Chesapeake Goal Line 2025

How Can We Manage Phosphorus Better?

Changing Trends in Agriculture Affecting Phosphorous Balance

Kevin H. Elder
Executive Director
Ohio Department of Agriculture

Ohio Lake Erie Phosphorus Task Force Report

Lake Erie-Western Basin
Research from Heidelberg College (Baker et al)

- Past 33 years of data from Ohio Tributary Loading program has shown dissolved reactive phosphorus (DRP) loading decreased 65% through mid 1990s. Since then, DRP loads have increased rapidly and in 2007 reached historic highs.
- The high bioavailability of DRP make it a prime suspect in the recurrence of harmful algal blooms within Lake Erie.
- Excessive phosphorus loading identified as cause for increases in Blue-green algae (Microcystis).

Photo by: Thomas Bridgeman, University of Toledo

Western and Central Basins---Lake Erie
Satellite Image, April 2, 2008
Sagady & Associates, East Lansing, MI.

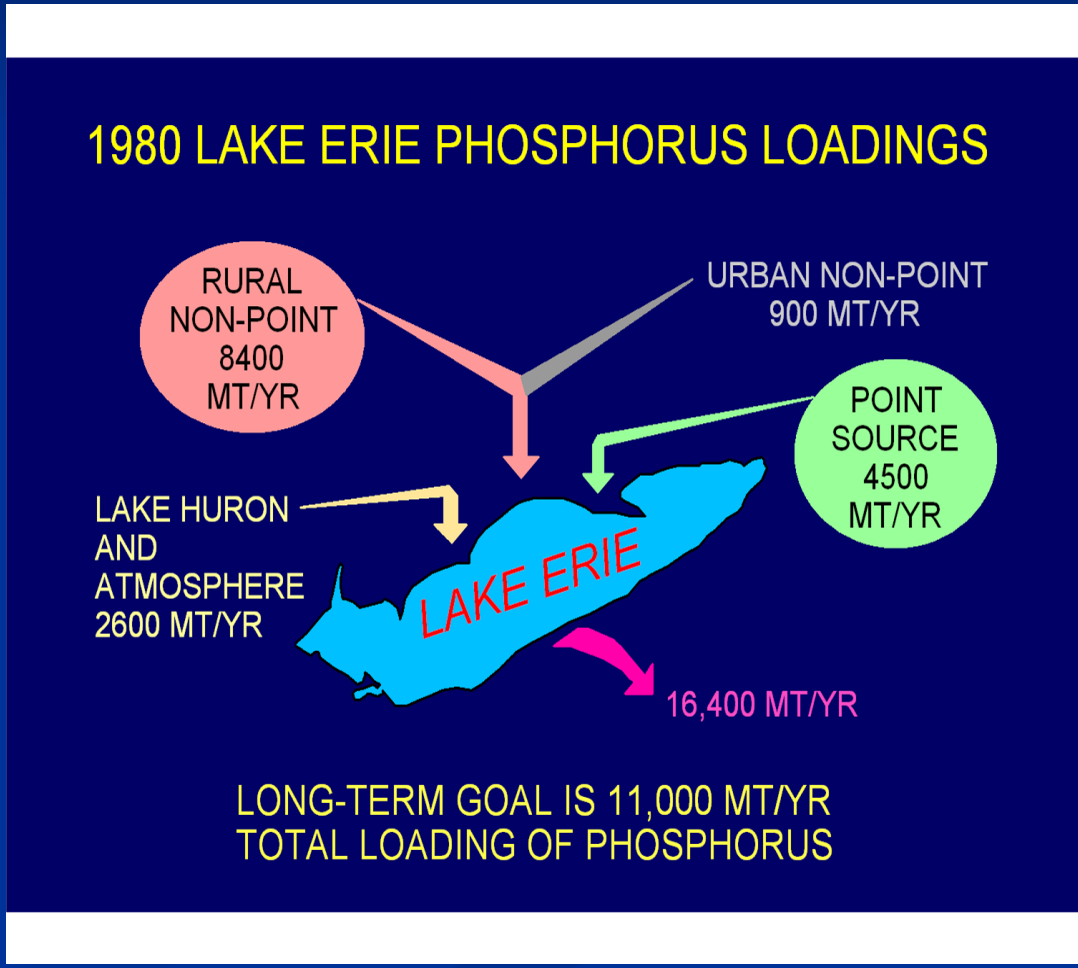
What were task force goals?

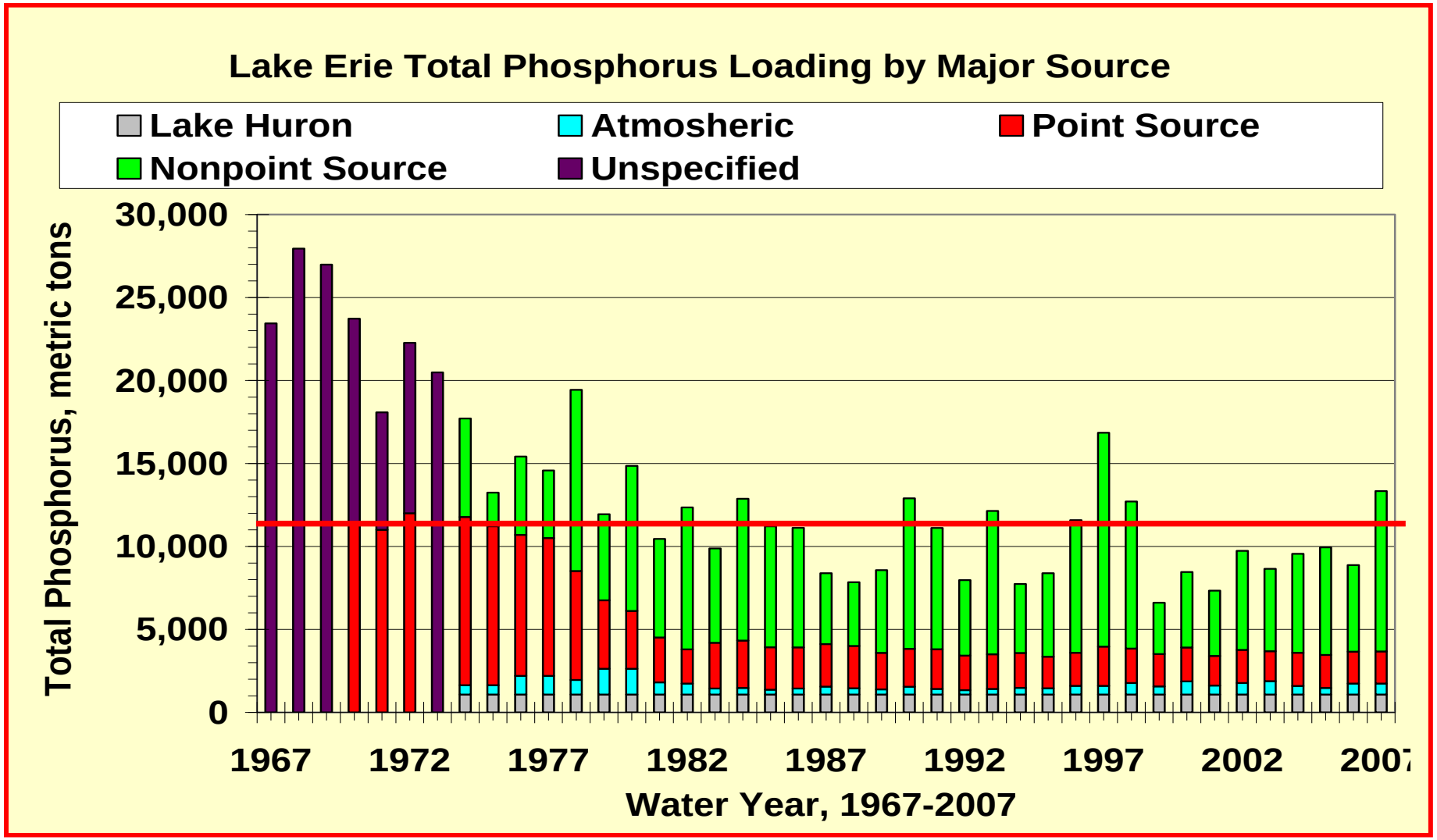
- Identify and evaluate potential point and nonpoint sources of Phosphorus
- Determine what practices may have changed to increase Phosphorus loading to the lake
- Examine various aspects of agriculture that might influence loads
- Review possible/probably relationships of increased DRP to returning lake water quality problems

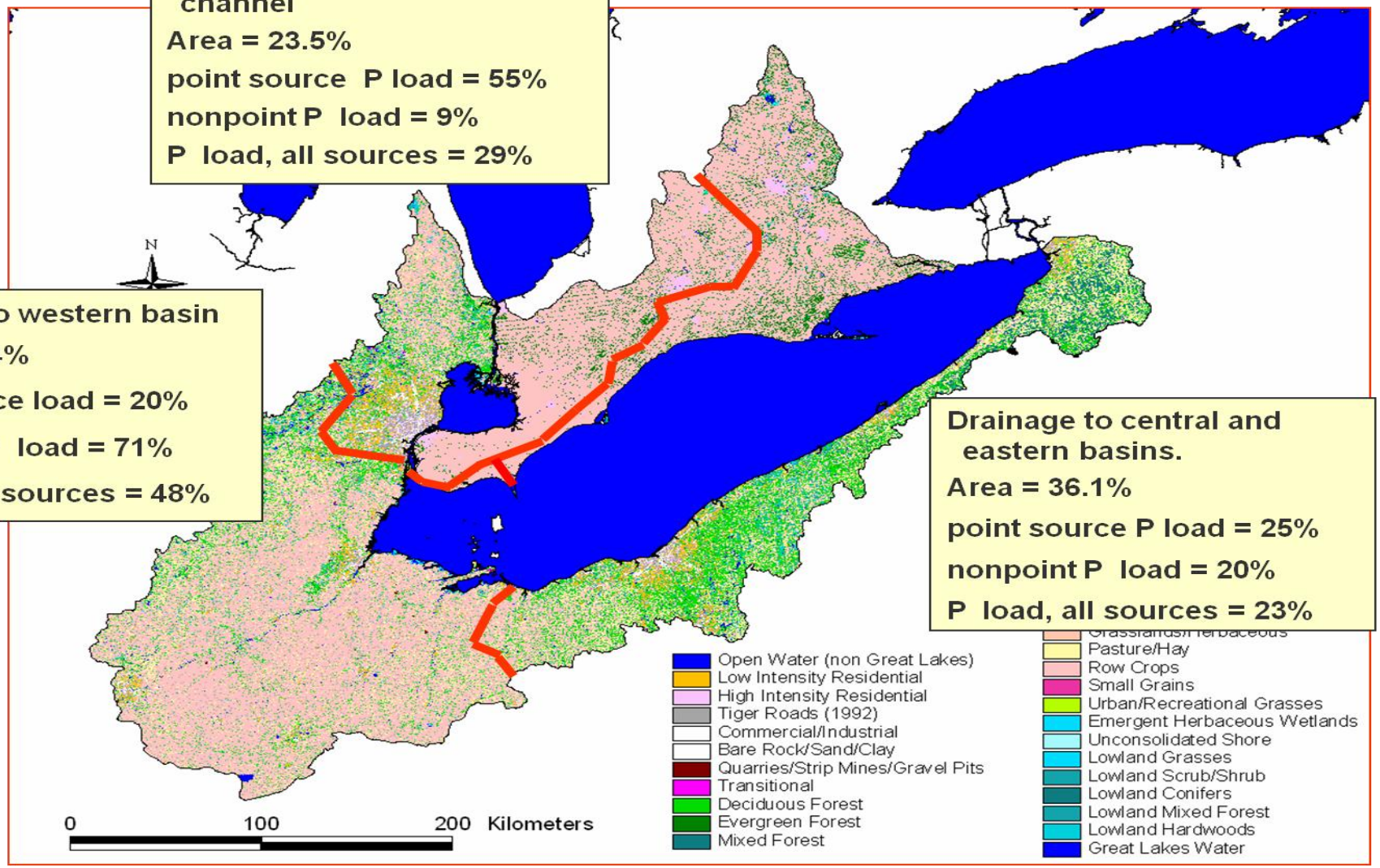
- Consider impacts of Invasive species in altering nutrient cycling in the lake.
- Identify research and monitoring needs
- Recommend management actions that could immediately be done to prevent further degradation of lake water quality

Background

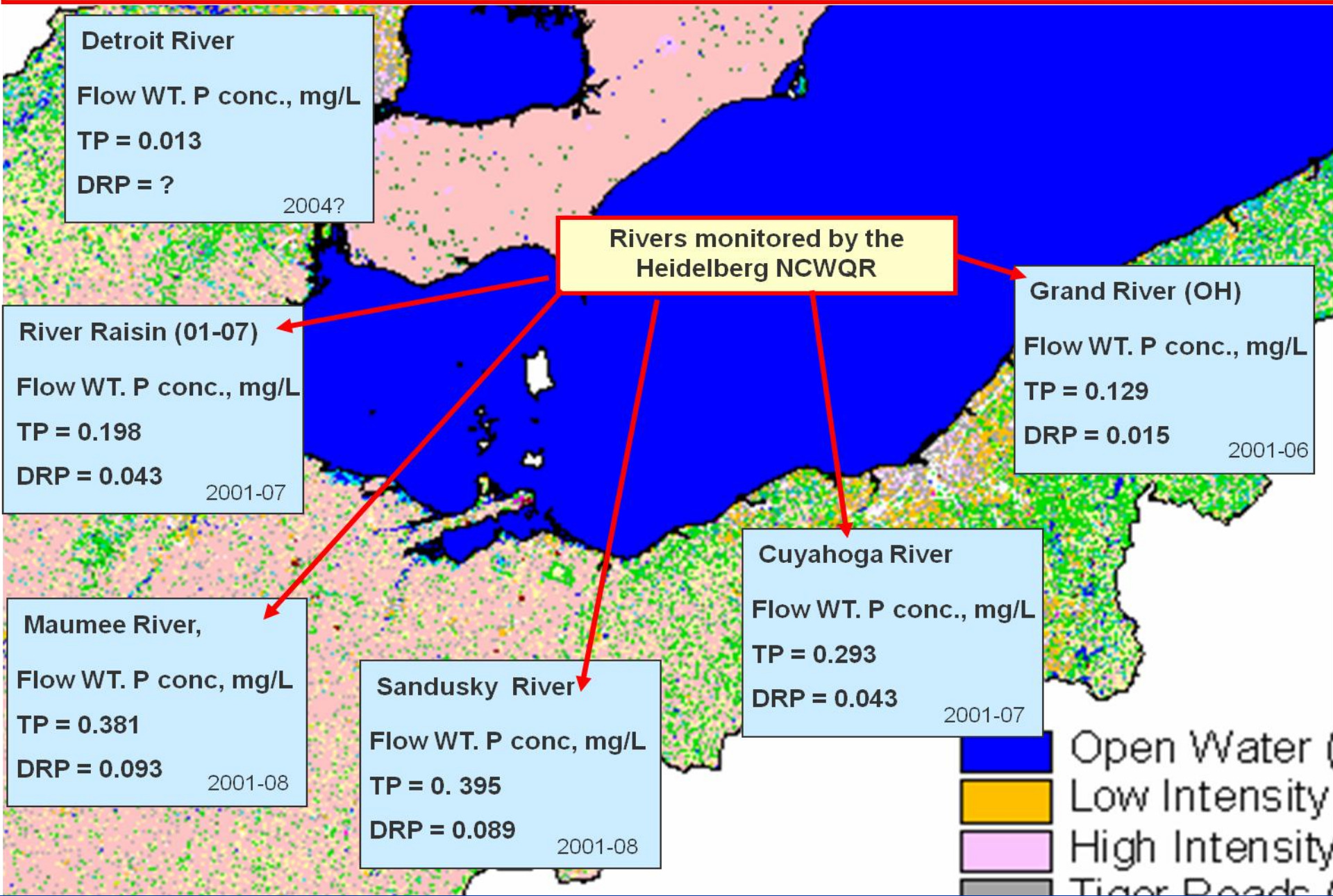
- 1960's had excessive growth of blue-green algae creating extreme water quality problems in the lake (as well as the Cuyahoga River catching fire)
- 1970's had Clean Water Act plan for restoring lake. Included both point and nonpoint loading Targeted goals for phosphorus

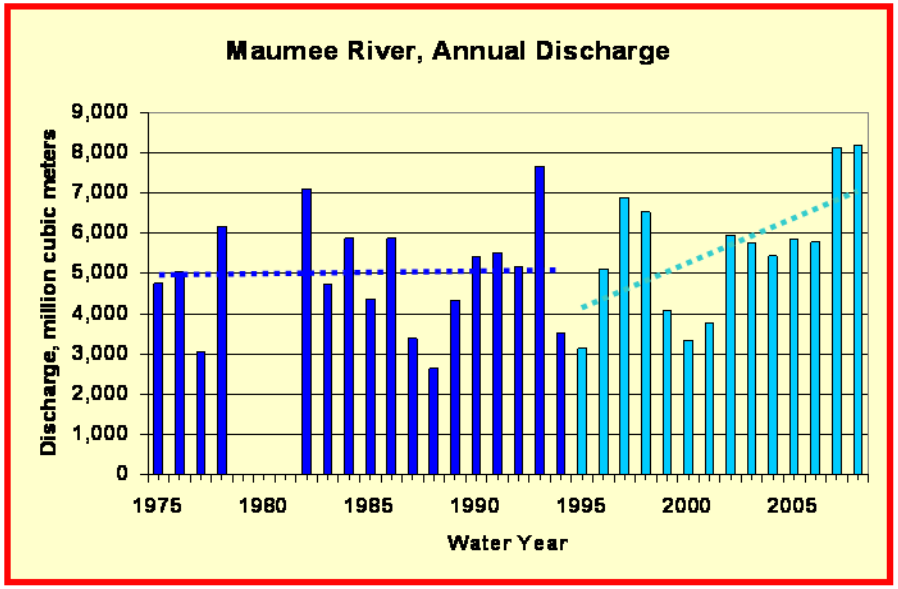



Lake Erie Total Phosphorus Loading by Major Source
Lake Huron
Atmosheric
Point Source
Nonpoint Source
Unspecified
Total Phosphorus, metric tons
30,000
25,000
20,000
15,000
10,000
5,000
0
1967
1972
1977
1982
1987
1992
1997
2002
2007
Water Year, 1967-2007

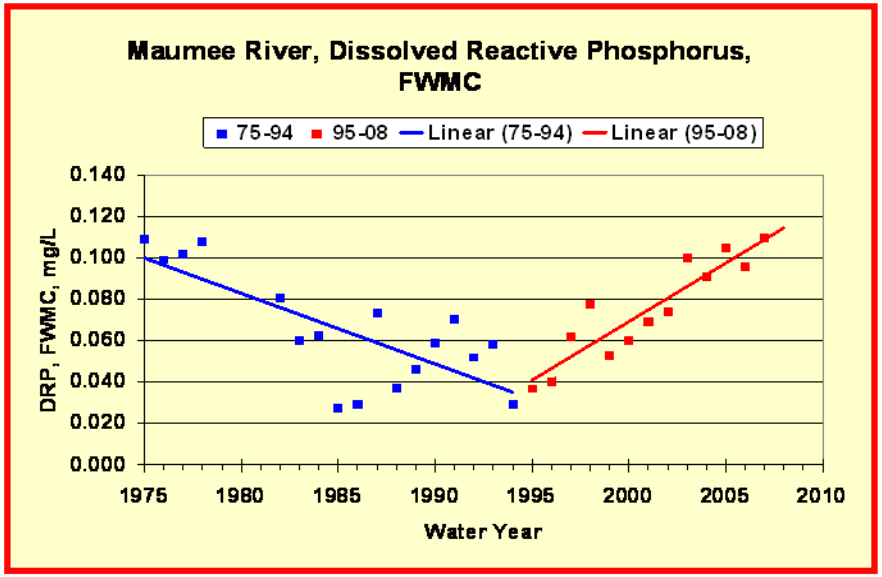

Drainage to interconnecting channel
Area = 23.5%
point source P load = 55%
nonpoint P load = 9%
P load, all sources = 29%
Drainage to western basin
Area = 40.4%
point source load = 20%
nonpoint P load = 71%
P load, all sources = 48%
Drainage to central and eastern basins.
Area = 36.1%
point source P load = 25%
nonpoint P load = 20%
P load, all sources = 23%
N
0
100
200 Kilometers
Open Water (non Great Lakes)
Low Intensity Residential
High Intensity Residential
Tiger Roads (1992)
Commercial/Industrial
Bare Rock/Sand/Clay
Quarries/Strip Mines/Gravel Pits
Transitional
Deciduous Forest
Evergreen Forest
Mixed Forest
Pasture/Hay
Row Crops
Small Grains
Urban/Recreational Grasses
Emergent Herbaceous Wetlands
Unconsolidated Shore
Lowland Grasses
Lowland Scrub/Shrub
Lowland Conifers
Lowland Mixed Forest
Lowland Hardwoods
Great Lakes Water

A comparison of phosphorus concentrations among Lake Erie tributaries

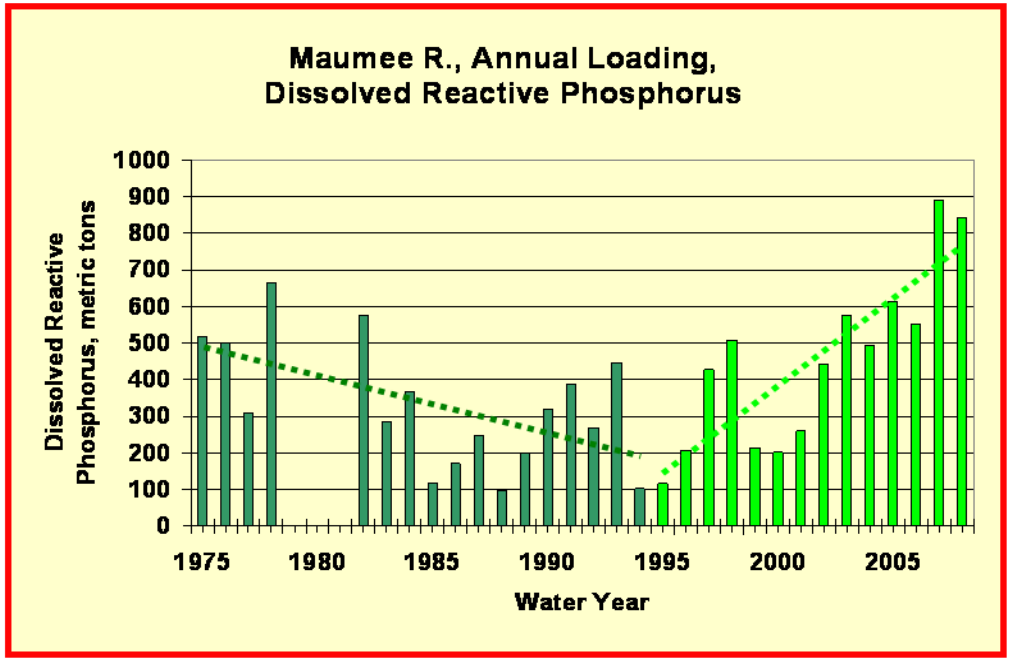




X



Annual discharges are variable but have increased during the study period.



Annual FWMCs of DRP decreased through the mid-1990s but then increased.

Agricultural Non Point Sources Examined

- Agriculture
  - Land use
  - Cropping history, acres, rotations, yields
  - Production practices
  - Fertilizer use
  - Livestock production
  - Biosolids use
  - Drainage

Row Crops are 50-80% of land use

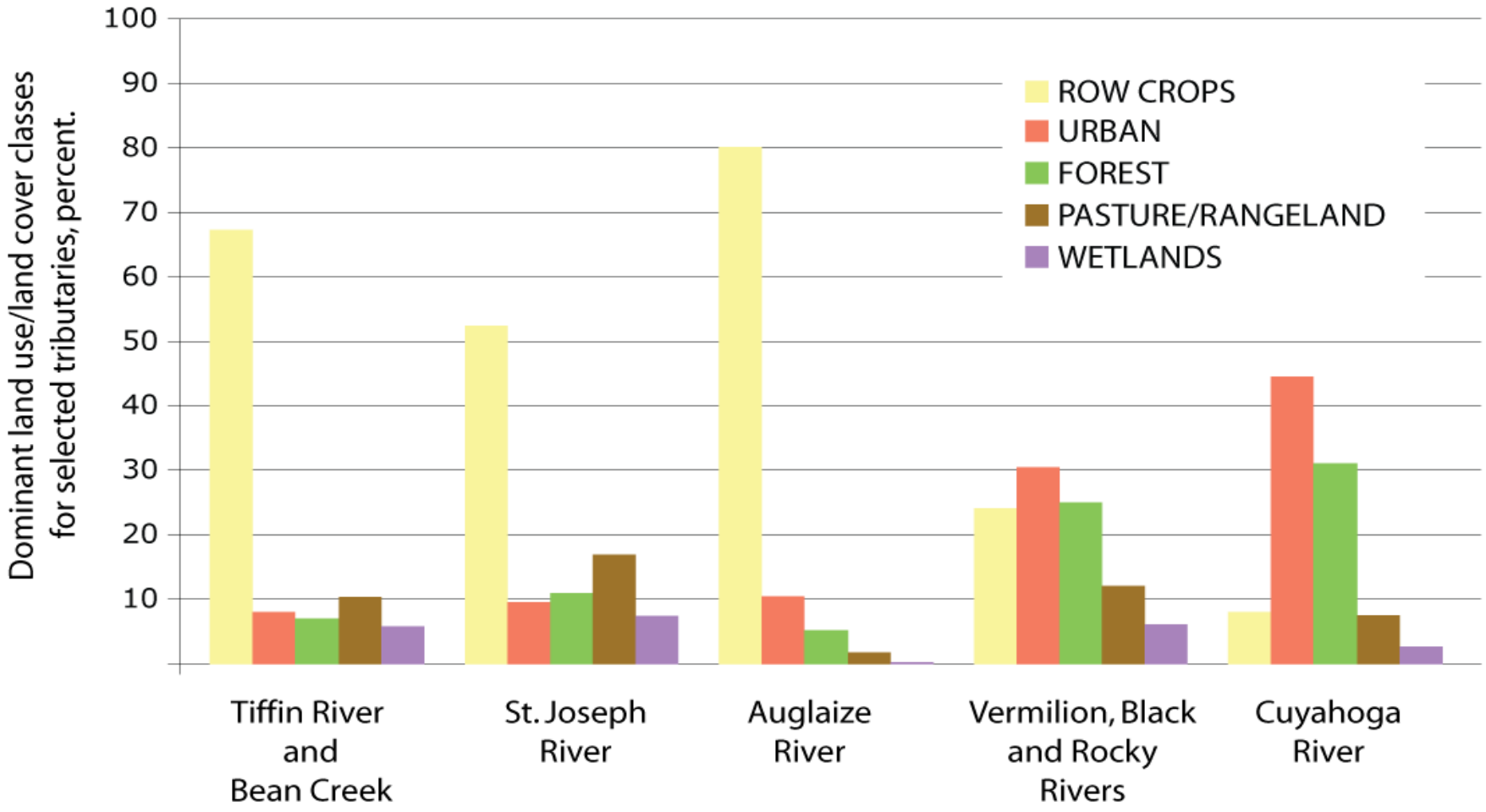
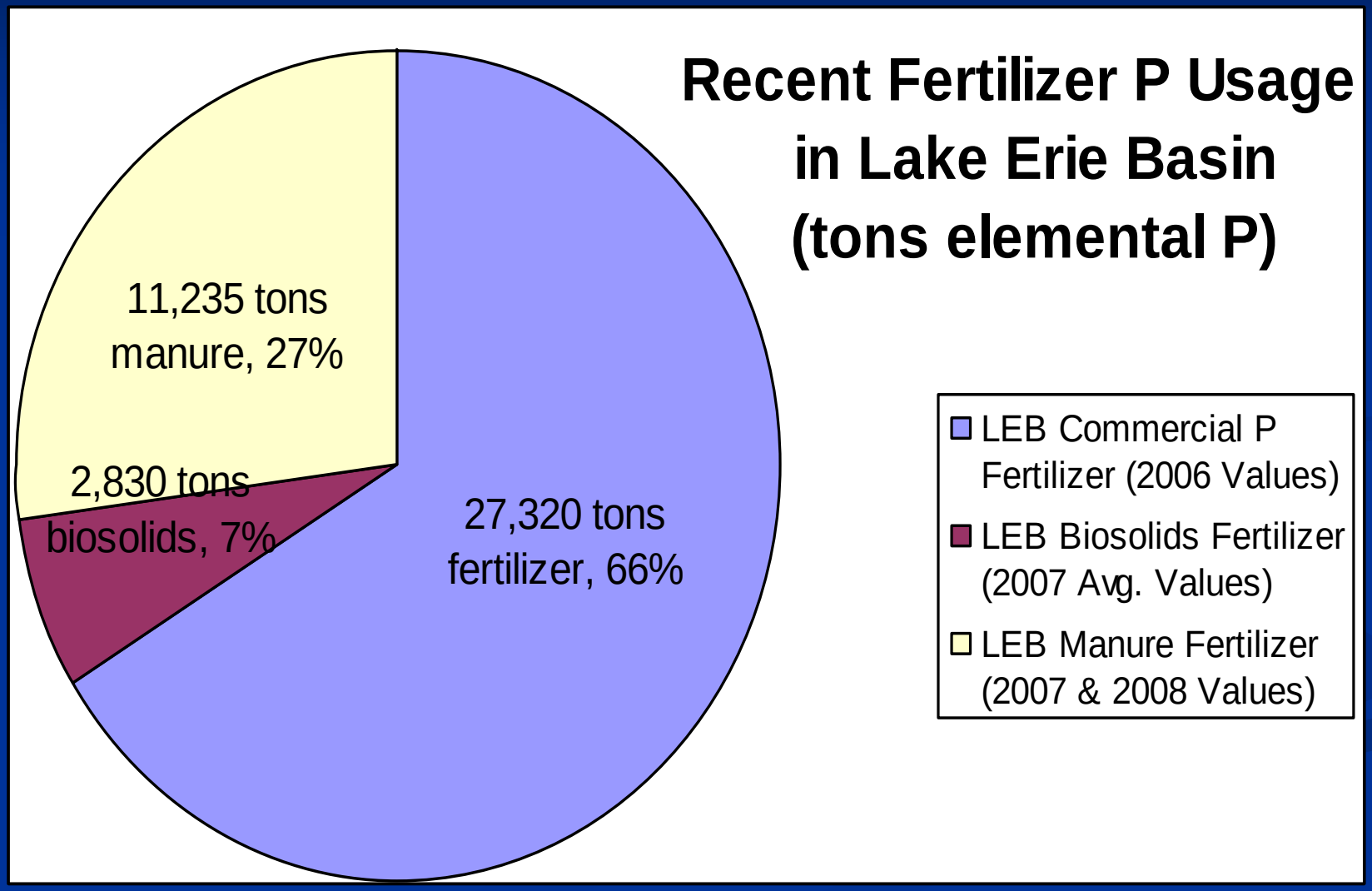


Figure 16. Dominant land use/land cover classes for a select few watersheds in the Lake Erie basin. Row-crop agriculture is more prevalent in Northwest Ohio watersheds than in the urban and forest dominated watersheds in Central and Northeast Ohio

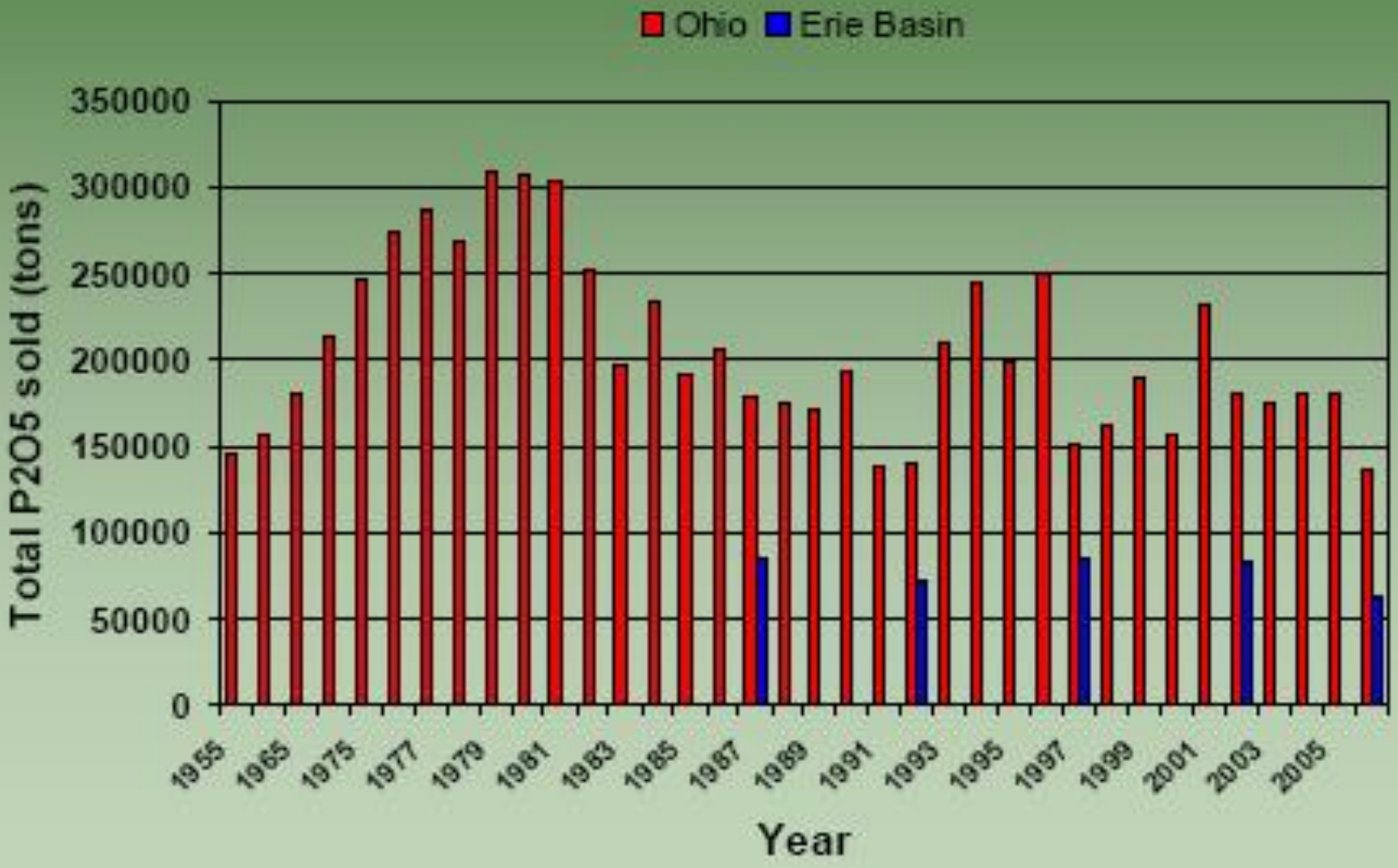
Historical Ag Trends

- From 1978's to 2007 In Ohio
  - Number of farms from 89,000 to 75,000
  - Number of farms with cattle have gone from 43,000 to 26,000
  - Number of farms with hogs from 17,000 to 3700
  - Number of farms with dairy cattle from 12,689 to 3650
- In Lake Erie Basin
  - Corn and wheat acreage has not changed.
  - Soybeans acreage has increased.
  - Hay acreage has decreased.

Where do the nutrient come from?



Historical Fertilizer Usage



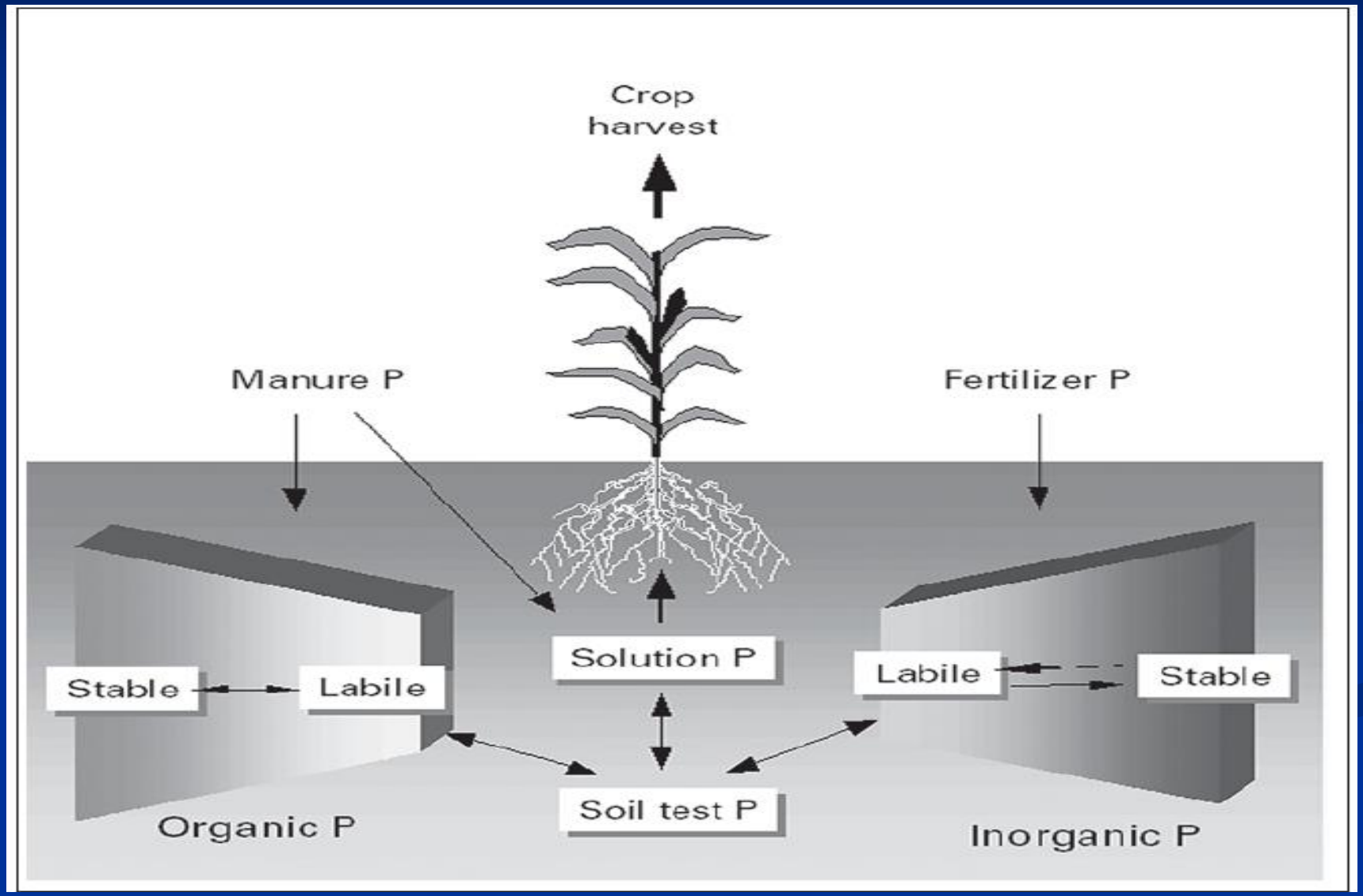
Lake Erie Basin Livestock

- Swine
  - 1993 611,400 head
  - 2006 860,000 head
    - Total Phosphorus 3800 Tons
- Cattle (Dairy and Beef)
  - 1975 603,000 head
  - 1997 339,000 head
  - 2006 338,000 head
    - Total phosphorus 5670 tons
- Poultry and Turkey
  - 2007 7.72 million layers
    266,000 turkeys
    - Total phosphorus 1130 tons
      - Plus another 640 tons brokered into LE watershed

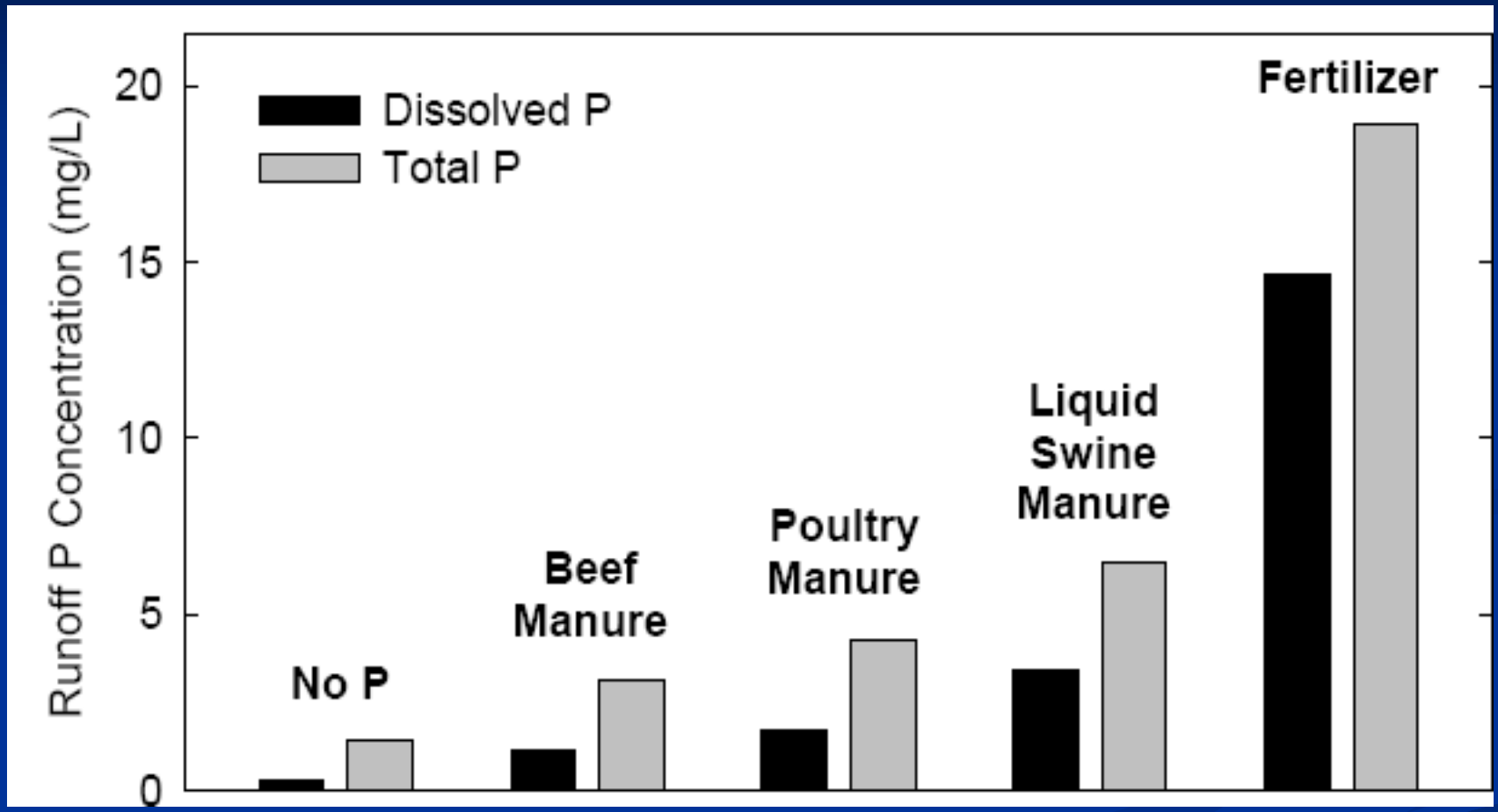
Other sources

- Bio-solids
  - 123,000 Tons land applied
    - Total phosphorus ~2829 tons
- Glyphosate
  - Estimated 1000 metric tons applied/year
    - Contains phosphonate
    - Total 165 tons

Phosphorus in Crop Production

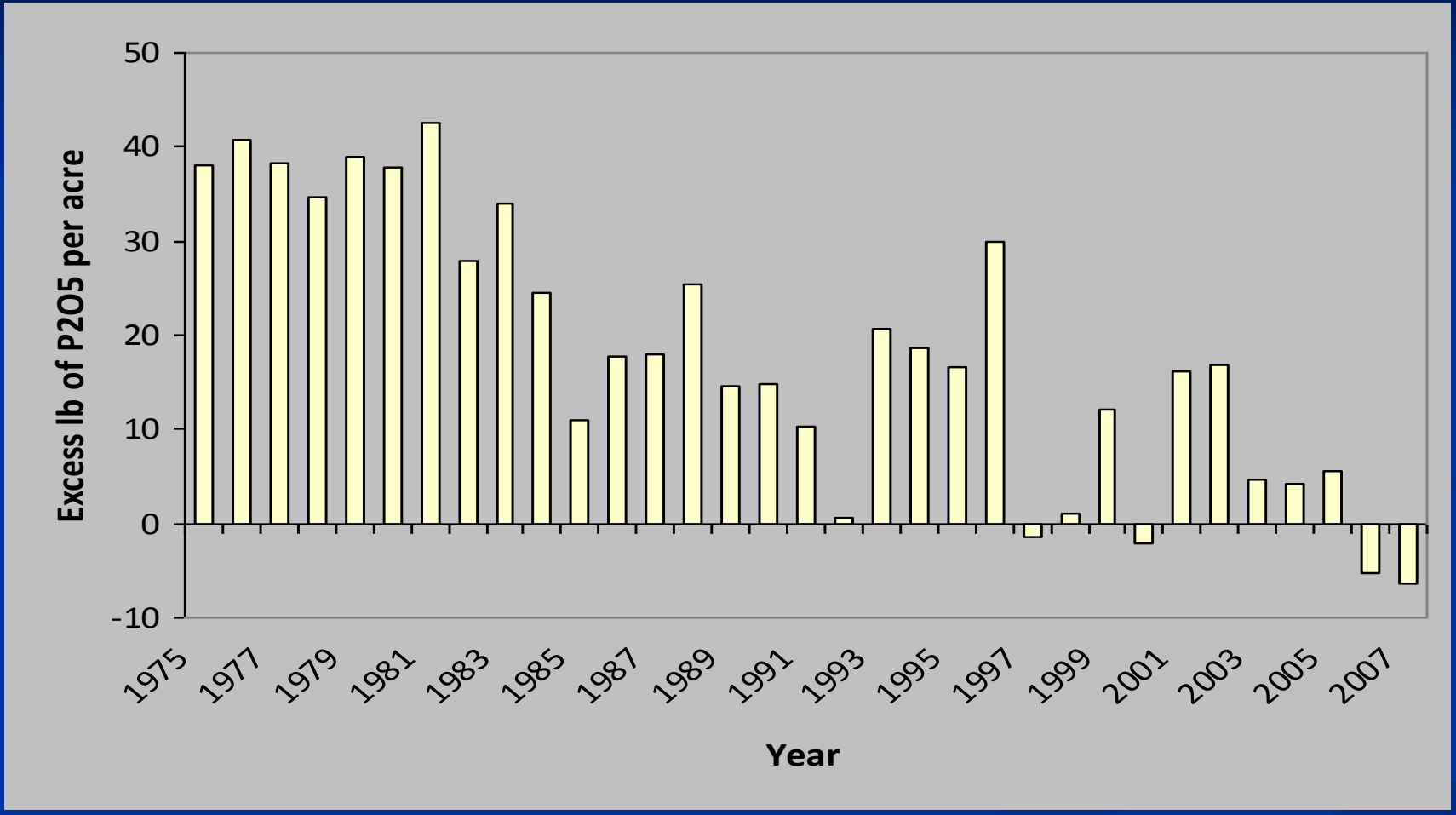


Phosphorus availability & movement



- **Figure 22**: Runoff P concentration within 24 hours of applying 100 lb P2O5/acre using fertilizer (DAP), beef, poultry, or swine manure without incorporation into the soil (averages across 21 Iowa fields). Source: Mallarino and Haq, November 25, 2009, Iowa State University,2009, Agronomy Extension Soil Fertility Web Site.

Balance of Ag Inputs and Outputs



- **Figure 23.** Excess phosphate per acre based upon commercial fertilizer sales information in the state of Ohio, manure generated from animal operations and the resultant amount phosphorus that theoretically will be land applied, and crop removal phosphorus estimates based upon NASS information.

So what is causing increases in P?

- We came up with a lot of hypothesis's but few certainties!

What has changed in Agriculture?

- Big changes in reduction in tillage.
- Larger farms, larger fields
- More soybeans
- Bigger equipment
- More specialization
- Changes in timing and placement of nutrients?

What has changed in Agriculture?

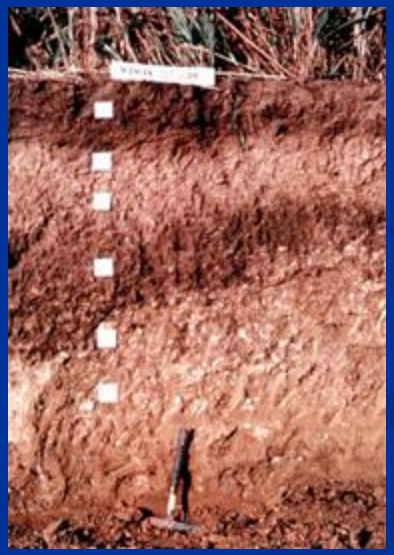
- Less fencerows?
- Less surface roughness?
- More land leveling?
- More surface drainage?
- More fall planting field prep? (Stale Seedbed)

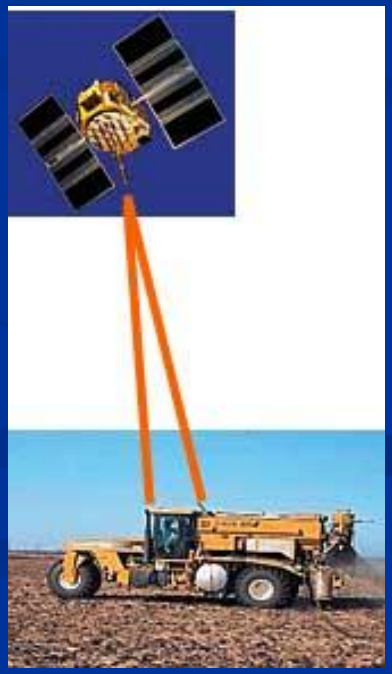
What has changed in Agriculture?

- Improved drainage outlets?
- More subsurface drainage?
- Closer subsurface tile spacing?

What has changed in Agriculture?

- Changes in timing & placement of nutrients?
- Nutrient Stratification?
- Frequency and methods of soil testing?
- Recommendations for crop nutrient yield goals?
- Soil quality changes?
  - Organic matter
  - Tilth
  - Compaction



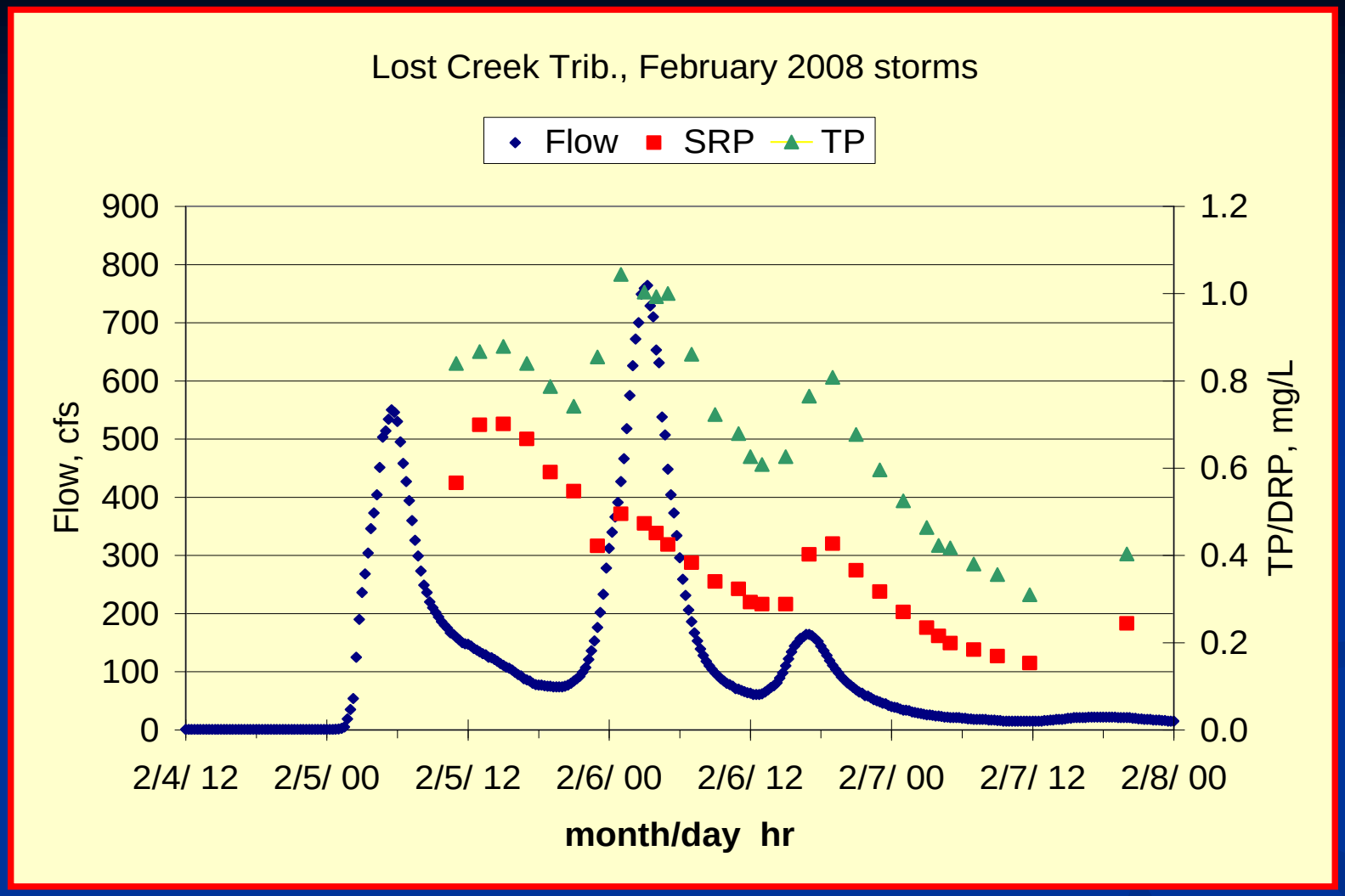


What do we Know we need to do?

- Soil Test! (frequency, sampling procedures, area)
- Know how to use those test results!
  - Keep records of previous tests, follow trends
  - Keep records of crops, rotations and yields to use in application plans
- Calibrate application equipment
- Use common sense!
  - (See example)

Some things not to do!

- Scenario:
  - Fertilizer prices are going up
  - No on farm storage
  - Dealer is needing to move his supply
  - Spreader is available and ground is frozen
- Results
  - Lots of work got done
  - Many tons of fertilizer was applied
  - A large percentage of a small watershed was covered
  - Nutrient losses were very HIGH
  - Some of the dollar savings buying fertilizer went down the river



Details of the February storms. Missing samples due to power outage. Estimated load from 2/05 00:00 to 2/06 12:00 was 0.382 metric tons. This DRP load for 36 hours exceeded the annual DRP loads for 10 of the 12 years of our earlier study at that site.

What else should I be looking at?

- Implement CRP, CREP and any other filter areas along streams & ditches.
- Incorporate/inject/band nutrients when possible.
- Use precision technologies for soil testing, fertilization, yield monitoring, recordkeeping.
- APPLY For EQIP bundled conservation practices.
- Be aware of soil quality, compaction, organic matter, permeability conditions

Hey ! Look, I got this far without talking about USDA NRCS Stds. 590 & 633!

- First addressed phosphorus in 1987!
  - Because of Lake Erie Water Quality Research
- Soil testing labs at that time just tested to 45 PPM or 90 lb/acre
- Tri- state fertility recommendations set 150 ppm environmental level
- Erosion control was primary nutrient reduction method

Ohio's Nutrient & Waste Utilization Standards

- Keep it simple!
- Includes a soil test index
  - Allows nutrient application for multiple crops or for buildup of low testing soils.
  - Limits total amount of P2O5 in one year to 250 Lb/yr
  - Soil test levels over 100 ppm have restrictions of allowing only annual P applications and additional conservation requirements of residue or incorporation

Ohio's Nutrient & Waste Utilization Standards Cont.

- Includes Phosphorus Site Assessment
  - Recognizes the complexity of method
  - Used for allowing some nutrient applications in most environmentally protective fields, while reductions occur over long term of high testing soils
  - Usually used on older existing livestock farms to allow them time to implement newer technologies

What are some of the other Task Force Recommendations?

- There are many areas of additional research needed. For Ag, some of those are:
  - What type of test is the best to measure P movement potential?
  - What are critical environmental soil test levels?
  - What best management practices can best mitigate nutrient potential to move off the fields?
  - We understand practices to minimize sediment nutrient movement, what practices dissolved nutrients?

Questions?

- The final report is available on Ohio EPA's web site.
- You may also contact:

Kevin H. Elder, executive director
ODA-livestock environmental permitting program
8995 east main street
Reynoldsburg, Ohio 43068
elder@agri.ohio.gov
www.ohioagriculture.gov.lepp
614/387-0469