COMMUNITY-BASED WATER QUALITY TRADING: THE POTENTIAL FOR COLUMBUS, OHIO

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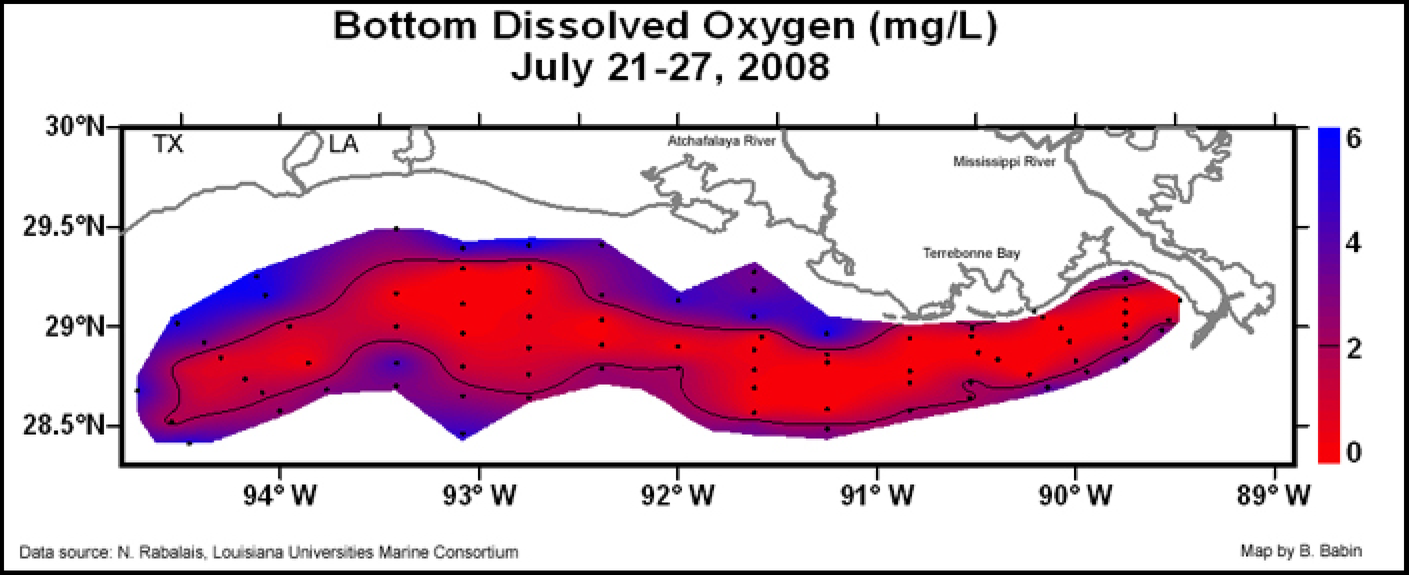
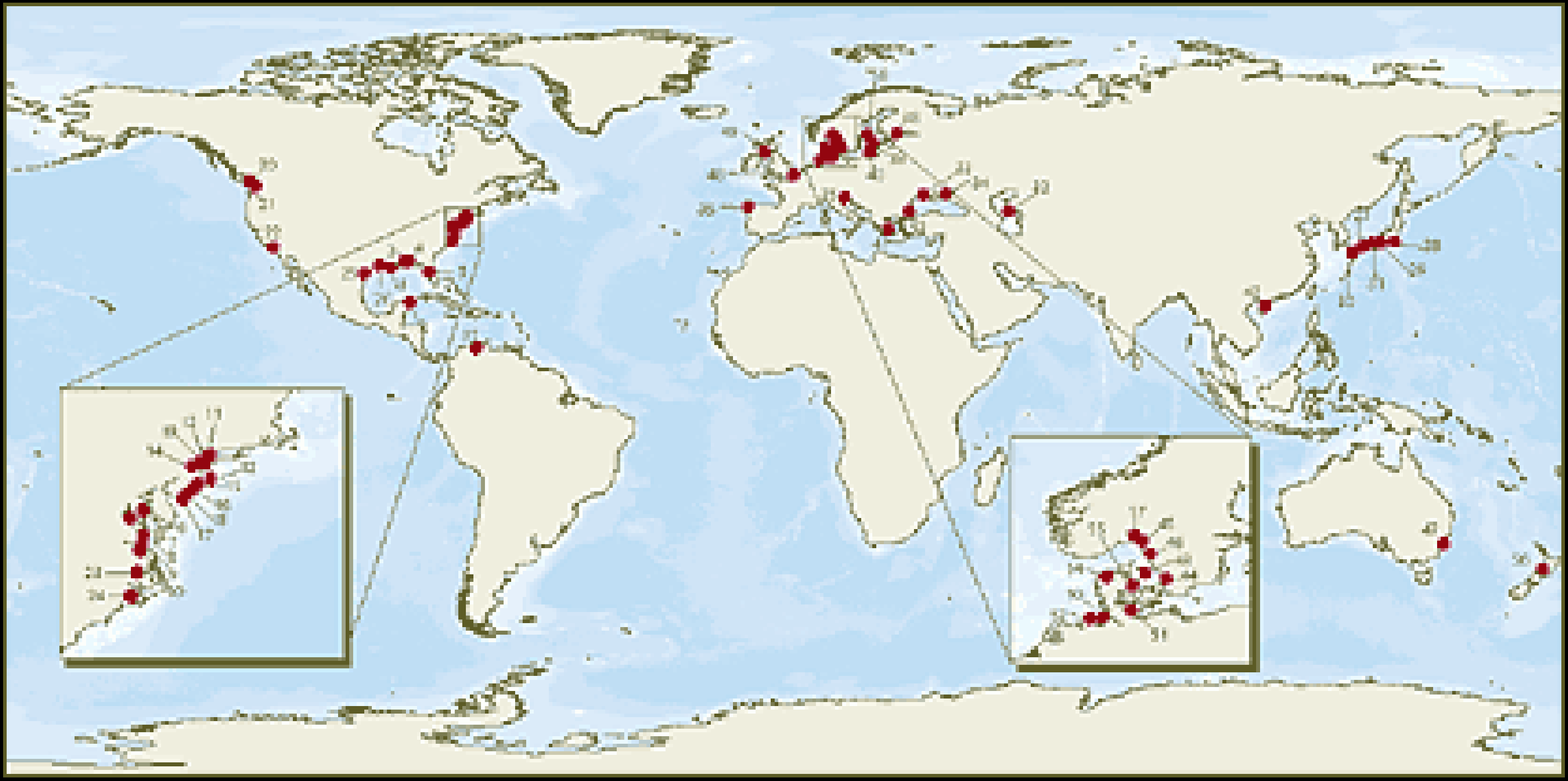
Hypoxia in the Gulf of Mexico

The average size of the Dead Zone over the past 5 years has been 6,600 square miles, much larger than the interagency Gulf of Mexico/Mississippi River Watershed Nutrient Task Force goal of 2,000 square miles.



Source: http://www.gulfhypoxia.net/research/shelfwidecruises/2008/

Global Occurrence of Hypoxia



Nutrient Impairments

Environmental Impacts

Phosphorous

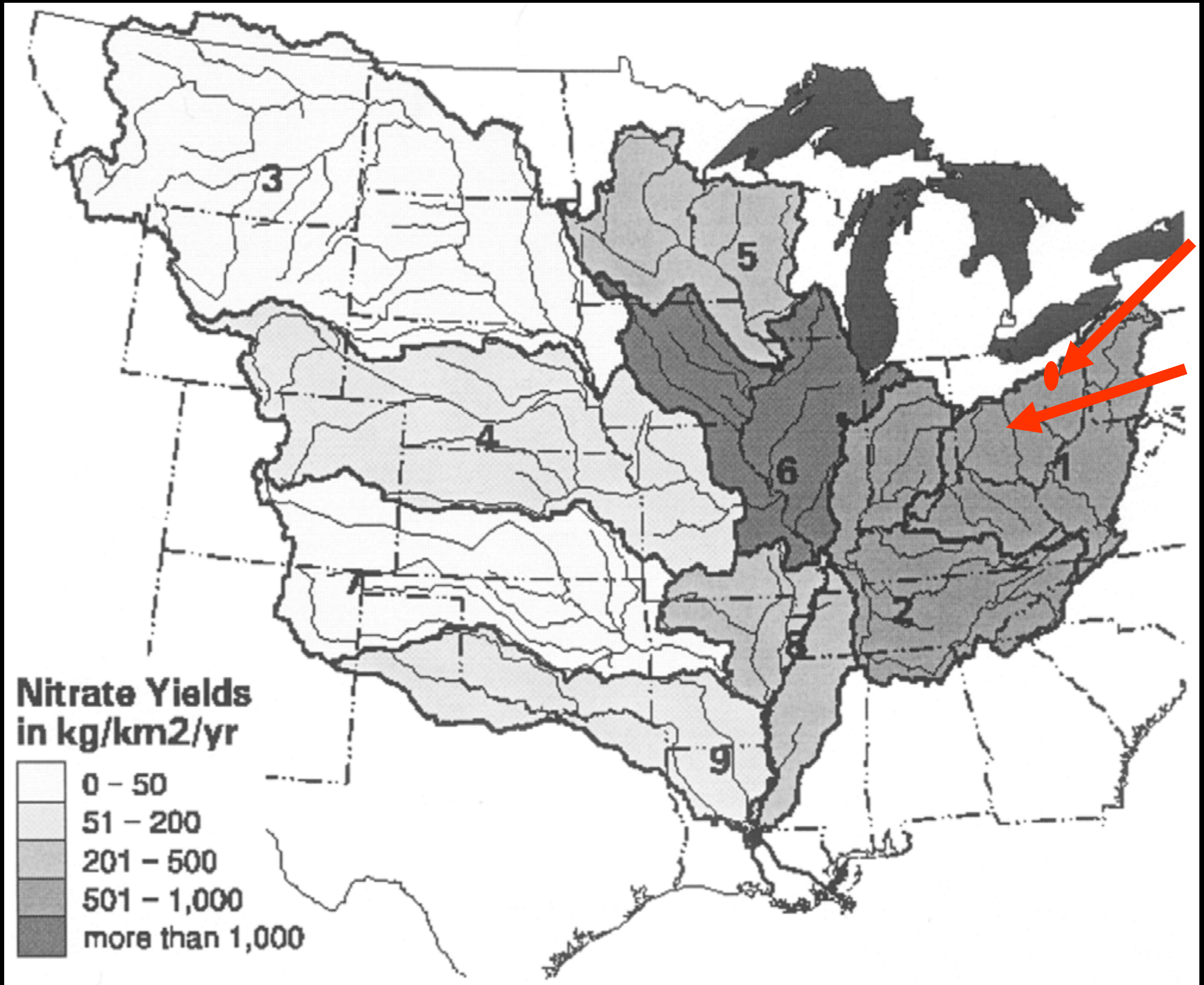
- Drinking water quality – health/economics
- Freshwater Eutrophication
- Toxic algae blooms
- Loss of recreational value
- Impairments – e.g., lower MN River DO
- Tied to sediment issues (e.g., Lake Pepin)

Nitrogen

- Drinking water quality – health/economics
- Blue Baby Syndrome
- Potential link to some cancers/birth defects
- Weight gain suppression in livestock
- Saltwater Eutrophication
- Impairments – e.g., Gulf of Mexico hypoxia

http://www.marietta.edu/~biol/biomes/images/mangroves/florida_eutrophication_7536.jpg

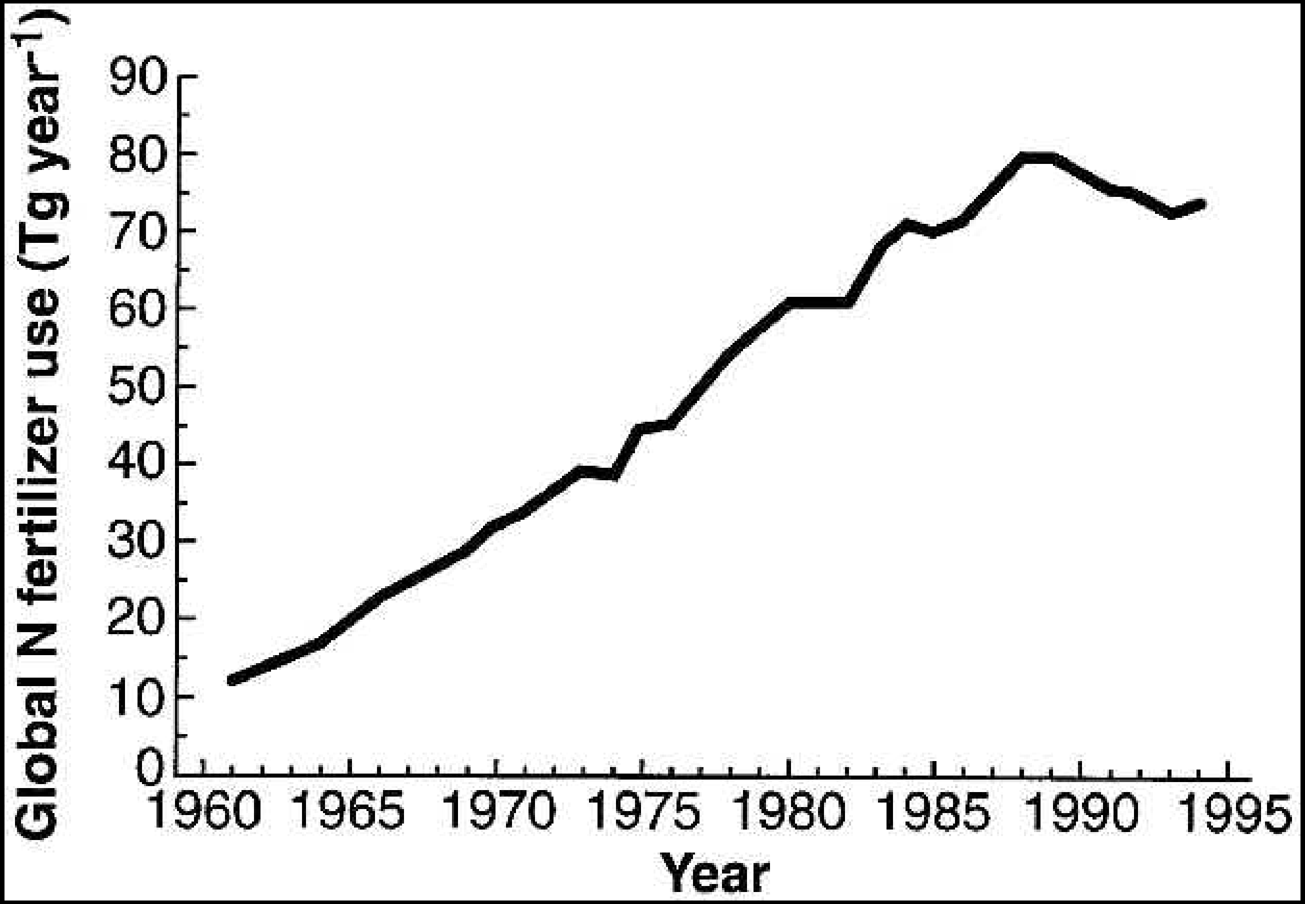
Sources of Nitrates in the Mississippi River System



Sugar Creek

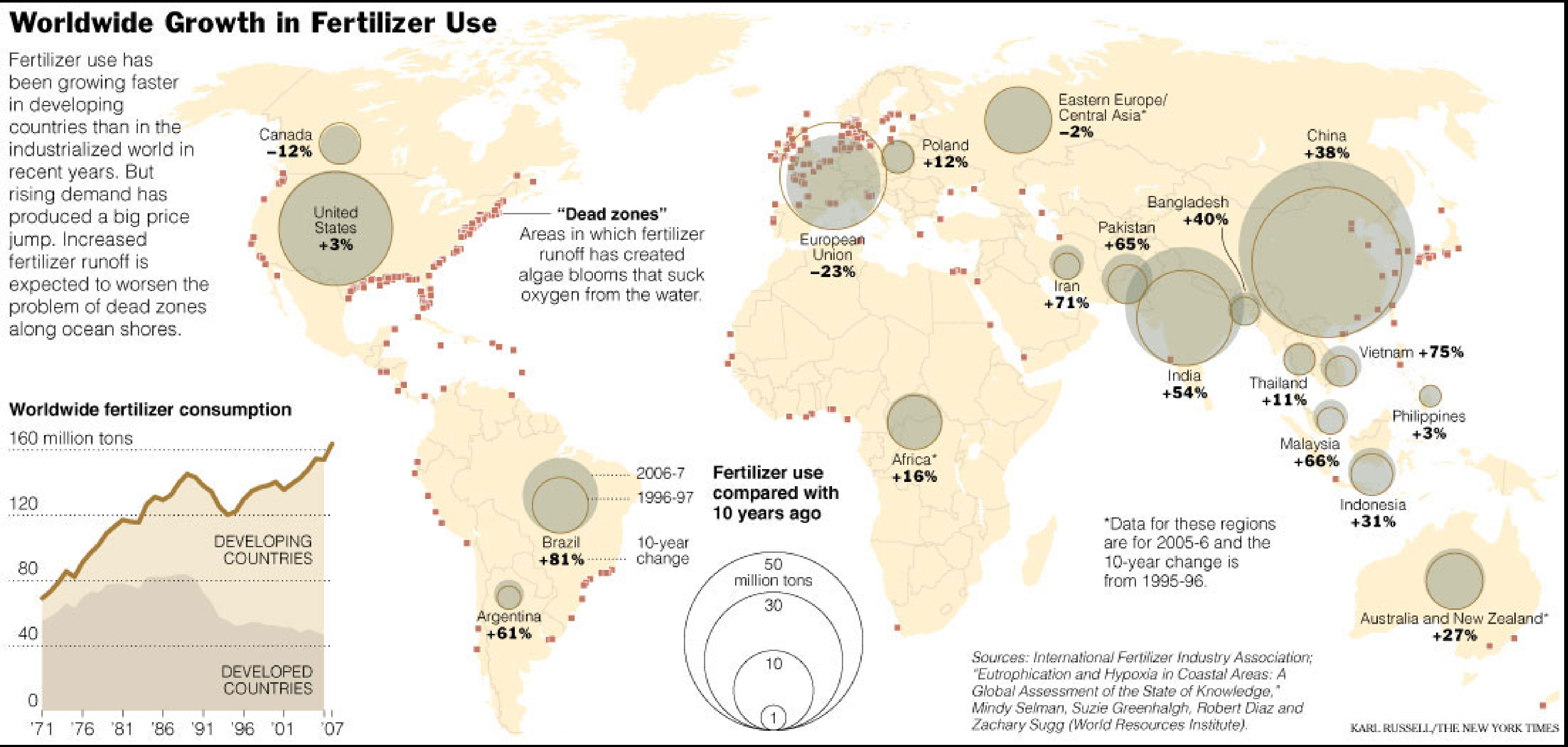
Scioto Basin

Worldwide Use of Nitrogen Fertilizer



Source: FAO Fertilizer Yearbook. Rome: various issues.

Worldwide Increase in Nitrogen Fertilizer Use



World Fertilizer Prices Rose Dramatically in 2007

Caption: Monthly averages of fertilizer prices from 2000 to 2008. World fertilizer prices -- especially diammonium phosphate -- have skyrocketed during 2007. FOB = Free on board. Average price, with supplier paying freight and insurance, to destination port. DAP = diammonium phosphate. MOP = muriate of potash.

Credit: Derived from Green Markets and FMB Weekly

The Legal Basis for Water Quality Trading

- 2003 Water Quality Trading Law
- Clean Water Act 1973
- Total Maximum Daily Limits (TMDL) as stated in the Clean Water Act

What are Trading Credits?

- Non Point Source (NPS)
- Point Source (PS) credits
- Trading ratio (1:3)—Ohio Rules of 2007
- Best Management Practices (BMP)
  - (conservation practices)

Water Quality Trading

Overview

(Pollutant Reductions = “Credits” = Unit of Exchange)

The Pollutants Traded

- Phosphorus
- Nitrogen
- Flows
- Solids
- Bacteria
- Temperature
- Heavy metals
- Pesticides
- “Legacy” pollutants

The Trading Currency

- Real
- Surplus
- Quantifiable
- Watershed-based
- Net improvement (trading ratio)

The Market:
Buyers and sellers of pollutant reductions.

Water Quality Trading

Overview

Point Source/Point Source

Permitted wastewater facilities

Point source/Non-point source

Permitted and non-permitted sources with voluntary credits

Non-point source/Non-point source

Regulated municipal stormwater permittees and unregulated agriculture

Major Ohio Water Quality Trading Programs

- Alpine Cheese Company
- HUC14 digit approach

  1 county (Holmes Co.)
- 3-way partnership between Alpine Cheese, local county SWCD (broker), and OSU
- Farmer incentives
- Ecological farm cap
- Trading ratio 4:1 based on P redeposition rates; 1:1 milk house waste

- Dayton WWTPs
- HUC4 approach (18 counties)
- Managed and brokered by Miami Conservancy District
- Reverse auction bidding system by SWCDs for credits
- Trading ratio 2:1 for advance purchasers

Headwaters Approach

- About 3/4 of streams in a watershed are headwaters streams.
- Reducing nutrients upstream lowers drinking water contaminants. All BMP's, but especially conversion of corn acres to wheat, will reduce atrazine and other weed control chemicals along with nitrate and phosphorus and reduce summer algal blooms and the water taste problem.

TYPES OF POSSIBLE WATER QUALITY TRADES

- Phosphorus
- Nitrates
- Dissolved Oxygen
- Bacteria
- Temperature
- Sediment

What is happening nationally?

- Over 100 NPDES permits.
- EPA goal of increasing 30% in 2006.
- USDA NRCS and EPA are working together.
- It appears that there is a drive to lower the cost of the trade. There is a wide range of prices for phosphorus.
- Brokers seem to be representing buyers more than sellers (farmers).
- SWCDs are usually not brokers.

Does “Trading” Mean “Free Market”? The conditions necessary for a free market are seldom found.

- Problem 1: Sellers and buyers of credit are not neutrally responding freely and equally to the same market. Brokers, often start with only a few buyers of credit (PS or WWTP) and then search for sellers (farmers) for whom they set the market structure (such as whether the local SWCD will be a subcontractor or broker) and constraints (terms of the contracts and selection of BMPs).
- Problem 2: NPS pollution cannot easily be measured routinely and accurately. It is also dependent on environment such as rainfall which is variable.
- Problem 3: Area of trade is restricted to TMDL watershed.
- Problem 4: Trading ratios are designed to control risk yet high ratios limit trading success.
- Problem 5: Ecosystem function is undervalued (imperfect information).
- Problem 6: Market clearing is slow.

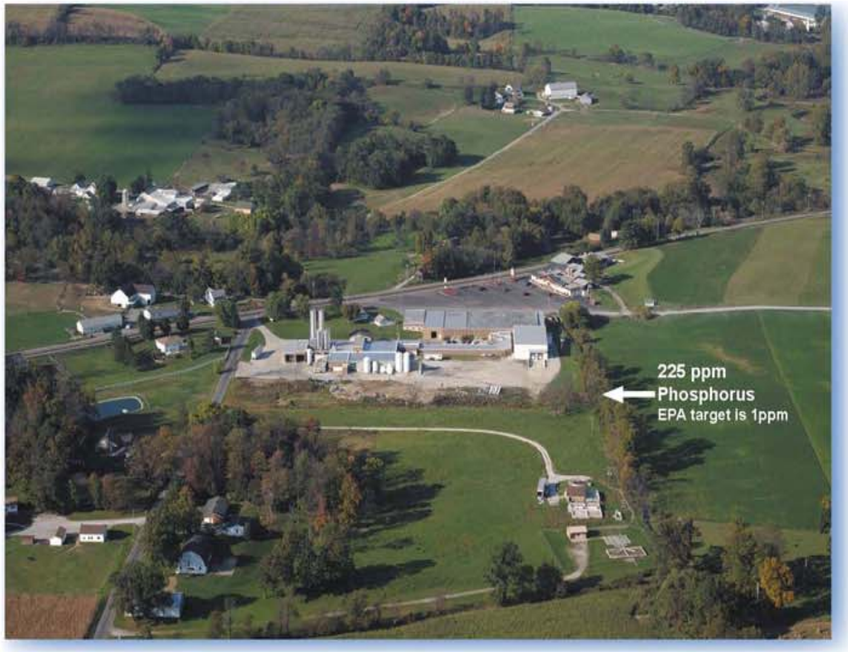
Nutrient Trading for Agriculture and Industry

- Creative nutrient trading to promote cleaner water
- Saving pollution remediation costs to industry
- Improving the bottom line for farmers
- Creating local jobs

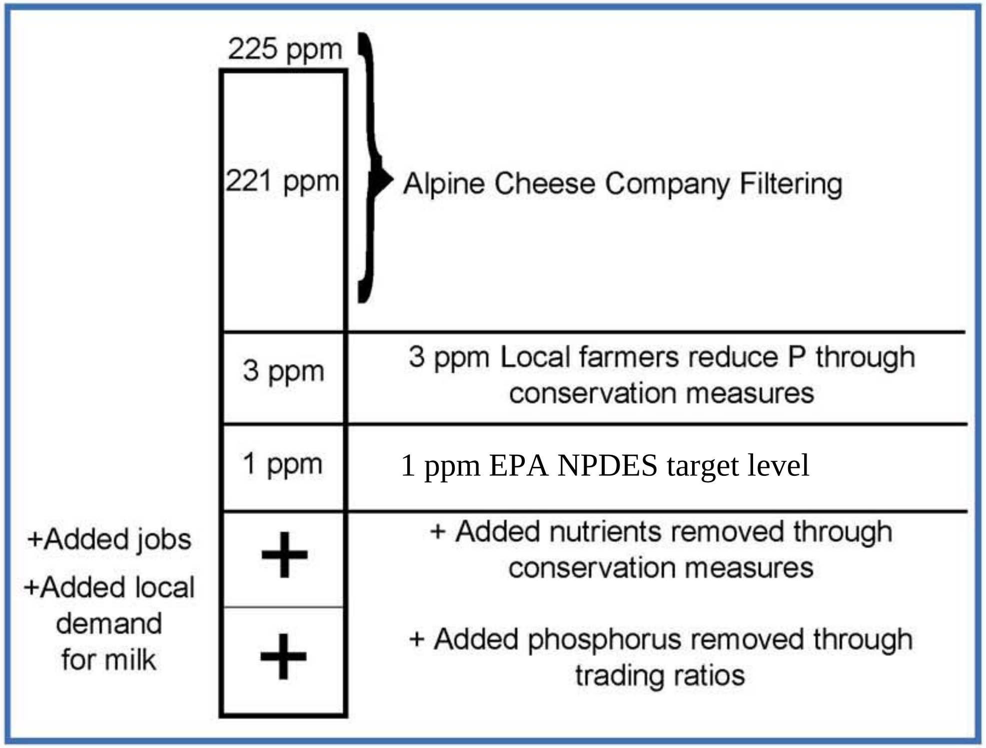
The Problem:

Alpine Cheese Company had phosphorus levels of 225ppm. The EPA goal for the NPDES 5 year permit was 1ppm. There was a much lower cost associated with filtering the first 221ppm than the last 3ppm. Alpine's NPDES permit was preventing plant expansion. The factory wanted to expand, creating 12 new jobs and local milk demand of 250,000 #/day.

Jarlsberg products wheel, loaf & lite loaf form.



Alpine Cheese Factory



The Solution:

The factory filtered their phosphorus down to 3ppm and pays the farmers to reduce phosphorus on their farms. A trading ratio favors more phosphorus being removed than if the factory filtered it by itself. Other nutrients being recycled are a plus. Farms save fertilizer costs. Extra incentives are included for the factory, local farmers, the Holmes Soil and Water Conservation District, and OARDC at The Ohio State University.

The community solution includes OARDC partnering with Holmes Soil and Water Conservation District, Holmes County Commissioners, Ohio EPA, Ohio DNR, OSUE and Local Congressional Representatives.

WHAT IS THE BENEFIT FOR THE FARMER?

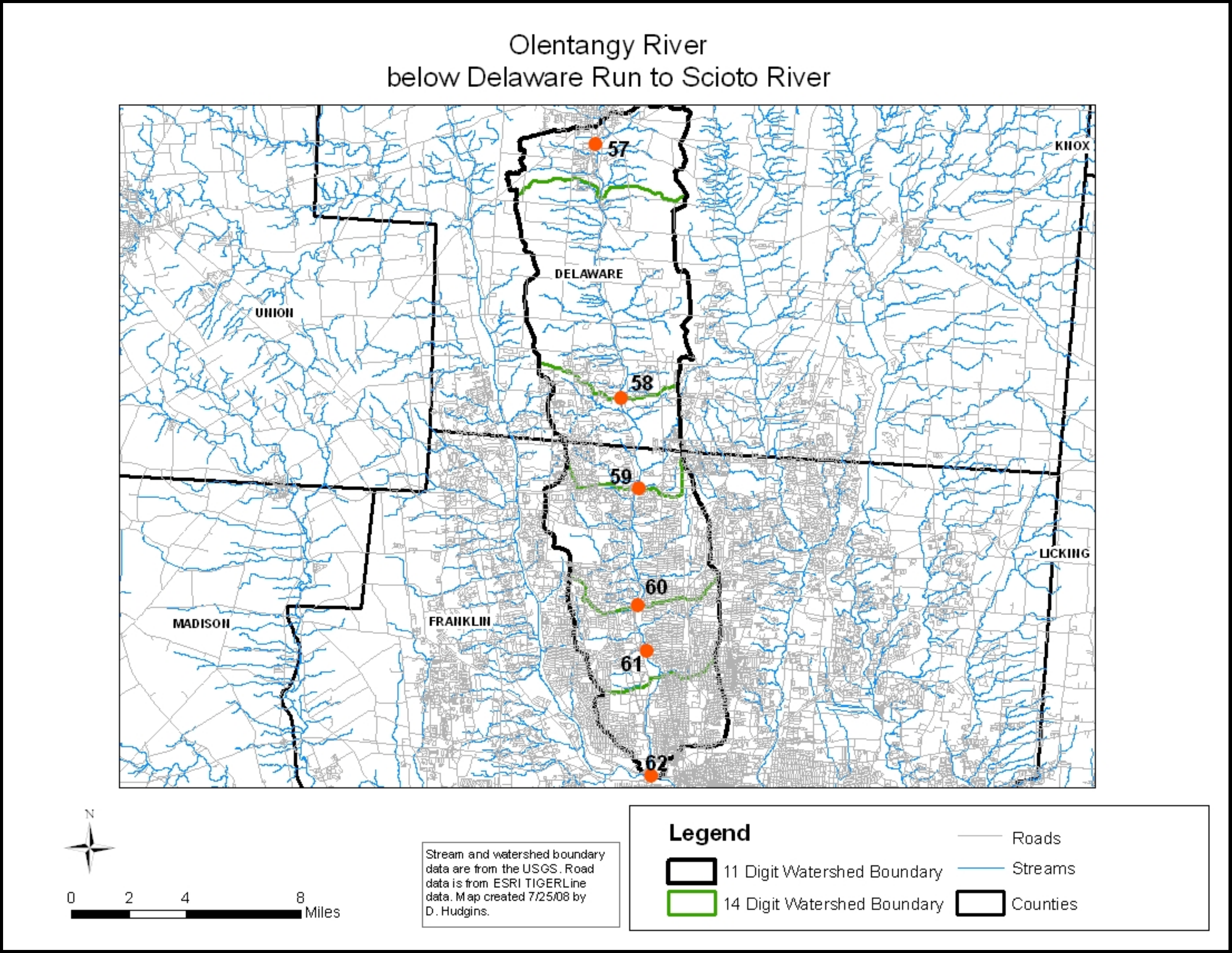
- Financial Benefit: A premium of $2 per pound of phosphorus reduced per year for environmental services.

- Ecological Benefit: Farmers are interested in passing down the farm in good condition to the next generation. Our program provides a means to make holistic improvements to the farm rather than a shot-gun approach to get credits.

WHY INTENSIVE WATER QUALITY MONITORING?

- Local effect of raising awareness. Biweekly with 1 site per 2 square miles.
- Each 14 digit HUC subwatershed has different social and natural conditions
- We are researching headwaters as a key factor in improving water quality through habitat improvement.
- A higher rate of N and P reduction is possible in the headwaters

Example of Our Proposed Monitoring System



WHY THE COUNTY SWCD IS THE BROKER?

- A high level of trust in the watershed
- Excellent relations between NRCS and SWCD at the county level
- A need to create local level budget funding
- Local desire to expand the program to include other permit holders.
- Both SWCDs and local WWTPs are under the direction of the county commissioners

2 WWTP's for Columbus

	Southerly WWTP	Jackson Pike WWTP
Average TN Concentration mg/l	10.5 mg/l (12/99-3/08)	11.4 (2000-2007)
Average TP Concentration mg/l	0.51 mg/l (2000-2007)	1.94 mg/l (2000-2007)

EPA requirement :
8mg/l N and 1mg/l P or
3mg/l N and 0.3mg/l P.

Columbus Water Quality Credits Needed

Our Assumptions: EPA requirement of 8mg/l N and 1mg/l P or 3mg/l N and 0.3mg/l P. 3:1 trading ratio.

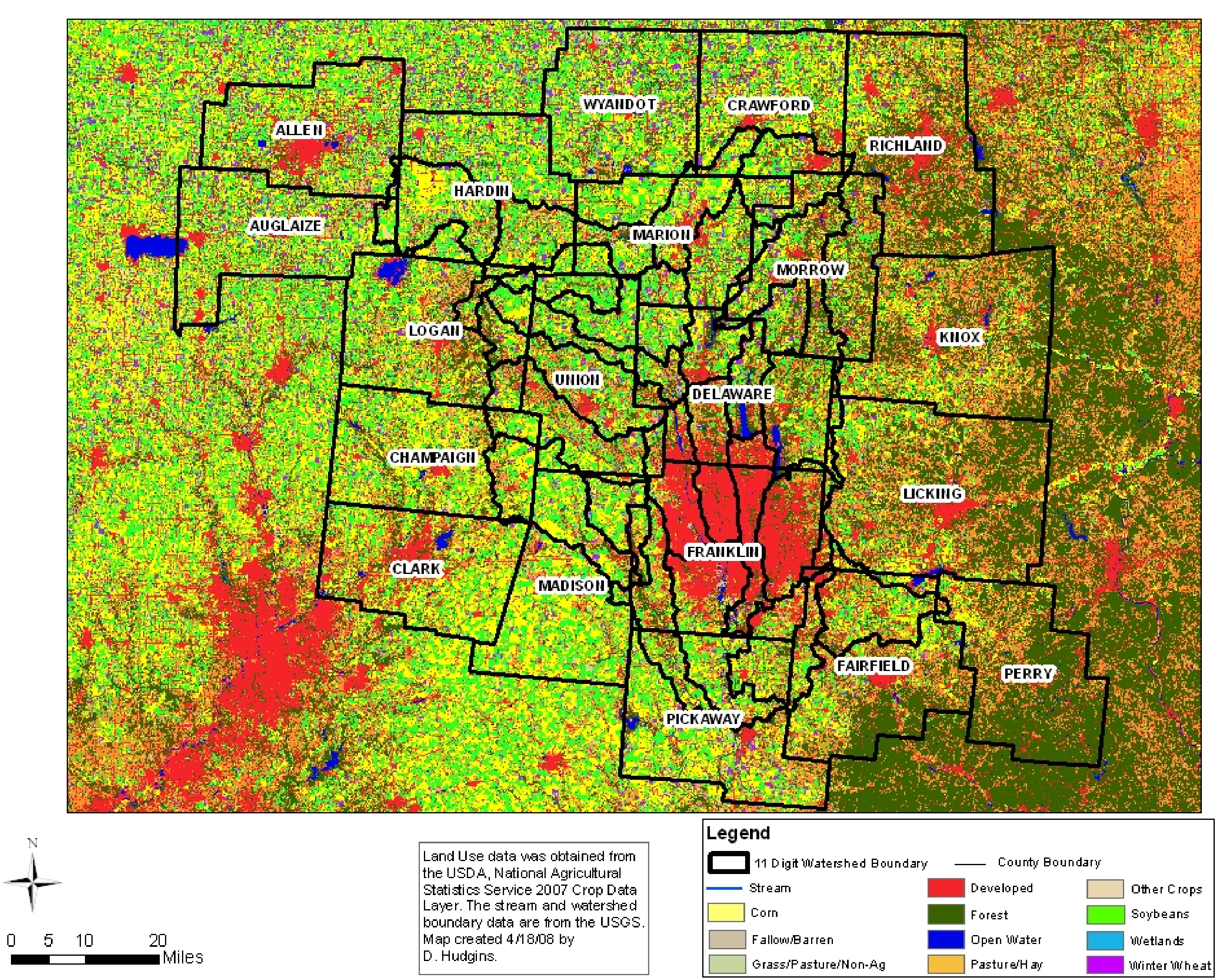
Jackson Pike Plant– needs 238,000 – 414,000 P credits per year and 856,000 – 2,116,000 N credits per year.

Southerly Plant - needs 0 – 81,000 P credits per year and 972,000 – 2,915,000 N credits per year

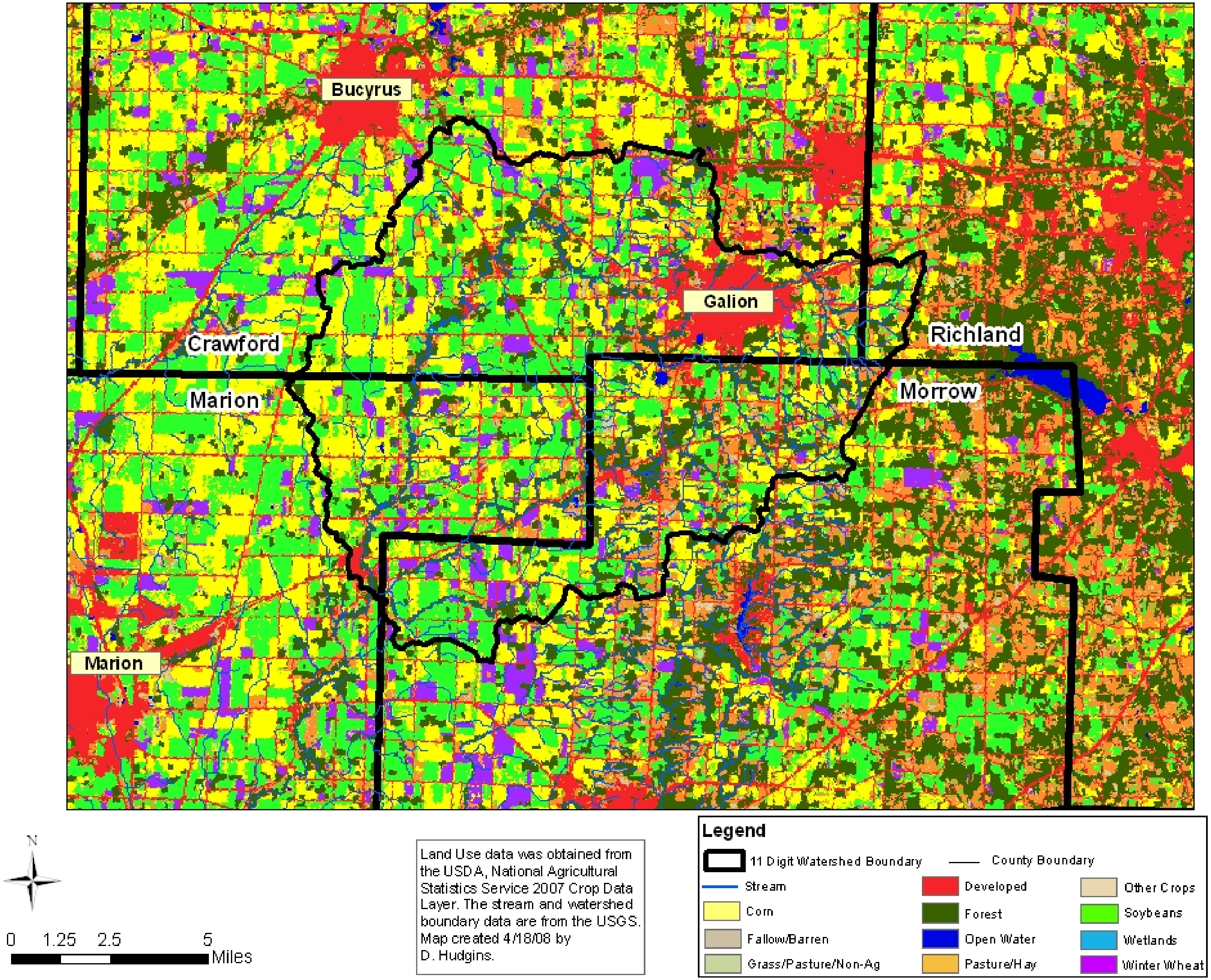
Watershed Characteristics

- Watershed area about 2 million acres.
- Approximately 20% corn, 25% soybeans, 3.5% wheat, 15% hay and pasture, 15% woods and 20% urban and residential.
- 40+% of row crops in conventional tillage (CT).

Corn andSoybeans!

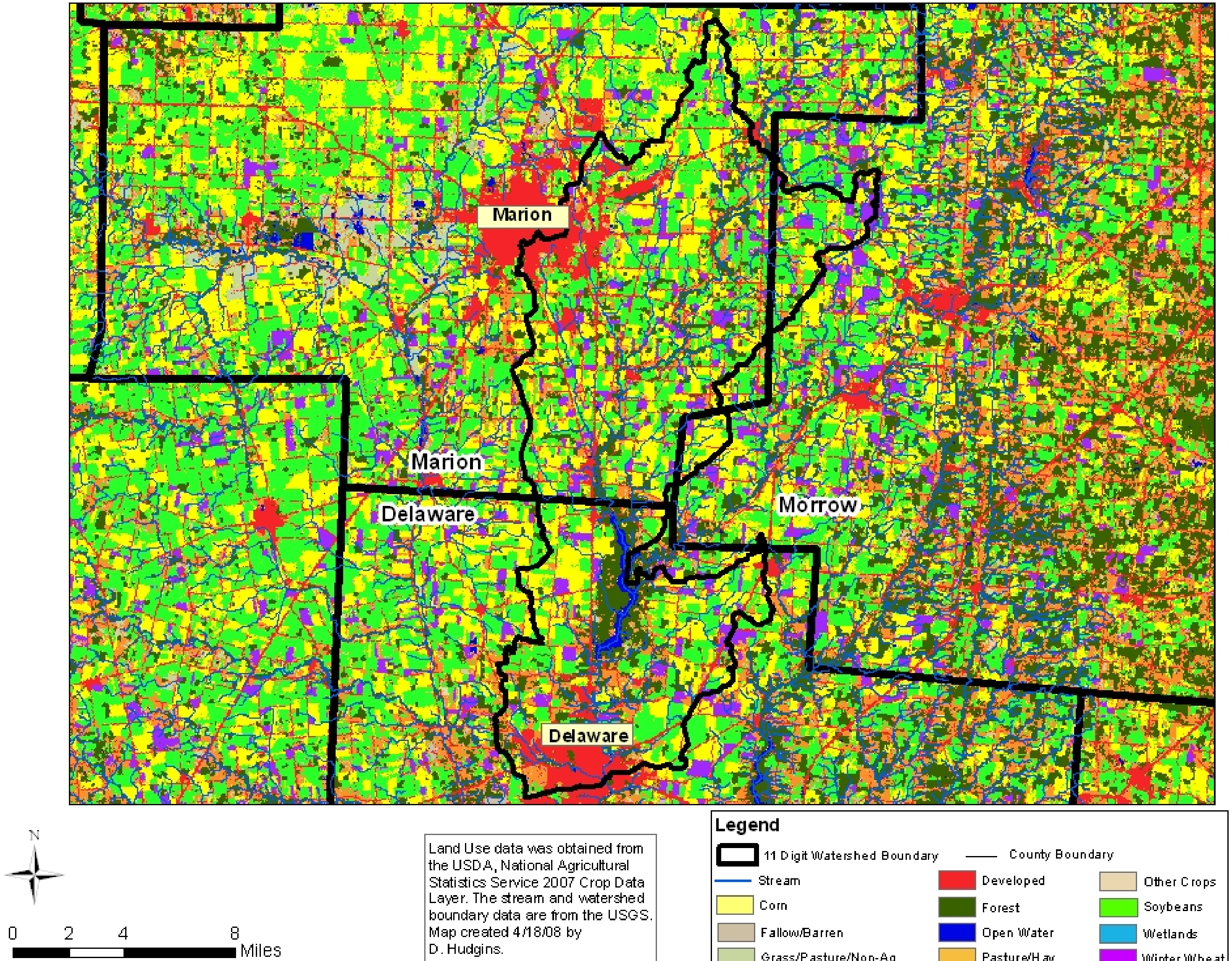


Olentangy River
Headwaters to below Flat Run



Land Use data was obtained from the USDA, National Agricultural Statistics Service 2007 Crop Data Layer. The stream and watershed boundary data are from the USGS. Map created 4/18/08 by D. Hudgins.

Olentangy River
Below Flat Run to below Delaware Run



Land Use data was obtained from the USDA, National Agricultural Statistics Service 2007 Crop Data Layer. The stream and watershed boundary data are from the USGS. Map created 4/18/08 by D. Hudgins.

Water Quality Credit Sources

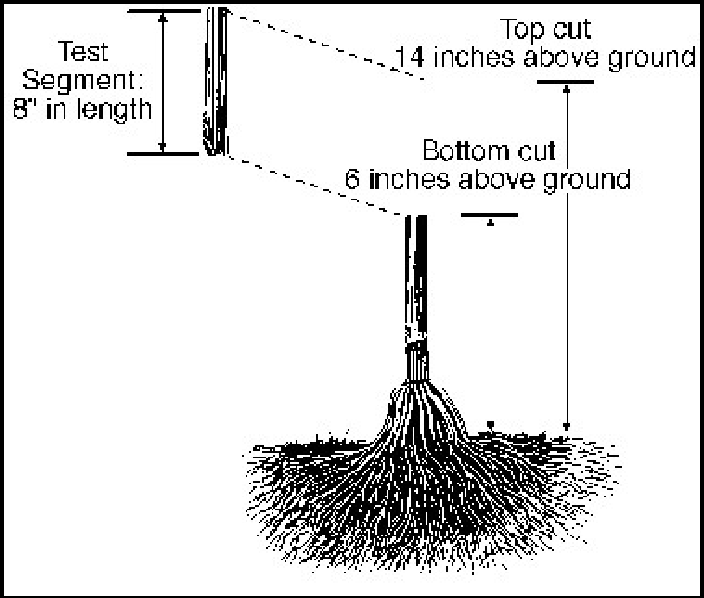
- Stream phosphorus (P) estimated at 0.9 #/A. 75% from CT row crops. 80+% reducible by BMP’s (1,080,000 #P). Does not include Columbus WWTP effluent, but does include other point sources.
- Stream nitrogen (N) estimated at 13 #/A. 60% from row crops (40% corn, 20% soybeans). Up to 90% reducible by BMP’s (14,000,000 #N). Does not include Columbus WWTP effluent, but does include other point sources.

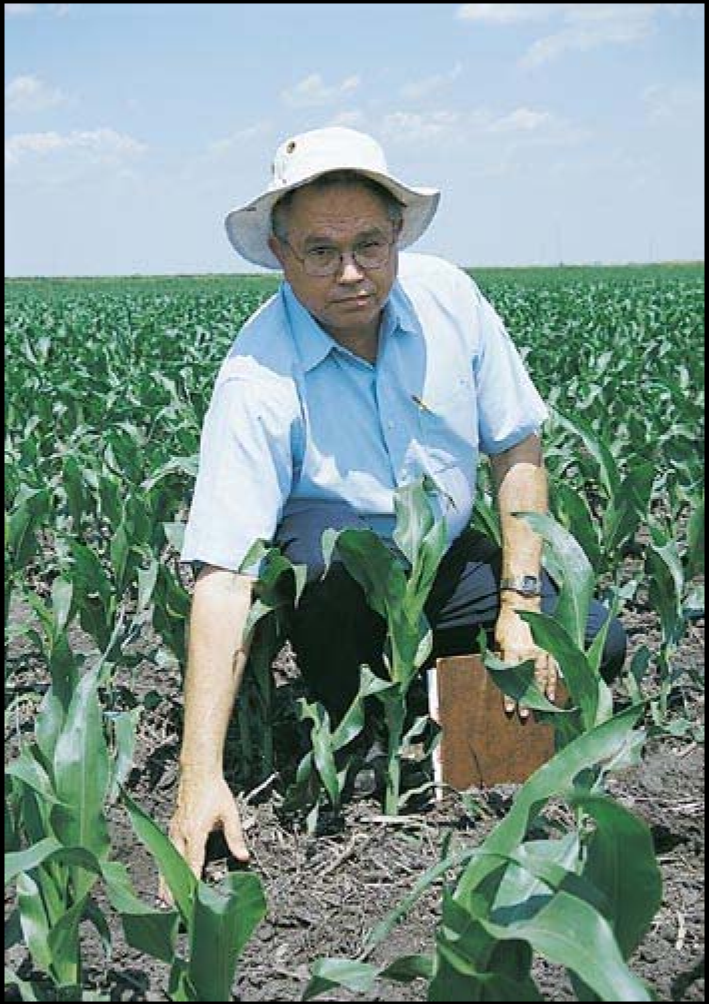
FARMING BMP’s

- Reduced / No Tillage – Can reduce sediment associated P and N losses by 80-90%.
- Contouring / Strip Contouring - Can reduce sediment associated P and N losses by 30-60%.
- Filter Strips - Can reduce sediment associated P and N losses by 75%.
- Fertilizer Reduction - Can reduce non-sediment associated P and N losses by 6 and 10% with 25% reductions in fertilizer applications.
- Planting small grain cover crop - Can reduce non-sediment N losses by 90%.

BMP EXAMPLE 1
Reduced Tillage and No-Tillage
no-till corn after corn

BMP EXAMPLE 2
Late Spring Nitrate Test for Corn





Corn Costs and Prices—a moving target!

- Today—corn is about $5/bushel (in 2005 it was $2.50).
- But fertilizer costs increased 5X… to about $200 per acre.
- For corn, non-land production costs for 2009 are projected at $529 per acre.

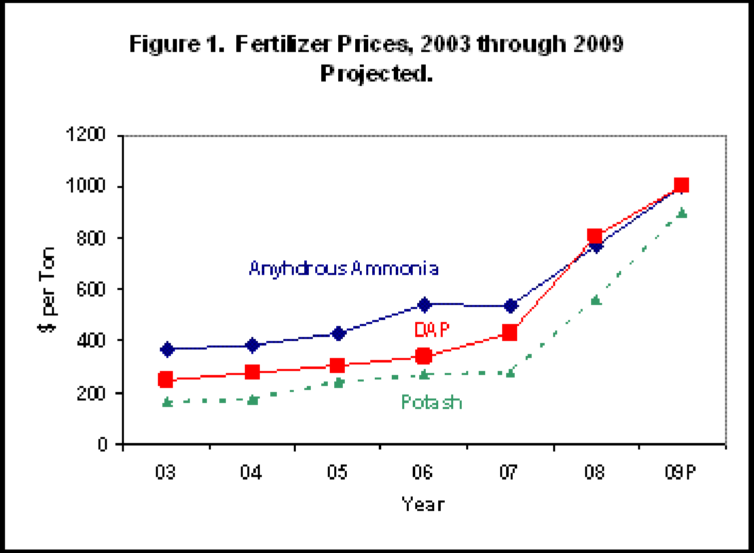


Table 1. Historical and Estimated (2008 - 2009) Crop Returns and Costs, Central Illinois High Productivity Farmland.

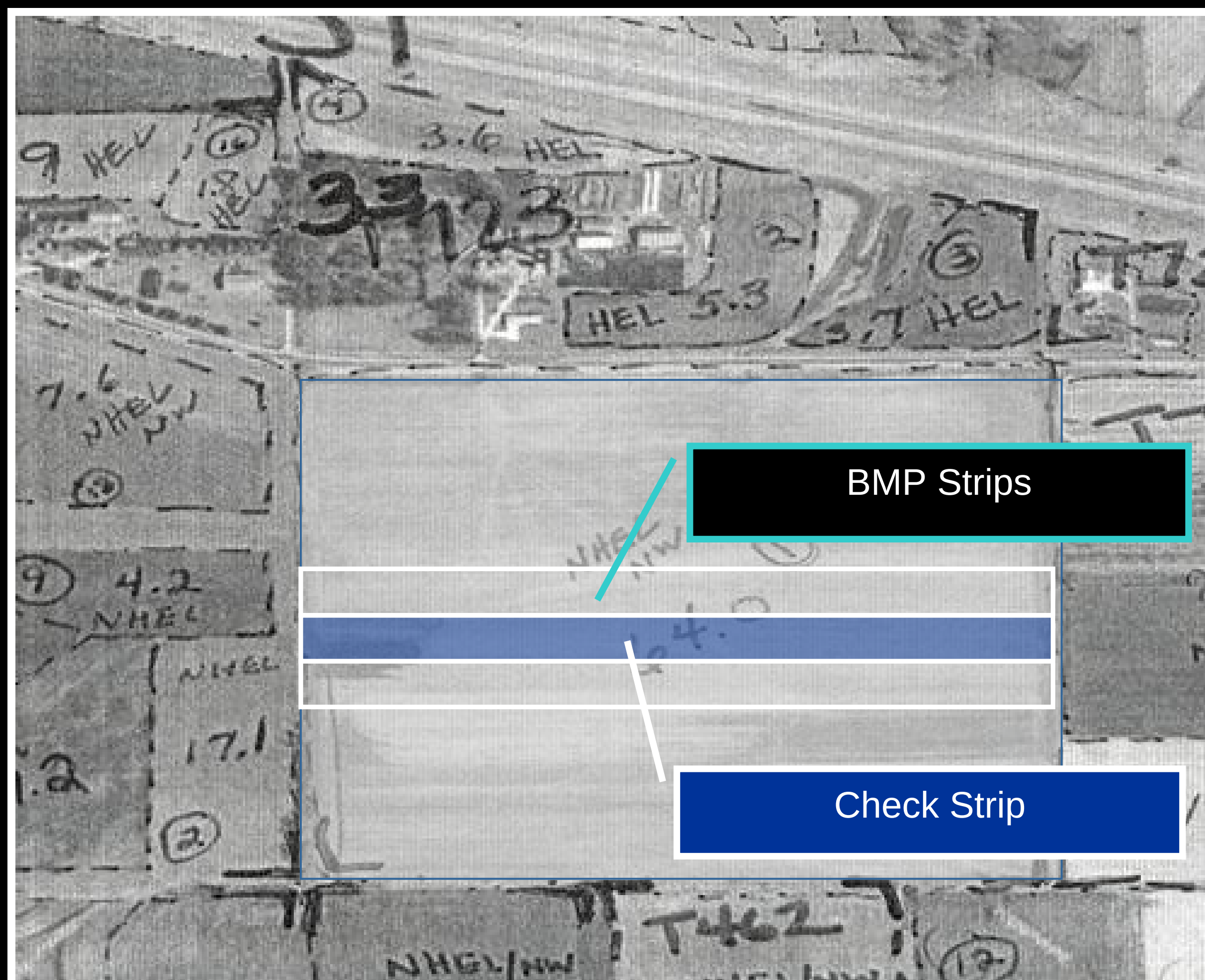
	2003-2007 Averages[1]		2008 Budgets		2009 Budgets	
	Corn	Soybeans	Corn	Soybeans	Corn	Soybeans
Yield per acre	186	52	175	48	191	54
Price per bushel[2]	$2.74	$7.28	$6.00	$12.75	*$4.80*	*$11.00*
LDP per bushel	0.13	0.03	0.00	0.00	0.00	0.00
Crop revenue	$517	$379	$1,050	$612	$917	$594
LDP revenue	24	2	0	0	0	0
Other government payments	32	32	25	25	24	24
Crop insurance proceeds	4	3	0	0	0	0
Gross revenue	**$577**	**$416**	**$1,075**	**$637**	**$941**	**$618**
Fertilizers	$75	$24	$118	$45	$215	$98
Pesticides	40	28	42	27	45	29
Seed	43	30	62	42	78	53
Drying	9	2	10	1	12	1
Storage	7	3	8	4	8	4
Crop insurance	10	6	20	8	27	12
Total direct costs	**$184**	**$93**	**$260**	**$127**	**$385**	**$197**
Machine hire/lease	$6	$5	$9	$7	$10	$8
Utilities	3	3	4	3	5	4
Machine repair	13	11	17	15	18	16
Fuel and oil	13	11	19	18	26	22
Light vehicle	2	1	2	1	2	1
Mach. depreciation	20	17	25	22	27	24
Total power costs	**$57**	**$48**	**$76**	**$66**	**$88**	**$75**
Hired labor	$8	$8	$9	$8	$9	$8
Building repair and rent	4	2	4	2	4	2
Building depreciation	4	2	4	2	4	2
Insurance	8	8	10	10	10	10
Misc.	6	6	7	7	7	7
Interest (non-land)	15	13	18	17	22	20
Total overhead costs	**$45**	**$39**	**$52**	**$46**	**$56**	**$49**
Total non-land costs	**$286**	**$180**	**$388**	**$239**	**$529**	**$321**
Operator and land return	**$291**	**$236**	**$687**	**$398**	**$412**	**$297**
Operator and land returns for[3]:						
1/2 corn -- 1/2 soybeans	$267		$554		$363	
2/3 corn -- 1/3 soybeans	$273		$591		$374	
all corn	$269		$649		$380	

[1] Averages for the years 2003 through 2007 for grain farms enrolled in Illinois Farm Business Farm Management.

[2] Prices for 2003-2007 are average prices farmers received. USDA estimates of farmer-received prices are used for 2008. Prices for 2009 are estimated equilibrium prices. In July 2008, futures prices suggest commodity prices significantly above prices above those in this table.

[3] The corn results represent a blend of corn-after-soybeans and corn-after-corn returns. For calculating operator and farmland returns, corn-after-soybeans is assumed to yield 5 bushels more than the corn shown above while corn-after-corn is assumed to yield 5 bushels less. Corn-after-soybeans is assumed to have $8 less costs than above and corn-after-corn is assumed to have $8 more costs.

Insurance to Guarantee the Results for LSNT



Example of BMP Challenge Insurance

Net Returns - Example

	Conventional	BMP
Total Nutrients *(lbs N/acre)*	140	92
Fertilizer Cost *(N=$0.37/lb)*	$51.80	$34.04
Planning Cost	$0	$0
Savings ***(per acre)***	**+$17.76/acre, 48 lbs N Reduced**	

Yield *(bu/acre)*	164	169
Value *($3.50/bu)*	$574.00	$591.50
Yield Gain/Loss	+$17.50/acre	
Guaranty Payment	**$—**	

Fertilizer Savings **Yield Gain** **Contributions**

Farmer contribution	**$5.88 per acre (1/3 of $17.76)**
Farmer Net Return	**$29.38 per acre ($17.76 + $17.50 - $5.88)**
Net Return ***(27 acres)***	**+$793.26**

BMP EXAMPLE 3
Grass Filter Strip

BMP EXAMPLE 4

Cover Crops—plant wheat in the corn and soybeans rotation

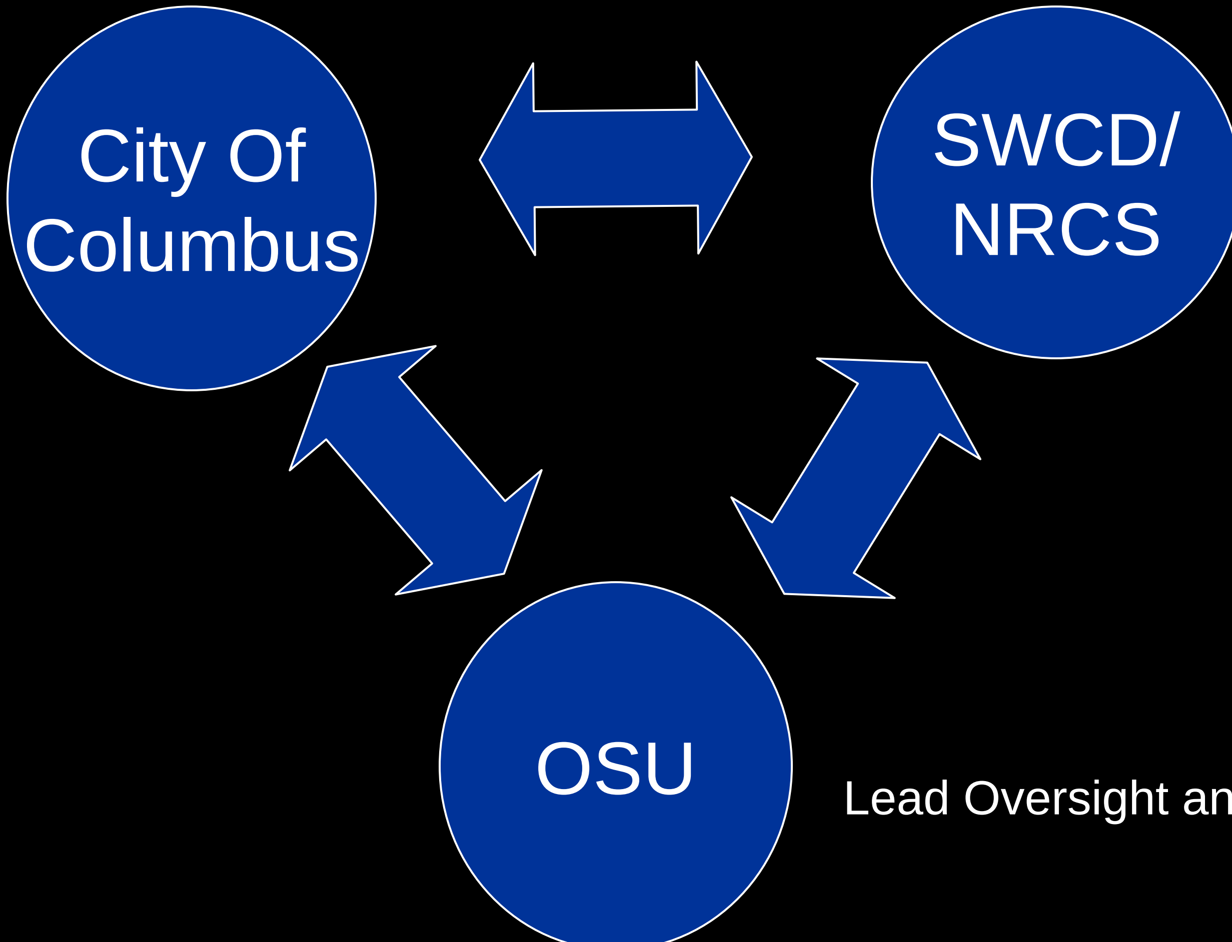
Wheat price in 2005 was $3.42

2008 price ranges from $6-$8

Are there Enough Ag P and N Credits to meet the Needs of the City of Columbus?

- Columbus needs 238,000# P credits
- There are a possible 360,000# P ag credits at a 3:1 trading ratio.
- Columbus needs 1,828,000# N credits
- There are a possible 4,700,000# N ag credits at a 3:1 trading ratio.
- We would advocate to OEPA a 2:1 trading ratio. (proactive ratio)

Organizational Partnership



County
Co-brokerage
Structure

Lead Oversight and Broker

Estimated Nutrient Trading Plan Costs

Farmer incentives, practice costs .

- BMP's have been identified that provide high reductions of nutrients with essentially no net farmer out of pocket expense. Incentives are still needed to spur program participation. Farmer payments of $3 per credit to cover practice costs and incentives may be adequate. This would require an estimated annual cost of $6,000,000.
- Coupling of carbon credit program (methane capture in manure lagoons, tree plantings, no-till) might reduce the cost.

Can it be done?

- Only if the EPA is willing to cooperate.
- The technology-based effluent limit restriction in the Ohio Water Quality Trading Rules will need to be revised or have Chris Korleski's approval.
- The trading ratio needs to be relaxed to 2:1 in recognition of the numerous additional positive environmental impacts of NPS BMP’s. This can be accomplished by proactive trading before the expiration of the NPDES permit.
- The imposed effluent limit lower than 1 mg/l P and 8 mg/l N make it very difficult.
- A high rate of farm participation is needed.

Additional Opportunities to Gain Credits and Cut Costs

- Beneficial reuse of water – 10,000 gallons of treated WWTP effluent may be land applied per acre per day. Upstream WWTP’s have adequate land for full disposal and significant nutrient credit generation. Significant agricultural land is in close proximity to the Southerly WWTP and could receive effluent from the Jackson Pike WWTP pumped to Southerly. Upstream applications earn a 1:1 trading ratio.

Additional Opportunities 2

- Urban Conservation of phosphorus and nitrogen fertilizer and use of rain gardens to reduce runoff. An ordinance might be possible to limit P in lawn fertilizer. This was done in Bloomington Minnesota. The city of Portland Oregon gives urban homeowners utility credits for rain gardens.
- Milk house waste
- Manure Management on Farms (CAFOs)
- Livestock Access Areas

Additional Opportunities 3

- Struvite formation **($MgNH_4PO_4 \cdot 6H_2O$)** – Several Canadian and USA WWTP's have this capability. This process also removes part of the N waste stream, reduces struvite damage issues within plant, produces a saleable product and can generate carbon credits. Cost issues make it so that only part of the waste stream for most plants are treated in order to supplement less costly methods.

Additional Opportunities 4
Managing Excessive Dissolved P Levels in Soil

- Cropping down (long time to remove P)

Reduce P losses from field

- Enhanced buffer strips: P sorbent in grass waterways or buffer strips to sorb dissolved P from runoff

- Sorbent tubes placed at edge of field to decrease dissolved P / runoff

Additional Opportunities 5

- Biogas generation – Removal of initial settled sludge for methane generation accomplishes major BOD and nutrient removal from the treatment waste stream, addresses on-site power needs, generate carbon credits, creates a lower volume / higher concentration material that could be precipitated with CaOH and the supernatant could be returned for additional treatment and the sludge could be land applied.
- Biofuels--Celulosic ethanol production in buffers and waterways for Columbus vehicles.

Additional Opportunities 6

- Habitat restoration projects, provided the pollutant load reductions can be calculated. Examples of habitat restoration projects include dam removal projects, stream bank stabilization and stream channel reconfiguration.

Additional Opportunities 7

- Our downstream friends! Just like we are trying to get credits upstream, our downstream friends might look at the Upper Scioto Watershed for trading credits.

So What's the Bottom Line on Ag Costs?

- Cost of Ag BMPs---
- Cost of Administration---
- Cost of NRCS/SWCD--

- 20 years Total ---$300 million?

Next Steps– 1 year Feasibility Study—applying to USEPA this Friday

- A water quality trading management plan application shall be submitted to the director at least six months prior an approved water quality trading management plan's expiration date. A water quality trading management plan renewal application shall be in accordance with this chapter and shall also:
- Cost-benefit analysis
- Research optional areas for additional credits
- Conduct survey on willingness to adopt/implement BMPs

THANK YOU