P Indices: A Southern Comparison

National CSREES Water Quality Conference

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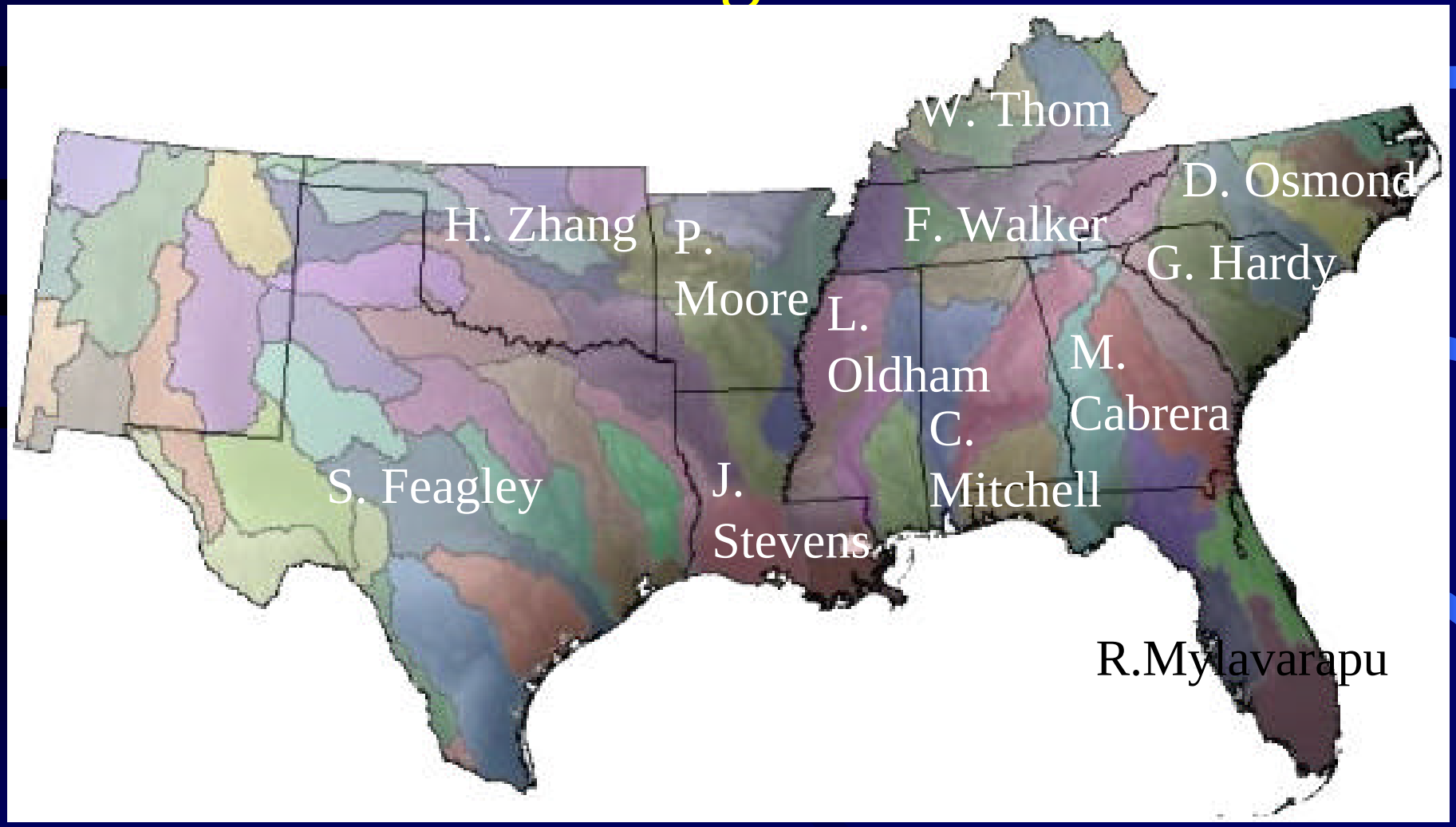
Southern CSREES Water Quality Region

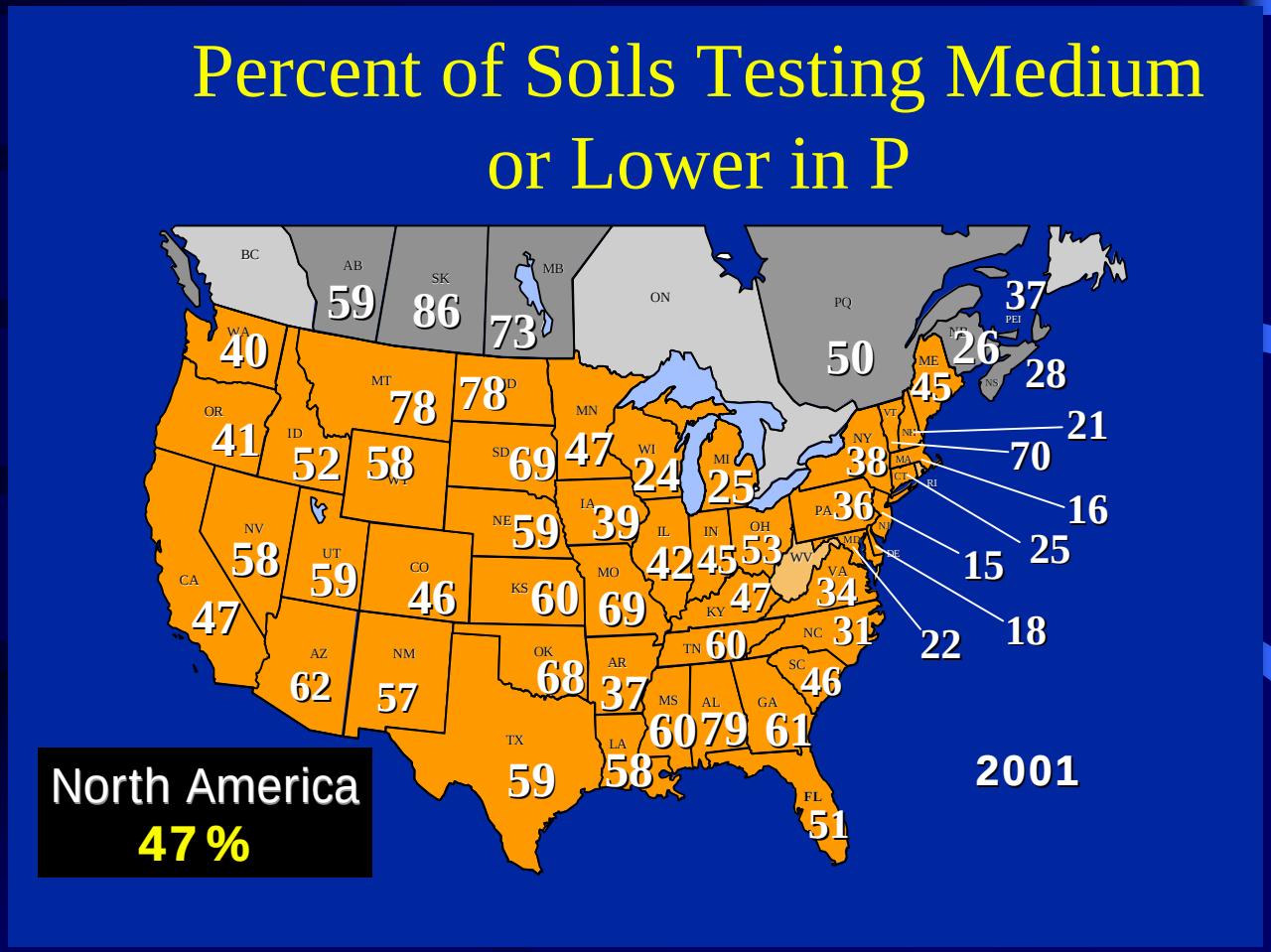


NRCS 590 Standard: State Choices for Priority Nutrient

- Soil Test
  - Below agronomic threshold: N based
  - Above agronomic threshold: P based or no manure
- Soil Phosphorus Threshold
  - Below threshold: N based
  - Above threshold: P based or no manure
- Phosphorus Index (PI) Rating
  - Low or medium: N based
  - High: P removal
  - Very High: No manure

Soil Test (3)

- California
- Connecticut
- South Dakota



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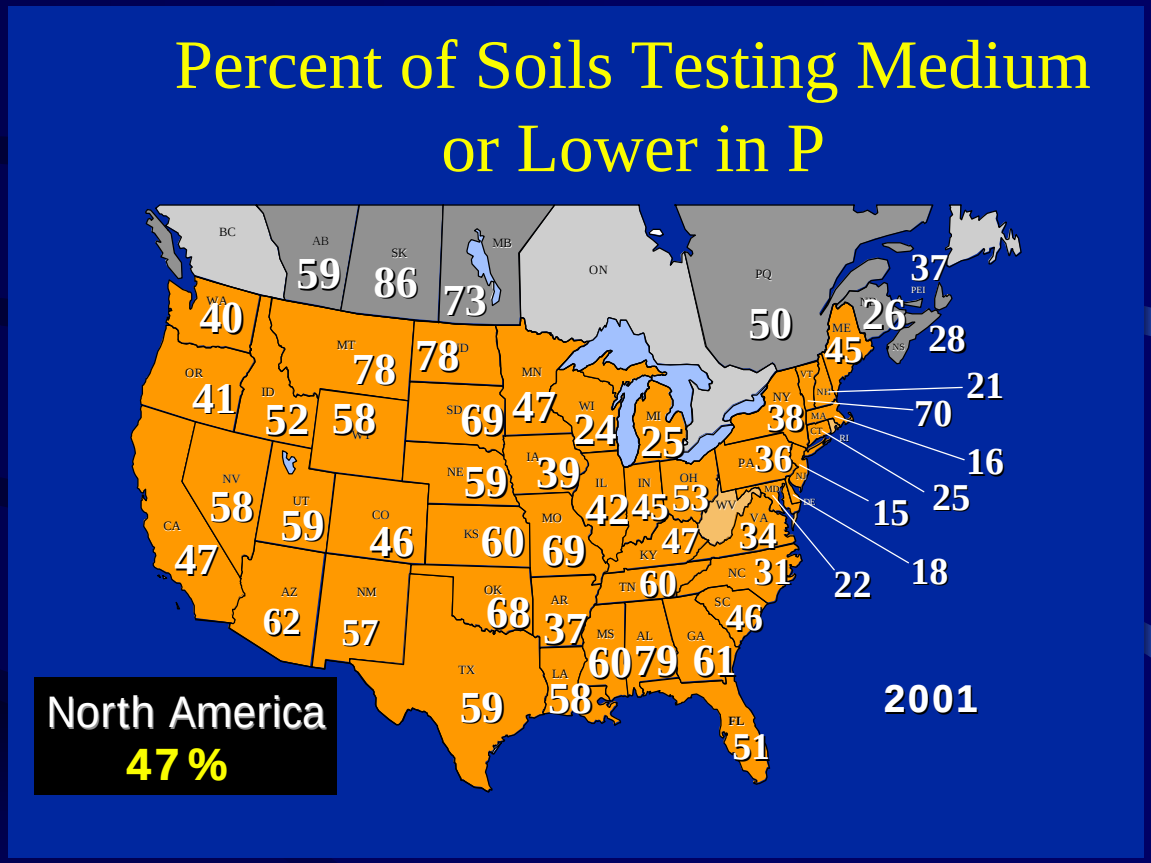
Original P Assessment Index: Lemunyon & Gilbert 1993

		Loss Rating (Value)				
Property	Weight Factor	None (0)	Low (1)	Med (2)	High (4)	Very High (8)
Soil Erosion	1.5	N/A	<5T	5-10 T	10-15 T	>15 T
Runoff Class	0.5	N/A	Low	Med	Hi	V. Hi
Soil P	1.0	N/A	Low	Med	High	V. High
Fert P Rate	0.75	None	<15	15-45	46-75	76+
App Method	0.5	None	@P, >5	Inc @P	3 mo	>3m
Organic Rate	1.0	None	<15	15-45	46-75	76+
App Methods	1.0	None	@P, >5	Inc @P	3 mo	>3m

Qualitative P-Indices (37)

- Alabama (+)
- Florida (x)
- Kentucky (+)
- Louisiana (x)
- Mississippi (x)
- New Mexico (+)
- Oklahoma (?)
- South Carolina (x)
- Tennessee (x)
- Texas (+)



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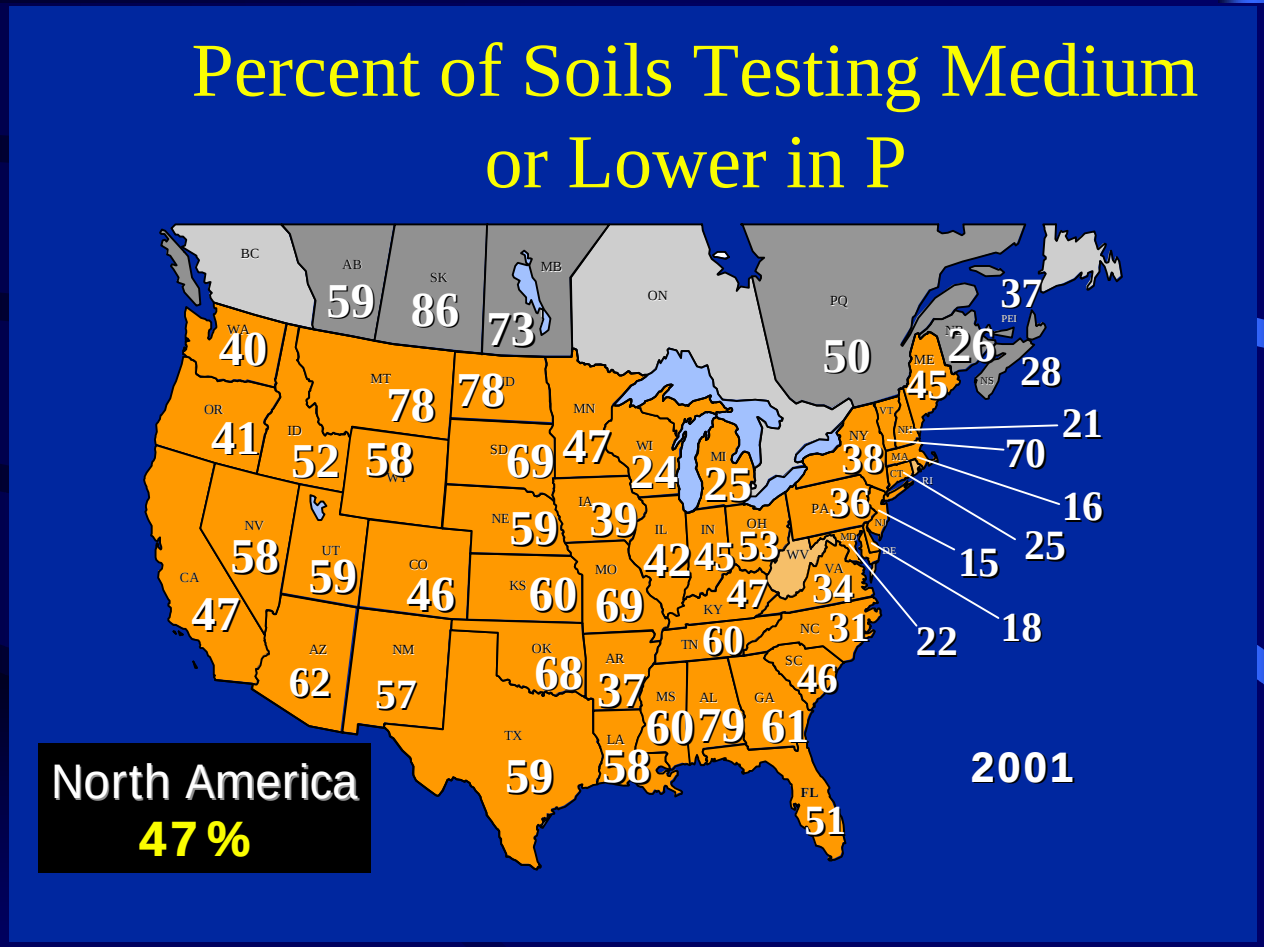
Quantitative P-Indices (10)

- Arkansas
- Georgia
- North Carolina



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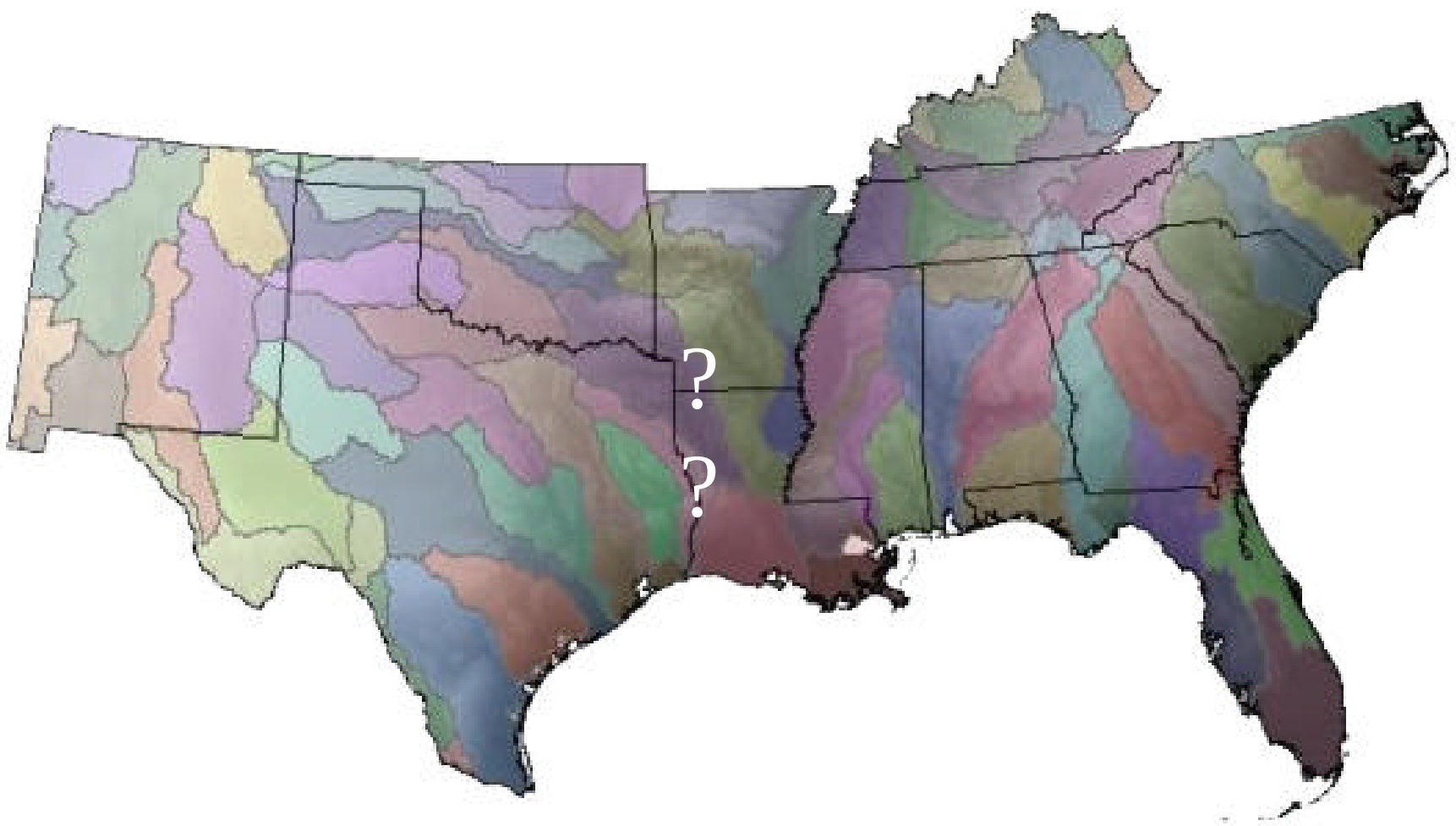
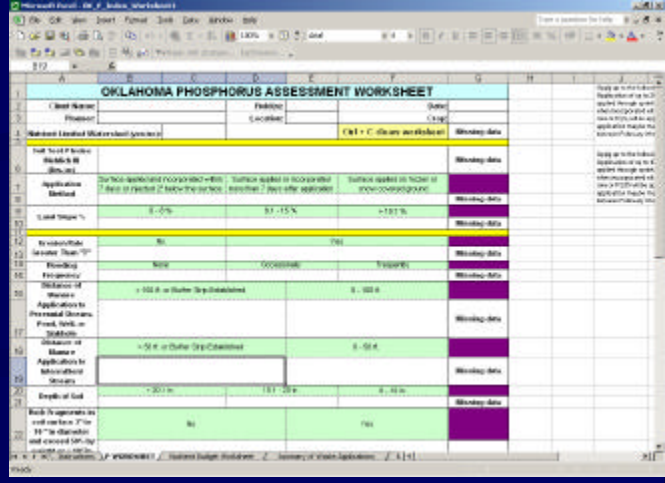
State Specific Changes to Original P Index

- Soil test threshold (Arkansas, Kentucky, Texas…..)
- Solubility of P (Arkansas, Florida, Georgia, North Carolina)
- Flooding frequency (Arkansas, Oklahoma)
- BMPs (Alabama, Arkansas, Georgia, North Carolina, Tennessee...)
- Ranking of priority water resources (Alabama, Florida, Kentucky, Louisiana, Oklahoma....)

How Similar or Dissimilar are Recommendations from the Southern Region P-Indices?

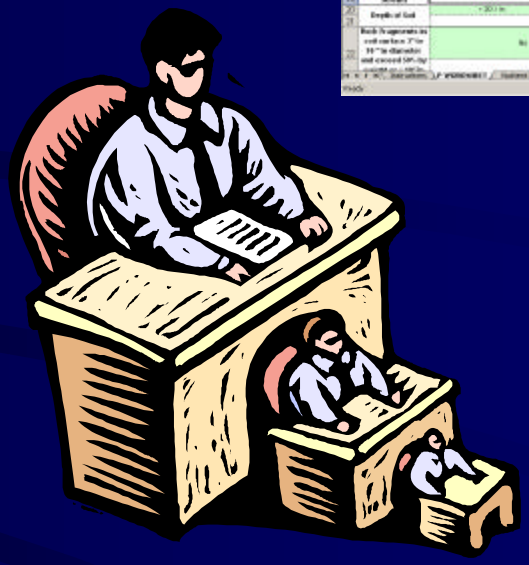


Methodology



Define all inputs

- Soil test P
- Source type, amount and application date
- Litter P solubility
- Erosion rate
- Hydrologic condition
- Depth to Water
- Curve number
- Flooding frequency
- Impaired water
- Drain spacing and depth



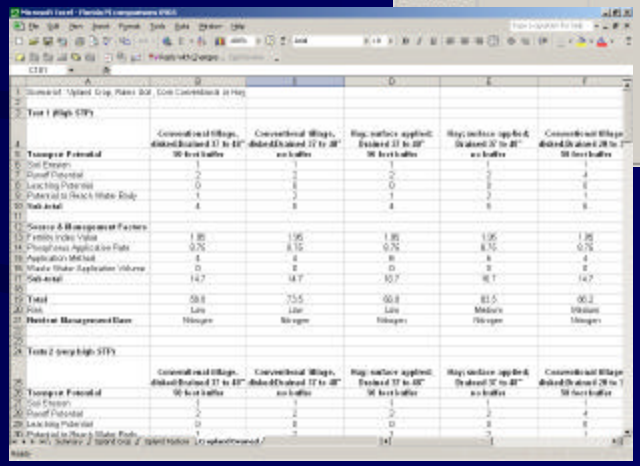
Develop scenarios

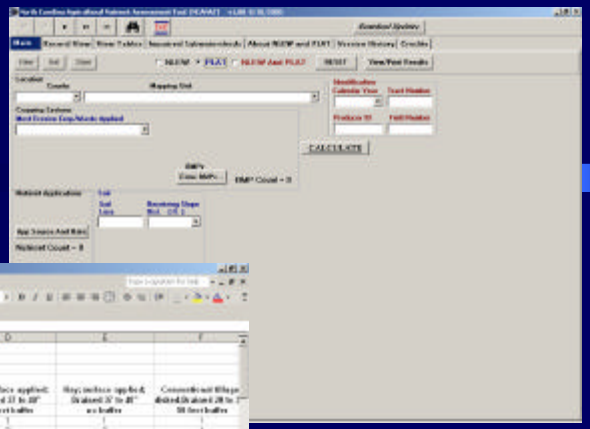
- Pasture
- Upland cropped soils
- Poorly drained soils

Comparison of Southern P-Indices

- Pastures
- Upland soils
- Poorly drained soils

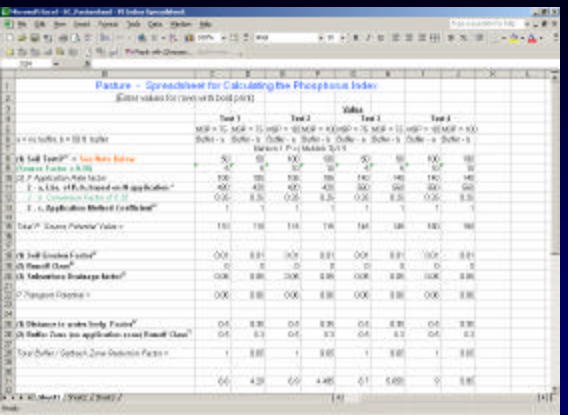
FL





NC

SC



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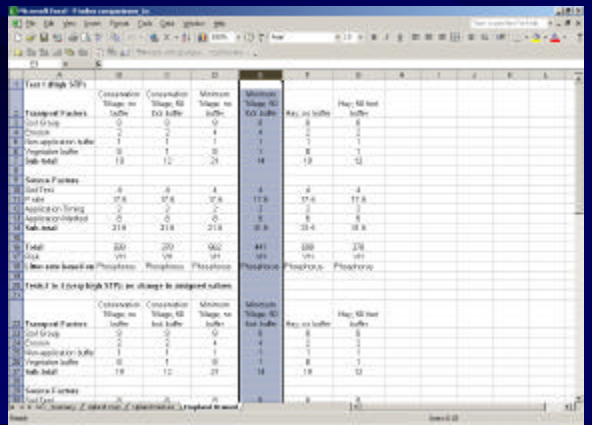
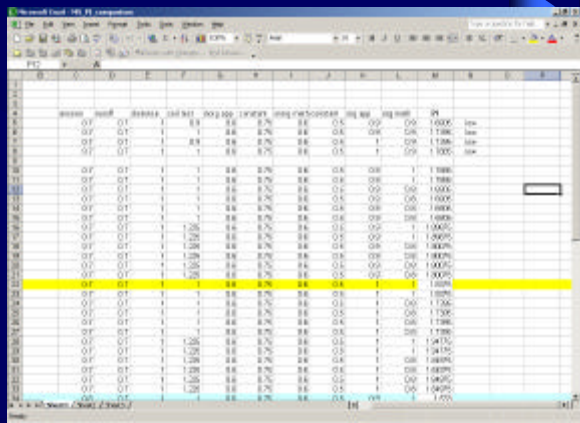


MS



Pasture Factors

- Source Content – 70 lb P_2O_5/t
- Litter P Solubility – 30% (GA, NC) or l lb P_2O_5 (AR)
- Waste Moisture – 30%
- Source Application – Surface
- Timing – April
- County – Wake (NC)
- Crop - Grass
- Soil Mapping Unit – Norfolk (NC), Orangeburg (FL), Pacelot/Goldsboro (GA)
- Erosion Rate – 1 t/ac
- Receiving Slope – No
- Hydrologic Group – B
- Hydrologic Condition – Good
- Slope – 5%

- Slope Length – 100 feet
- Runoff Class – Moderate
- Soil Drainage Class – Well
- Curve Number – 58
- Rainfall – 46 inches/year
- Depth to Water Table - > 4 feet
- Distance to Water – 50 feet
- Flooding Frequency – Occasional
- Impaired - Yes
- MLRA – Other (KY)
- Depth to Soil - >20 inches

Pasture – Factors Varied: 14 Scenarios

- STP
  - 75 M3P
  - 150 M3P
- Source Amount
  - 2 t/ac
  - 4 t/ac
  - 6 t/ac
  - 8 t/ac
- Buffer
  - Yes
  - No

Pasture: M3P = 75

Scenario		P-Index Rating			
Litter	Buffer	Low	Medium	High	V. High
2 t/ac	No	AL, FL, GA, LA, MS, NC, SC	AR	KY, TN, TX	OK
4 t/ac	No	GA, LA, MS, NC, SC	AL, FL	AR, KY, TN, TX	OK
6 t/ac	No	GA, MS, NC	FL, SC	KY, LA, TX	AL, AR, OK, TN
6 t/ac	Yes	GA, LA, MS, NC, SC	FL	AL, AR, KY, TN, TX	OK
8 t/ac	No	GA, MS, NC	SC	FL, KY, LA, TX	AL, AR, OK, TN
8 t/ac	Yes	GA, LA, MS, NC, SC	FL	AL, AR, KY, TN, TX	OK

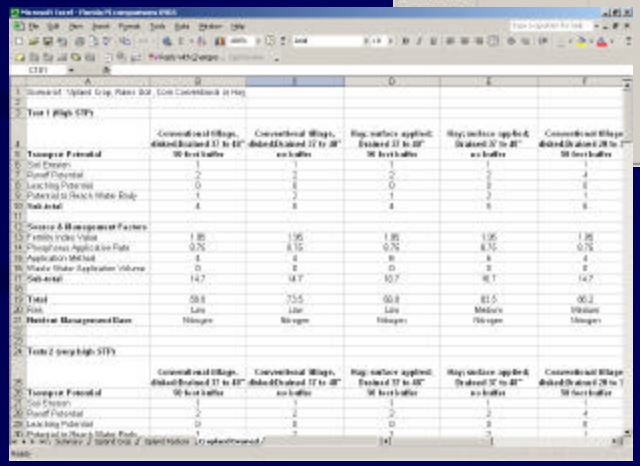
Pasture: M3P = 150

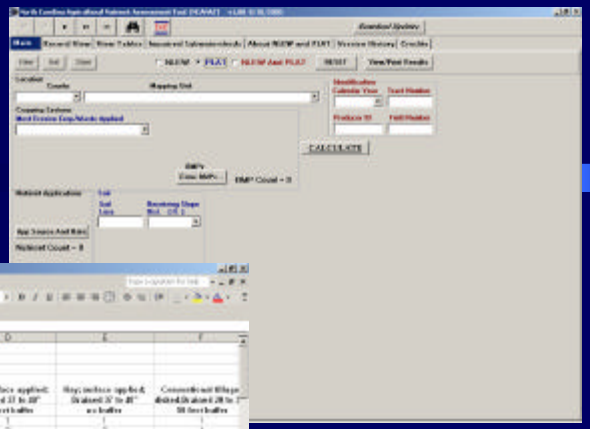
Scenario		P-Index Rating			
Litter	Buffer	Low	Medium	High	V. High
6 t/ac	No	MS, NC	GA, SC	FL, KY, LA, TX	AL, AR, OK, TN
6 t/ac	Yes	GA, LA, MS, NC, SC	FL	KY, TX	AL, AR, OK, TN
8 t/ac	No	MS, NC	GA, SC	FL, KY, TX	AL, AR, LA, OK, TN
8 t/ac	Yes	GA, MS, NC, SC	LA	FL, KY, TX	AL, AR, OK, TN

Comparison of Southern P-Indices

- Pastures
- Upland soils
- Poorly drained soils

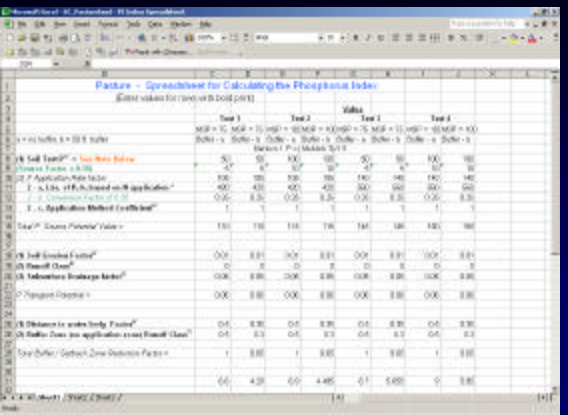
FL





NC

SC



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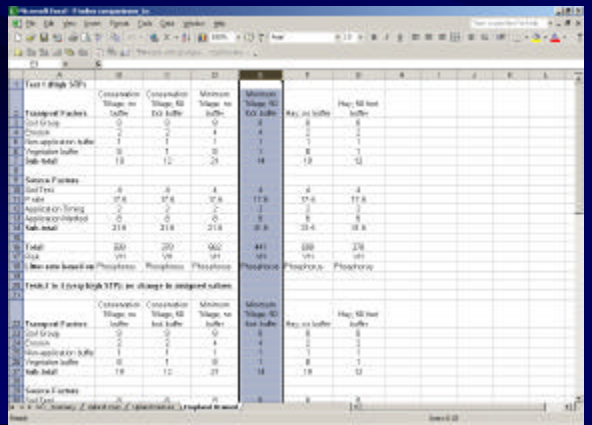

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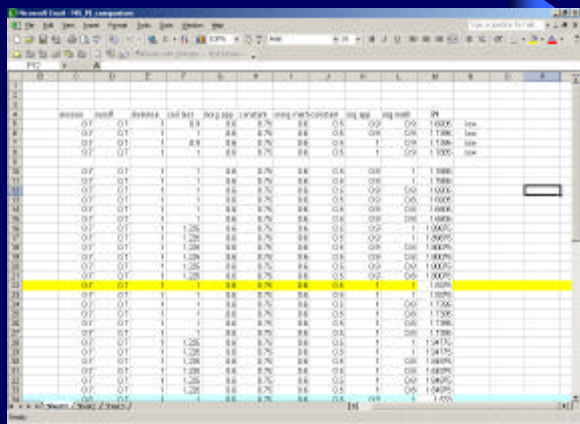


Cropped Upland Factors

- Source Content – 70 lb P_2O_5/t
- Litter P Solubility – 30% or l lb P_2O_5
- Waste Moisture – 30%
- Timing – 15 days before planting
- County – Wake (NC)
- Crop - Corn
- Soil Mapping Unit – Norfolk (NC), Orangeburg (FL), Pacelot/Goldsboro (GA)
- Receiving Slope – No
- Hydrologic Group – B
- Hydrologic Condition – Good
- Slope – 5%
- Slope Length – 100 feet
- Runoff Class – Moderate
- Soil Drainage Class – Well
- Curve Number – 83(conventional) & 75(conservation)
- Rainfall – 46 inches/year
- Depth to Water Table - > 4 feet
- Distance to Water – 50 feet
- Flooding Frequency – Occasional
- Impaired - Yes
- MLRA – Other (KY)
- Depth to Soil - > 20 inches (OK)

Cropped Upland – Factors Varied: 24 Scenarios

- STP
  - 75 M3P
  - 150 M3P
- Source Amount
  - 2 t/ac
  - 4 t/ac
- Tillage
  - Conservation
  - Minimum
  - Conventional
- Source Application
  - Surface (conservation)
  - Incorporated within 15 days (minimum and conventional)

- Erosion Rate
  - 1 t (conservation)
  - 4 t (minimum)
  - 8 t (conventional)
- Buffer
  - Yes
  - No

Uplands Cropped: M3P = 75, Litter = 2 t/ac

Scenarios		P-Index Rating			
Buffer	Tillage	Low	Medium	High	Very High
No	Cons.	MS, NC	LA	GA, KY, SC, TX	AL, OK, TN
No	Mini.	GA, MS	FL, LA, NC, SC	KY, TX	AL, OK, TN
No	Conv.	GA, MS	FL, LA, NC,	KY, TX, SC	AL, OK, TN
Yes	Cons.	GA, LA, MS, NC	SC, TN	AL, KY, TX	OK
Yes	Mini.	GA, LA, MS, NC, SC	FL, KY, TN	AL, TX	OK
Yes	Conv.	FL, GA, LA, MS, NC	SC	AL, KY, TN, TX	OK

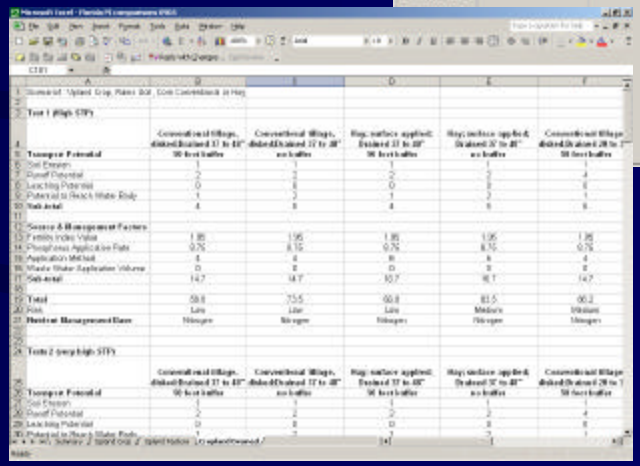
Uplands Cropped: M3P = 150, Litter = 4 t/ac

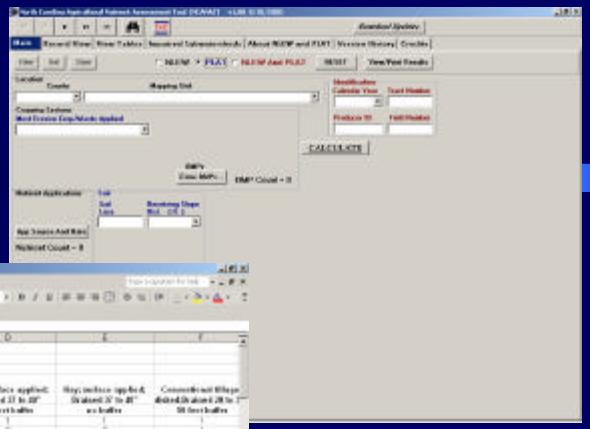
Scenarios		P-Index Rating			
Buffer	Tillage	Low	Med	High	Very High
No	Cons.		MS, NC	KY, LA, SC, TX	AL, GA, OK, TN
No	Mini.		FL, GA, MS, NC	KY, LA, SC	AL, OK, TN, TX
No	Conv.		FL, GA, MS	KY, NC, SC	AL, LA, OK, TN, TX
Yes	Cons.	GA, LA, NC	MS	KY, SC, TN, TX	AL, OK
Yes	Mini.	GA, NC	FL, KY, LA, MS, SC	TN	AL, OK, TX
Yes	Conv.	GA, NC	FL, LA MS	KY, SC	AL, OK, TN, TX

Comparison of Southern P-Indices

- Pastures
- Upland soils
- Poorly drained soils

FL





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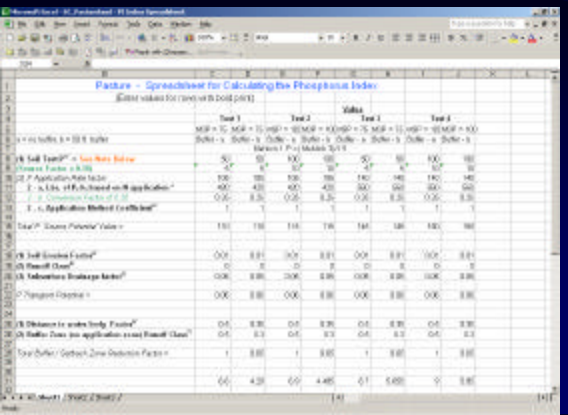

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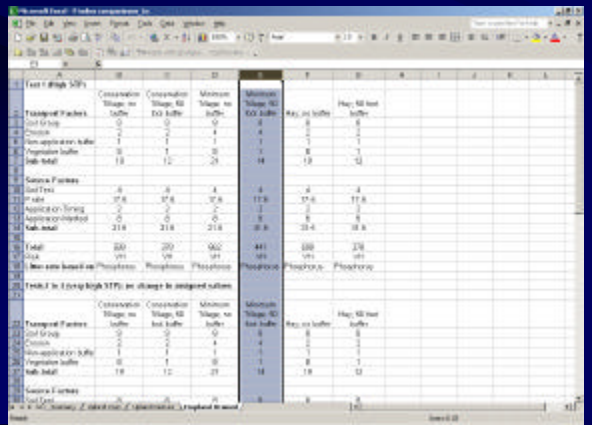

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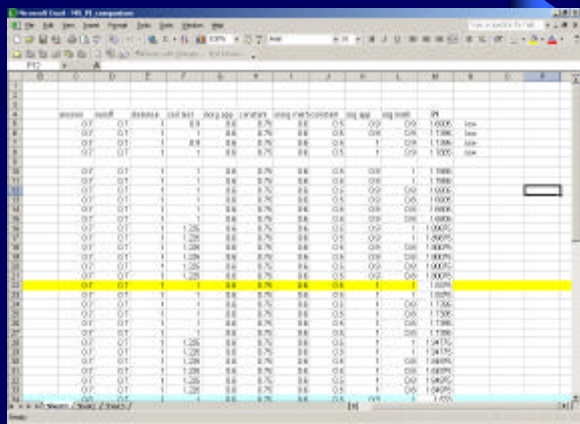

Poorly Drained Soil Factors

- Source Content – 70 lb P_2O_5/t
- Litter P Solubility – 30% or l lb P_2O_5
- Waste Moisture – 30%
- Source Amount – 2.5 t/ac
- Timing – 15 days before planting
- County – Carteret (NC)
- Soil Mapping Unit – Rains (NC, FL), Pelham (GA)
- Erosion Rate – 0.5 t/ac
- Receiving Slope – No
- Hydrologic Group – D (undrained), B (drained)
- Slope – < 1%
- Slope Length – 500 feet

- Runoff Class – High
- Soil Drainage Class – Poorly drained
- Curve Number – 59(hay), 79 (conventional) & 74(conservation)
- Rainfall – 56 inches/year
- Depth to Water Table - ~ 1 foot
- Drain Spacing = 300 feet (NC)
- Drain Depth = 36 inches (NC)
- Distance to Water – 50 feet
- Flooding Frequency – Occasional
- Impaired Water - Yes
- MLRA – Other (KY)
- Depth to Soil - > 20 inches (OK)

Poorly Drained Soils – Factors Varied: 24 Scenarios

- STP
  - 75 M3P
  - 150 M3P
  - 225 M3P
  - 300 M3P
- Tillage/Crop
  - Corn, Conservation
  - Corn, Minimum/Conventional
  - Hay
- Buffer
  - Yes
  - No
- Soil type
  - Mineral
  - Organic

Drained Mineral Soil: M3P = 75

Scenarios		P-Index Rating			
Buffer	Tillage/Crop	Low	Medium	High	Very High
No	Corn Cons.	MS	NC, TX	KY, LA, SC	AL, GA, OK, TN
No	Corn Conv.	GA, MS, NC	FL, TX	KY, LA, SC	AL, OK, TN
No	Hay	MS	FL, GA, NC, TX	KY, LA, SC	AL, OK, TN
Yes	Corn Cons.	GA, MS	LA, NC, TX	KY, SC	AL, OK, TN
Yes	Corn Conv.	GA, MS, NC	FL, KY, LA, SC, TX		AL, OK, TN
Yes	Hay	GA, MS	FL, KY, LA, NC, TX	SC	AL, OK, TN

Drained Mineral Soil: M3P = 300

Scenarios		P-Index Rating			
Buffer	Tillage/ Crop	Low	Medium	High	Very High
No	Corn Cons.		MS, TX	KY	AL, GA, LA, NC, OK, SC, TN
No	Corn Conv.		GA, MS, TX	FL, KY, NC	AL, LA, OK, SC, TN
No	Hay		MS, TX	FL, GA, KY	AL, LA, NC, OK, SC, TN
Yes	Corn Cons.	GA	MS, TX	KY	AL, LA, NC, OK, SC, TN
Yes	Corn Conv.	GA	FL, KY, MS, TX	NC	AL, LA, OK, SC, TN
Yes	Hay	GA	FL, MS, TX	KY	AL, LA, NC, OK, SC, TN

Conclusions

- Each state has a unique P Index
  - Some qualitative (AR, GA, NC)
  - Some quantitative (AL, FL, KY, LA, MS, SC, TN, TX)
  - Varied time frame of development
- Due to the uniqueness, each P Index has different "drivers"
  - AL – Impaired waters
  - GA – Buffers
  - TN – Animal waste rate
  - FL – Drainage depth
  - NC – STP and soil type
  - MS – STP