

The Wisconsin Phosphorus Index

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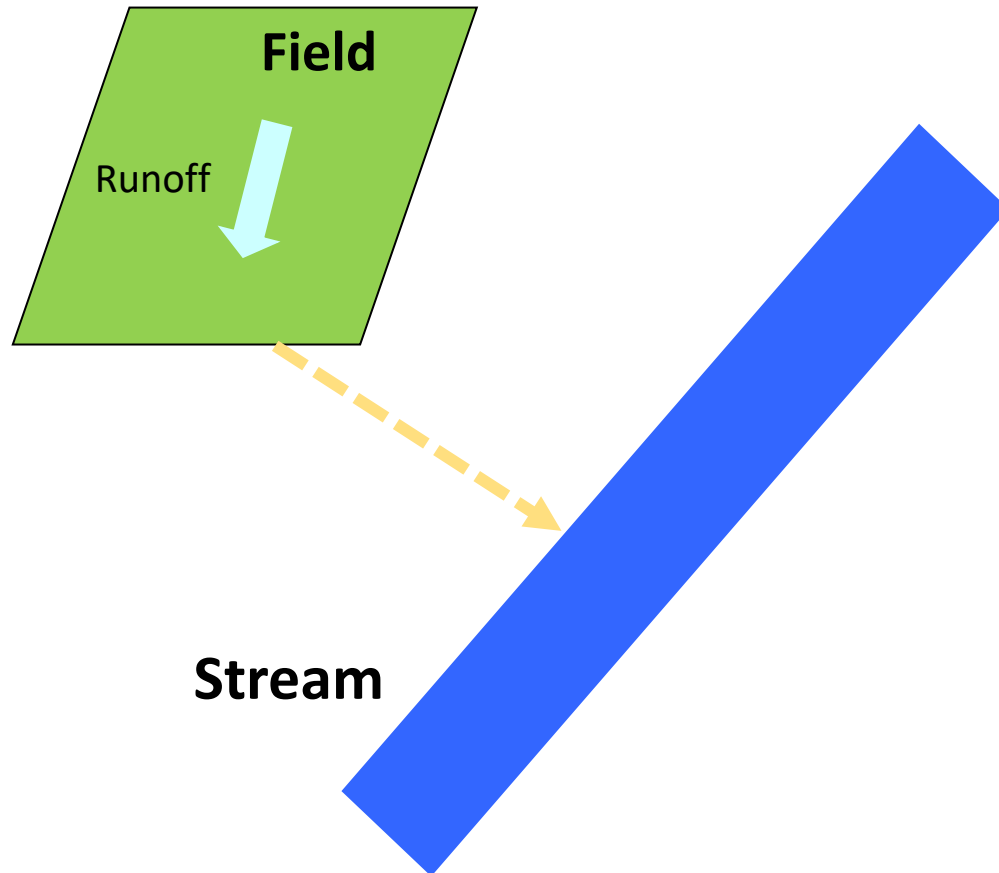
2025 Regional Nutrient Management Meetings



**Department of Soil and
Environmental Sciences**
COLLEGE OF AGRICULTURAL & LIFE SCIENCES
UNIVERSITY OF WISCONSIN-MADISON

What is the Wisconsin Phosphorus Index?

A model that estimates phosphorus (P) delivery from a field to the nearest surface water.



Soil Nutrient Application Planner (Plus)

SnapPlus: Wisconsin's nutrient management planning software



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Nutrient Management for Wisconsin

SnapPlus 20.4 built on 2021-06-03 - Examples for P Index

File Import/Export Tools View Help Save Snapshot

Subfarm: Show all fields. Field: manure fall Farm name: Examples for P Index.snapDb Location: D:\Desktop

Group: Show all fields.

Farm Soil Tests SnapMaps Fields Nutrients Cropping Records Reports

Fast Facts

Year	Soil Test	pH	OM	P	K	County	Acres	Pred. Soil	Symbol	Group	Texture	Field Ret
2023	2022-12-12	7.0	3.0	144	150	Brown	1	Kewaunee	KhB	L	Silt Loam	

manure fall Rotation Wizard Calculate all years Add/Copy/Delete Years

Crop Year

2023	2024
Crop Year	Crop Year
Crop	Crop
Yield	Yield
Tillage	Tillage
Soil Test	Soil Test
Lime rec	Lime rec
MRTN	MRTN
Notes	Notes
lbs/acre	lbs/acre
UW Rec	UW Rec
Prior extra	Prior extra
Adj UW rec	Adj UW rec
Legume credit	Legume credit
2nd & 3rd yr man	2nd & 3rd yr man
Manure	Manure
Fertilizer	Fertilizer
Totals	Totals
Over/Under	Over/Under
Total PI	Total PI
Part PI	Part PI
Sol PI	Sol PI

Dominant critical soil details:

Name: Kewaunee

Symbol: KhB Slope: 4.0

Texture: Silt Loam

Rotation Settings

Start 2023 Years 2

Contouring

None

On contour

Strip crop

Filter Area

None

Designed, field edge

Designed, in field

Summary 2023 to 2024

Avg soil loss 2.3 t/ac/yr

Field "T" 3 t/ac/yr

Crop Year	2023	2024
Crop	Corn grain	Soybeans 7-10 inch row
Yield	171-190	56-65
Tillage	Fall Chisel, no disk	Fall Chisel, no disk
Soil Test	2022-12-12	2022-12-12
Lime rec	0	0
MRTN	☐ Irrigated 0.1/MRTN	☐ Irrigated
Notes		
lbs/acre	N P2O5 K2O	N P2O5 K2O
UW Rec	165 0 25	0 0 45
Prior extra	- 0 0	- 72 179
Adj UW rec	165 0 25	0 0 0
Legume credit	0 - -	0 - -
2nd & 3rd yr man	0 - -	0 - -
Manure	120 72 204	120 72 204
Fertilizer	0 0 0	0 0 0
Totals	120 72 204	120 72 204
Over/Under	-45 72 179	120 72 204
Total PI	5	3
Part PI	4.6	1.8
Sol PI	0.8	0.7

Summary 2023 to 2024

Avg soil loss 2.3 t/ac/yr

Field "T" 3 t/ac/yr

Avg P Index 4 SCI 0.4

P2O5 K2O

Removal 120 135 lb/ac

Balance 24 273 lb/ac

Soil test P is greater than 100 ppm so P2O5 balance should be less than -30 lb / acre.

P management – 590 standard

**Natural Resources Conservation Service
CONSERVATION PRACTICE STANDARD
NUTRIENT MANAGEMENT**

Code 590

(Ac.)

2. **Develop a P management strategy** when manure or organic by-products are applied during the crop rotation to minimize surface water quality impacts. Use either **the Phosphorus Index (PI)** in section IV.C.2.a. or Soil Test Phosphorus Management Strategy in section IV.C.2.b. on all fields within a farm or tract and follow IV.A.1.h.

See also: Wisconsin NR 151.04 “Phosphorus index performance standard”
Wisconsin NR 243.14(5) “Phosphorus delivery”



Runoff carries dissolved and sediment-bound P...

And some is delivered to the nearest surface water

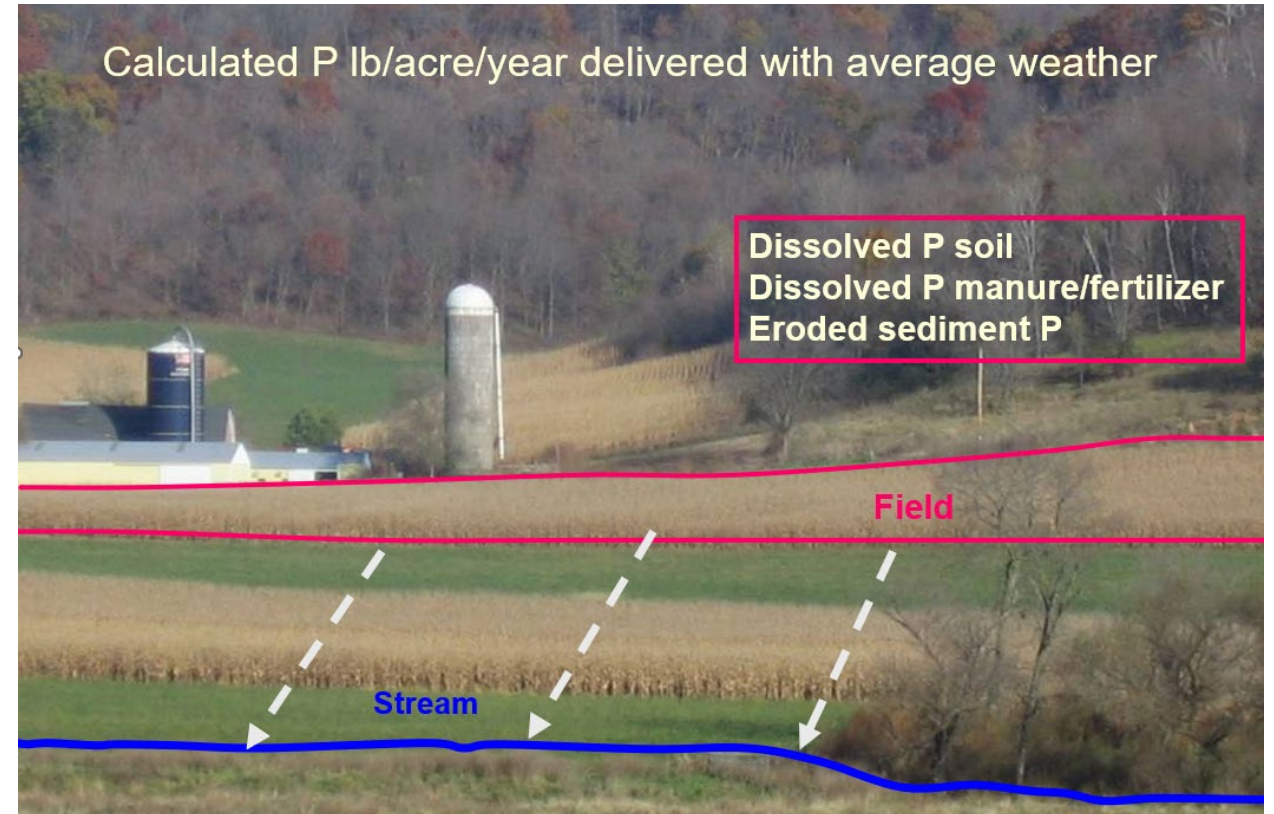


Key Takeaways: P Index in SnapPlus V3

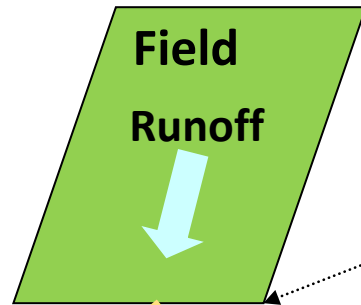
- Soils data has been updated (from 2019 to 2024 SSURGO)
- Precipitation data has been updated (from 1996-2016 to 2004-2024)
- Some research-based updates to P Index in V3



= recent updates



Components



Annual “field-edge” runoff losses estimated for each crop year:

Sediment-bound P

Dissolved P from soil

Dissolved P from manure and fertilizer

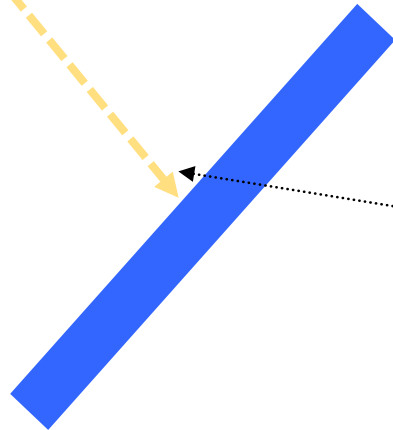
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Total P field to stream delivery ratio *applied to account for P deposition and infiltration: assumes channelized flow similar to a grassed waterway*

=

Annual P delivery to surface water
(P Index)

Stream



Particulate P (sediment bound)

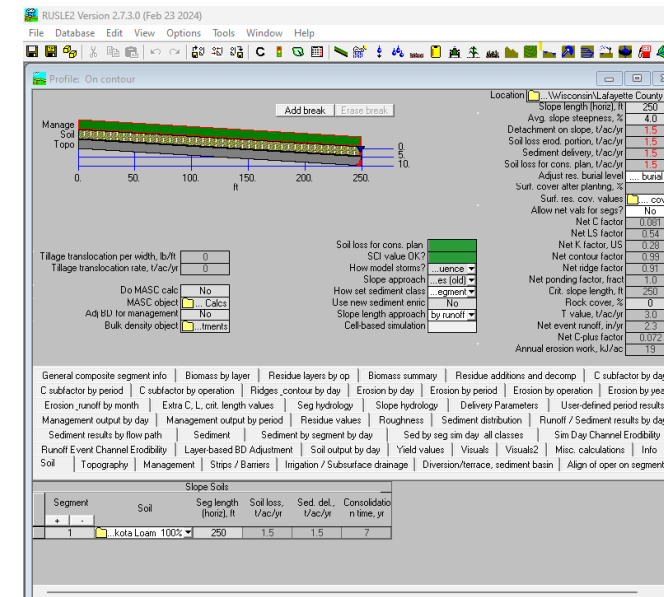
PP = Sediment P concentration x Amount of sediment leaving field

P content:

- Use adjusted surface soil test P and OM% to estimate soil total P
- ★ • Assume clay and silt particles have P content higher than the bulk soil (enrichment)

How much moves:

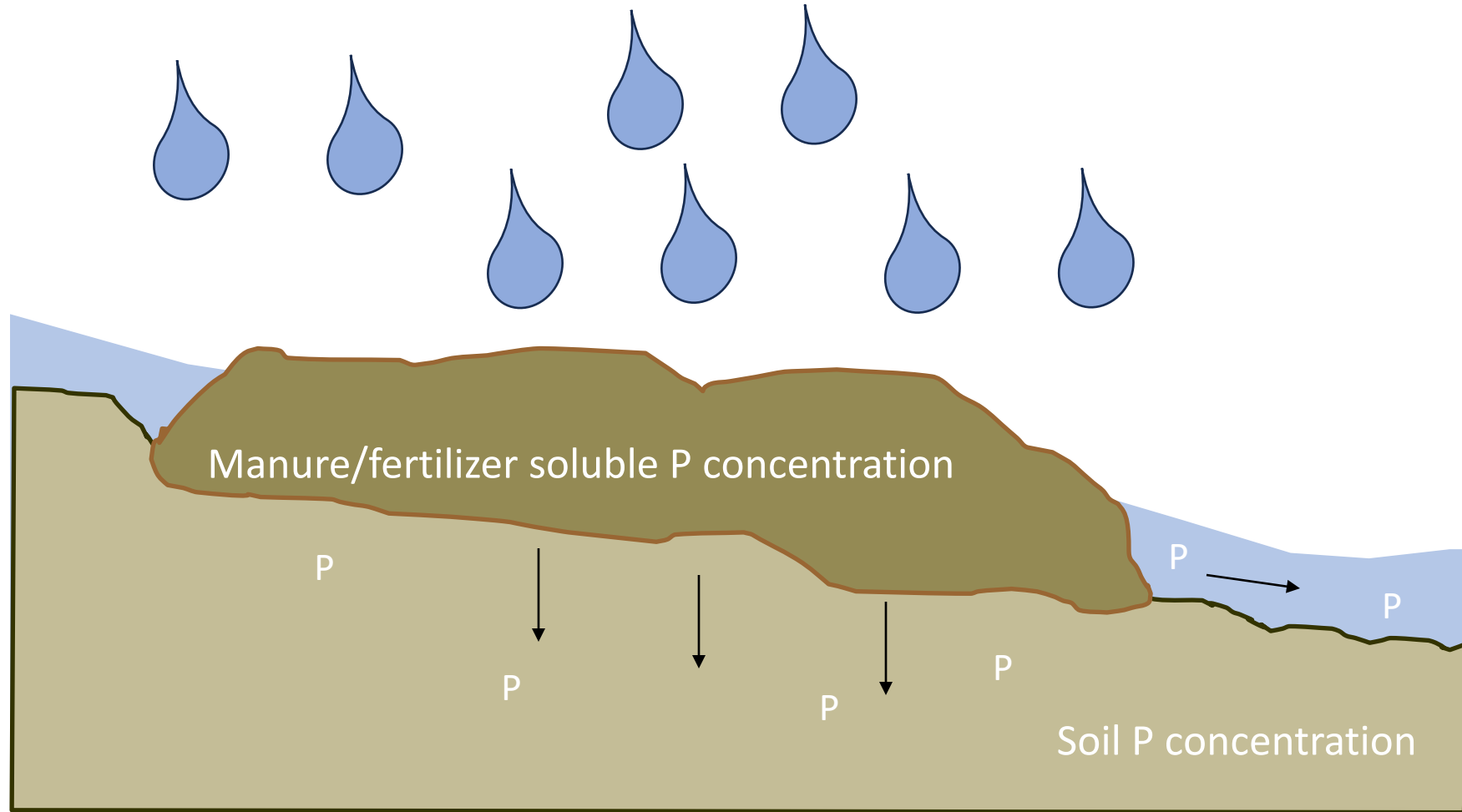
- Use RUSLE2 average sediment mass by particle size (clay, silt, small and large aggregates + sand).



Good, L. W., Vadas, P., Panuska, J. C., Bonilla, C. A., & Jokela, W. E. (2012). Testing the Wisconsin Phosphorus Index with Year-Round, Field-Scale Runoff Monitoring. *Journal of Environmental Quality*, 41(6), 1730–1740. <https://doi.org/10.2134/jeq2012.0001>

Dissolved P

From soil, manure, fertilizer



Dissolved P

Estimating rainfall runoff is an important part of the dissolved P calculation.

To calculate runoff, we use a modified curve number method.

Key inputs: runoff curve numbers from RUSLE2 and 20-year county precipitation database



New method for winter runoff



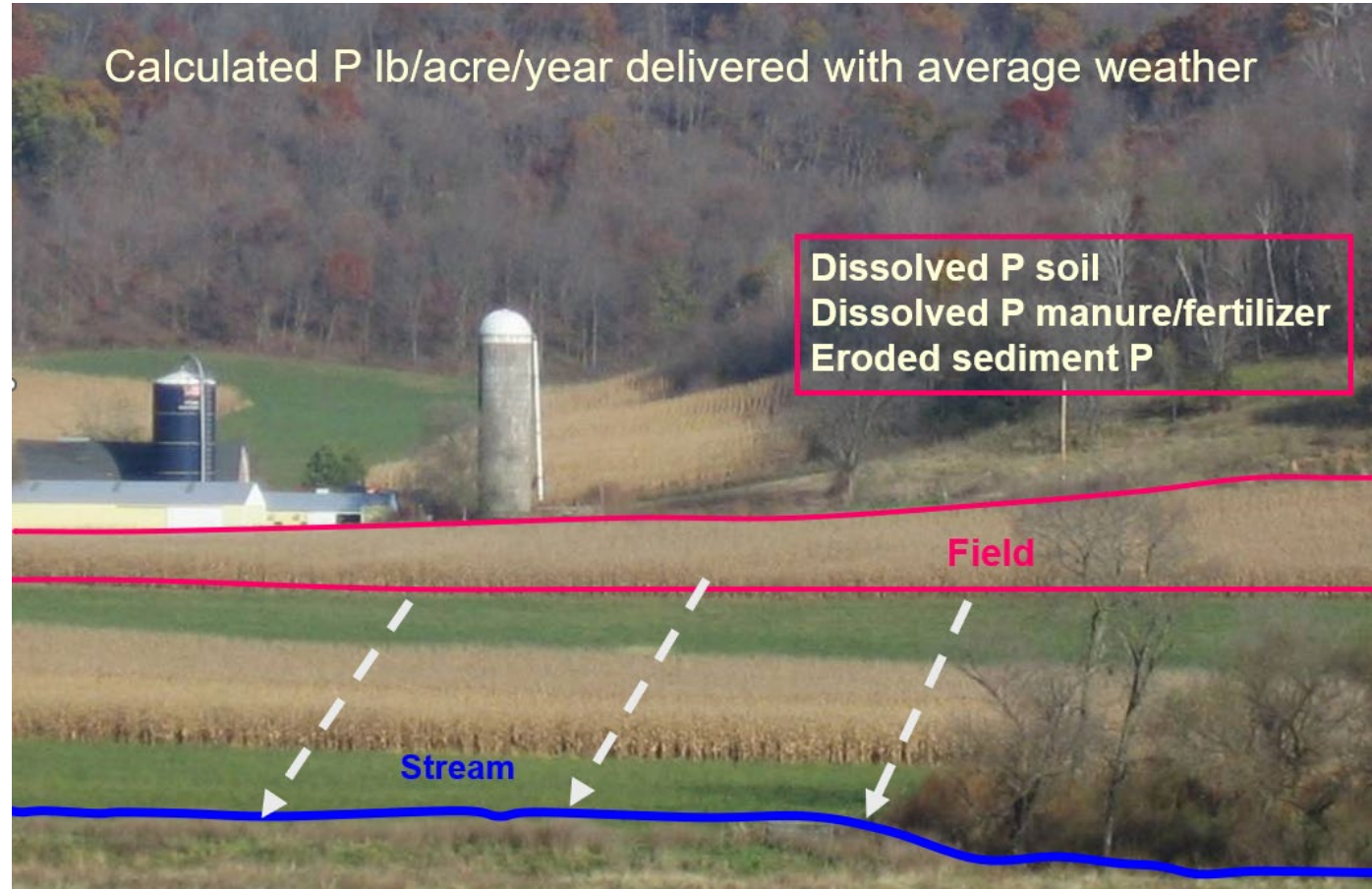


What fraction of fertilizer/manure P remains on surface after tillage?

SnapPlus tillage systems	Fraction on surface
Chisel plow, no disk	0.08
Chisel plow, disk	0.07
Disk	0.27
Cultivation	0.6
Moldboard plow	0.06
None	1
No Till	1
Subsoiler	0.7
Strip till	0.9
Vertical tillage	0.48

Field to stream delivery ratio

- applied to account for P deposition and infiltration
- assumes channelized flow similar to a grassed waterway
- based on distance and slope to water

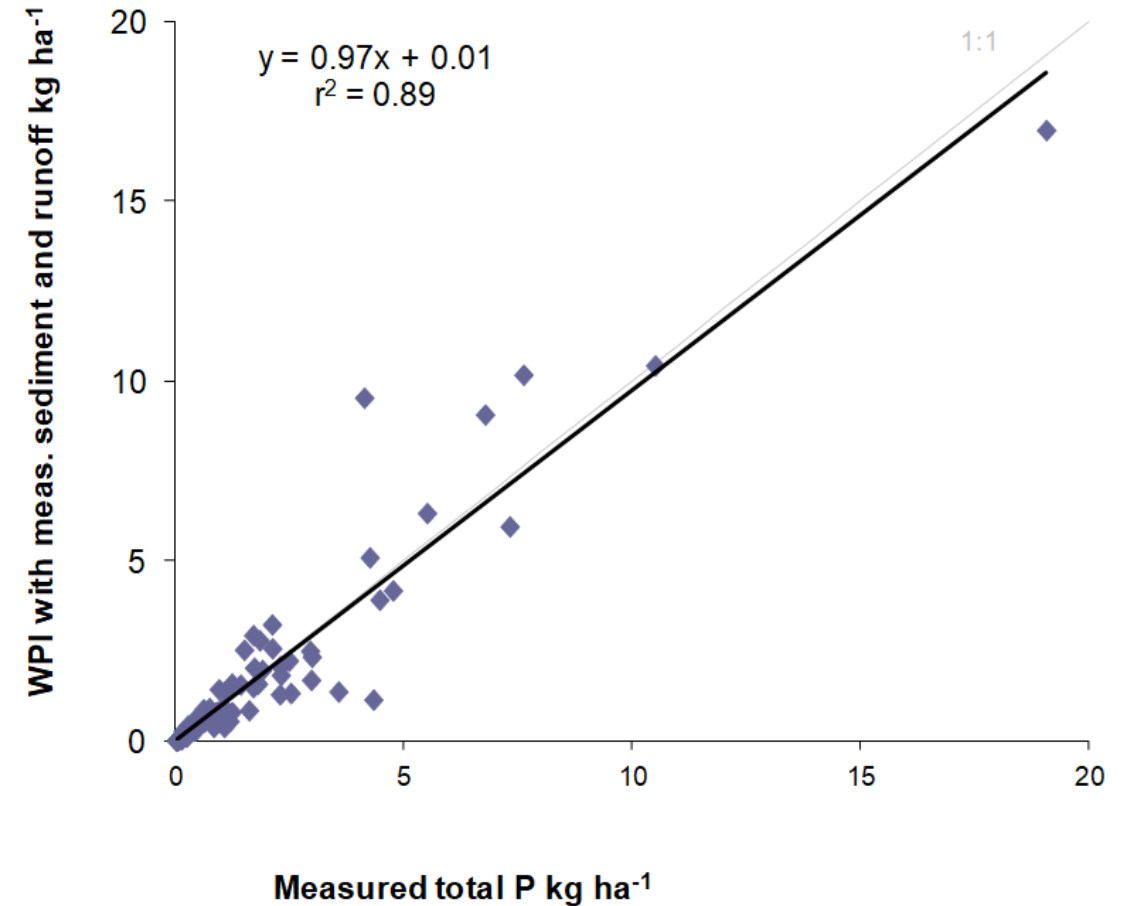


What are the impacts of recent updates?

Category	Components Impacted	Change
P Enrichment Ratios	Particulate P	Particulate P generally going up
Winter runoff	Dissolved P	Variable
P remaining on surface after incorporation	Dissolved P & Particulate P	Variable – depends on tillage

Tested – field data

Revised WI P Index compared to measured runoff losses for 86 site years



Good, L.W., P. Vadas, J.C. Panuska, C.A. Bonilla, W.E. Jokela, 2012. Testing the Wisconsin Phosphorus Index with Year-Round Field-Scale Runoff Monitoring. *Journal of Environmental Quality*. 41:1730-1740.

Key P Index Contributors

(an incomplete list)

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- Dr. Anita Thompson (UW BSE)
- Data from: Discovery Farms, Pioneer Farm, Marshfield ARS

Thank you!

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