Development and Validation of the Wisconsin Phosphorus Index

Laura Good and Larry Bundy

January, 2006

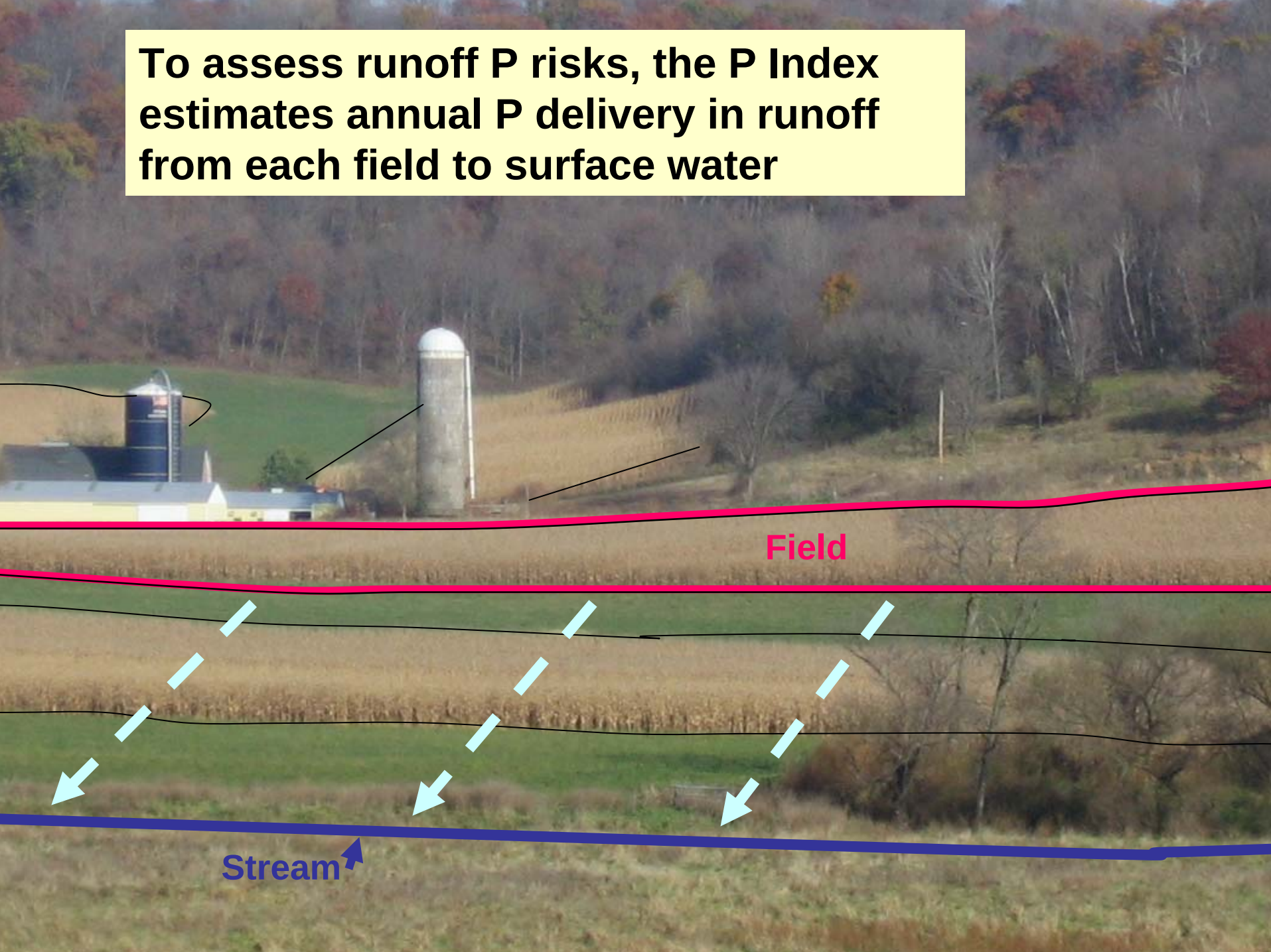
WI Nutrient Management Standard 590 Phosphorus Management Guidelines

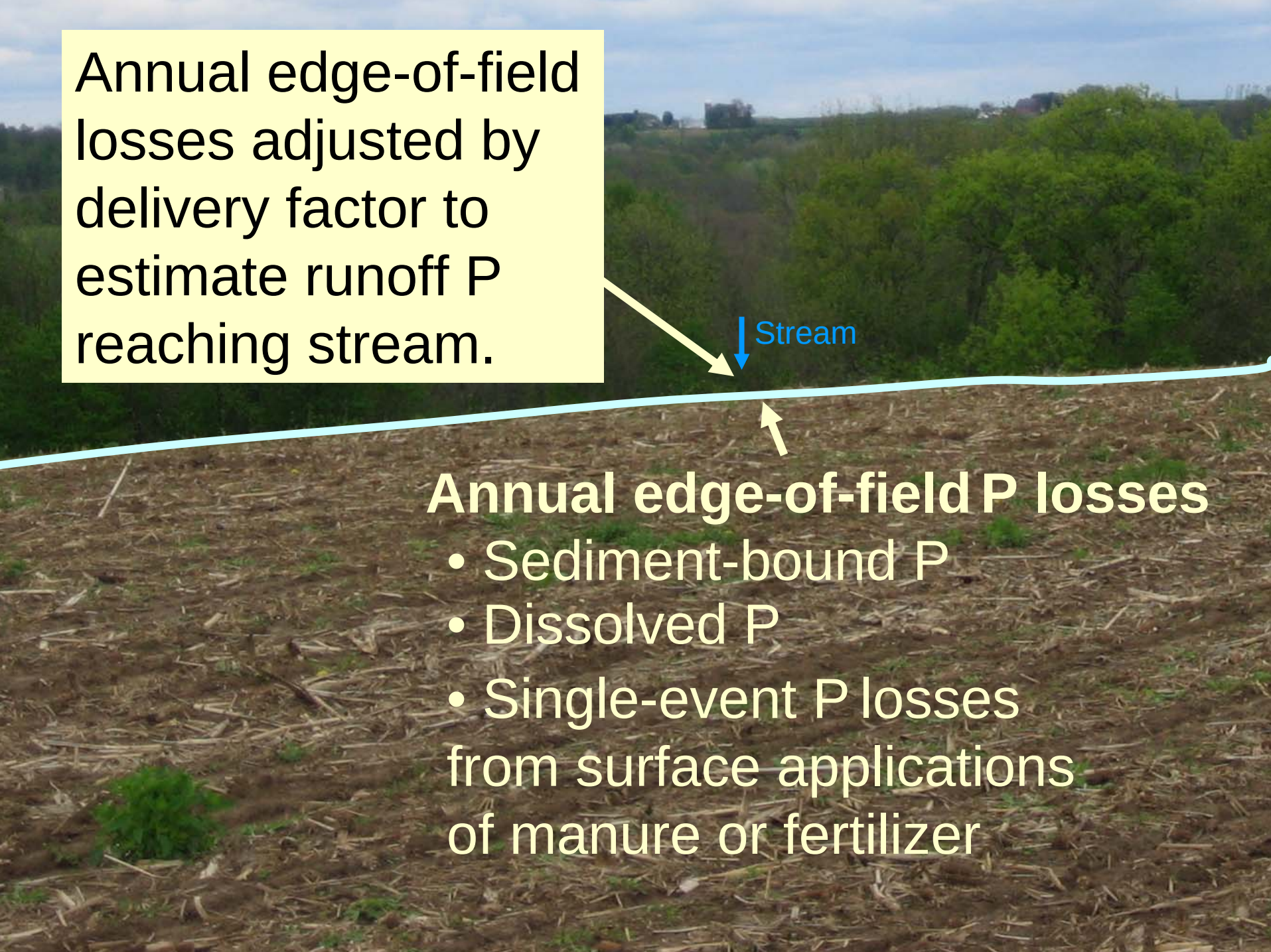
Choices for planning manure applications:

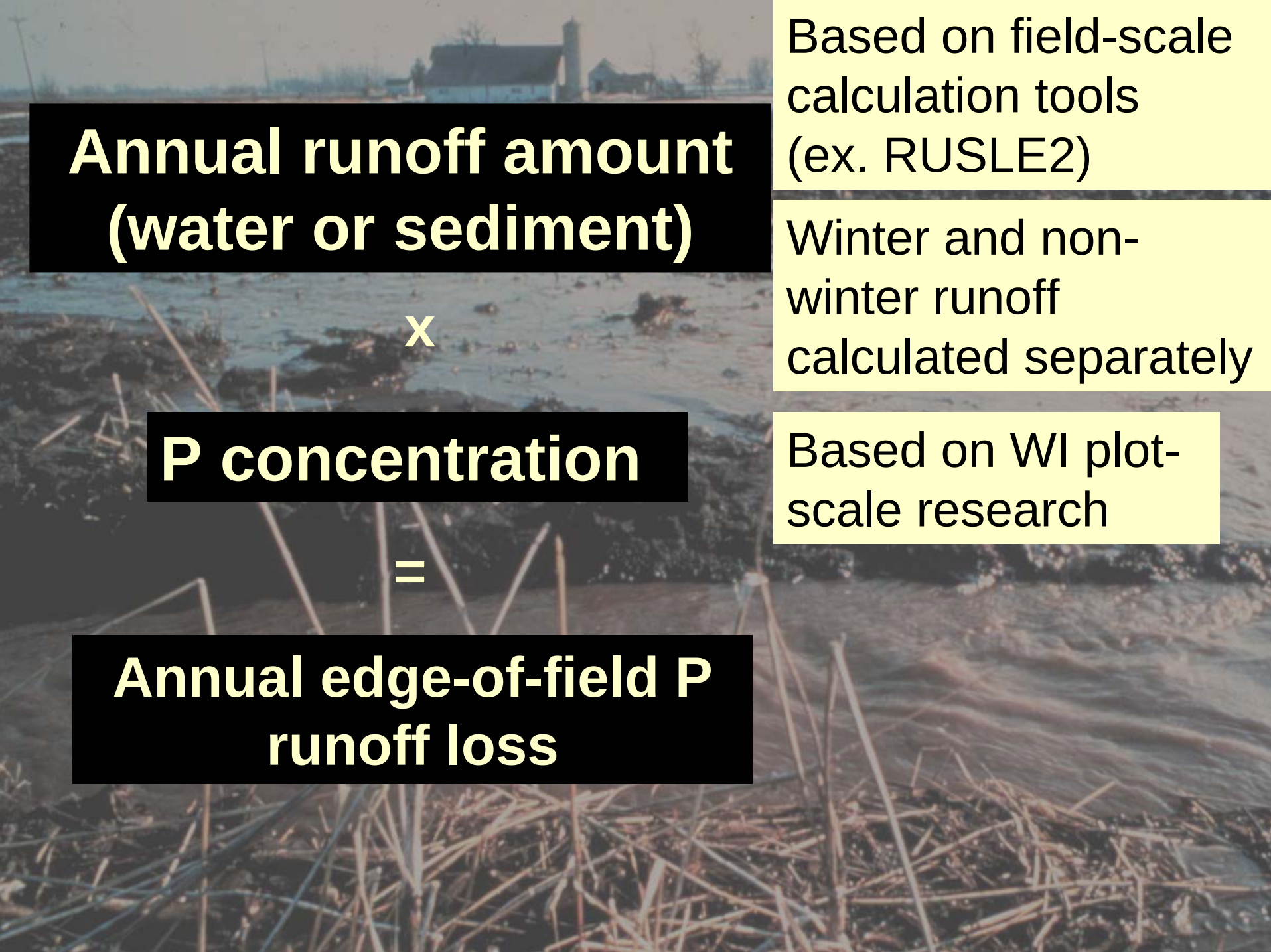
- Limit applications at high soil P concentrations
- Use the WI P Index

P Index-Based Planning

As long as the risk of P delivery from a field to surface water remains below a target level, manure can be applied at N-based rates.


To assess runoff P risks, the P Index estimates annual P delivery in runoff from each field to surface water
Field
Stream


Annual edge-of-field losses adjusted by delivery factor to estimate runoff P reaching stream.
Stream
Annual edge-of-field P losses
• Sediment-bound P
• Dissolved P
• Single-event P losses from surface applications of manure or fertilizer



Annual runoff amount (water or sediment)

x

P concentration

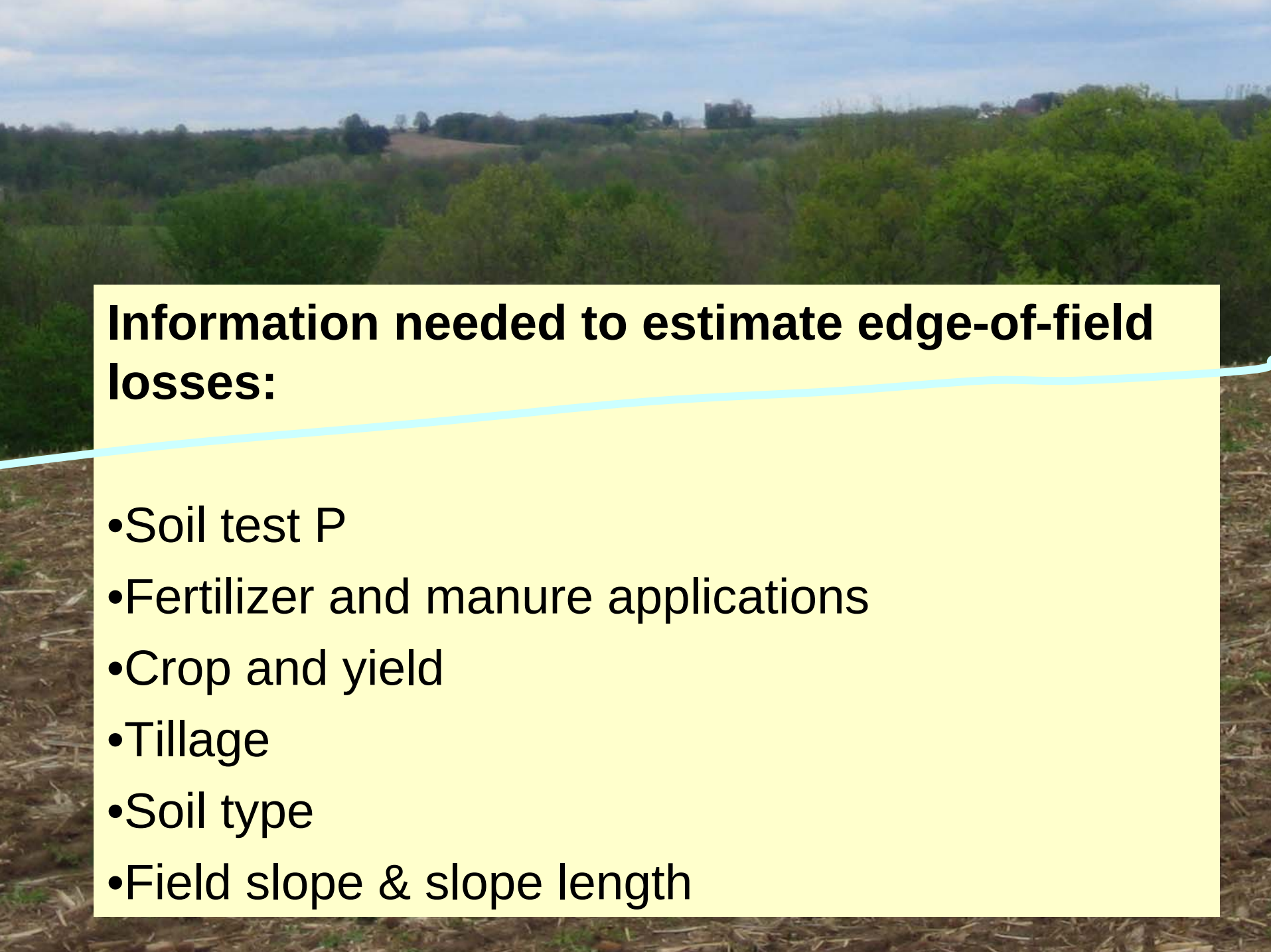
=

Annual edge-of-field P runoff loss

Based on field-scale calculation tools (ex. RUSLE2)

Winter and non-winter runoff calculated separately

Based on WI plot-scale research

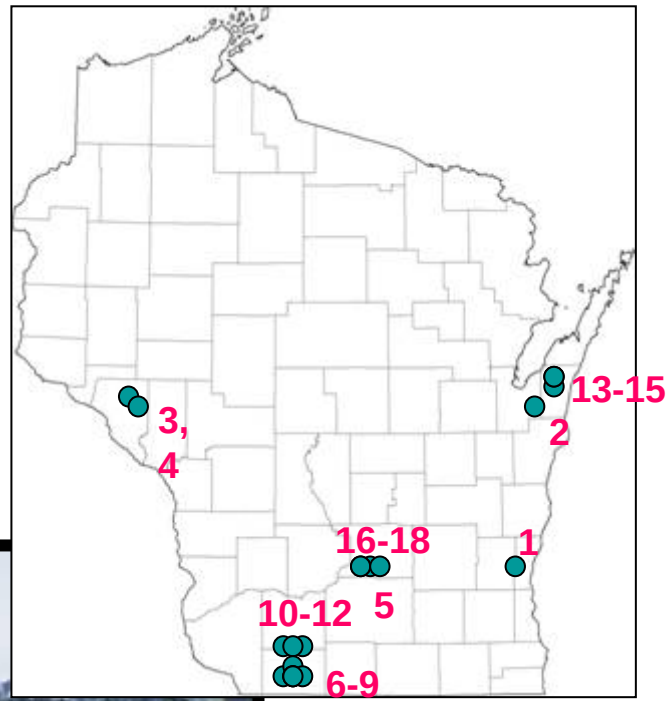


Information needed to estimate edge-of-field losses:

- Soil test P
- Fertilizer and manure applications
- Crop and yield
- Tillage
- Soil type
- Field slope & slope length

Year-round Field Runoff Monitoring

- "Real" fields on private and research farms
- Monitored by US Geological Service or UW-Madison researchers
- Sites vary by soils, slopes, crops, and tillage

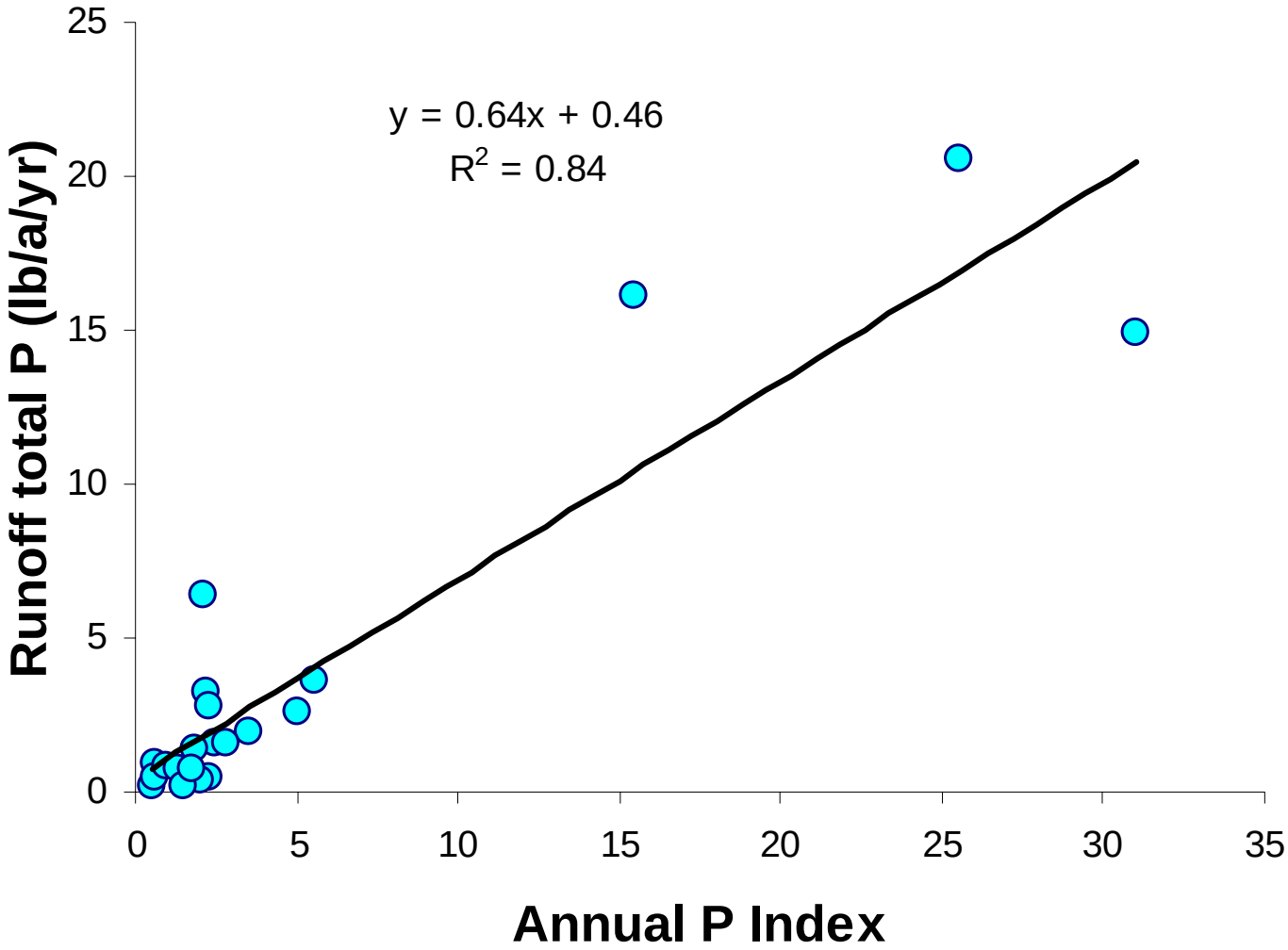


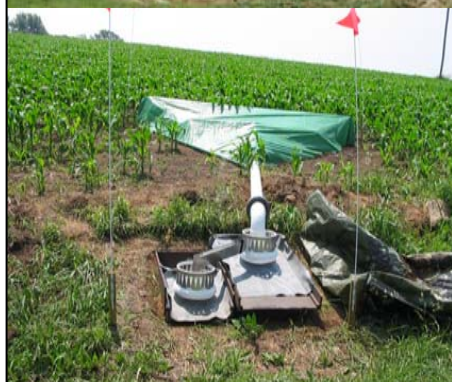
Runoff Measurements

- Rainfall and snowmelt runoff amounts
- Sediment
- Dissolved P
- Total P

P Index and Measured Runoff P

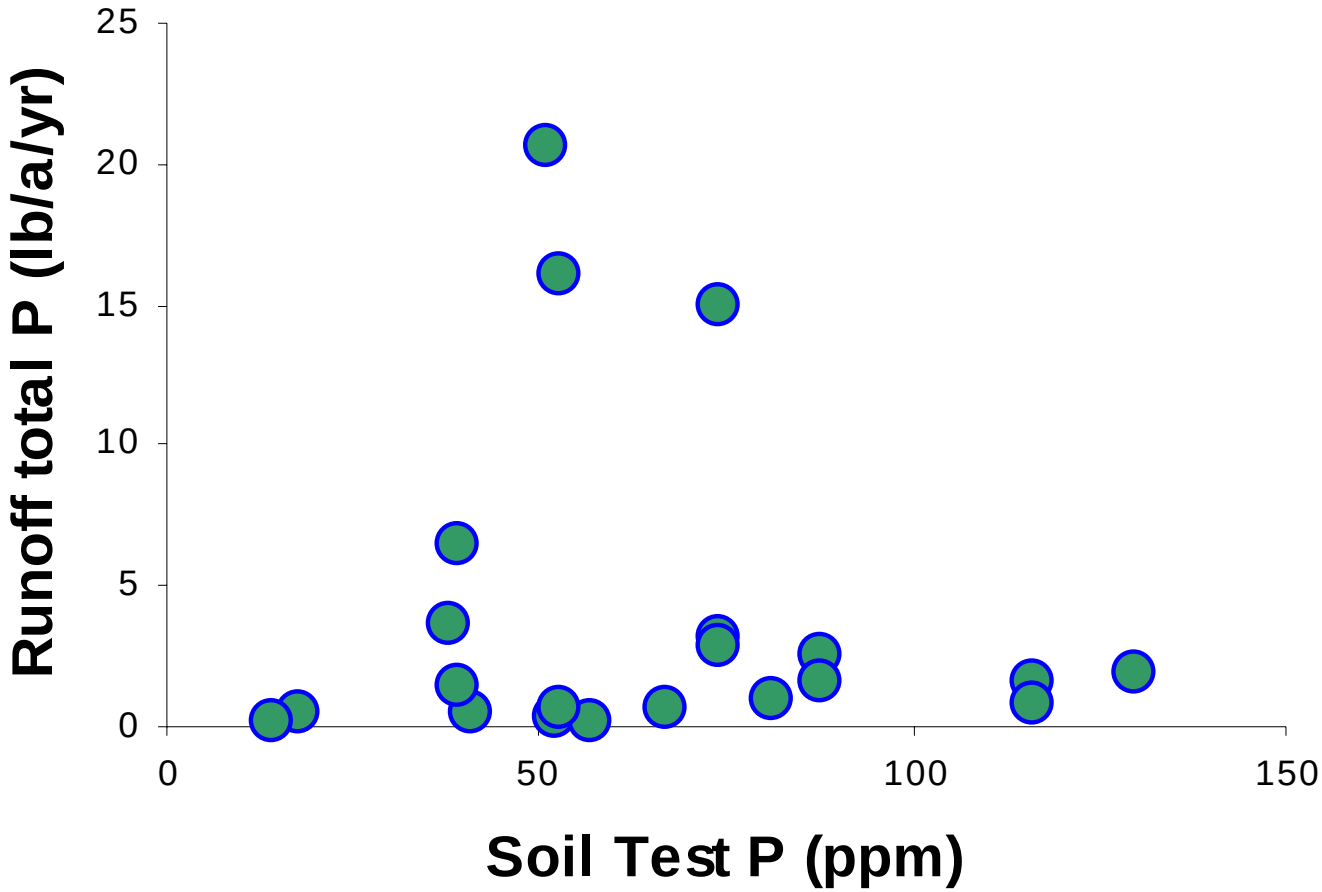
Edge-of-field, Crop years 2003 and 2004

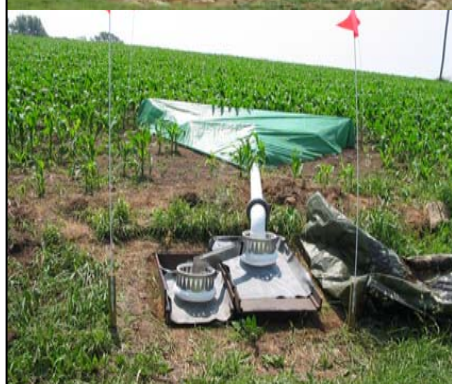




Soil Test P and Measured Runoff P

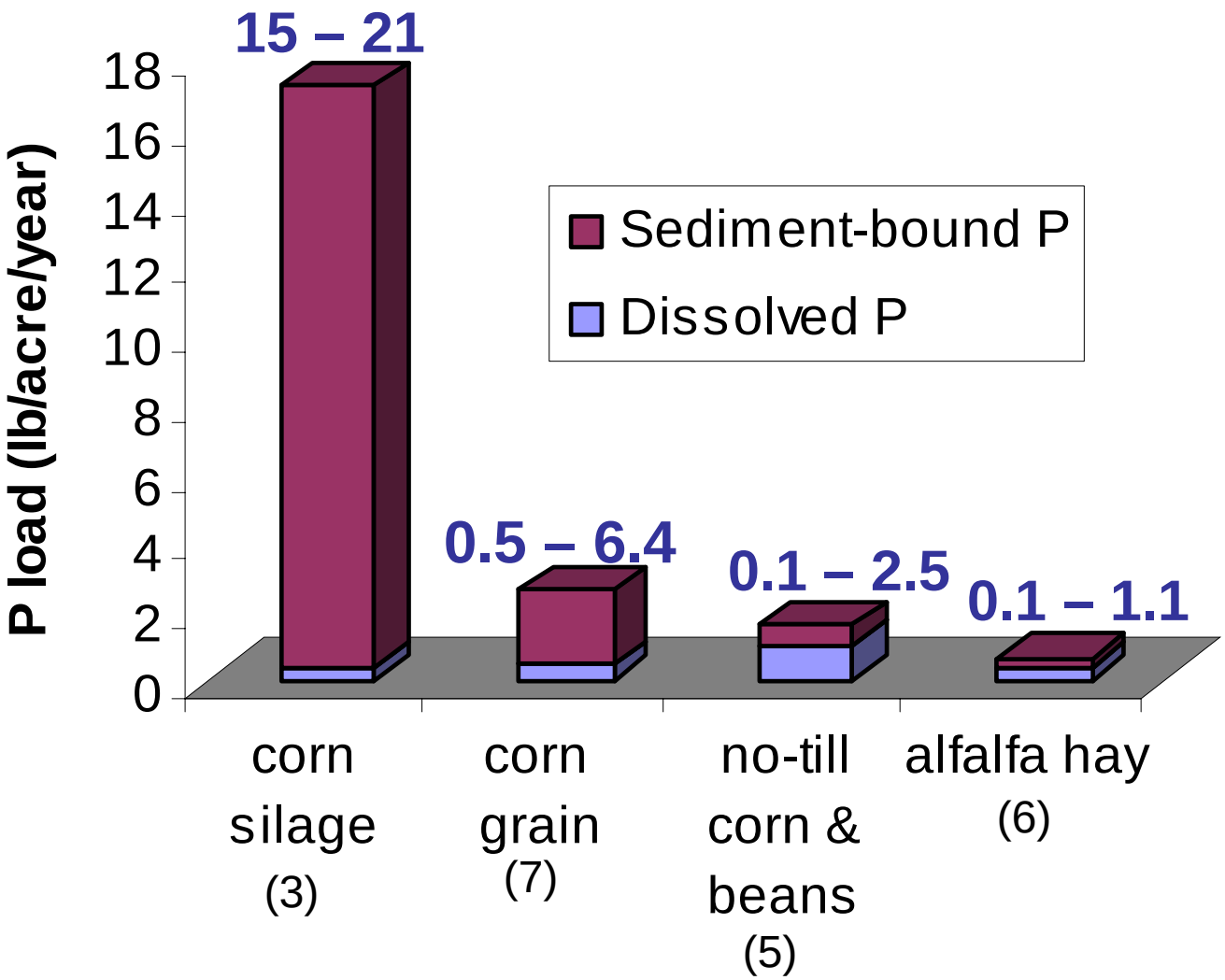
Edge-of-field, Crop years 2003 and 2004

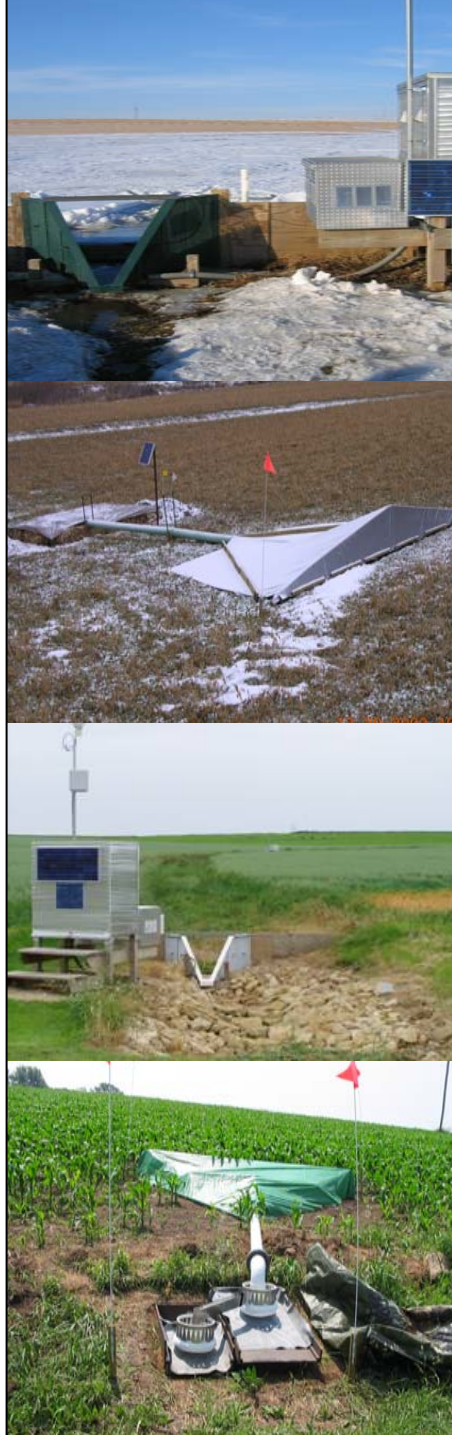




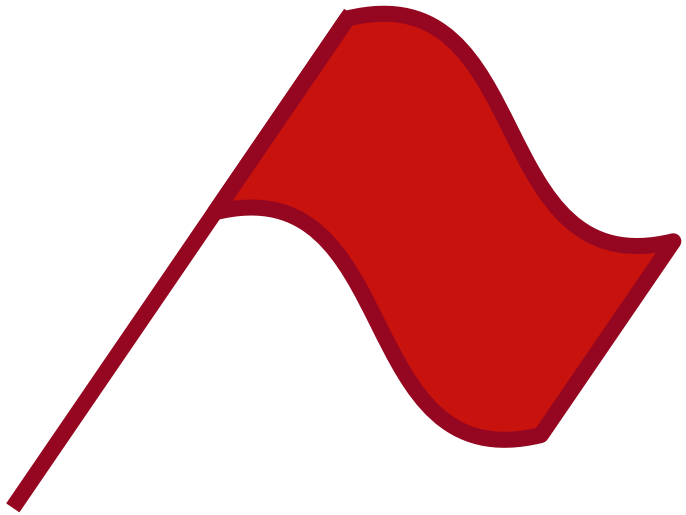
Annual Runoff P Losses Averaged by Crop and Tillage

Edge-of-field, Crop years 2003 and 2004





Last year's slide:



Have just a single year of runoff data for any set of management practices on any field

Last year's slide #2:

Weather variability can interfere with looking at relative effects of management practices with a single year of data

Runoff P content

x

Amount transported

=

P delivered

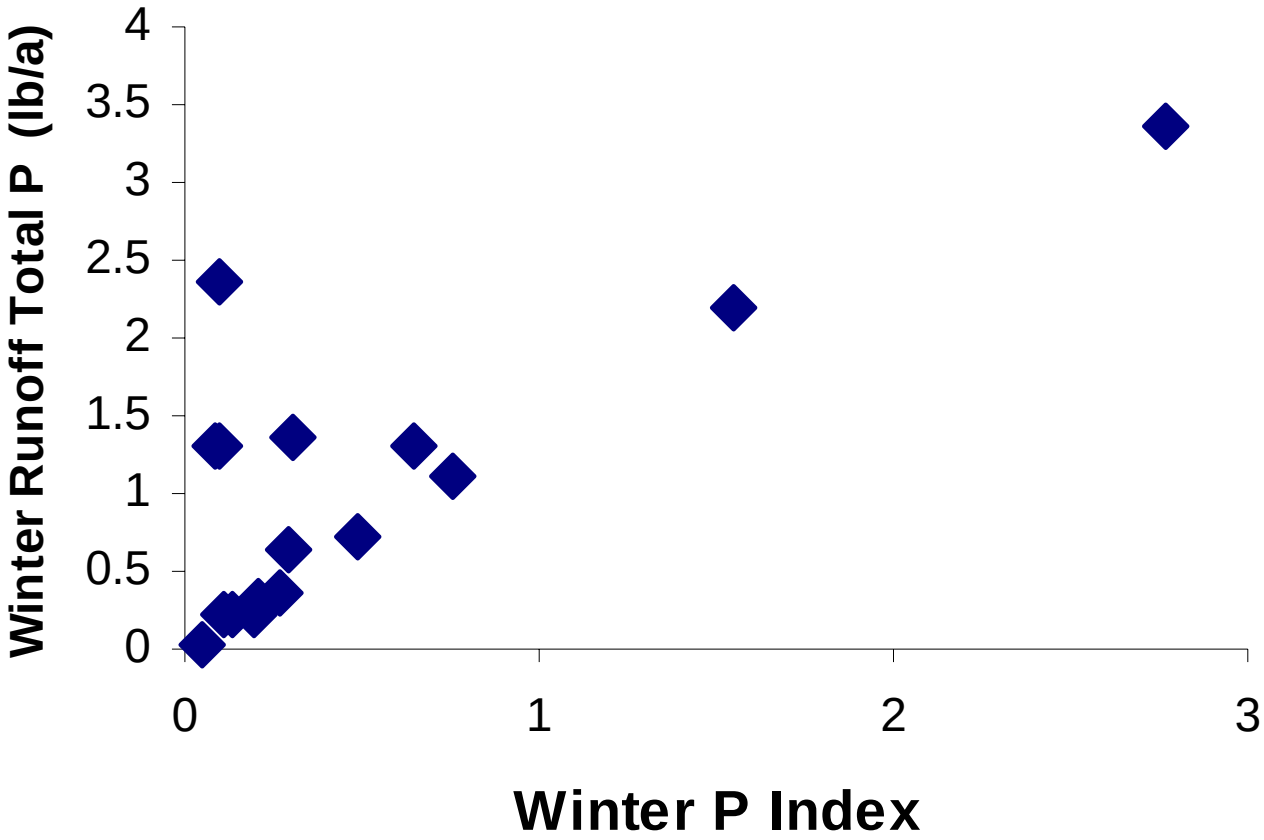
Used drought year as an example:
No rain = No runoff = All field managements result in low runoff P losses

Crop Year 2005

- Higher winter runoff volumes than 2003 and 2004
- Little rainfall runoff

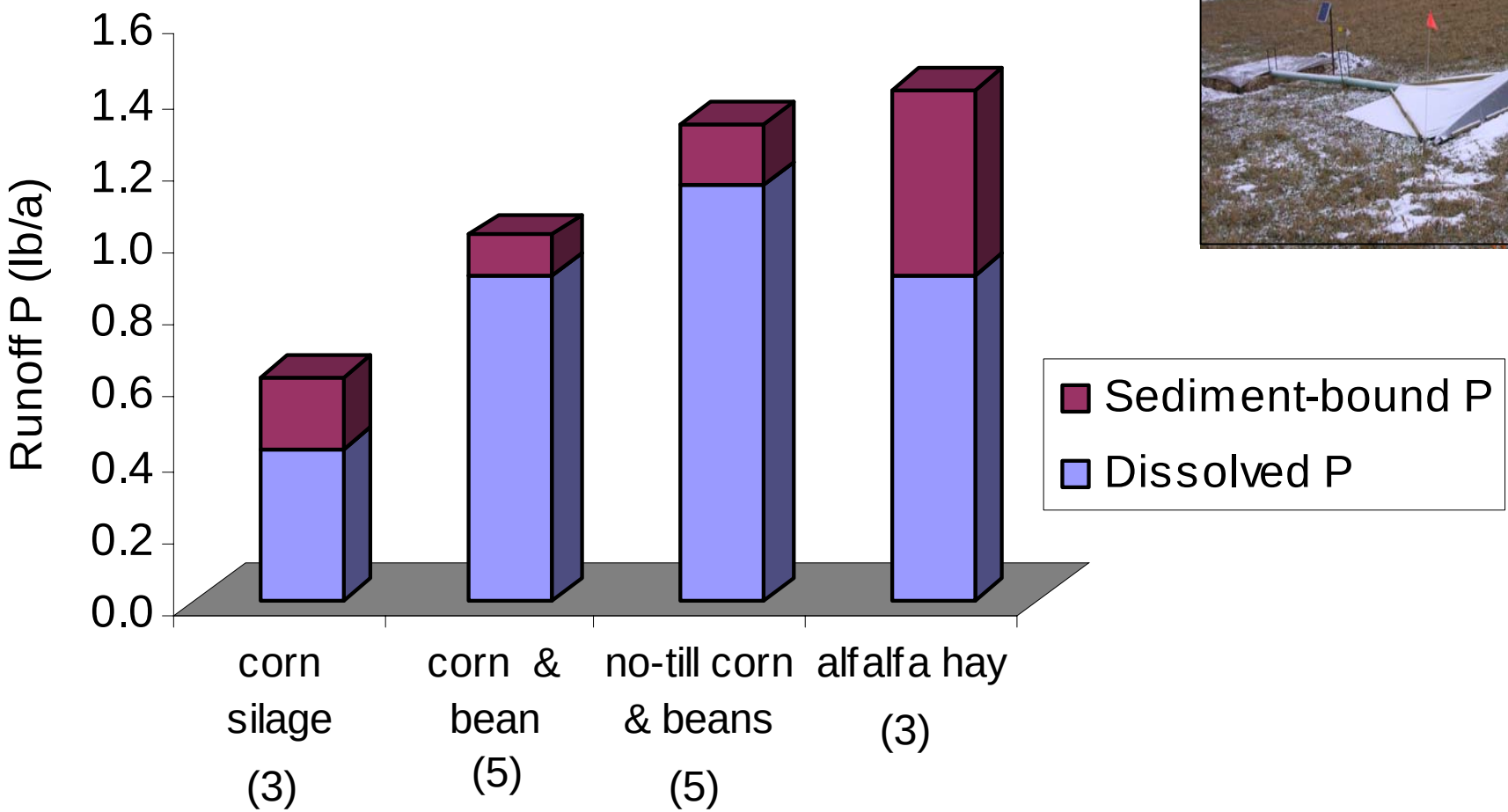
Frozen Soil Runoff P Index and Measured Runoff P

Edge-of-field, January through March, 2005



Frozen Soil Runoff P Losses Averaged by Crop and Tillage

Edge-of-field, January through March, 2005



Summary

- A P Index value indicates the relative risk of P delivery from a field to surface water under planned management with an average weather year.
- Crop management choices and field conditions can have different effects on non-frozen and frozen soil runoff P losses.
- The WI P Index does a fairly good job of indicating relative effects of crop management and field conditions on edge-of-field runoff P losses from both non-frozen and frozen soils.

Acknowledgements

Wes Jarrell, U. of Illinois

John Panuska, UW-Extension

Researchers conducting runoff monitoring and/or help with algorithms:
Dave Owens, Todd Stuntebeck, and Matt Komiskey, USGS; Todd Andraski, Nancy Bohl, Carlos Bonilla, John M. Norman, Christine Molling, Julie Studnicka, and Jeff Topel, UW-Madison Soil Science Department; John Panuska, Paul Miller, and K.G. Karthikeyan, UW-Madison Biological Systems Engineering Department; Randy Mentz, Chris Baxter, and Tom Hunt, UW-Platteville Pioneer Farm; Dennis Frame and Fred Madison, UW-Discovery Farms.

Major funding contributors for P Index- related research:
UW College of Agricultural and Life Sciences (CALS), Department of Agriculture, Trade, and Consumer Protection (DATCP), Wisconsin Fertilizer Research Program (WFRP), Wisconsin Buffer Initiative (WBI), UW Consortium for Agricultural and Natural Resources Research