# Water Quality and Freedom to Operate

Presented by Sean McMahon

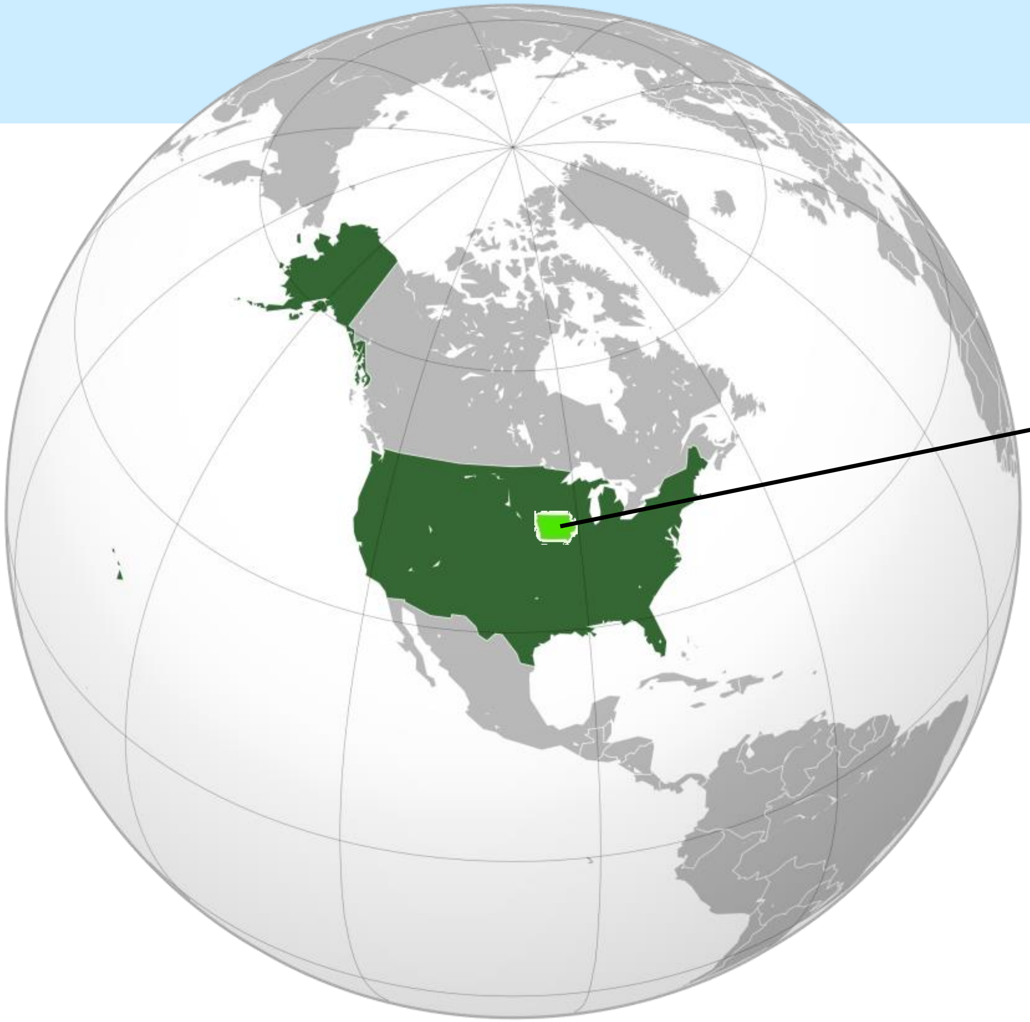
And Tim Smith

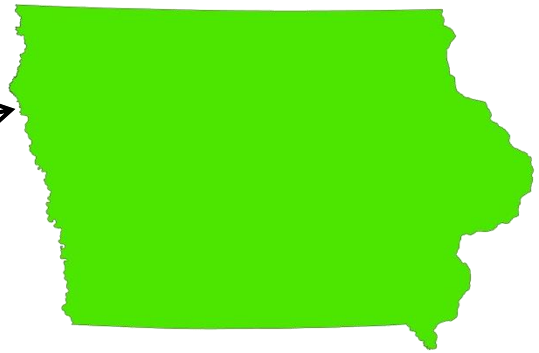
IAWA

IOWA AGRICULTURE WATER ALLIANCE

# Iowa Water Quality Initiative

IOWA DEPARTMENT OF AGRICULTURE & LAND STEWARDSHIP





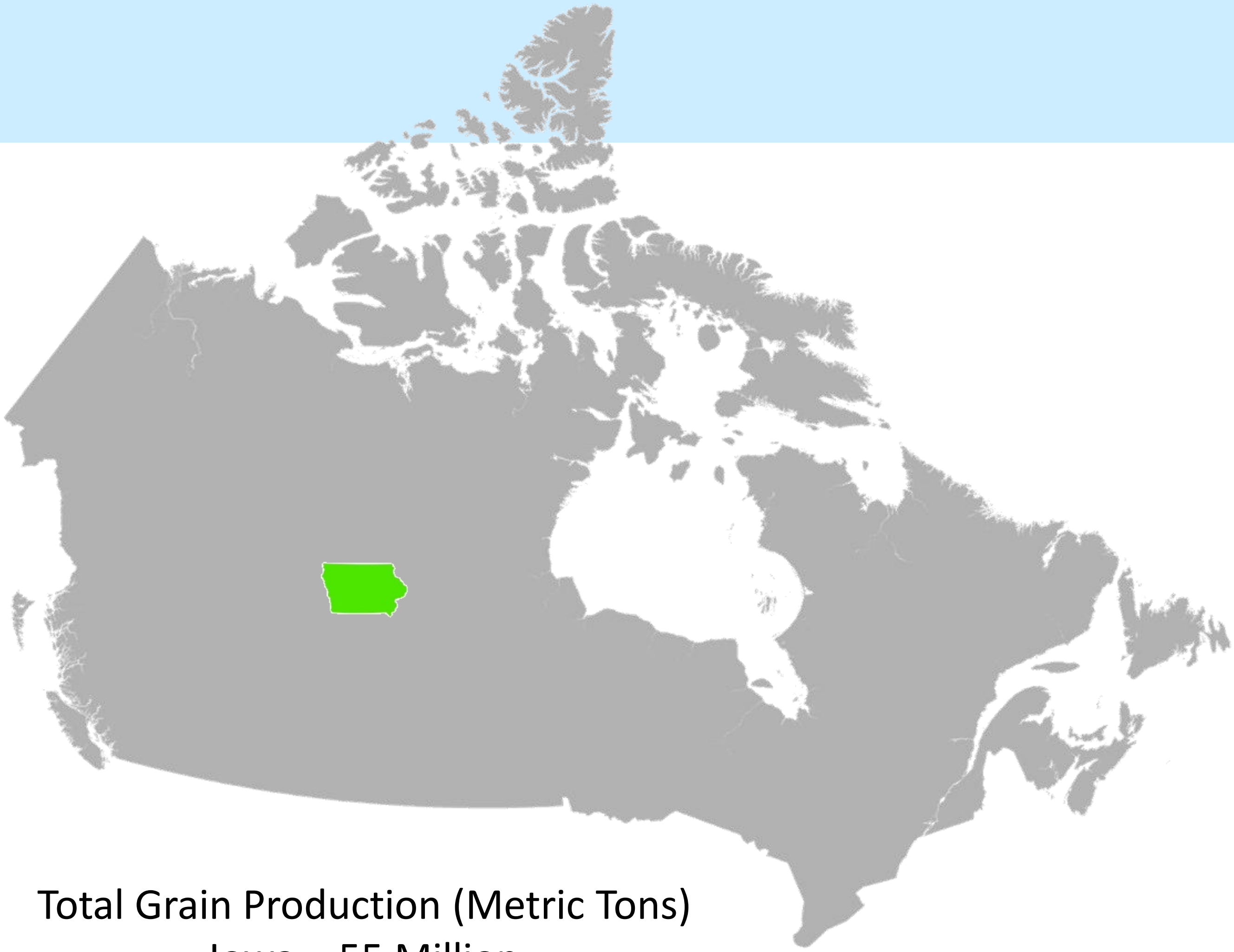
<u>Iowa</u>

0.04% of World Population

1.5% of US Area

<u>United States</u>

4.5% of World Population

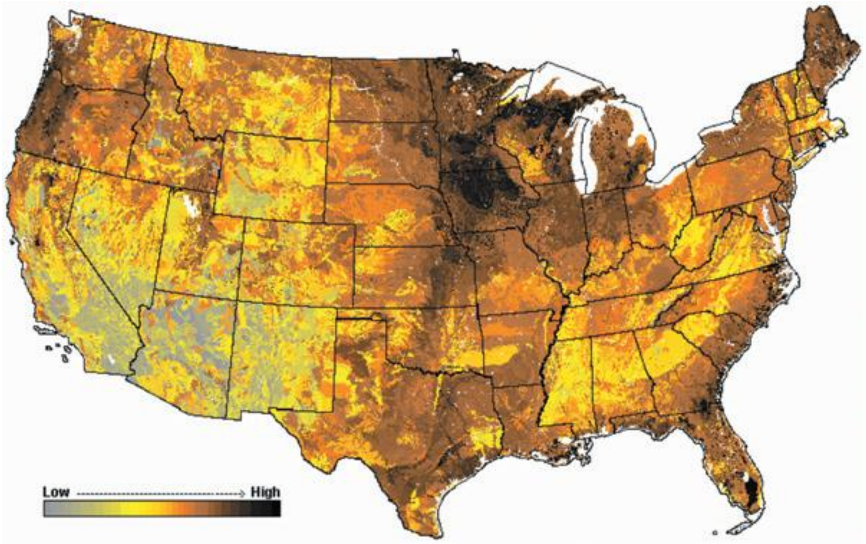


Total Grain Production (Metric Tons)
Iowa – 55 Million
Canada – 45 Million

# Total Soybean Production (Metric Tons)

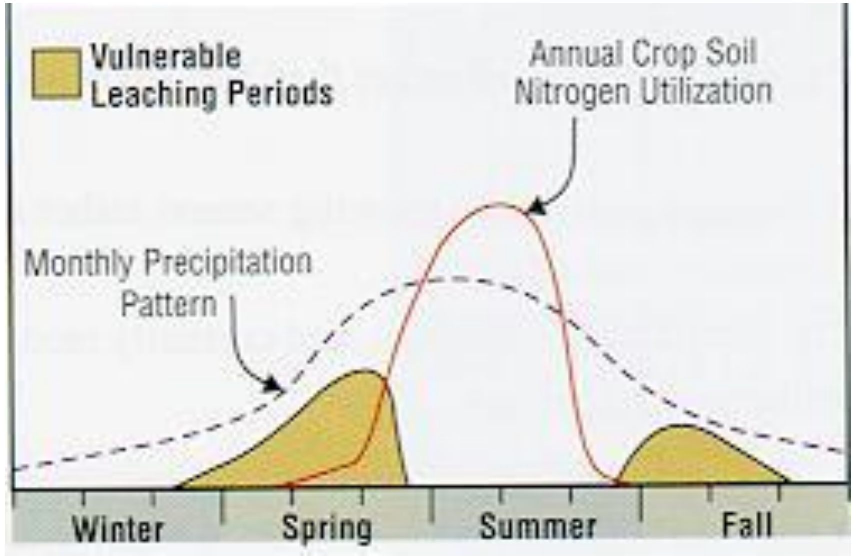
China – 15 Million
Iowa – 14 Million

# SOILS VULNERABLE TO LEACHING

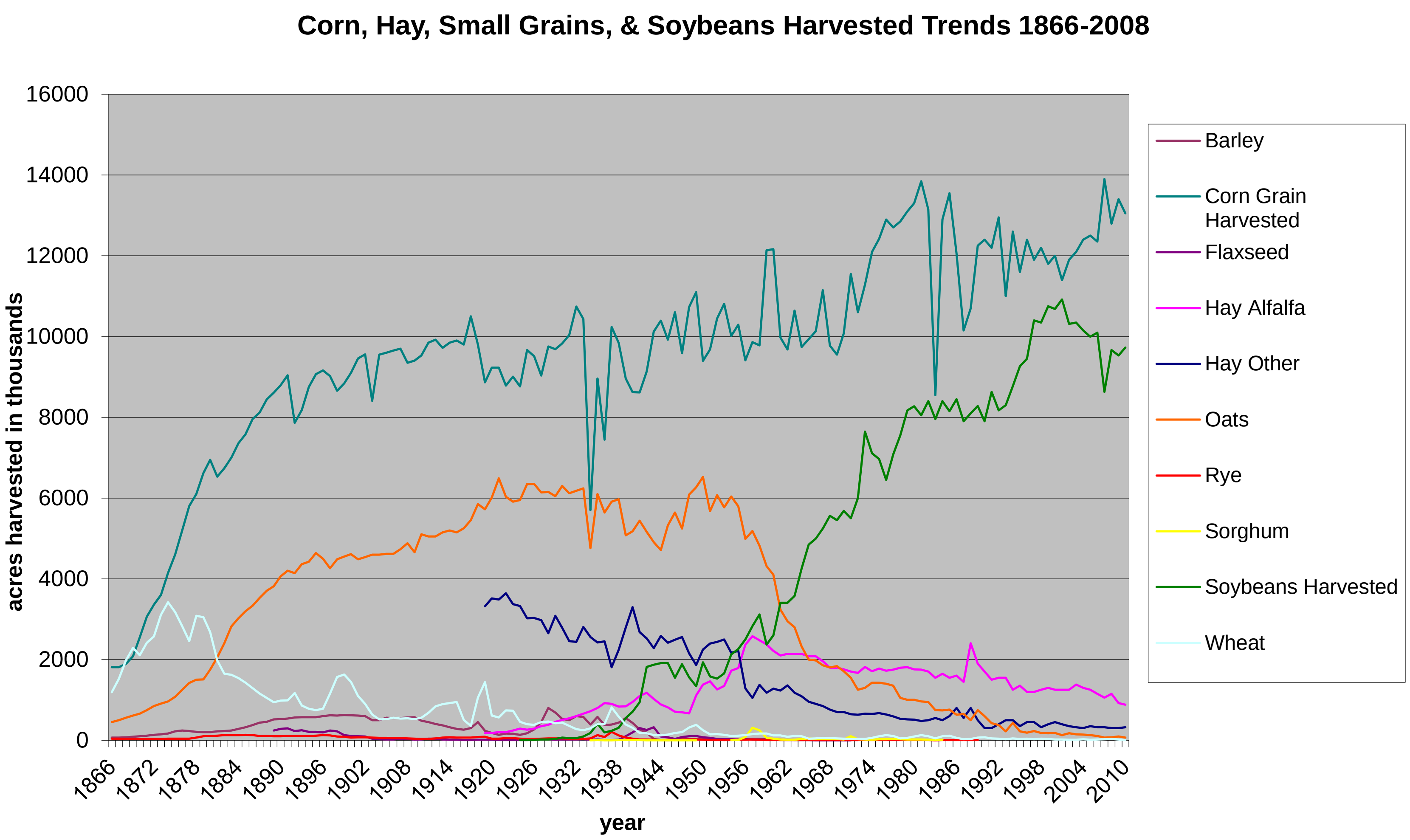



- Current major cropping system leaves soil vulnerable to erosion and nutrient leaching.
- Markets and Technological Advances have shifted cropping patterns and increased productivity.
- Have the most tools available to date and will still continue to develop and adopt new technologies

- Nutrient impairment is beyond the usual culprit of mismanagement of fertilizers and manures, but more to historic changes in land use and hydrology.

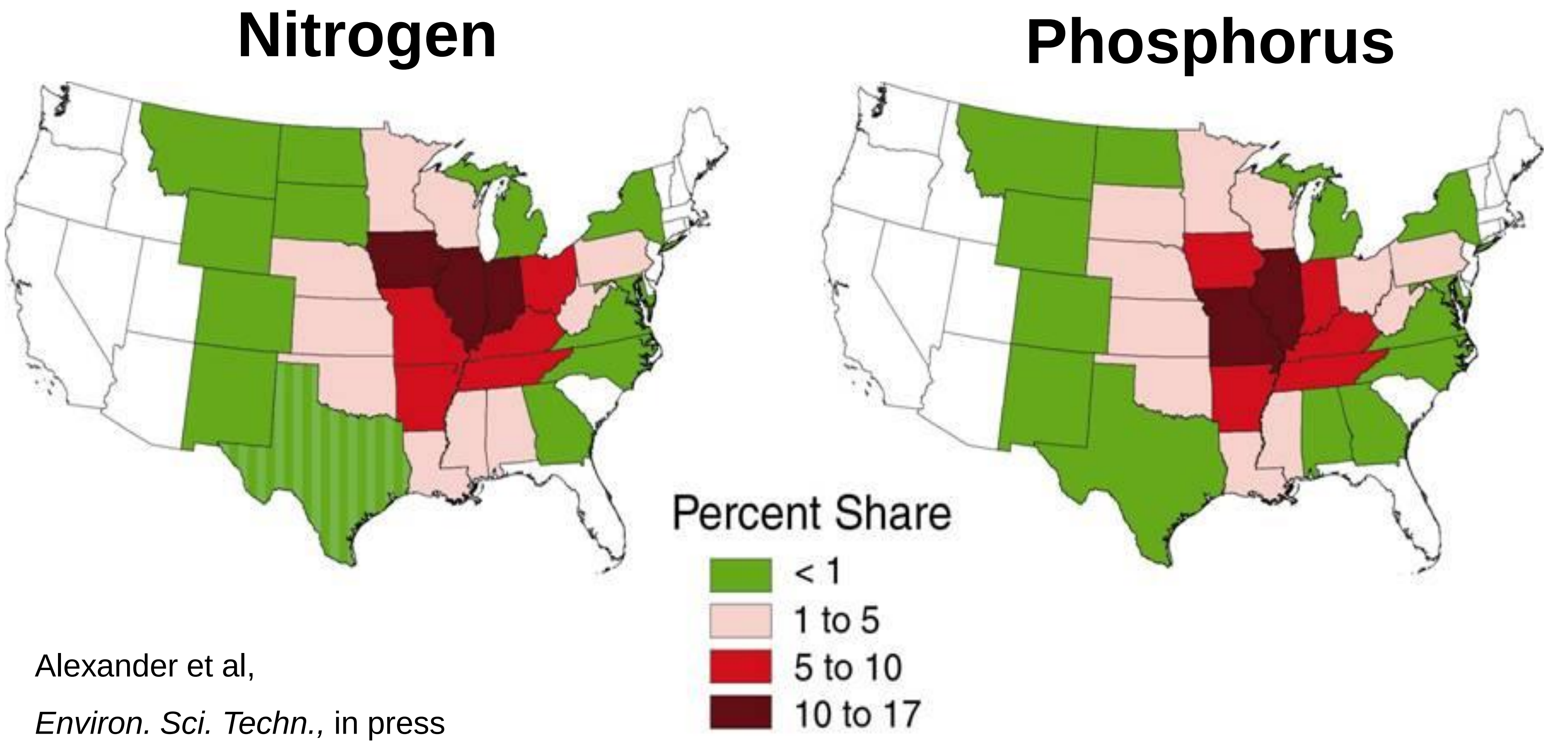


# CHANGES IN LAND USE



# NUTRIENT DELIVERY TO THE GULF OF MEXICO

State shares of the total annual nutrient flux




Alexander et al,

*Environ. Sci. Techn.*, in press

# Clean Water, Clean Air, Productive Soil ……

**Water quality (N and P)**

- groundwater **nitrate-N** contamination
- surface water **N and P** contamination
  - eutrophication: lakes, streams/rivers, estuaries, and coastal waters

- **Ag needs profitability**



# USEPA Reports that Nutrients

- **Are Causing Water Quality Impairments:**
- **>100,000 miles of rivers and streams,**
- **Approx. 2.5 million acres of lakes, reservoirs and ponds,**
- **> 800 square miles of bays and estuaries in the U.S.**
- **166 coastal hypoxic areas or “dead zones” nationwide**
- **“nutrient pollution is widespread”: 27% river and stream miles have high N, 40% have high P**
- **Stream biological condition:**
  - **55% poor, 23% fair;**
  - **9% more “good” N condition, 19% fewer “good” P condition**

**Source**: 2013 EPA website: http://water.epa.gov/type/rsl/monitoring/riverssurvey/index.cfm , http://www2.epa.gov/nutrientpollution/effects-environment , http://www2.epa.gov/nutrientpollution/where-occurs-lakes-and-rivers

# Wadeable Streams with High Nutrients

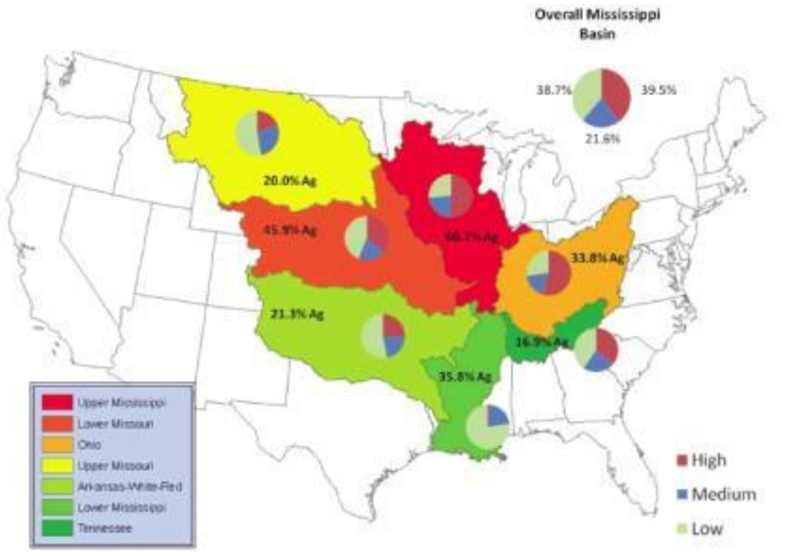


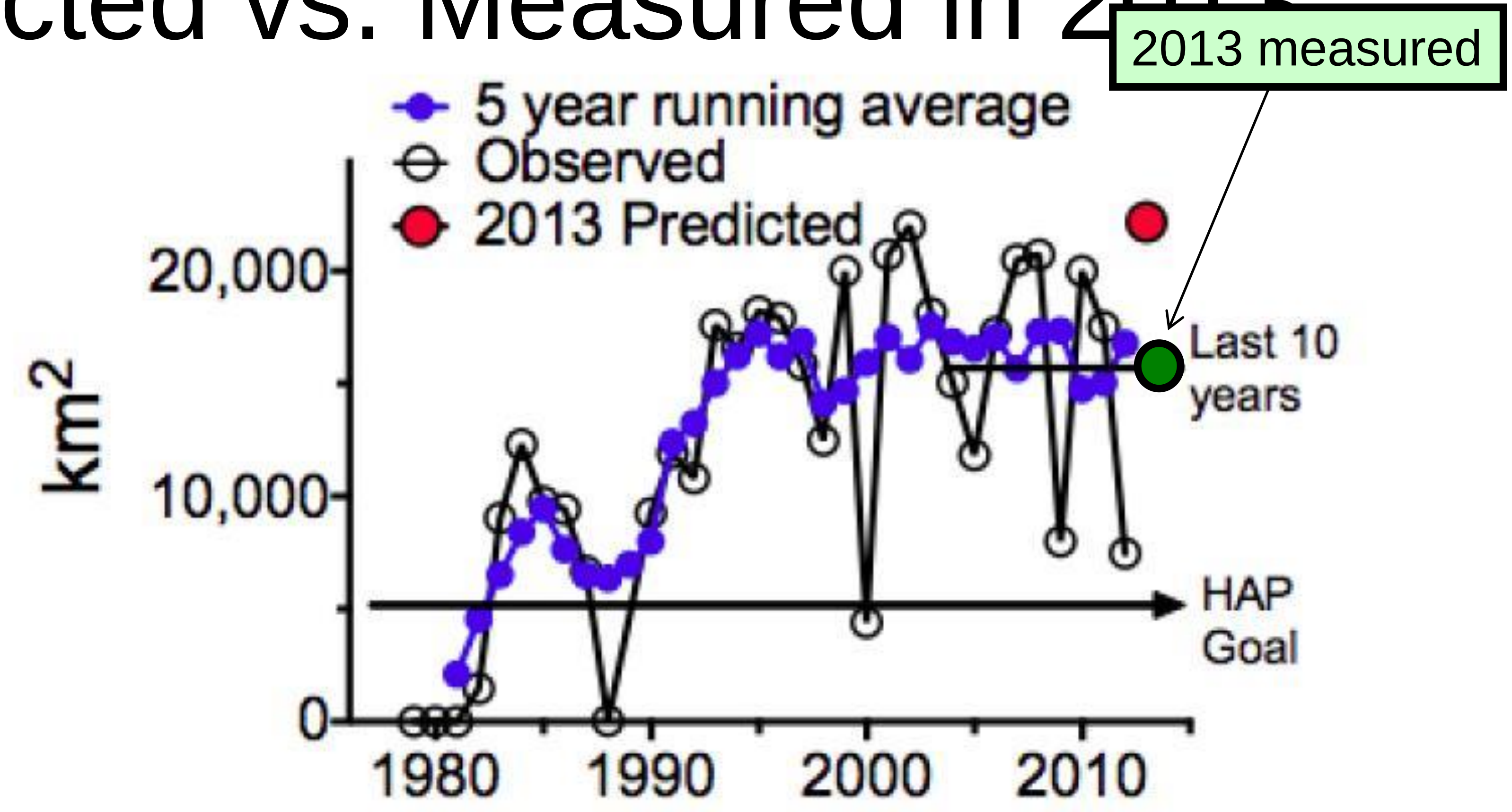

*Figure 2. Percent of streams with high, medium and low levels of nitrogen and percent of land area in agricultural use (Source: WSA)*

| | Phosphorus | Nitrogen |
|---|---|---|
| Total U.S. (lower 48) | 30.9% | 31.8% |
| Total MS River Basin | 32.5% | 39.5% |
| Upper Mississippi | 23.4% | 50.4% |
| Ohio | 43.2% | 54.6% |
| Tennessee* | 18.1% | 36.3% |
| Upper Missouri | 22.4% | 18.6% |
| Lower Missouri | 27.7% | 34.9% |
| Arkansas | 41.2% | 25.9% |
| Lower Mississippi* | 38.6% | 1.6% |

** Small sample sizes in these sub-basins result in lower statistical significance*

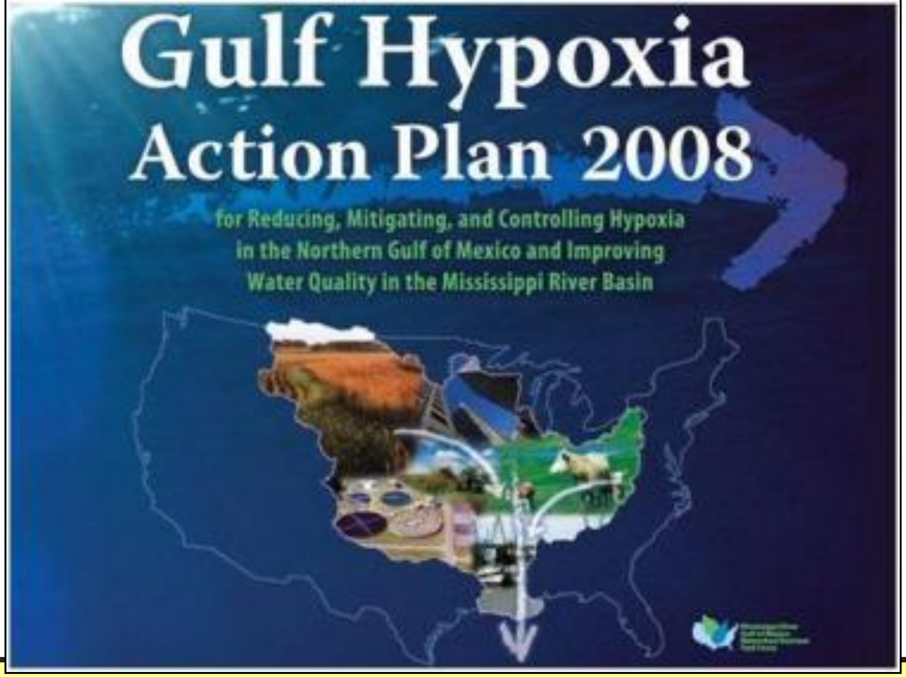
http://water.epa.gov/type/rsl/monitoring/upload/EPA-MARB-Fact-Sheet-112911_508.pdf

# Gulf of Mexico Hypoxia - Historic, and Predicted vs. Measured in 2013




Are we comfortable with this and with our ability to respond?
Can we connect in-field practices with downstream impacts?

Rabalais & Turner, 6/18/2013




**EPA Hypoxia SAB report suggested**

**45% less total N**

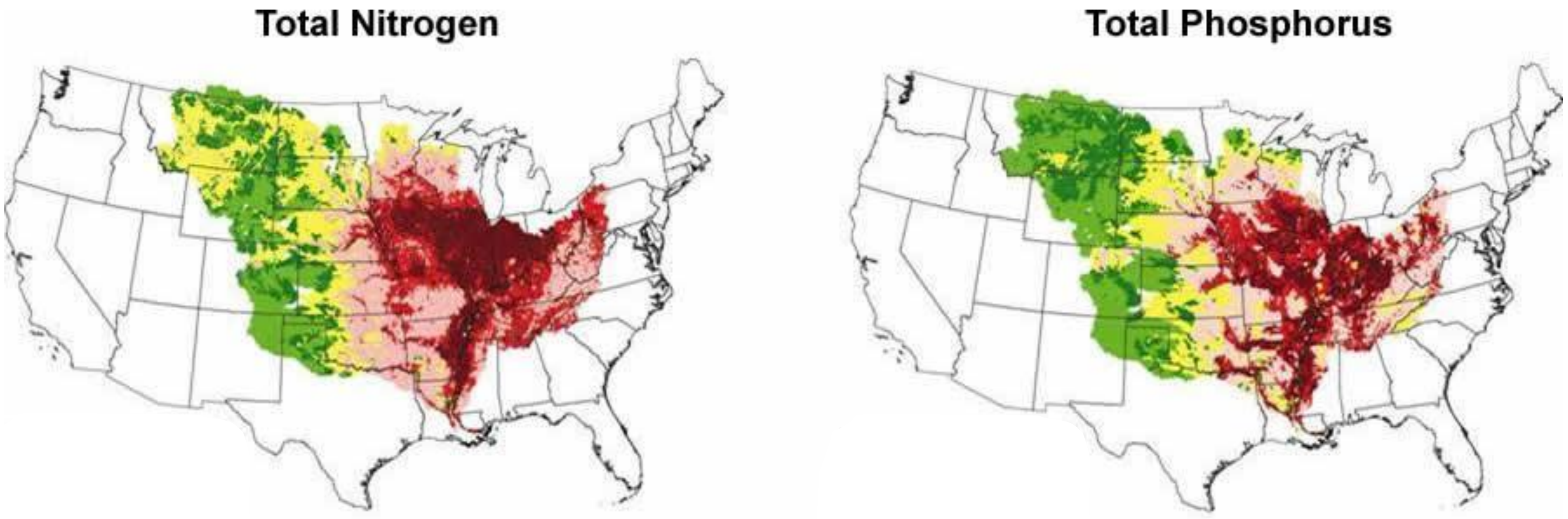
**AND**

**45% less total P**

**discharge to the Gulf to reduce hypoxia**

# USGS Estimates of Loss and Delivery of N and P to the Gulf

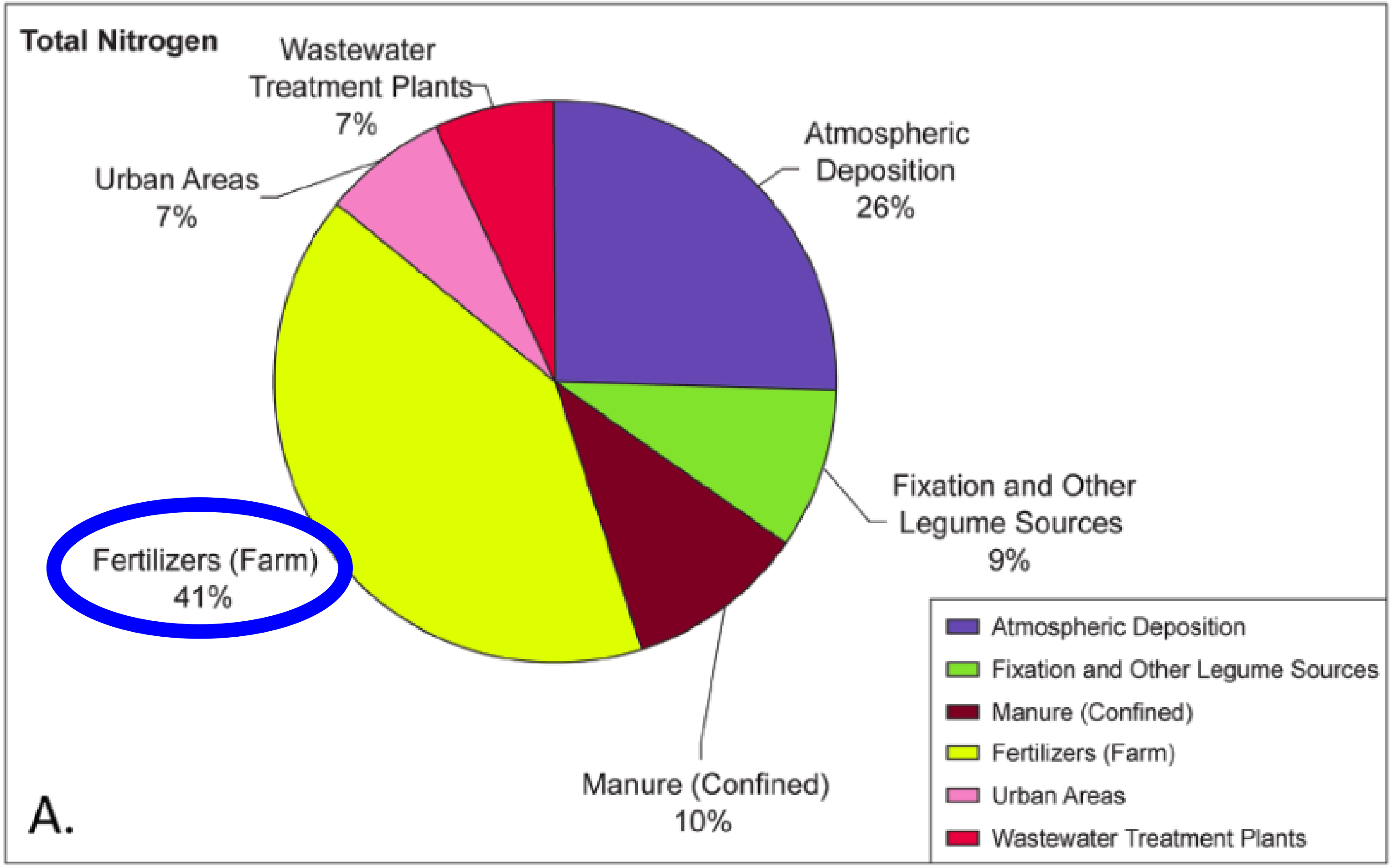
SPARROW - Modeled Estimate of N and P Discharge in Watersheds of the Mississippi R. Basin




| $kg\ km^{-2}\ yr^{-1}$ | | lbs/A/yr (approx.) |
|---|---|---|
| <1 | | <0.01 |
| 1 to 10 | | 0.01 to 0.1 |
| 10 to 100 | | 0.1 to 1.0 |
| 100 to 500 | | 1.0 to 5.0 |
| 500 to 1000 | | 5.0 to 10.0 |
| >1000 | | >10.0 |

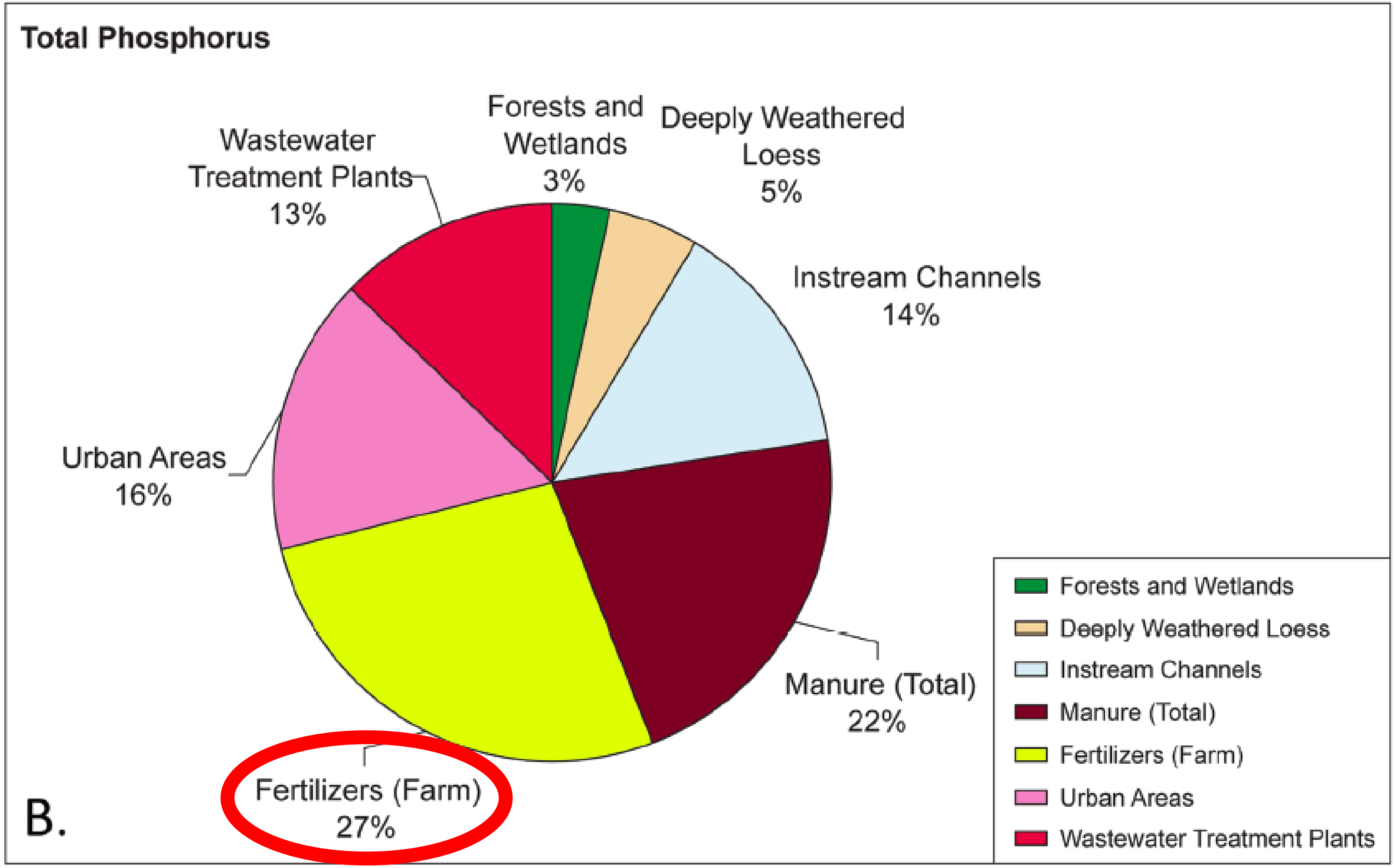
Alexander et al. *Environ. Sci. Technol. 2008, 42, 822–830*

# USGS SPARROW Modeled Sources of Annual N Load to Gulf of Mexico



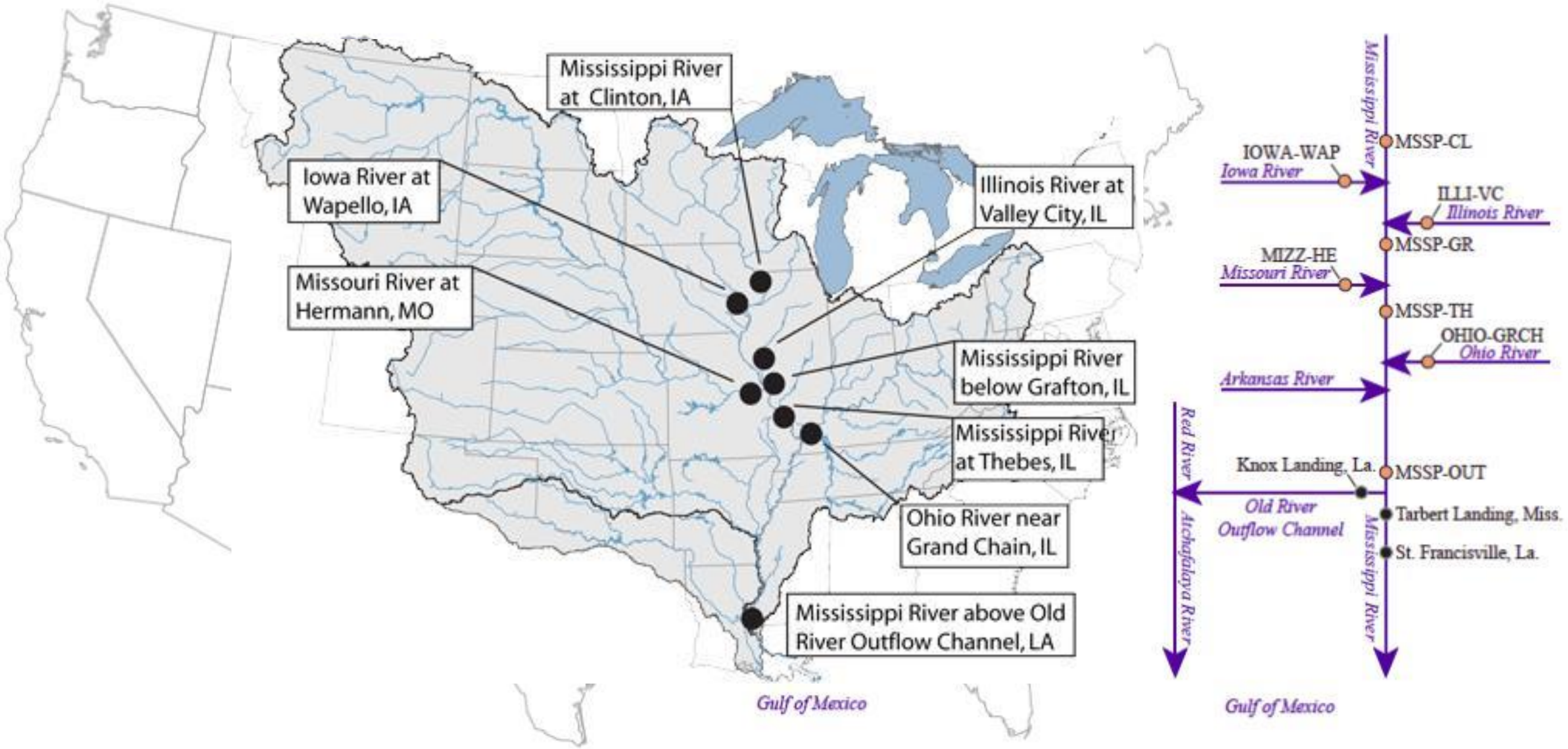

Robertson and Saad. 2013. J. Environ. Qual. 42:1422–1440

# USGS SPARROW Modeled Sources of Annual P Load to Gulf of Mexico




Robertson and Saad. 2013. J. Environ. Qual. 42:1422–1440

# USGS Sampling Sites - Miss. River Basin




Nitrate in the Mississippi River and Its Tributaries, 1980–2010: An Update
Murphy et al. USGS . Scientific Investigations Report **2013-5169**

# Annual Total N Concentration and Flux Declined in IA and IL Rivers, 1980-2010

| Site | in 1980 | | | 30-year annual trends (1980–2010) | | | |
|---|---|---|---|---|---|---|---|
| | | | | FN concentration | | FN flux | |
| | FN annual mean conc (mg/L) | FN annual flux ($10^6$ kg/yr) | FN annual yield (kg/km$^2$/yr) | Change (mg/L) | Trend (percent change) | Change ($10^6$ kg/yr) | Trend (percent change) |
| MSSP-CL | 1.19 | 71 | 321 | 0.84 | Strongly increasing (70) | 39 | Strongly increasing (55) |
| IOWA-WAP | 5.28 | 63 | 1,955 | –0.60 | Decreasing (–11) | –9 | Decreasing (–15) |
| ILLI-VC | 3.85 | 102 | 1,478 | –0.55 | Decreasing (–14) | –15 | Decreasing (–14) |
| MSSP-GR | 2.59 | 342 | 771 | 0.45 | Increasing (17) | 39 | Increasing (11) |
| MIZZ-HE | 0.98 | 95 | 70 | 0.78 | Strongly increasing (79) | 42 | Strongly increasing (45) |
| MSSP-TH | 1.96 | 496 | 269 | 0.38 | Increasing (19) | 40 | Minimal change (8) |
| OHIO-GRCH | 0.99 | 310 | 589 | –0.02 | Minimal change (–2) | –16 | Minimal change (–5) |
| MSSP-OUT | 1.26 | 819 | 281 | 0.22 | Increasing (17) | 119 | Increasing (14) |

Nitrate in the Mississippi River and Its Tributaries, 1980–2010: An Update
Murphy et al. USGS . Scientific Investigations Report **2013-5169**

# Spring Total N Conc. and Flux Decreased in IL River, 1980-2010

| Site | in 1980 | | 30-year spring trends (1980–2010) | | | |
|---|---|---|---|---|---|---|
| | | | FN concentration | | FN flux | |
| | FN spring mean conc (mg/L) | FN spring flux ($10^6$ kg/yr) | Change (mg/L) | Trend (percent change) | Change ($10^6$ kg/yr) | Trend (percent change) |
| MSSP-CL | 1.25 | 30 | 0.96 | Strongly increasing (76) | 17 | Strongly increasing (56) |
| IOWA-WAP | 6.00 | 27 | 0.43 | Minimal change (7) | –0.3 | Minimal change (–1) |
| ILLI-VC | 4.89 | 44 | –0.75 | Decreasing (–15) | –7 | Decreasing (–15) |
| MSSP-GR | 3.19 | 146 | 0.72 | Increasing (23) | 27 | Increasing (18) |
| MIZZ-HE | 1.32 | 41 | 0.78 | Strongly increasing (59) | 14 | Increasing (33) |
| MSSP-TH | 2.54 | 221 | 0.43 | Increasing (17) | 12 | Minimal change (6) |
| OHIO-GRCH | 1.12 | 94 | 0.07 | Minimal change (6) | 0.7 | Minimal change (1) |
| MSSP-OUT | 1.54 | 325 | 0.38 | Increasing (25) | 54 | Increasing (17) |

Nitrate in the Mississippi River and Its Tributaries, 1980–2010: An Update
Murphy et al. USGS . Scientific Investigations Report **2013-5169**

THE WALL STREET JOURNAL.

**September 23, 2013** ...mber 23, 2013 As of 5:54 PM EDT

Home | World | U.S. | Business | Tech | Markets | Market Data | Your Money | Opinion

Updated September 23, 2013, 5:54 p.m. ET

"Environmental advocates in states along the Mississippi River have won a round toward a **long-term goal of having federal standards created to regulate farmland runoff and other pollution** blamed for the oxygen-depleted "dead zone" in the Gulf of Mexico, & problems in other waterbodies

"In a ruling Friday (**September 20, 2013**) , U.S. District Judge Jay Zainey in New Orleans gave the EPA **six months to decide whether to set Clean Water Act standards for nitrogen and phosphorous in all U.S. waterways** or explain why they're not needed."

http://online.wsj.com/article/AP2487f967679546a68c80936888476f7b.html

http://water.epa.gov/type/watersheds/named/msbasin/upload/hypoxia_reassessment_2013_SEPT-UPDATE_508-Copy.pdf

# Basin-Wide Criteria-Downstream Protection?

**On November 18,** lawyers for the EPA filed a notice of appeal in the case (*Gulf Restoration Network (GRN), et al. v. EPA, et al)* indicating they plan to ask the U.S. Court of Appeals for the 5th Circuit to overturn Judge Jay C. Zainey's ruling requiring EPA to take a definitive stand on whether states' current nutrient policies are adequate to address water quality impairment in the basin and the Gulf of Mexico. (adapted from Inside EPA, Environmental NewsStand)

2013 Task Force Reassessment: "**Achieving significant water quality improvements in water bodies as large as the Mississippi River and Gulf of Mexico takes time**, and the increasing impacts of climate change such as more frequent extreme weather events pose additional challenges. The **progress we've made across the board during the past five years provides an excellent foundation** and we will work to accelerate our progress over the next five years," said Nancy Stoner, acting Assistant Administrator for Water for the USEPA and co-chair of the Task Force.

# Hypoxia Task Force Launches New Monitoring Efforts to Track Water Quality Improvements (September 2012)

- "The new Mississippi River Monitoring Collaborative, made up of federal and state agencies, is identifying streams with long-term nutrient monitoring and streamflow records.
- So far, the team has collected more than 670,000 nutrient data records from 12 states in the Mississippi River Basin, which it will use to evaluate where conservation practices and policies are working, and **where new or enhanced nutrient reduction strategies need to be developed**."

EPA news via Enviro-News by Water Quality Information Center at the National Agricultural Library. September 12, 2012

# Newly Proposed Changes to EPA Water Quality Standards Authority - Sept. 4, 2013

- **Proposed rule** issued in Federal Register **to modify/clarify the Clean Water Act** (*90-days for comments*)
  - attempts to ensure that courts will not find EPA has made a determination that a federal water quality standard is necessary unless EPA actually intends to make such a determination
  - defines highest attainable use
  - in situations where a CWA 101(a) designated use (e.g., fishable, swimmable) is found to be unattainable, the State must specify the next highest attainable use that will apply instead
  - **Concerns that this could open more citizen suits**

https://www.federalregister.gov/articles/2013/09/04/2013-21140/water-quality-standards-regulatory-clarifications


# Iowa Nutrient Reduction Strategy

# PS/NPS Collaboration

- PS account for 8% of the TN and 20% of the TP annually
- NPS account for 92% of the TN and 80% of the TP annually
- **Both NPS and PS play important roles on an <u>annual</u> and <u>seasonal</u> basis for Iowa water quality**

# PS/NPS Collaboration

- Nonpoint sources
  - 41% reduction of statewide N load
  - 29% reduction of statewide P load

- Point sources
  - 4% reduction of statewide N load
  - 16% reduction of statewide P load

- **Combined 45% N and P reductions**

# Iowa Water Quality Initiative

IOWA DEPARTMENT OF AGRICULTURE & LAND STEWARDSHIP

cleanwater IOWA
CLEANWATERIOWA.ORG

IOWA DEPARTMENT OF AGRICULTURE AND LAND STEWARDSHIP

## Nitrogen Practices

## Phosphorus Practices

### Nitrogen moves primarily as nitrate-N with water

| | Practice | Comments | % Nitrate-N Reduction[+] | % Corn Yield Change[++] |
|---|---|---|---|---|
| | | | Average (SD*) | Average (SD*) |
| Nitrogen Management | Timing | Moving from fall to spring pre-plant application | 6 (25) | 4 (16) |
| | | Spring pre-plant/sidedress 40-60 split Compared to fall-applied | 5 (28) | 10 (7) |
| | | Sidedress – Compared to pre-plant application | 7 (37) | 0 (3) |
| | | Sidedress – Soil test based compared to pre-plant | 4 (20) | 13 (22)** |
| | Source | Liquid swine manure compared to spring-applied fertilizer | 4 (11) | 0 (13) |
| | | Poultry manure compared to spring-applied fertilizer | -3 (20) | -2 (14) |
| | Nitrogen Application Rate | Nitrogen rate at the MRTN (0.10 N:corn price ratio) compared to current estimated application rate. (ISU Corn Nitrogen Rate Calculator – http://extension.agron.iastate.edu/soilfertility/nrate.aspx can be used to estimate MRTN but this would change Nitrate-N concentration reduction) | 10 | -1 |
| | Nitrification Inhibitor | Nitrapyrin in fall – Compared to fall-applied without Nitrapyrin | 9 (19) | 6 (22) |
| | Cover Crops | Rye | 31 (29) | -6 (7) |
| | | Oat | 28 (2) | -5 (1) |
| | Living Mulches | e.g. Kura clover – Nitrate-N reduction from one site | 41 (16) | -9 (32) |
| Land Use | Perennial | Energy Crops – Compared to spring-applied fertilizer | 72 (23) | |
| | | Land Retirement (CRP) – Compared to spring-applied fertilizer | 85 (9) | |
| | Extended Rotations | At least 2 years of alfalfa in a 4 or 5 year rotation | 42 (12) | 7 (7) |
| | Grazed Pastures | No pertinent information from Iowa – assume similar to CRP | 85 | |
| Edge-of-Field | Drainage Water Mgmt. | No impact on concentration | 33 (32) | |
| | Shallow Drainage | No impact on concentration | 32 (15) | |
| | Wetlands | Targeted water quality | 52 | |
| | Bioreactors | | 43 (21) | |
| | Buffers | Only for water that interacts with the active zone below the buffer. This would only be a fraction of all water that makes it to a stream. | 91 (20) | |

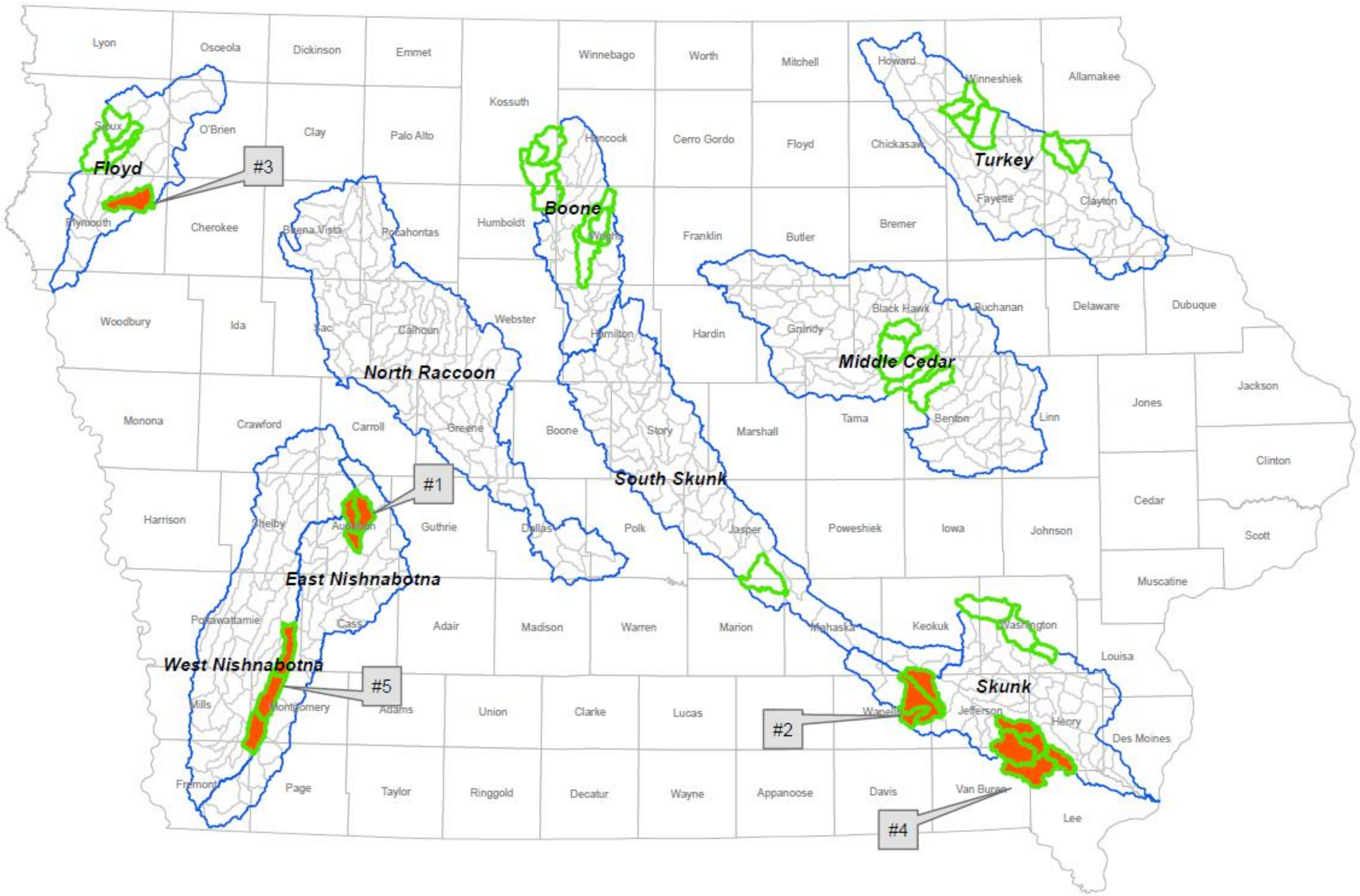
### Phosphorus moves primarily with eroded soil

| | Practice | Comments | % P Load Reduction[a] | % Corn Yield Change[b] |
|---|---|---|---|---|
| | | | Average (SD[c]) | Average (SD[c]) |
| Phosphorus Management Practices | Phosphorus Application | Applying P based on crop removal – Assuming optimal STP level and P incorporation | 0.6[d] | 0 |
| | | Soil-Test P – No P applied until STP drops to optimum | 17[e] | 0 |
| | Source of Phosphorus | Liquid swine, dairy, and poultry manure compared to commercial fertilizer – Runoff shortly after application | 46 (45) | -1 (13) |
| | | Beef manure compared to commercial fertilizer – Runoff shortly after application | 46 (96) | |
| | Placement of Phosphorus | Broadcast incorporated within 1 week compared to no incorporation, same tillage | 36 (27) | 0 |
| | | With seed or knifed bands compared to surface application, no incorporation | 24 (46) | 0 |
| | Cover Crops | Winter rye | 29 (37 | -6 (7) |
| | Tillage | Conservation till – chisel plowing compared to moldboard plowing | 33 (49) | 0 (6) |
| | | No till compared to chisel plowing | 90 (17) | -6 (8) |
| Land Use Change | Perennial Vegetation | Energy Crops | 34 (34) | |
| | | Land Retirement (CRP) | 75 | |
| | | Grazed pastures | 59 (42) | |
| Erosion Control and Edge-of-Field Practices | Terraces | | 77 (19) | |
| | Buffers | | 58 (32) | |
| | Control | Sedimentation basins or ponds | 85 | |

# WQI DEMONSTRATION WATERSHED PROJECTS

- Targeted to Priority Watersheds to Provide:
    - Demonstration of practices and technologies outlined in science assessment
    - Foster partnerships with wide range of project stakeholders to leverage resources and expand audience.
    - Strong outreach/education components to provide information on practices and adoption of available practices detailed in the Science Assessment
    - Local/regional hubs for demonstrating practices and providing practice information to farmers, landowners, farm managers, peer networks, etc.

# WQI WATERSHED PROJECTS



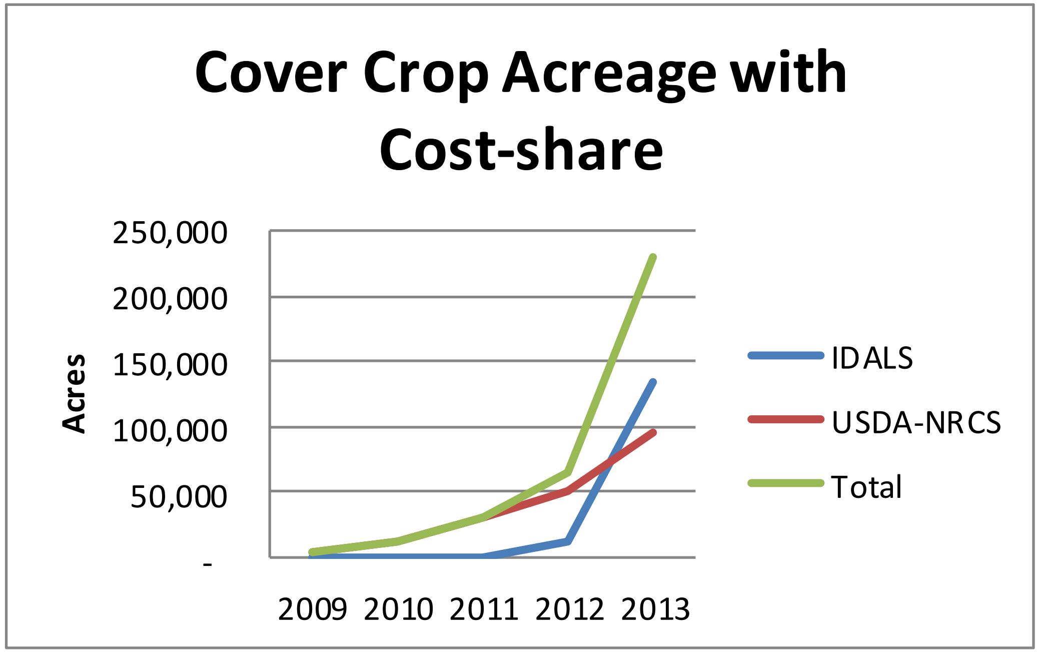
# STATEWIDE EFFORTS

- Statewide efforts
  - Offer incentives to try a new practice from NRS Science Assessment
  - Follow-up efforts to offer the information necessary to improve chances of successful implementation
    - Any new practice adds complexity to already complex weather and management related variables
  - Recruit the help of experienced farmers in providing assistance to new users.




# STATEWIDE EFFORTS

## Interest is growing…




*Does not account for acres of Cover Crops done privately or through Conservation Stewardship Program contracts.


30

## Mission

To increase the pace and scale of implementation of the Iowa Nutrient Reduction Strategy.

## Supporting Organizations

- Iowa Corn Growers Association
- Iowa Pork Producers Association
- Iowa Soybean Association

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WATER ALLIANCE

# Iowa Agriculture Water Alliance

## Activities

- Enhance understanding by the public and key decision makers about need for flexibility in addressing nonpoint nutrient sources
- Support Iowa State University and other committed partners in developing environmental performance metrics and measurements
- Secure significant funding from public and private sources to accomplish the mission.
- Maintain Iowa producers’ freedom to operate.
- Drive Adoption of Conservation Practices

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WATER ALLIANCE

# Conservation Practices

- Cover Crops
- Nutrient Management
- Conservation Tillage
- Nutrient Treatment Wetlands
- Bioreactors
- Saturated Buffers
- Drainage Water Management
- Buffers, Grass Waterways, Terraces

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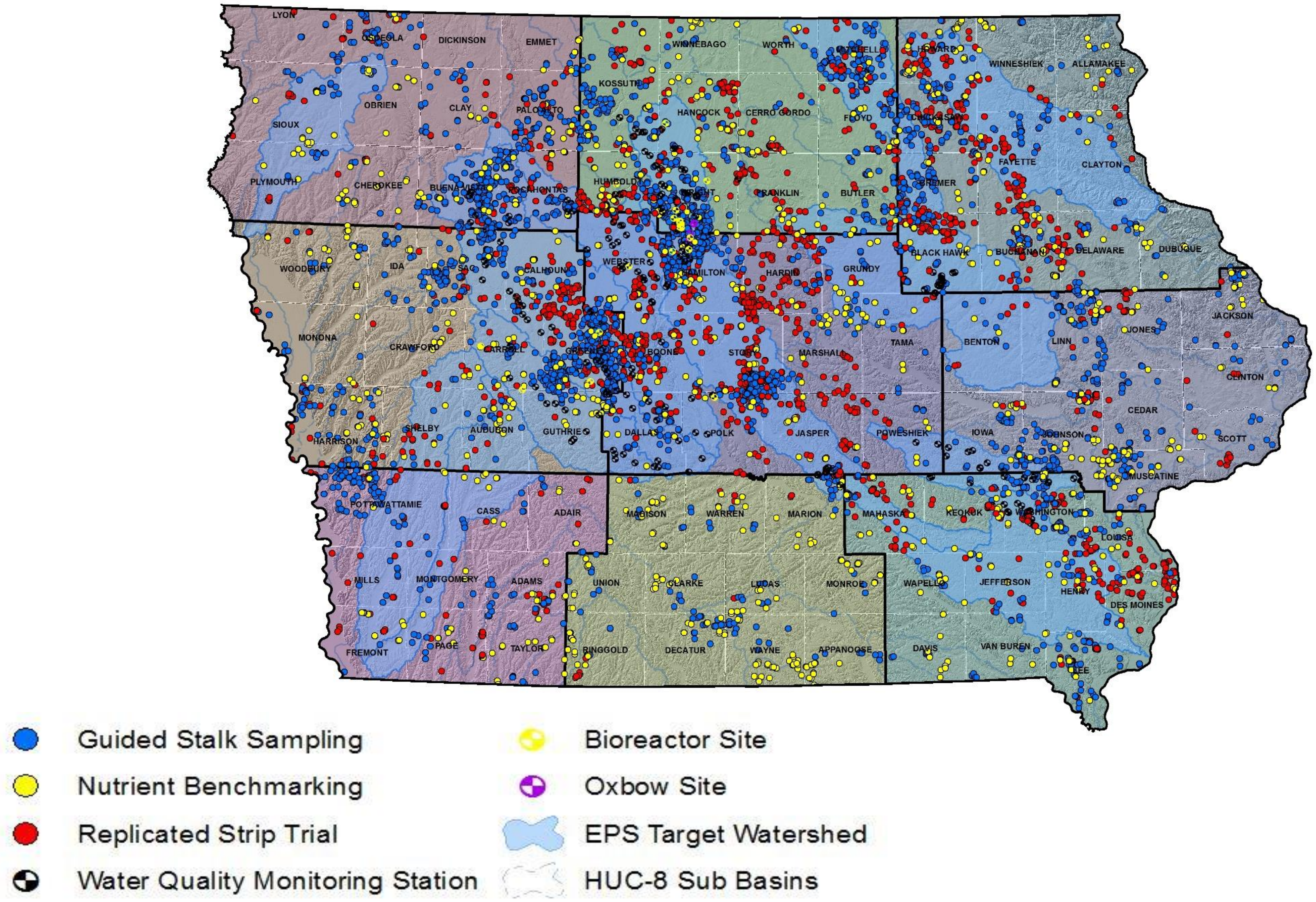
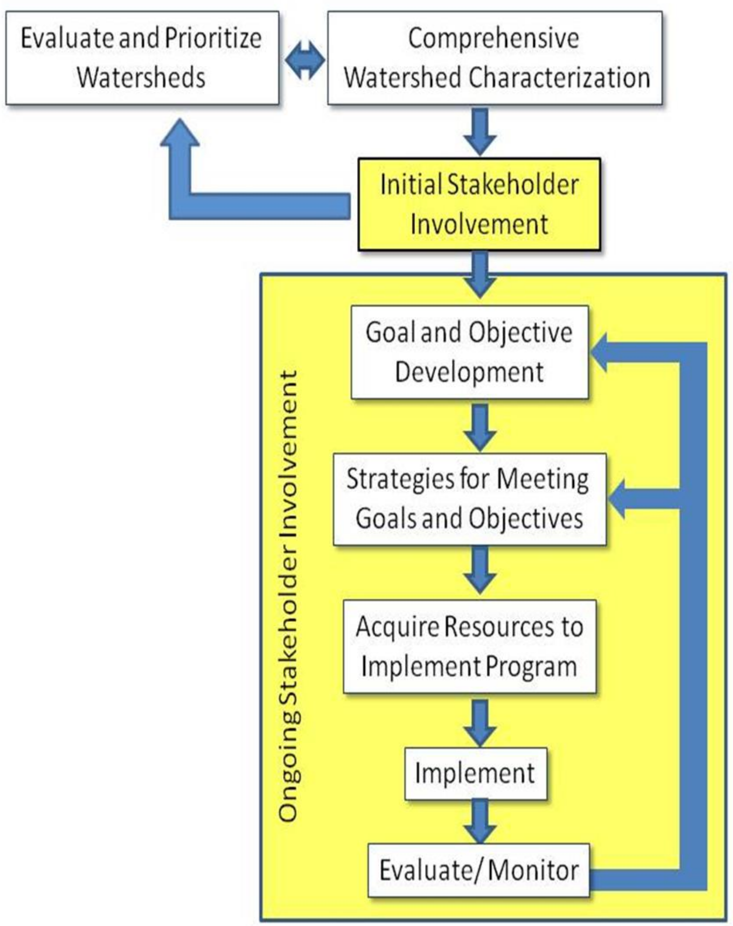
# Engagement


Guided Stalk Sampling
Nutrient Benchmarking
Replicated Strip Trial
Water Quality Monitoring Station
Bioreactor Site
Oxbow Site
EPS Target Watershed
HUC-8 Sub Basins

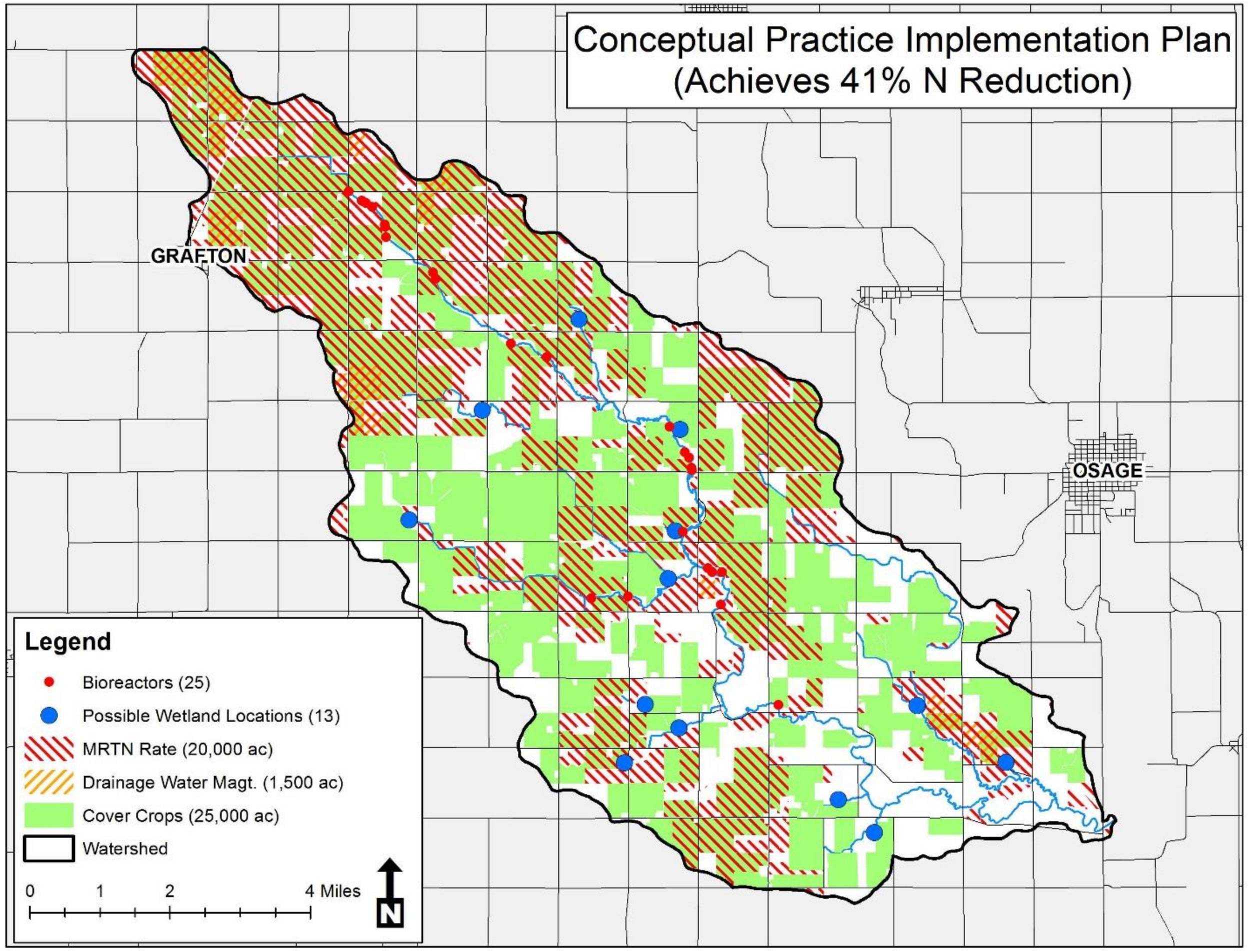
# Environmental Programs and Services Watershed Services - Planning

- **A comprehensive plan for the watershed (follows watershed planning protocol)**
  - Farmer involvement; locally-led
  - Identify resource concerns
  - Establish specific goals/objectives
  - Inventory watershed
  - Formulate alternatives/evaluate alternatives
  - Make decisions/write plan; includes implementation schedule and resource needs.
- **Infield/Edge of Field**
- **Set of integrated solutions; no silver bullet**
- **Implementation**



# Conceptual Implementation

First Draft Rock Creek Watershed Management Plan



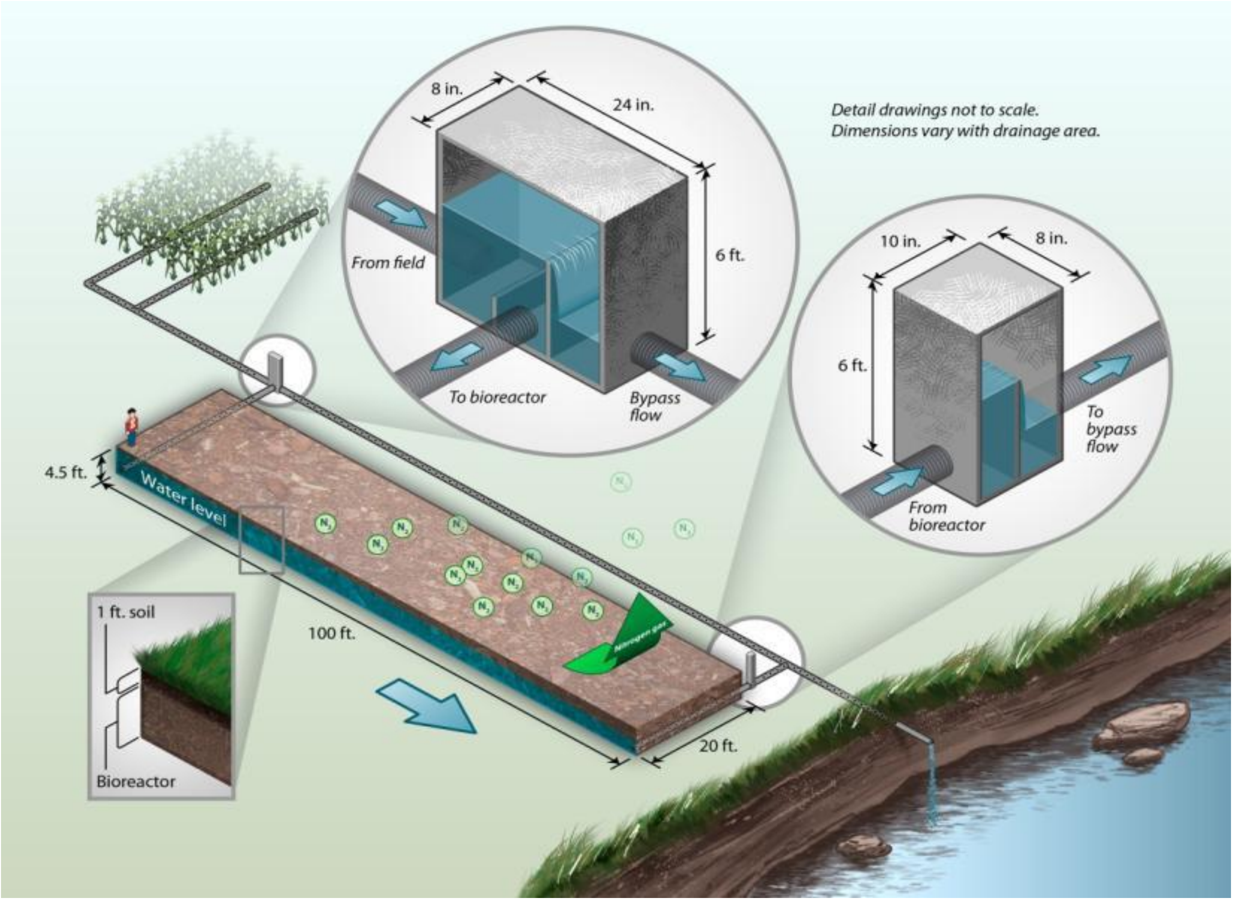

**Initial Estimated Costs**

Initial Cost: $5.0m ($117/ac)

Yearly Cost: $750k ($45/ac)

***Update** – after completion of watershed plan, Mitchell SWCD applied and received WPF/WSPF funding from IDALS. $174K/year one; $962K total request.

# Drainage Water Treatment
# Woodchip Bioreactor

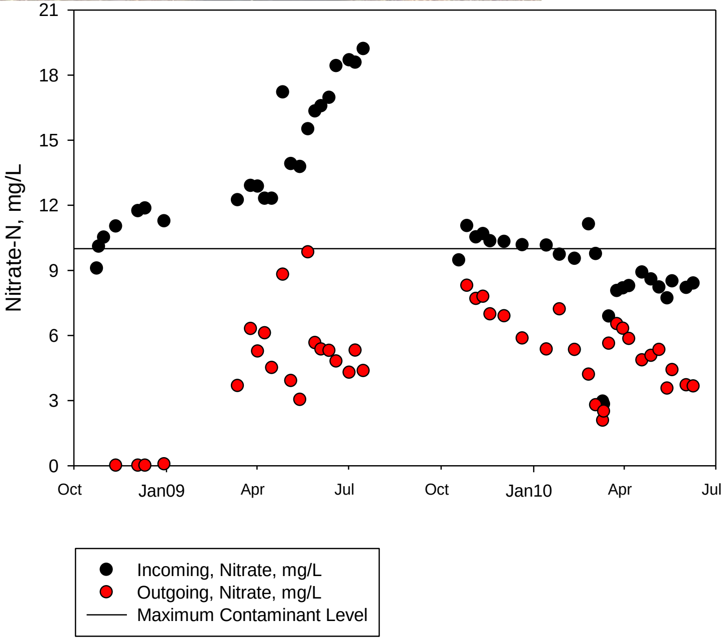



ISA EPS – 22 Bioreactors

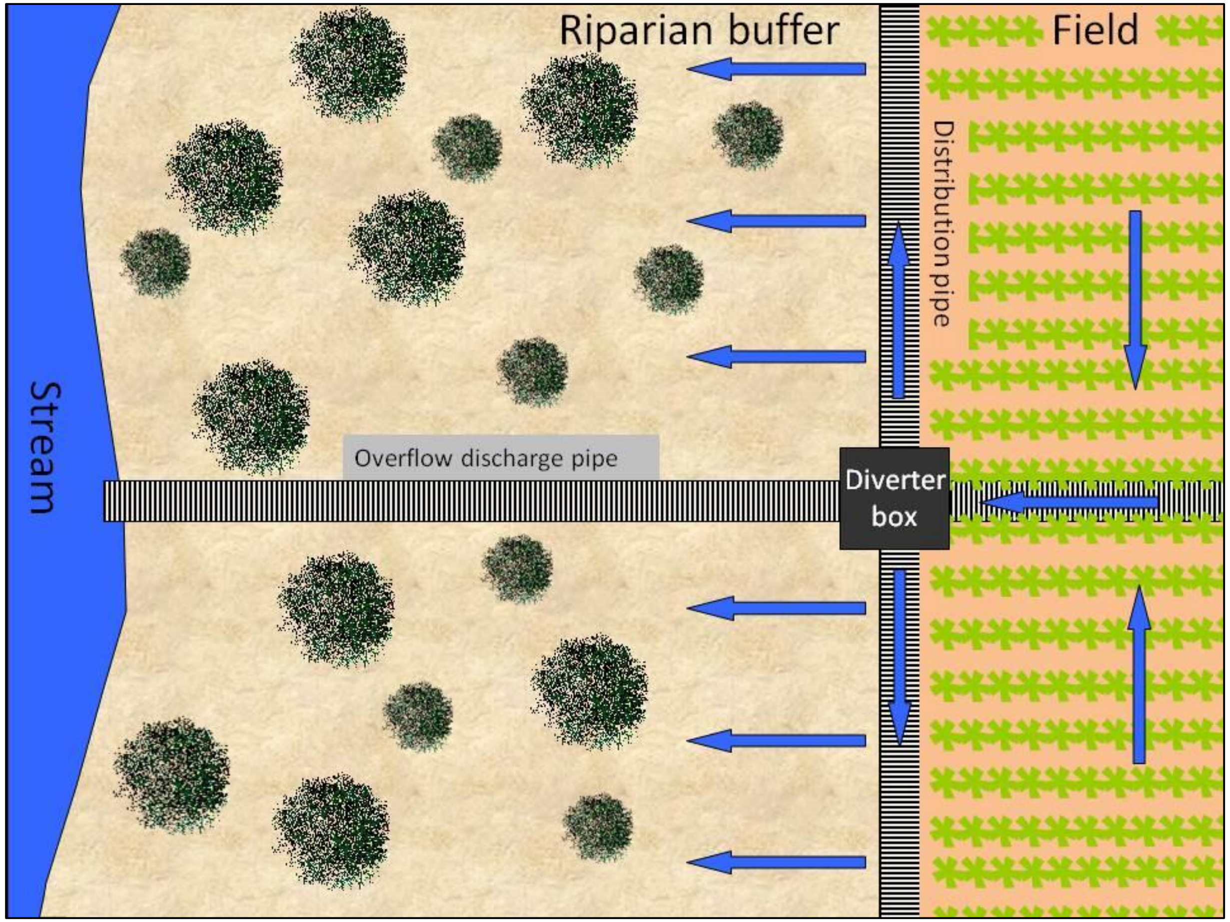
- 12 actively monitoring
- Project with Iowa Nutrient Research Center

# Drainage Water Treatment
# Woodchip Bioreactor

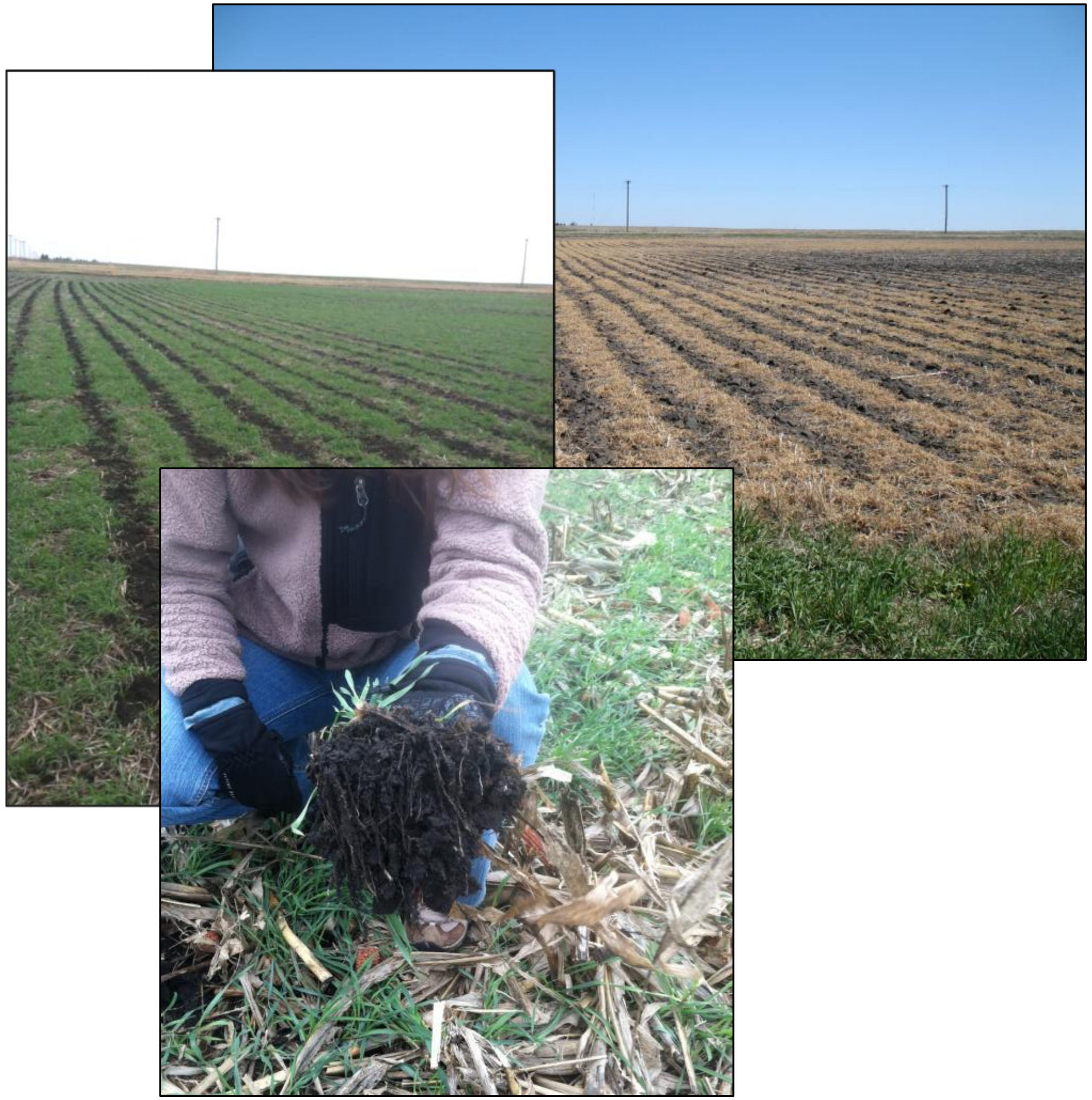
**Woodchip Bioreactors for N removal.** An innovative practice being applied in watersheds with nitrogen resource concerns. Water monitoring data to validate performance.



# Re-saturated Riparian Buffers



# Cover Crops

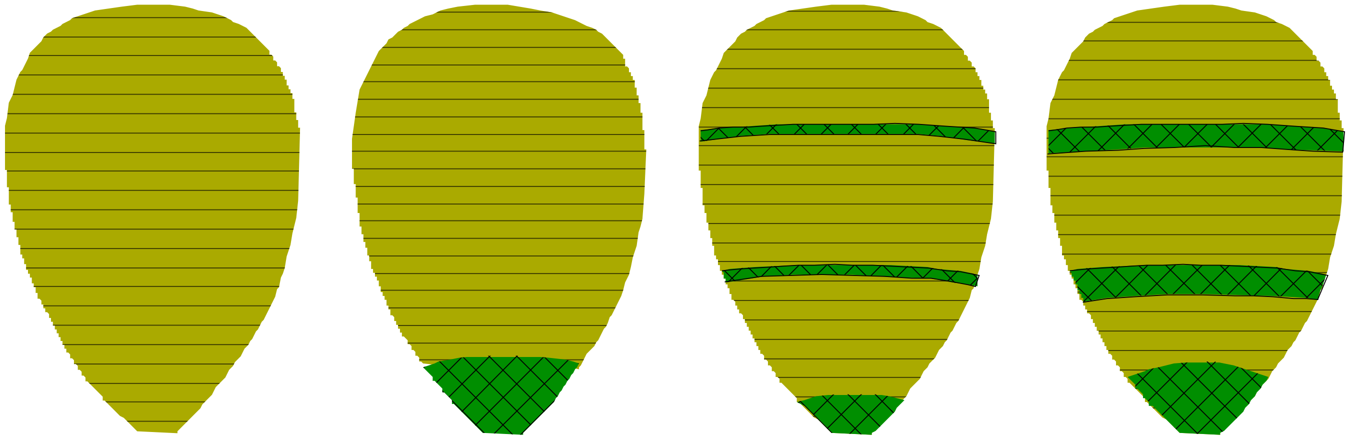


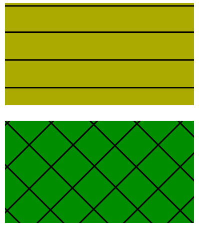
- **NRCS Cover Crop Project**: Integrated project with OFN on developing a cover crop planning and evaluation protocol for Iowa farmers. Includes demo trials, field days, and communication/outreach.

- **IDALS Cover Crop Project**: A cover crop research project in the Upper Cedar River watershed to evaluate economic, agronomic, and environmental risks/benefits on the implementation of cover crops. The project includes an evaluation of the hydrologic impacts from cover crops, and overall farmer interest on the use of cover crops in their operation. Includes demo trials, field days, and communication/outreach.

# Prairie STRIPS

12 small watersheds – 1-8 ac:
Random Incomplete Block Design:
3 reps X 4 treatments X 3 blocks





= corn and bean row crops

= reconstructed ***prairie***

*60% reduction in water runoff; *88% reduction in N;*89% reduction in P with just 10-20% of watershed converted to prairie.

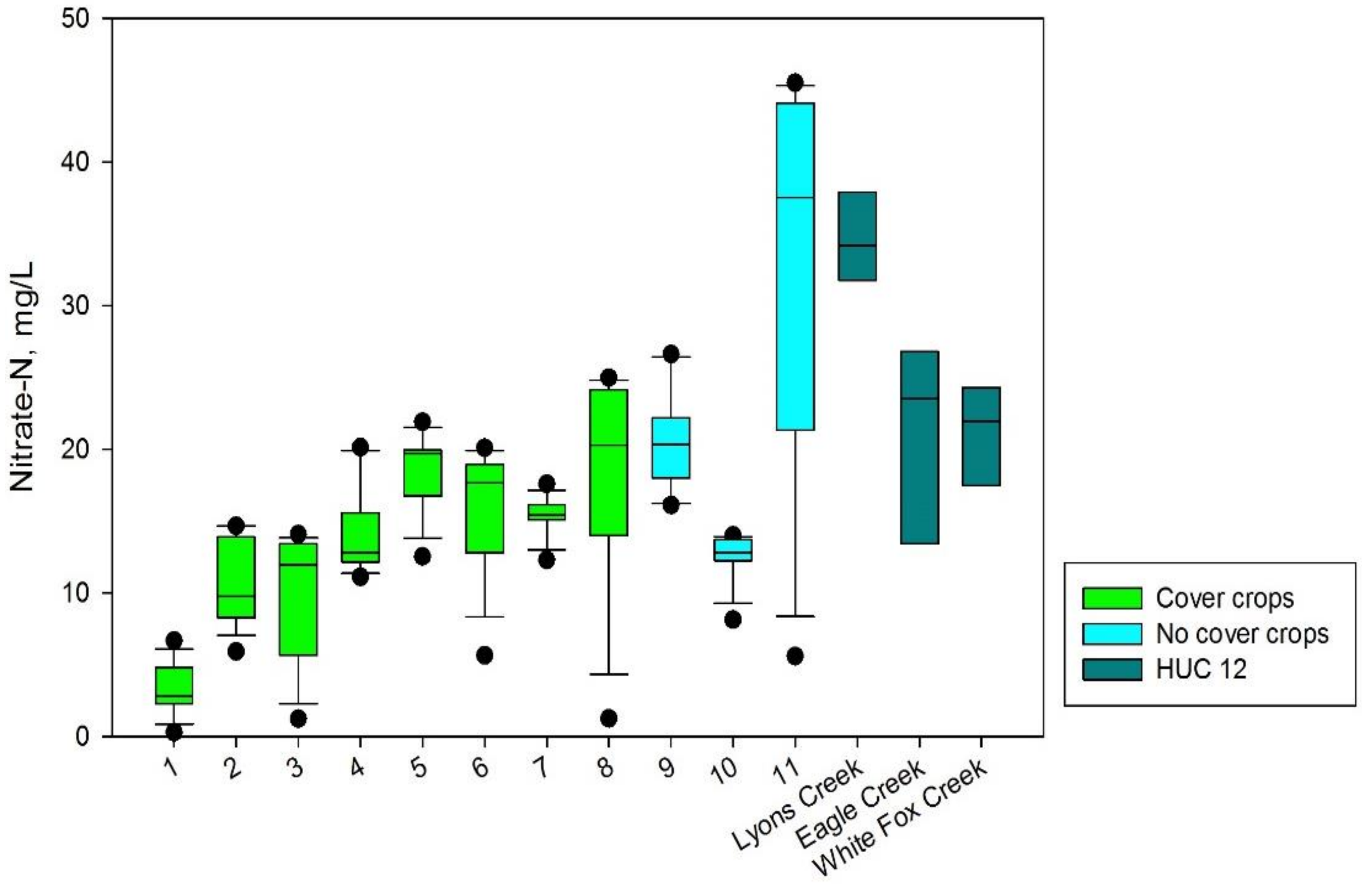
*sediment loss was reduced by more than 90 percent.

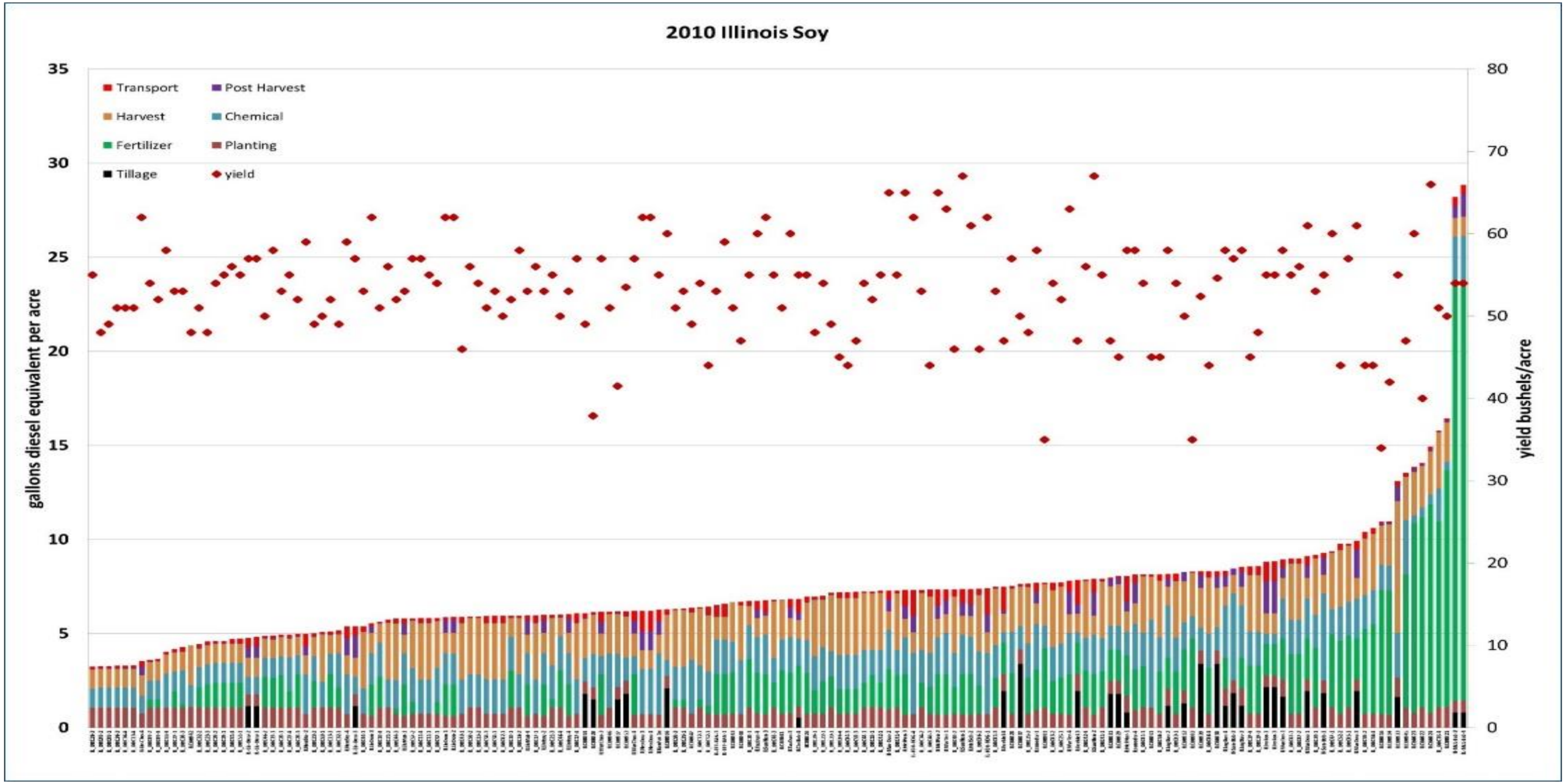
Images: Jose Gutierrez

# Edge of Field Monitoring

- NRCS EQIP Standard IA-799
- Monitoring of BMP’s
- 6 producers enlisted with 9 total contracts

# 2013 Boone River EOF monitoring






**New Multi-state Sustainability Initiative for Continuous Improvement**

- Highlight existing efforts and strategies for improving sustainability
- Provide new learning opportunities
- Define plan for demonstrating continuous improvement

# Acknowledgements for slides, data, research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# Regulation vs Freedom to Operate

**[Battle Lines Drawn On EPA's Chesapeake Bay TMDL Authority]**

The 21 State Attorneys General's amicus brief, filed in February, also challenged EPA's authority over state authority.

# Questions?

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