

# P (and other nutrients): learning from T

Charles Wortmann

[cwortmann2@unl.edu](mailto:cwortmann2@unl.edu)

USDA-CSREES National Water  
Conference 2009

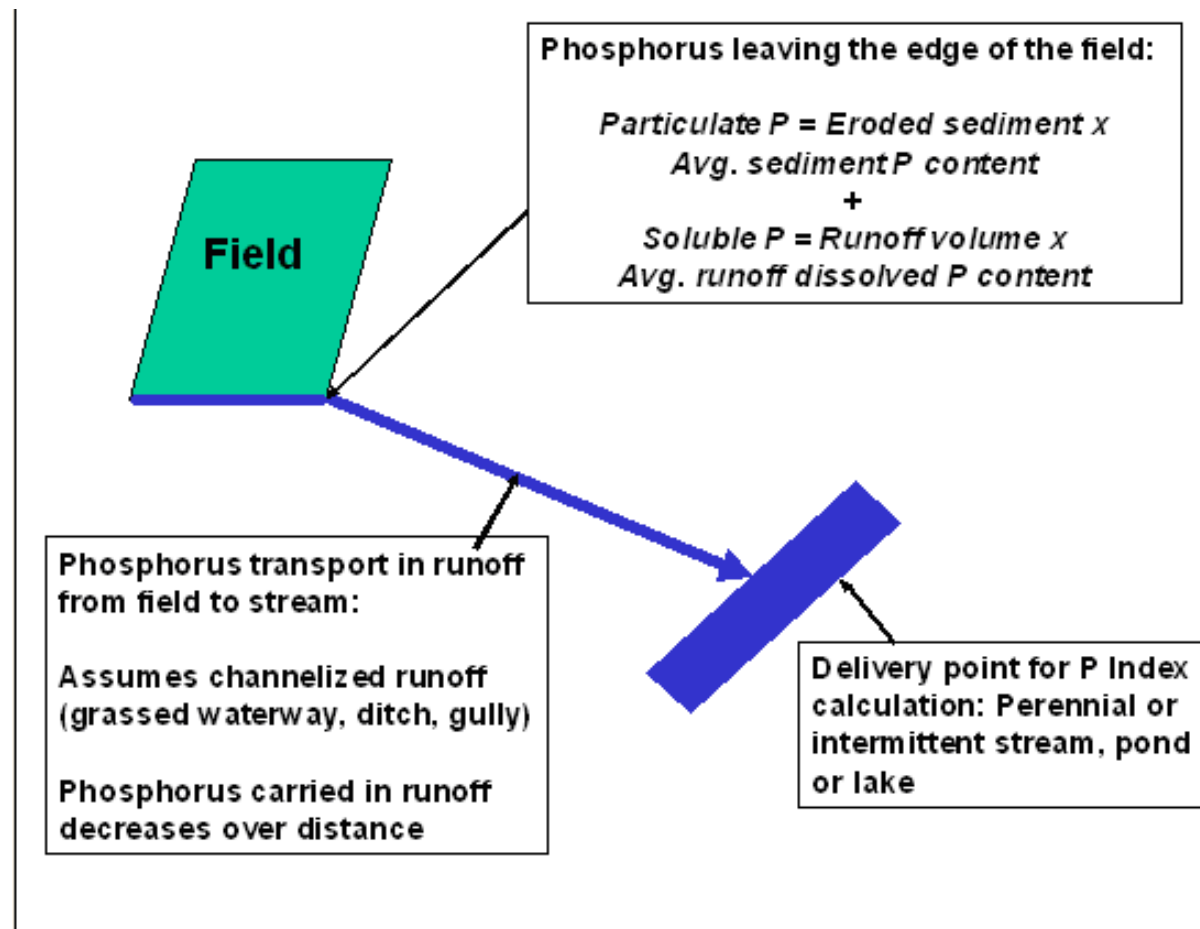
# Assess risk or quantity of P leaving field and entering surface water

## ■ Phosphorus Index: e.g. Wisconsin index

(Particulate +  
soluble P  
leaving field)

x

Delivery to surface  
water



# Factors affecting P loss

## Site/management factors

- Soil P levels
- P application practices: time, rate and method of application
- Management practices such as tillage, cover crops, conservation practices, etc.

## Transport factors

- Runoff
- Erosion: rainfall, snowmelt and irrigation
- Distance from center of 'field' to a stream, water body, channel, etc.
- Also, sub-surface drainage and under-ground movement of P to seepage areas

# Phosphorus Loss Assessment

**No Manure Applications**

**Very High**

**P-based Applications**

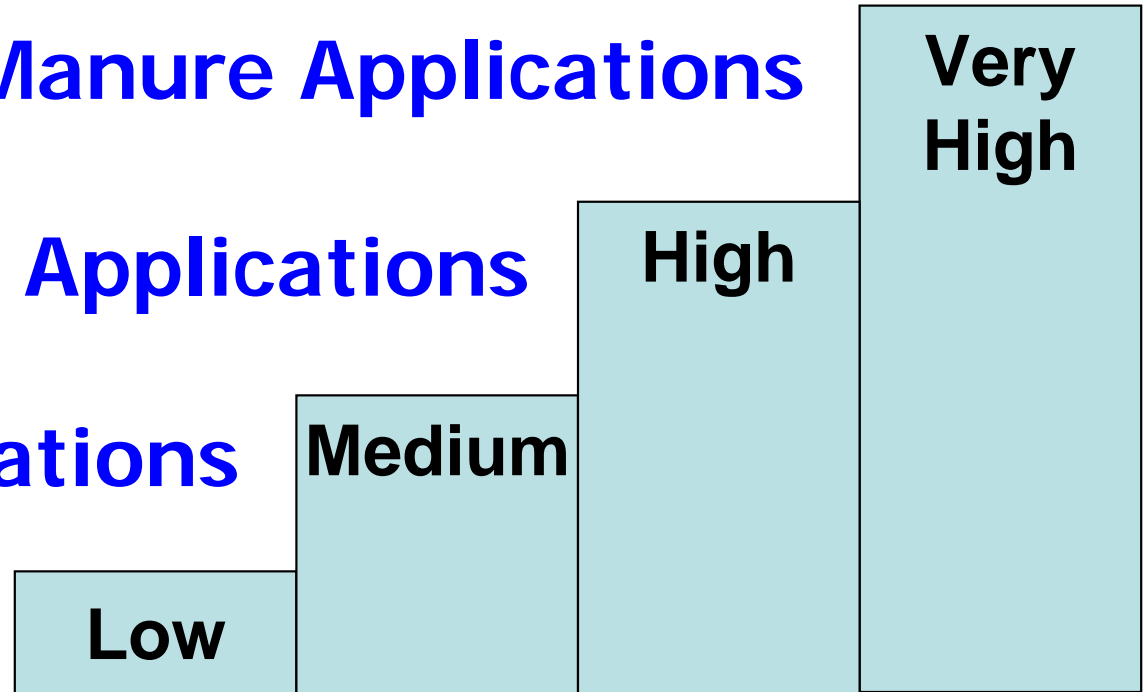
**High**

**N-based Applications**

**Medium**

**N-based Applications**

**Low**



PHOSPHORUS LOSS ASSESSMENT RATING, 10-04										Field/Site Number(s):	
Site Category (weight)	None (0)	Low (1)	Medium (2)	High (4)	Very High (8)	Risk Value 0, 1, 2, 4 or 8	Weighted value	Pr	Weighted value is calculated		
Soil Erosion (1.5)	N/A	< 5 tons/ac/yr	5-8 tons/ac/yr	9-12 tons/ac/yr	> 12 tons/ac/yr	4	6		Weighted value is calculated		
Furrow Irrigation Erosion (1.5)	Weighting factor	Tailwater recovery, QS < 6 very erodible soils, or QS < 10 other soils	QS > 10 for erosion resistant soils	QS > 10 erodible			0		Enter risk values in this column		
Sprinkler Erosion/Runoff (0.5) (Refer to Agronomy Tech Note 104 for more specific values and breakdowns on this category)		All sites 0-3% slope, all sandy sites, or site evaluation indicates little or no runoff., large spray on silts 3-8%	Medium spray on silty soils 3-15% slopes, large sprays on silty soils 8-15% slope, low spray on silt soils 3-8%, large spray on clay soils 3-15% slopes	Medium spray on clay soils 3-8% slopes, large spray clay soils >15% slope, medium spray on silt soils >15% slope	Medium spray on clay soils >8 slope, low spray on clay soils 3-8% , low spray on silty soils >15% slope	Low spray on clay soils >8% slope		0			
Runoff Class (1.5)	Negligible	Very Low or Low	Medium	High	Very High		0				
Bray P1 Soil P Test or Olson (1.0)	-----	<30 ppm Bray, <20 ppm Olson	30-60 ppm Bray, 20-40 ppm Olson	60-120 ppm Bray, 40-80 ppm Olson	> 120 ppm Bray, > 80 ppm Olson		0				
Commercial P Fertilizer Application Method (0.5)	None Applied	Placed with planter or injected deeper than 2 inches	Incorporated < 3 months prior to planting or surface applied during the growing season	Incorporated > 3 months before crop or surface applied < 3 months before planting	Surface applied > 3 months before planting		0				

	A	B	C	D	E	F	G	H	I	
9	Commercial P Fertilizer Application Rate (0.5)	None Applied	<30 P <sub>2</sub> O <sub>5</sub> lbs/ac	31-90 P <sub>2</sub> O <sub>5</sub> lbs/ac	91-150 P <sub>2</sub> O <sub>5</sub> lbs/ac	> 150 P <sub>2</sub> O <sub>5</sub> lbs/ac	0	0		
10	Manure/ Organic P Source Application Method (1.0)	N/A	Injected Deeper Than 2 inches	Incorporated < 3 months prior to planting or surface applied during the growing season	Incorporated > 3 months before planting or surface applied < 3 months before planting	Surface applied to pasture or > 3 months before crop	0	0		
11	Manure/ Organic P Application Rate (1.0)	None Applied	<30 P <sub>2</sub> O <sub>5</sub> lbs/ac	31-90 P <sub>2</sub> O <sub>5</sub> lbs/ac	91-150 P <sub>2</sub> O <sub>5</sub> lbs/ac	> 150 P <sub>2</sub> O <sub>5</sub> lbs/ac	0	0		
12	Distance to Concentrated Surface Water Flow (1.0)	Runoff and sediment can not exit the site	>200 feet or functioning grassed waterways, or tile outlet terraces or sediment basins in concentrated surface water flow areas, or functioning grassed filter strips that are at least 100 feet wide	100-200 feet or functioning grass filter strips that are at least 35 feet wide that filter runoff from the field	<100 feet	0 feet (occurs on-site), or applied directly to concentrated surface water flow or occurs at application site	1	1		
13	Site/Field Vulnerability Total Risk Rating (Low <14, Medium 14-27.5, High 28-55.5, Very High >55.5):								12	
14	Place a value for each applicable category in the shaded area to get an overall risk rating for each site/field(s)									
15	For assistance contact Mike Kucera, State Resource Conservationist, at 402-437-4102									
	Refer to Nebraska NRCS Agronomy Technical Note 104, "Assessing and Managing Phosphorus Loss for Manure Management," for guidance at the following									

Risk values are entered for each factor, the weighted values are calculated and totaled.

The risk rating is determined; 12 = low risk.

# Nebraska Phosphorus Index

Summary

Run # (1 to 6): \_\_\_\_\_ Prepared By: \_\_\_\_\_  
 Field name: \_\_\_\_\_ Prepared For: \_\_\_\_\_  
 Option name: \_\_\_\_\_ Note!



**INSTRUCTIONS:** Enter data in white cells. Indicate run, field name and option. Then enter all erosion data, runoff data next, and irrigation data.

**Erosion Component** Value **#N/A**

County **Cuming** Note!

Soil Type \_\_\_\_\_

Gross Erosion (average tons/acre/year)  
 Note! Sheet & Rill (e.g. RUSLE2 value) **9.0**

Estimate	Field Area (acres)	Tons (total)
Ephemeral <b>0.00</b>		
Gully <b>0.00</b>		
Factor <b>9.04</b>		

Conservation Practices  
 Note! None  
 Factor **1.00**

Landform Region  
**Till Plains**  
 Select Landform Region >>> View/Map and Choose

Note! Enter the distance in feet from the center of the field or management unit to the closest point where runoff enters a intermittent or perennial stream, river, or lake, or where runoff enters a ditch or channel, outside the field, that leads to one of these water bodies.  
**100**  
 Factor **0.87**

Grassed Filter Strip Width  
 Note! **0-10 R** 393 Standard Hot Link  
 Factor **1.00**

Next >

**Runoff Component** Value **0.00**

Tillage and Cropping System  
 Enrichment \_\_\_\_\_ Note!  
 Tillage System \_\_\_\_\_  
 Crop System \_\_\_\_\_ Note!

Precipitation Factor	<b>6.3</b>
Runoff Curve Number	
RCN Fraction	
Factor	<b>0.00</b>
Enrichment Factor	<b>#N/A</b>

Phosphorus Test  
**Bray-1 P, Mehlich-3**

Note! Enter the P test result \_\_\_\_\_ (ppm)  
 Factor (runoff) **0.05**  
 Factor (erosion) **#N/A**

Application Rate  
 Note! Annual P application \_\_\_\_\_ pounds per acre  
 P<sub>2</sub>O<sub>5</sub> \_\_\_\_\_  
 elemental P \_\_\_\_\_ Convert

**Incorporate or Inject Within 24 Hours**  
 Factor **0.00** Next >

**Irrigation Component**

Type of Irrigation  
**Sprinkler**

**Manure Component**

Note! Manure Application (tons/acre) \_\_\_\_\_

**Erosion Estimator**

Note! Sheet & Rill Erosion Estimate **#N/A**

**P - Index Value**  
 0 to 2 = Low risk  
 2 to 5 = Medium risk  
 5 to 15 = High risk  
 15+ = Very high risk

**P - Index Value** **#N/A**

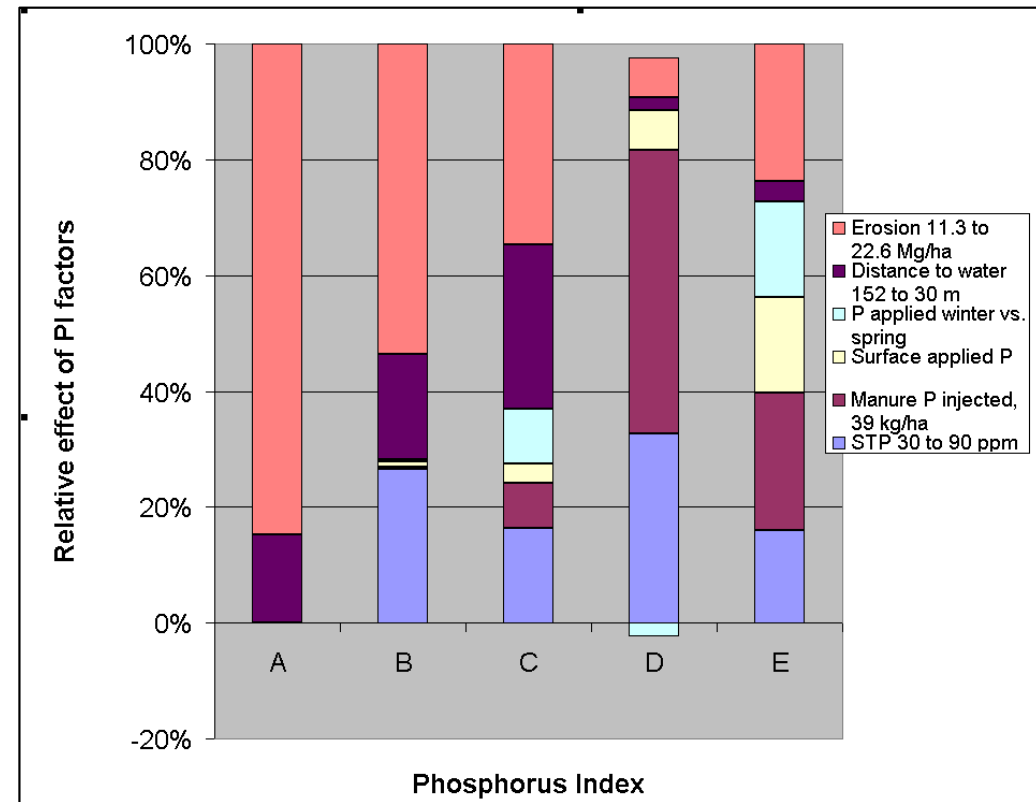
Summary

# Nebraska Phosphorus Index



# P index development

- A comparison of 5 PIs from the Midwest.
- Differences evaluated considering results from numerous studies
- Soluble vs. total P
- Benning and Wortmann, 2005. J. Soil Water Conserv. 60:221-228.



# Main factors affecting P loss

- **Erosion > runoff >> soil test P > distance to water body if within 300 ft > P application (rate, time and method of application are somewhat important but P source is not of much importance.)**



# Nebraska Phosphorus Index

Summary

Run # (1 to 6): \_\_\_\_\_ Prepared By: \_\_\_\_\_  
Field name: \_\_\_\_\_ Prepared For: \_\_\_\_\_  
Option name: \_\_\_\_\_ Note!

INSTRUCTIONS: Enter data in white cells. Indicate run, field name and option.  
Then enter all erosion data, runoff data next, and irrigation data.

**Erosion Component** Value **#N/A**

County **Cuming** Note!

Soil Type \_\_\_\_\_

Gross Erosion (average tons/acre/year)  
Note! Sheet & Rill (e.g. RUSLE2 value) **9.0**  
Field Area (acres) (total) \_\_\_\_\_

Estimate Ephemeral	0.00
Gully	0.00
Factor	9.04

Conservation Practices  
Note! None  
Factor **1.00**

Landform Region  
**Till Plains**  
Select Landform Region >>> View/Map and Choose

Note! Enter the distance in feet from the center of the field or management unit to the closest point where runoff enters a intermittent or perennial stream, river, or lake, or where runoff enters a ditch or channel, outside the field, that leads to one of these water bodies.  
**100**  
Factor **0.87**

Grassed Filter Strip Width  
Note! **0-10 R**  
Factor **1.00** [393 Standard](#) [Hot Link](#)

Next >

**Runoff Component** Value **0.00**

Tillage and Cropping System  
Enrichment \_\_\_\_\_ Note!  
Tillage System \_\_\_\_\_  
Crop System \_\_\_\_\_ Note!

Precipitation Factor	6.3
Runoff Curve Number	
RCN Fraction	
Factor	0.00
Enrichment Factor	#N/A

Phosphorus Test  
**Bray-1 P, Mehlich-3**

Note! Enter the P test result \_\_\_\_\_ (ppm)  
Factor (runoff) **0.05**  
Factor (erosion) **#N/A**

Application Rate  
Note! Annual P application \_\_\_\_\_ pounds per acre  
P<sub>2</sub>O<sub>5</sub> \_\_\_\_\_  
elemental P \_\_\_\_\_ Convert

**Incorporate or Inject Within 24 Hours**  
Factor **0.00** Next >

**Irrigation Component**

Type of Irrigation  
**Sprinkler**

**Manure Component**

Note! Manure Application (tons/acre) \_\_\_\_\_

**Erosion Estimator**

Note! Sheet & Rill Erosion Estimate **#N/A**

**P - Index Value** **#N/A**

8 to 2 = Low risk  
2 to 5 = Medium risk  
5 to 15 = High risk  
15+ = Very high risk

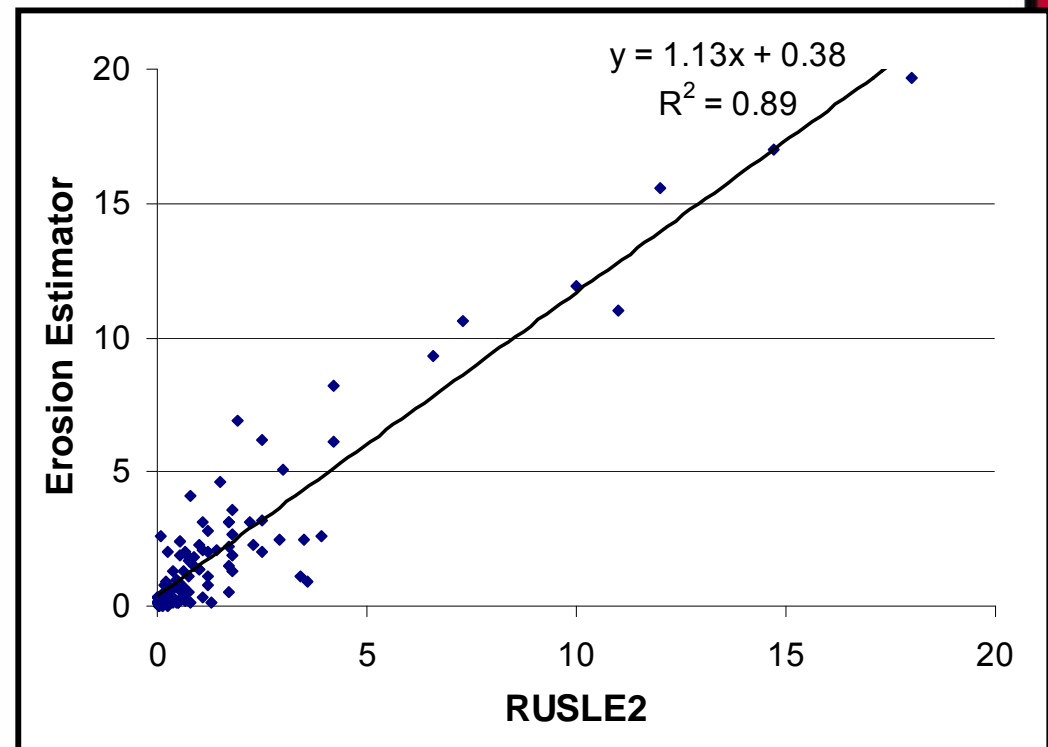
# Nebraska Phosphorus Index



# Erosion calculator

$$\text{Erosion (t/ac)} = 12.5 * \text{LU} * \text{CP} * ((\text{K} - 0.32) * 0.5 + 0.32) / .32 * \text{SF} * \text{R} / 135 * \text{T} * \text{I}$$

- LU = Land use
- CP = Conservation practice
- K = Soil erodibility
- SF = Intermediate slope factor
- R = County rainfall factor
- T = Tillage factor
- I = Irrigation



Note!

Note!

Estimates of sediment bound P and dissolved P are reduced by 2% for each t/yr of manure dry matter;

e.g. 7.5t/yr = 15% decrease in PI score.

Type of Irrigation

Sprinkler

### Manure Component

Note! Manure Application (tons/acre/yr)

### Erosion Estimator

Note! Sheet & Rill Erosion Estimate

#N/A

Use Estimate

0.00

Next >

P - Index Value

#N/A

### P - Index Value

0 to 2 = Low risk

2 to 5 = Medium risk

5 to 15 = High risk

15 + = Very high risk

Summary

# Total P (other nutrient) loss tolerance (T) levels

- Or is it
  - ◆ Acceptable level
  - ◆ Agronomic acceptable level
  - ◆ Interim acceptable level
  - ◆ Interim agronomic acceptable level
  - ◆ Interim agronomic, economic, social.....???

# How do we intend to use the “T” “A” “AA” “I” levels?

- Identification of most critical situations
- Guiding value in the
  - ◆ Characterization of situations
  - ◆ Prioritization of situations
  - ◆ Attainability analysis
  - ◆ Setting targets
- Used together with models

# Should the “level” be soil, field, or landscape based?

- E.g. soil erosion T
- P index values

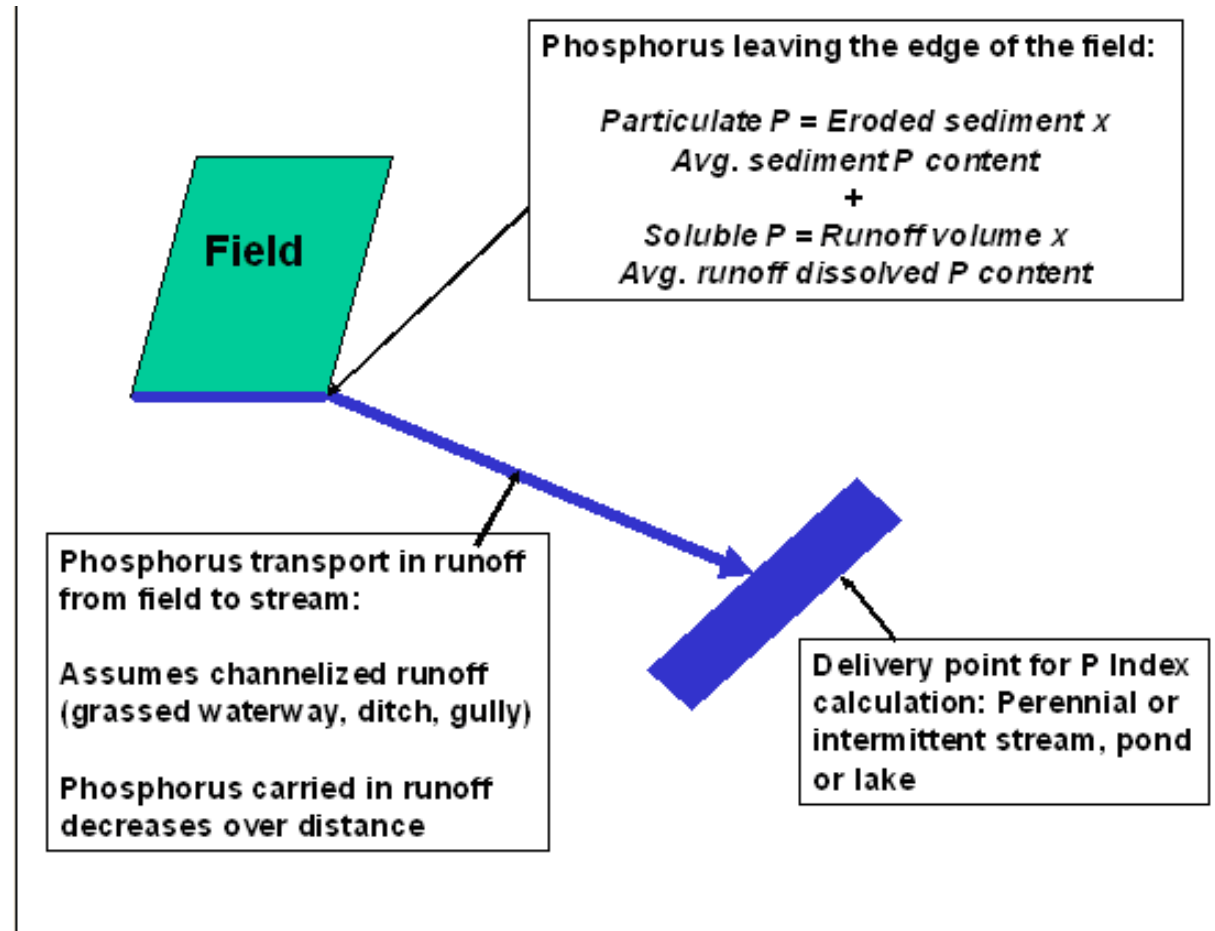
# Should the P (or other nutrient) levels be water body based?

- Water P concentration in water body, e.g. 0.01 - 0.1 ppm??
  - ◆ The EPA RTAGs
  - ◆ TMDLs

- Value of water body:
  - ◆ water supply, recreation, etc. vs.
  - ◆ reservoir to protect downstream waters??
  - ◆ Contributing vs. receiving streams/lake??
- Cost of achieving and/or maintaining the targeted maximum load??
- Contributing land area relative to water body size and how well can the disproportionalities be targeted??
- Is P the limiting nutrient for aquatic vegetative growth? If not, should the focus be on the most limiting nutrient?

# Consideration of the continuum

- Field
- upper and lower water bodies
- as well as channel or stream bank and beds



Thank you