	ppm			
[2]Magnesium (Mg)	187	ppm			

RECOMMENDATIONS: *(See back messages for important information)*

Limestone*: 3000 lb/A for a target pH of 6.5. **Magnesium (Mg):** NONE

**Calcium Carbonate equivalent*



Drainage ditch monitoring network

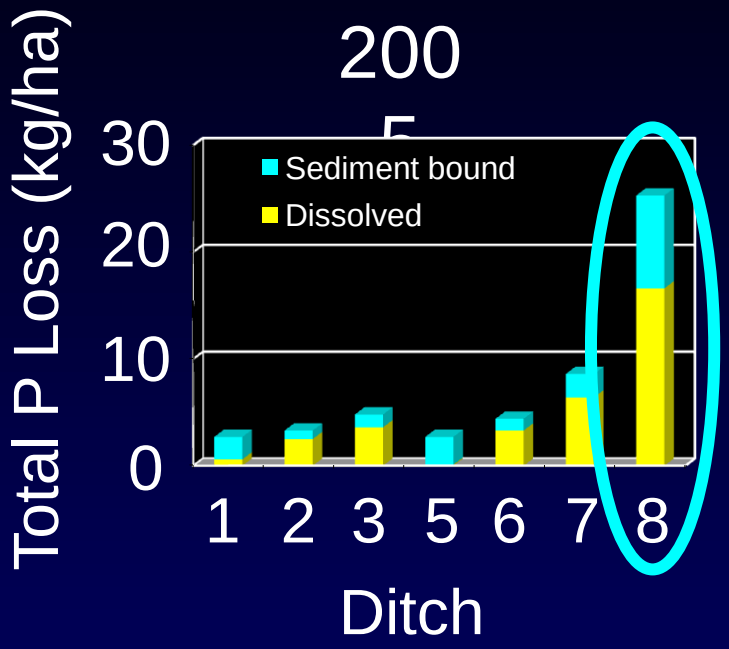
Field ditch
1 m deep
2 ha catchment

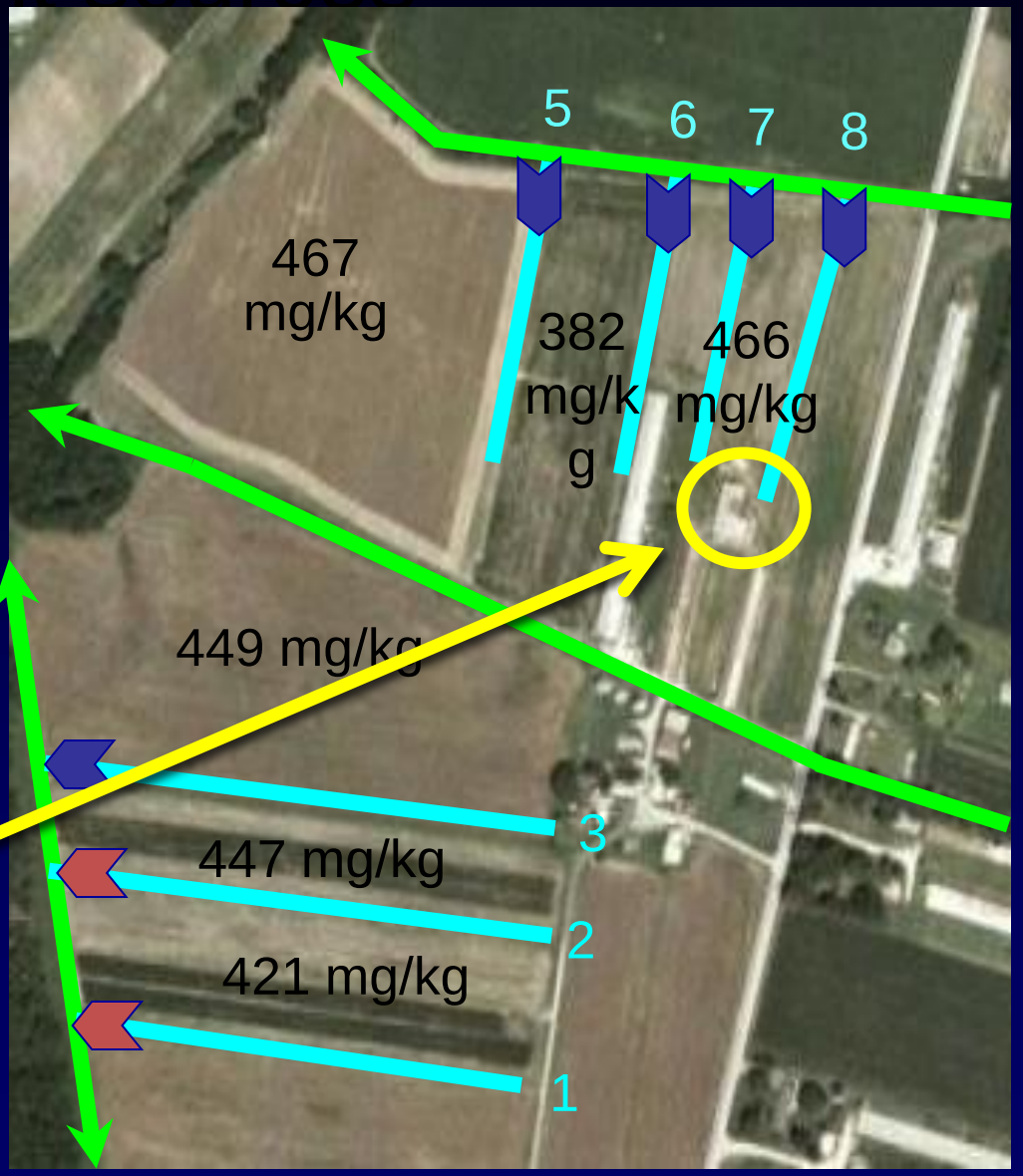
H Flume on
Field Ditch

Collection ditch
2.5 m deep
17 ha catchment

V-Notch Weir on
Public Drainage Association
Ditch

Point sources as a major concern



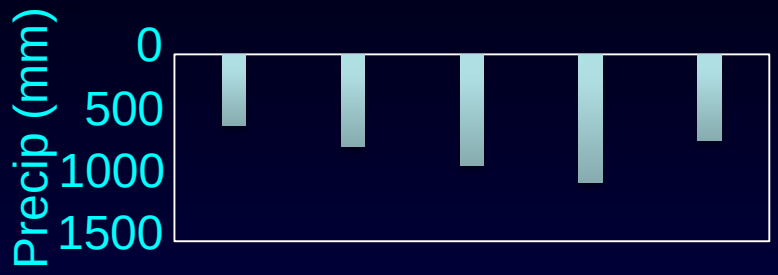


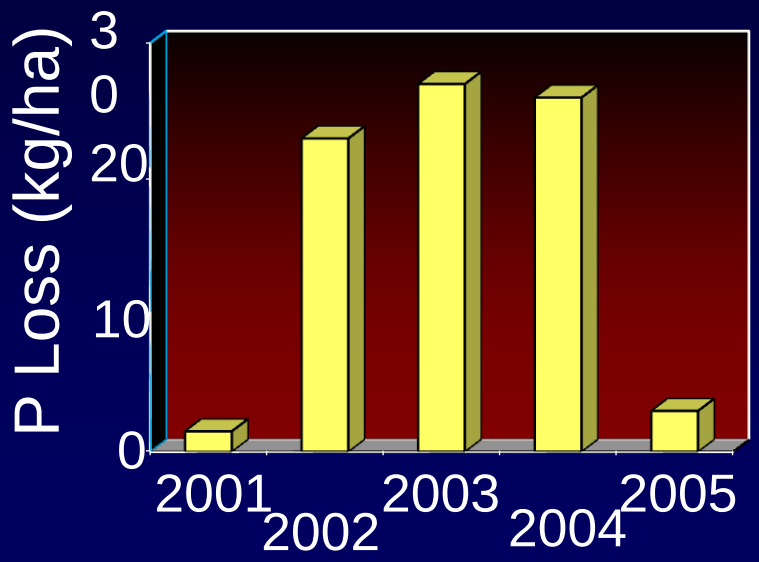
Kleinman et al., 2007 (J. Soil Water Conserv.)

Infrastructure maintenance

Drainage losses from non-point sources

Variability in flow determines annual load

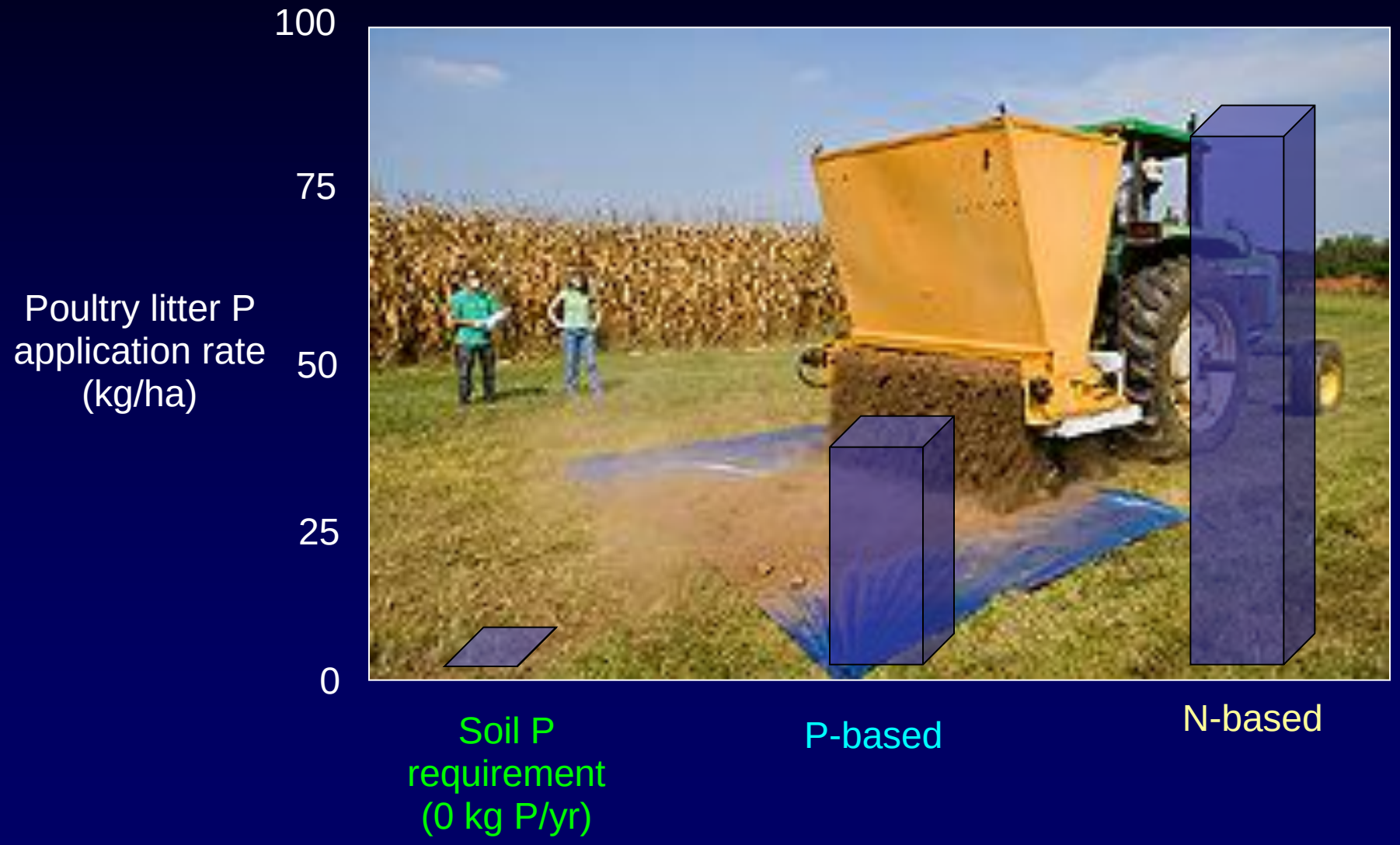




Kleinman et al., 2007 (J. Soil and Water Conserv.)

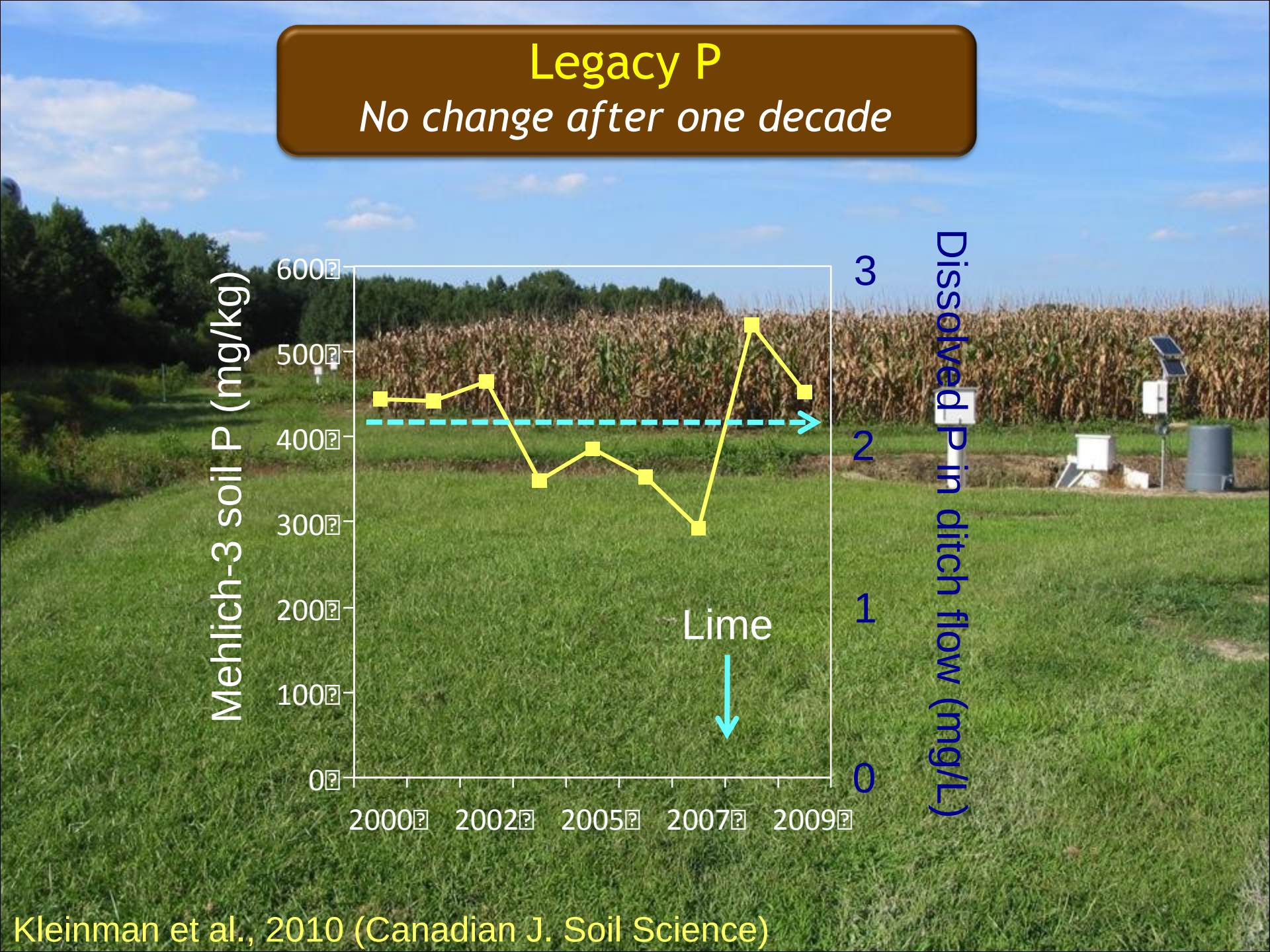
UMES draw-down study

how long to lower soil test P?



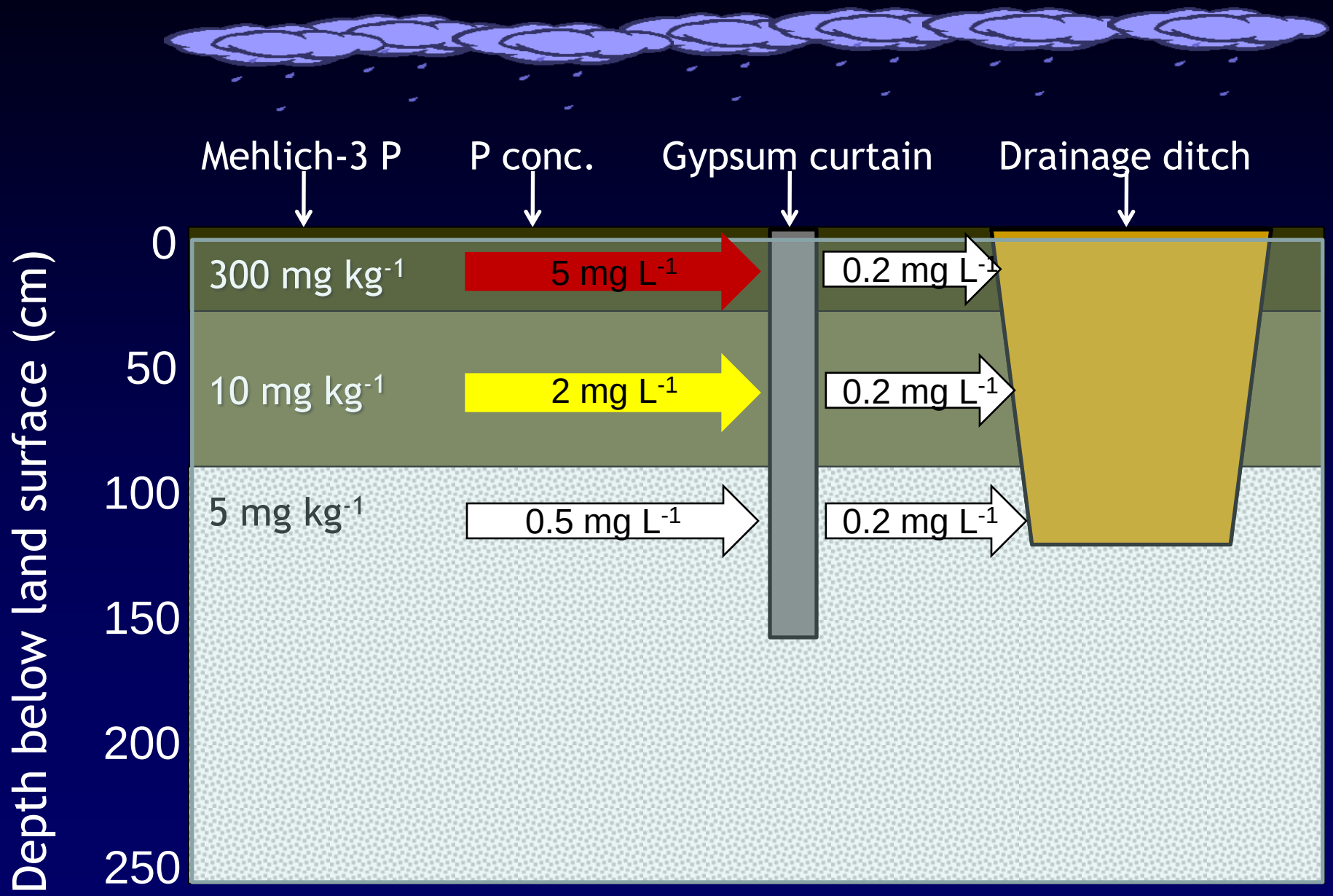
Legacy P

No change after one decade



Kleinman et al., 2010 (Canadian J. Soil Science)

Ray Bryant's gypsum curtains



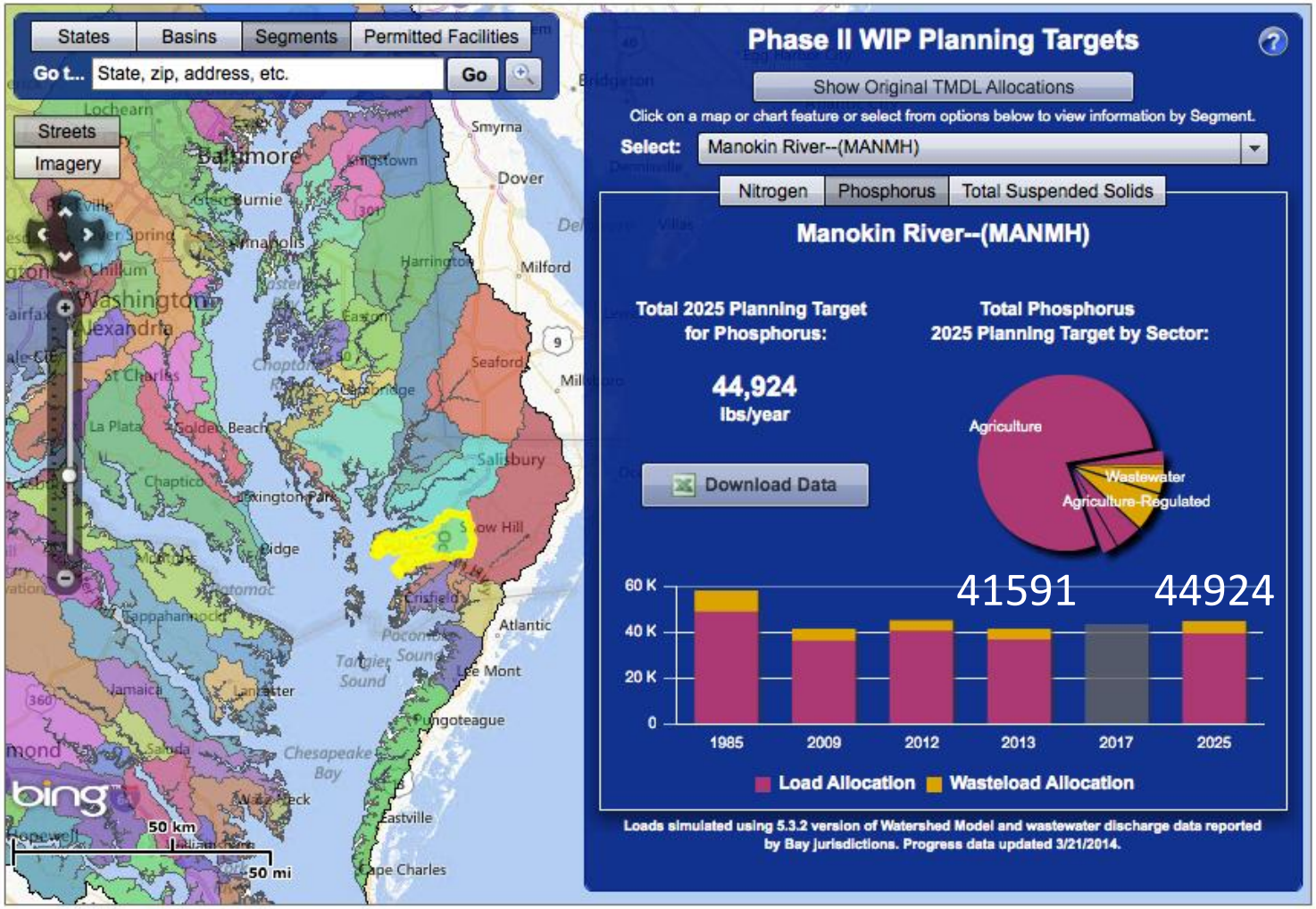
Ray Bryant's gypsum curtains

ChesapeakeStat.net, verified April 1, 2014

Overview | Agriculture | TMDL Tracking | BMP Review | 2009-2011 Milestones | 2012-2013 Milestones

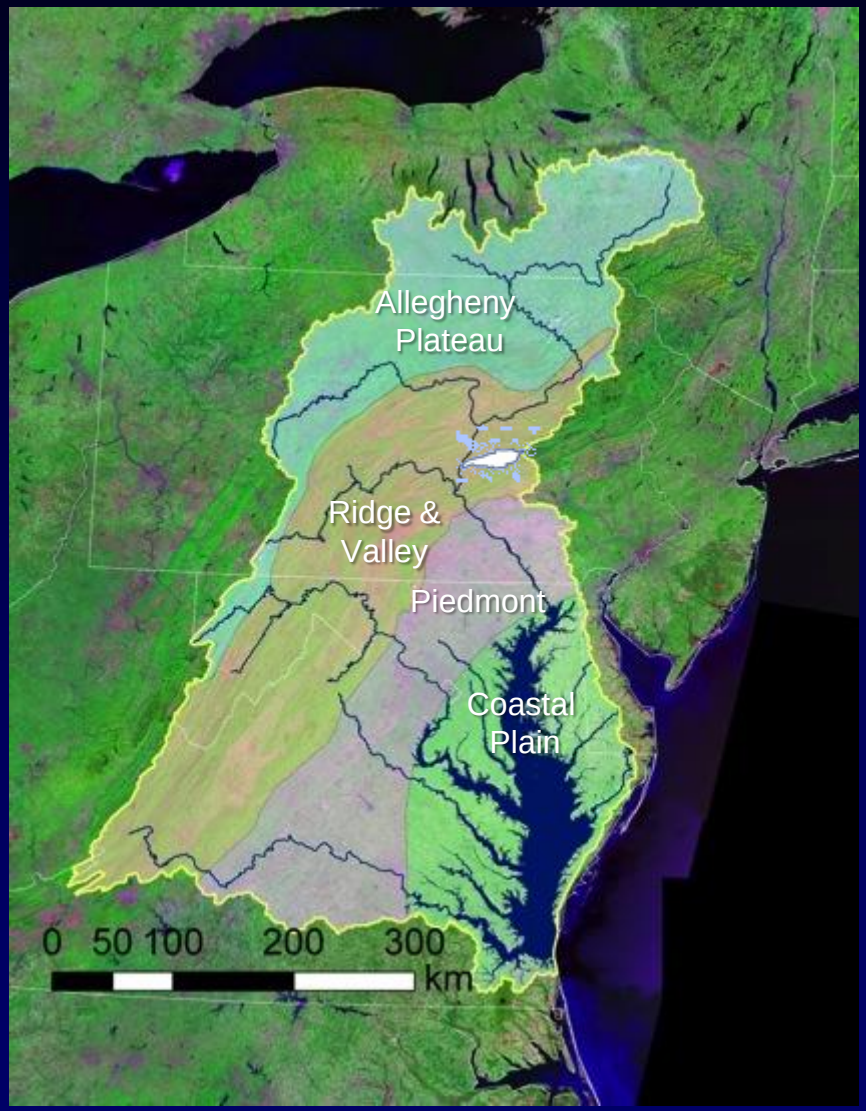
Chesapeake Bay TMDL Tracking and Accounting System

The Chesapeake Bay TMDL Tracking and Accounting System (BayTAS) was developed to inform EPA, the Bay Jurisdictions, and the public on progress in implementing the Bay Total Maximum Daily Load (Bay TMDL). BayTAS stores the TMDL allocations (based on the Watershed Model Phase 5.3.0 and tracks implementation progress (based on the Watershed Model Phase 5.3.2 and the jurisdictions' Phase II Watershed Implementation Plans (WIPs)). BayTAS data are displayed through the TMDL Tracker. Learn more about BayTAS and the terminology of the TMDL in the glossary found in Section 13 of the TMDL. Get answers to frequently asked questions about the Bay TMDL.



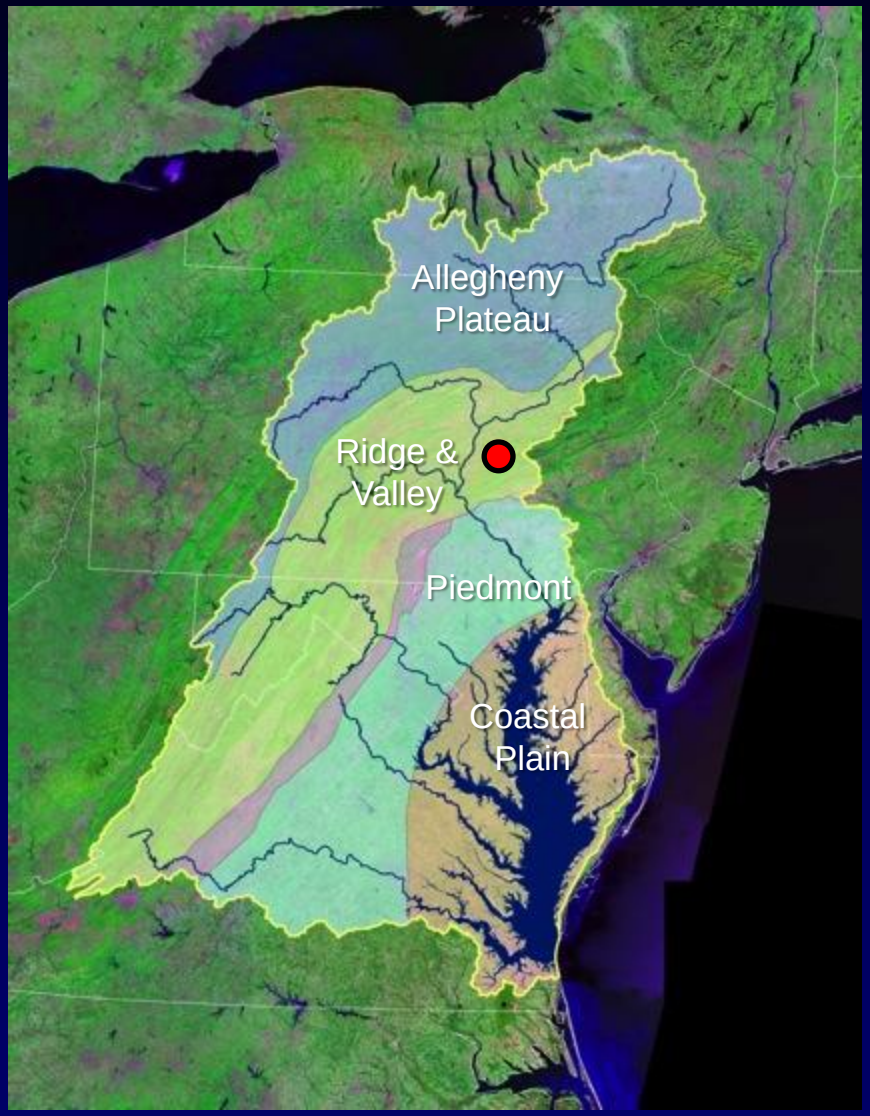
Mahantango Creek Watershed

A rich history of hydrologic research



WE-38 Watershed (7.3 km^2)

Legacy phosphorus: Not so obvious loads from little places



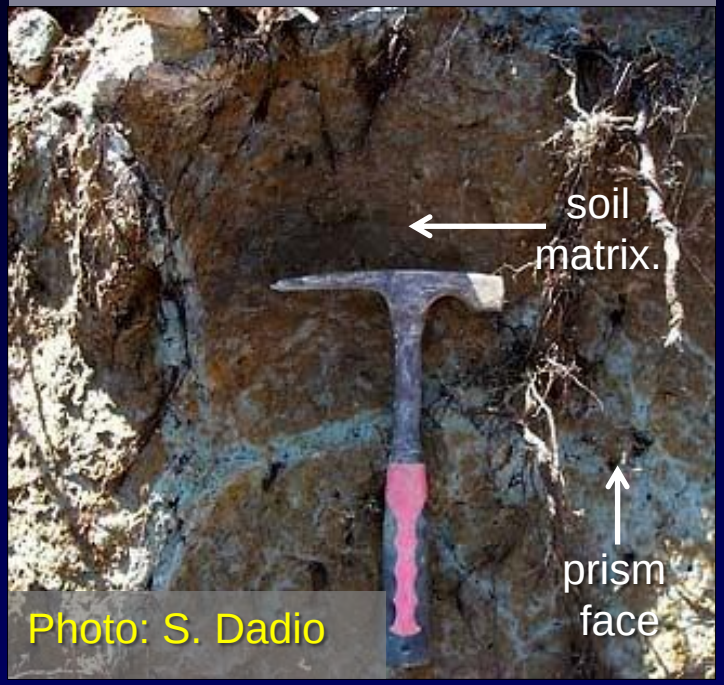
Mahantango Creek
Experimental Watershed
Klingerstown, PA
Area = 7.2 km^2

Mattern watershed
hillslope study

The Mattern watershed

The fragipan and saturation excess runoff

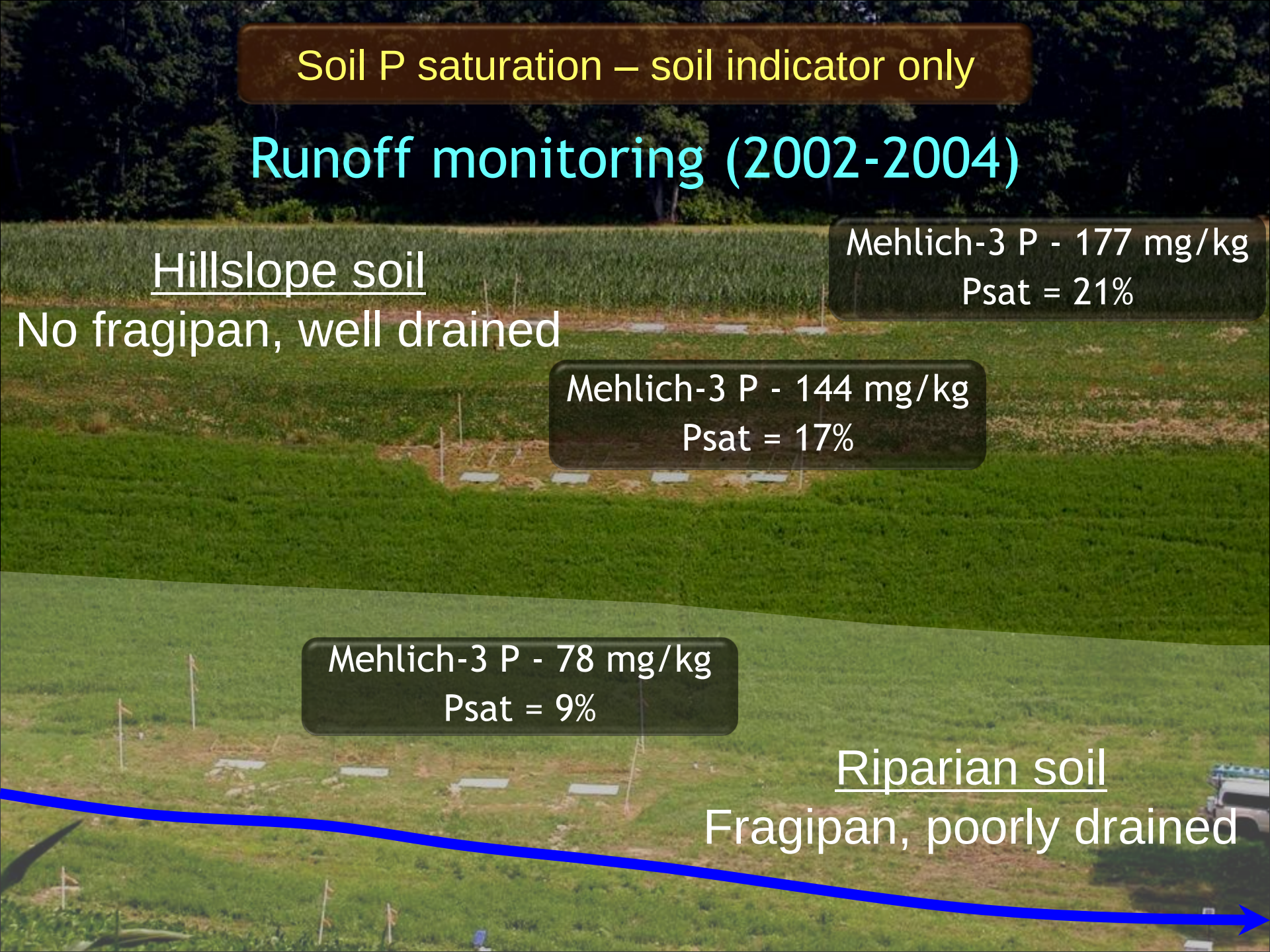
Poorly-drained soil
fragipan

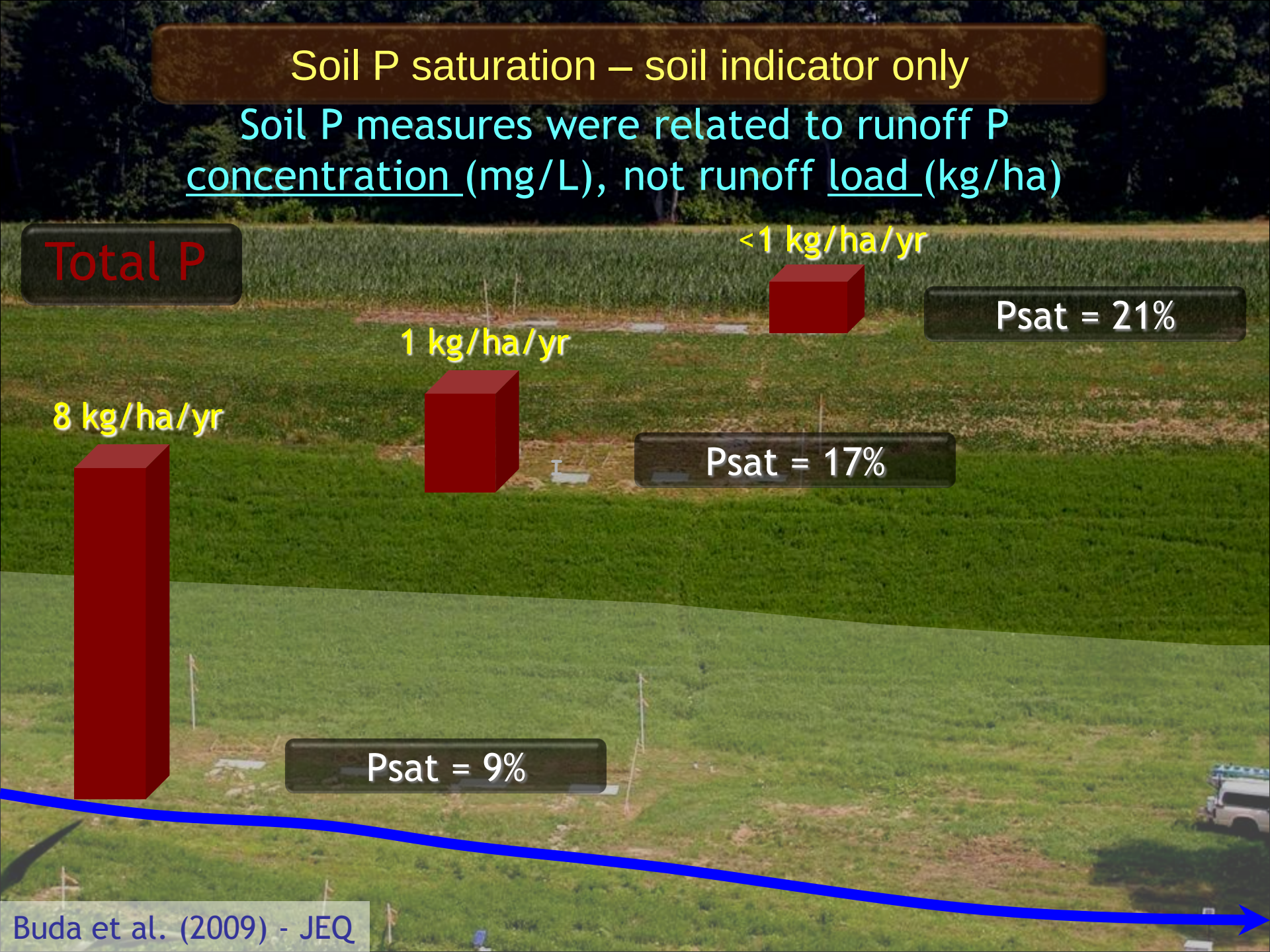


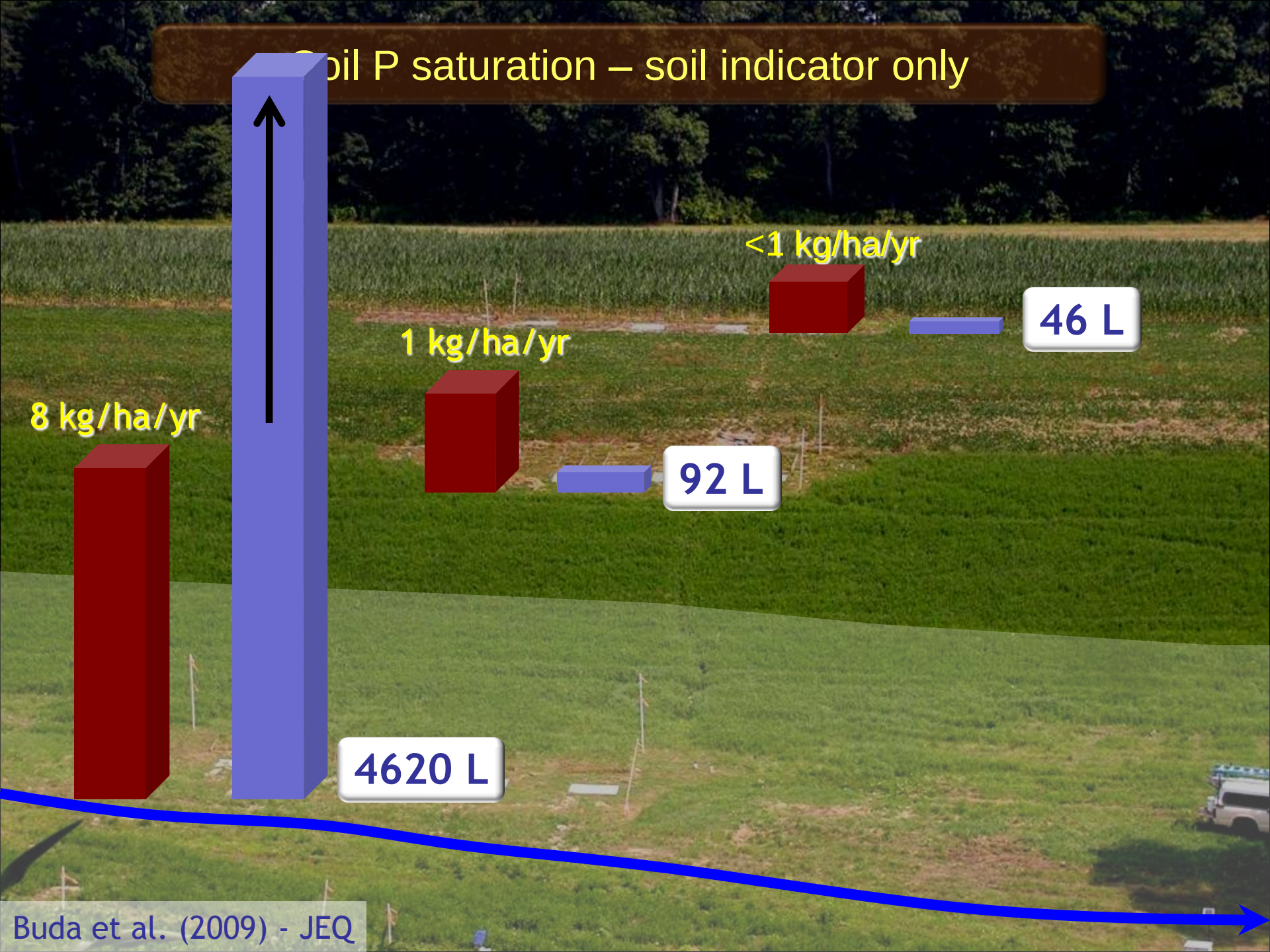
Relatively impermeable (seasonal perched groundwater)

Well-drained soil
no fragipan

Large interstices allow for rapid water infiltration


Soil P saturation – soil indicator only
Runoff monitoring (2002-2004)
Hillslope soil
No fragipan, well drained
Mehlich-3 P - 177 mg/kg
Psat = 21%
Mehlich-3 P - 144 mg/kg
Psat = 17%
Mehlich-3 P - 78 mg/kg
Psat = 9%
Riparian soil
Fragipan, poorly drained

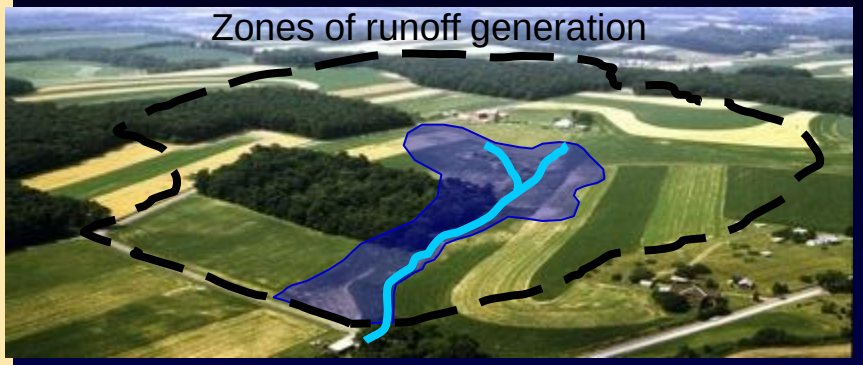

Soil P saturation – soil indicator only
Soil P measures were related to runoff P concentration (mg/L), not runoff load (kg/ha)
Total P
<1 kg/ha/yr
Psat = 21%
1 kg/ha/yr
Psat = 17%
8 kg/ha/yr
Psat = 9%
Buda et al. (2009) - JEQ

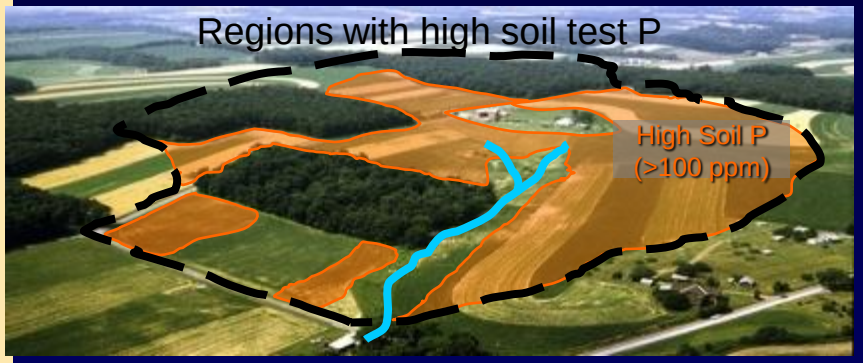

oil P saturation – soil indicator only
<1 kg/ha/yr
46 L
1 kg/ha/yr
92 L
8 kg/ha/yr
4620 L
Buda et al. (2009) - JEQ

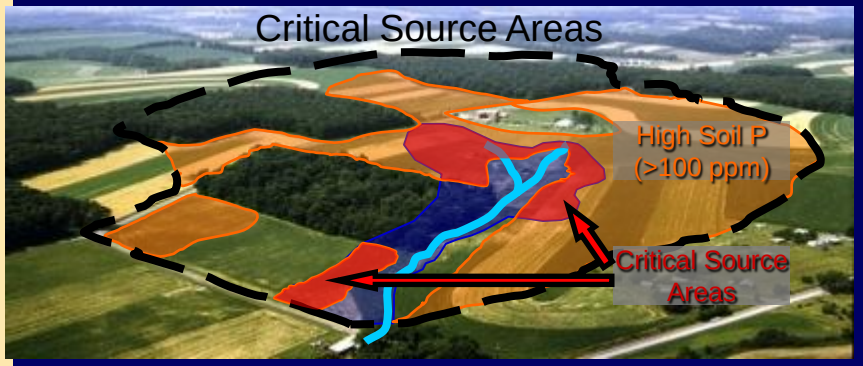
The FD-36 Watershed
Critical source area concept – P-Index

WE-38 watershed (7.3 km^2)

FD-36
(40 ha)







Courtesy Sharpley, USDA-ARS

The Mattern Watershed
Identifying zones of saturation

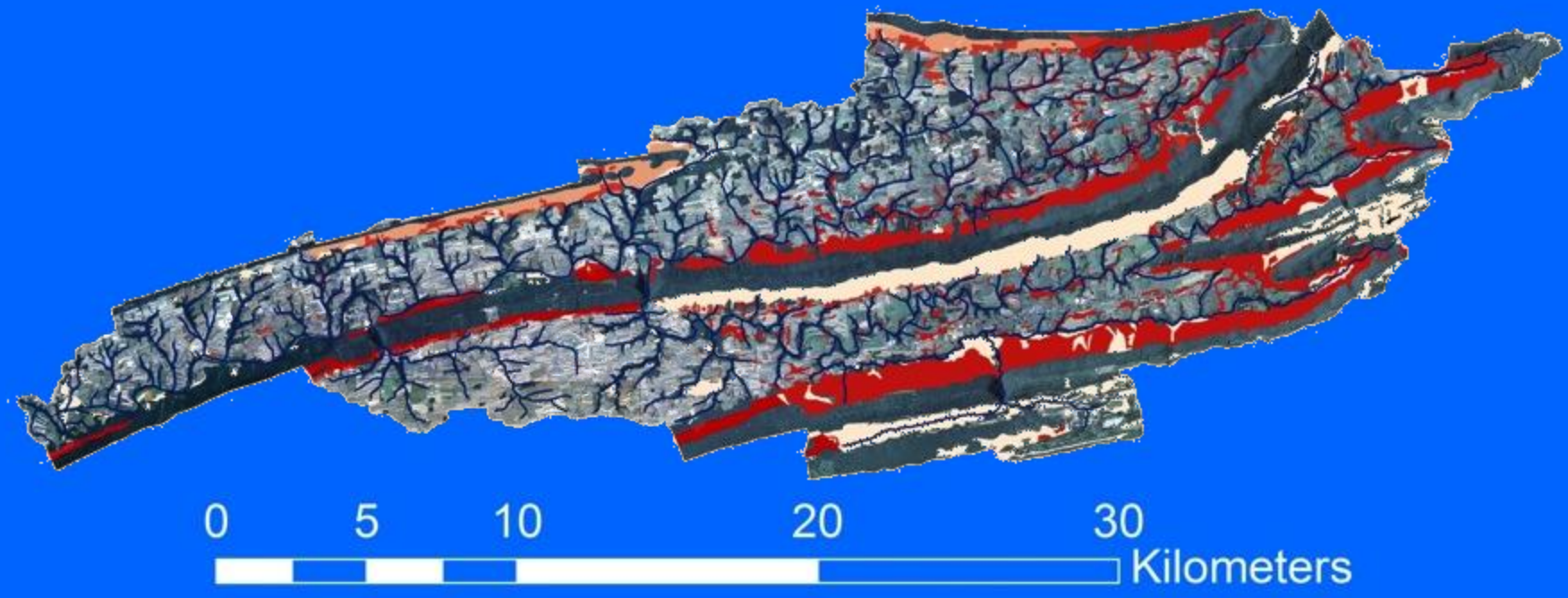
WE-38 watershed (7.3 km^2)

August 2003

October 2003

Mattern
(11 ha)

Extent of fragipan soil horizons in Mahantango Creek



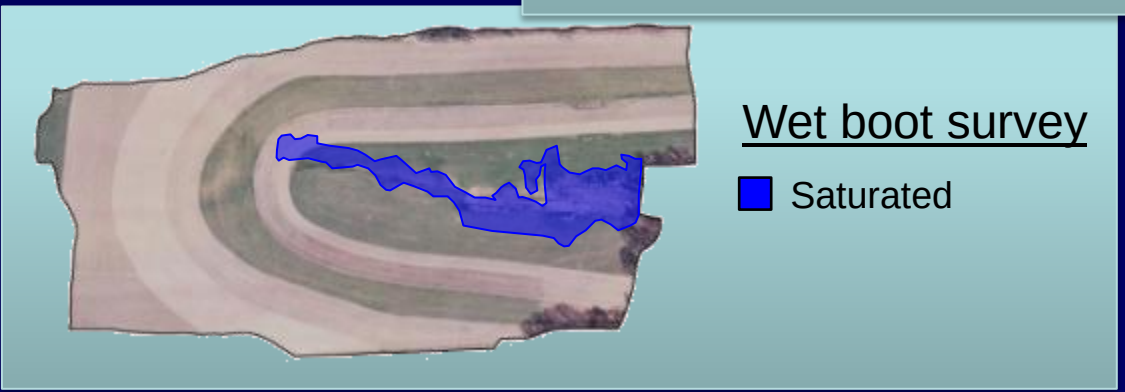
Percent of SSURGO soil map unit mapped as fragipan

1-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100

Data courtesy of Sharon Waltman, USDA NRCS

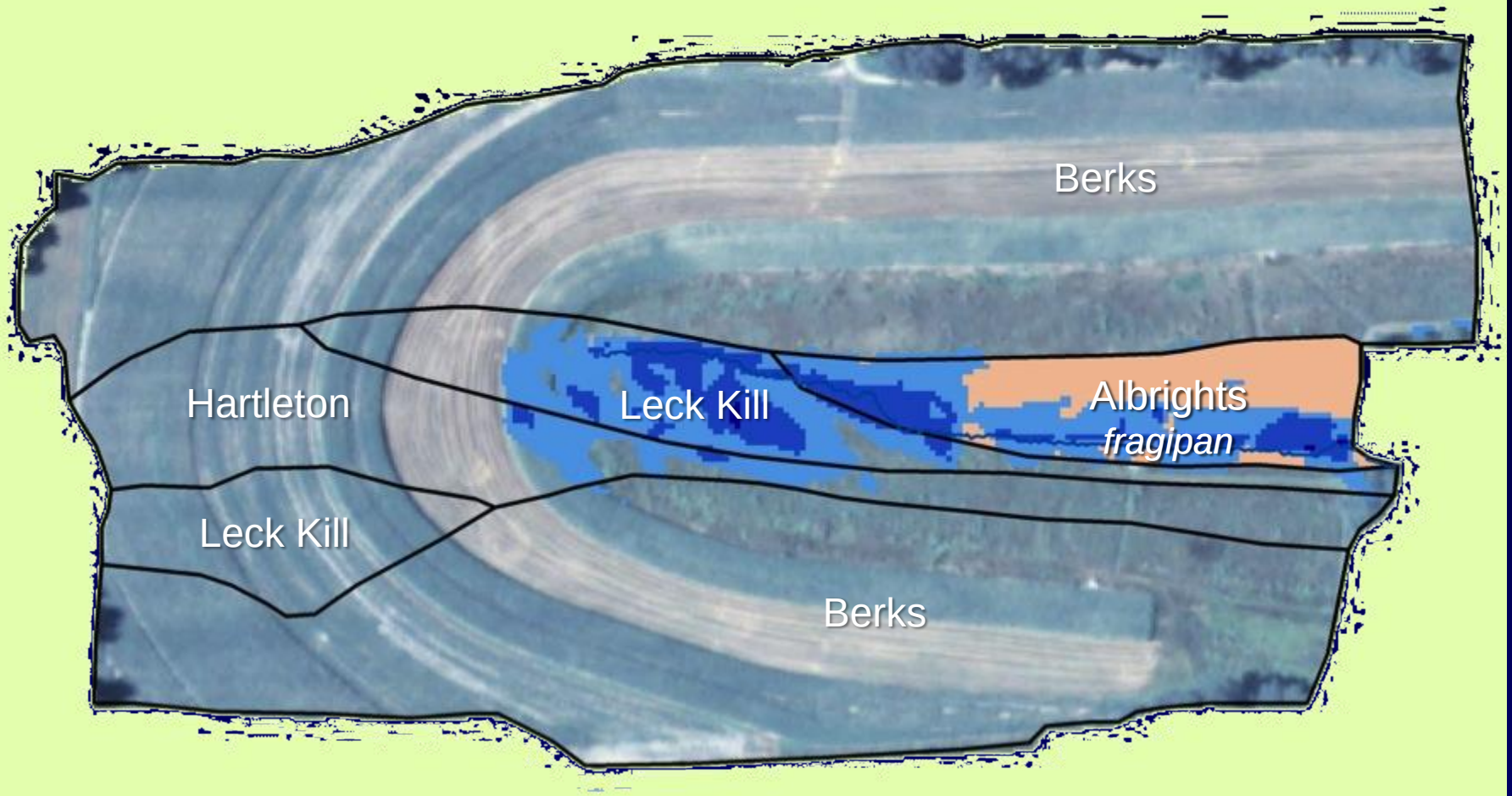
Need for improved mapping to identify "where" runoff is most likely to occur

Lessons from the Mattern watershed:



Mattern fragipan prediction

for lower landscape positions

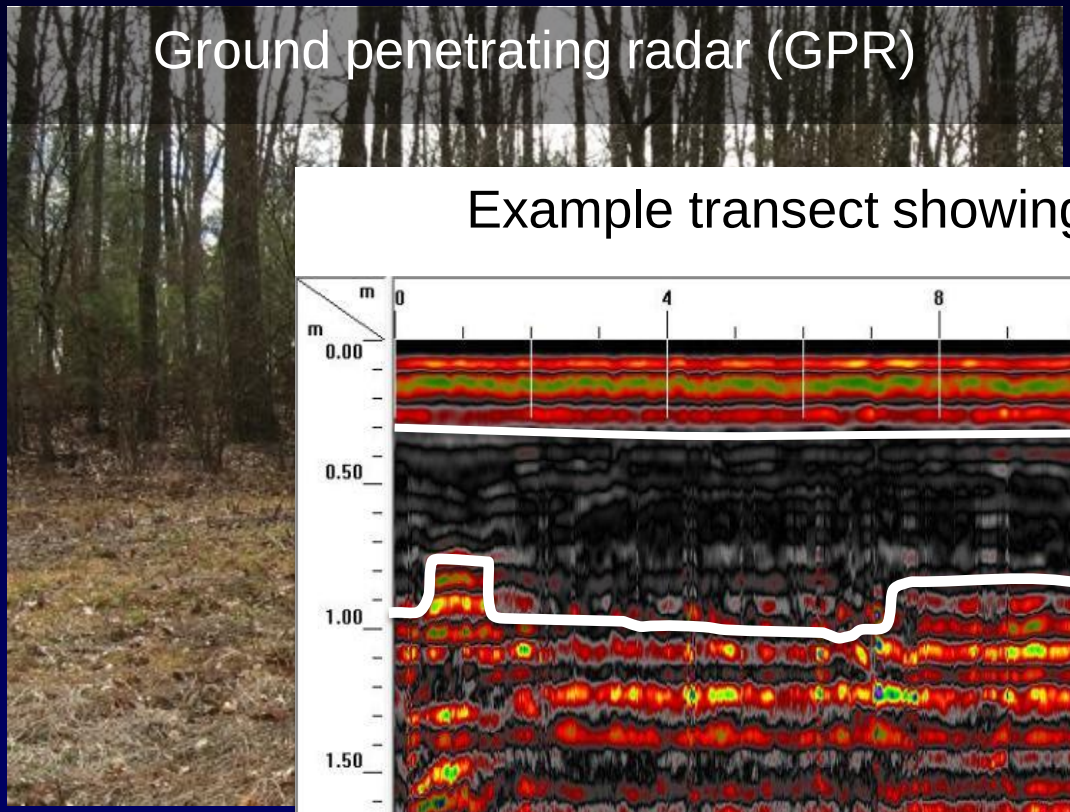


Probability of a restrictive layer (%)

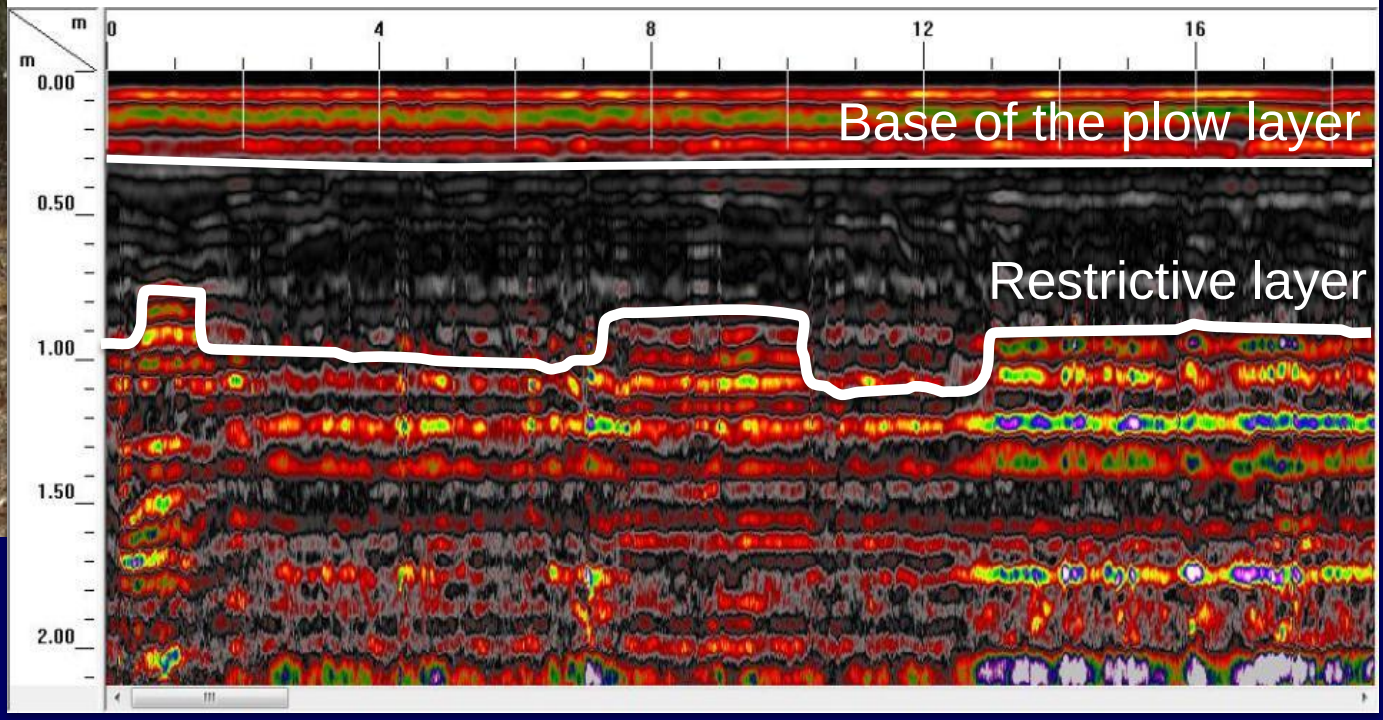
1-25 25-50 50-75 75-100

Courtesy Drohan, Penn State

Validation efforts are ongoing

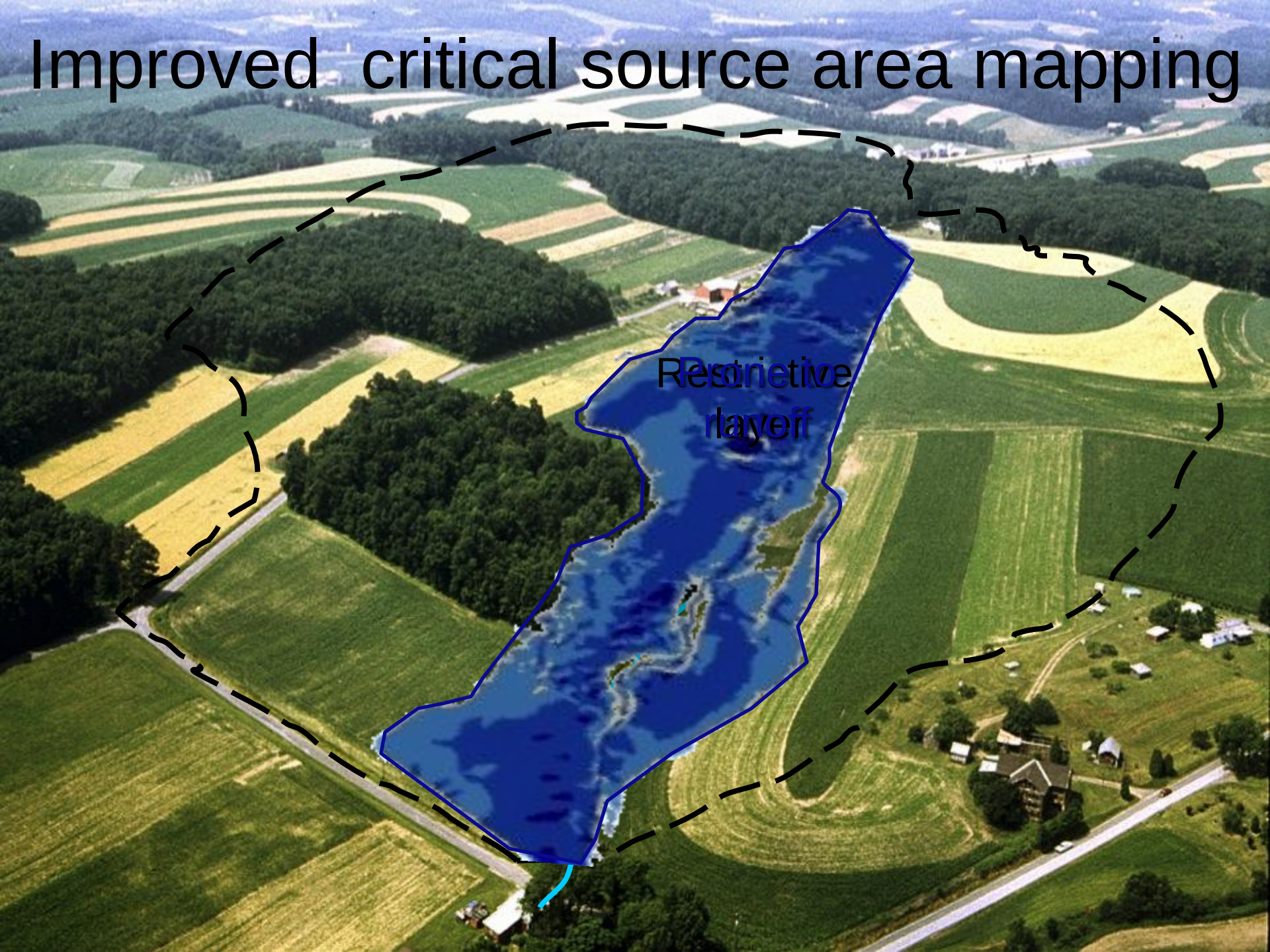


Example transect showing GPR reflectance



Courtesy Drohan, Penn State

Improved critical source area mapping




Thanks