Conservation Practices and Water Quality in the Iowa River's South Fork Watershed

M.D. Tomer, T.B. Moorman,
C.H. Green, D.E. James, and G. Hadish

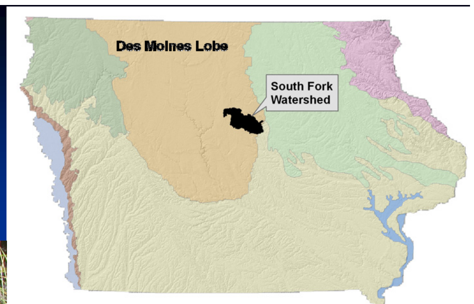
United States Department of Agriculture
Agricultural Research Service
National Soil Tilth Laboratory

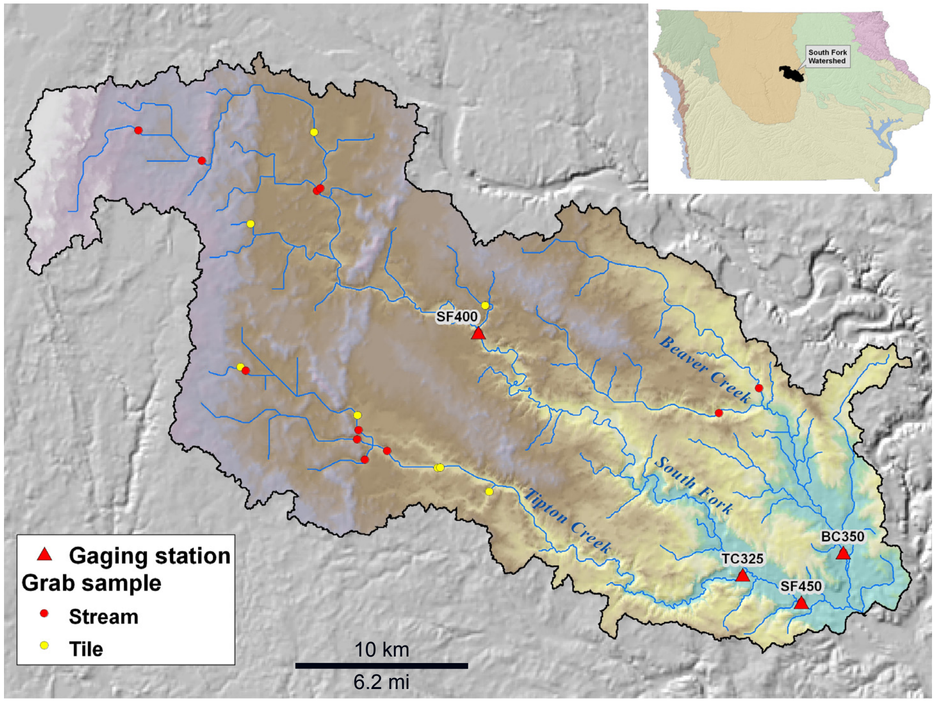
Outline

- Background on SFIR watershed
- NO_3-N, Phosphorus, and E. coli
- Land use and conservation practices
  - Are CPs placed on 'sensitive' lands?
- How do WQ and CPs correspond?
  - Implications for conservation and research
- Viable practices that can improve WQ
- Closing comments – new tools, approaches

Setting:

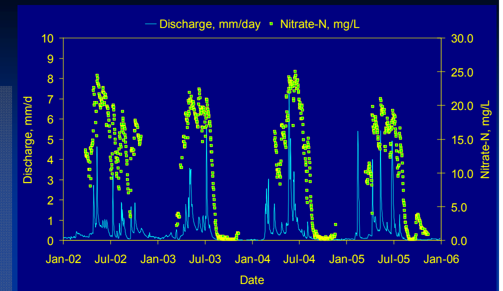
Recent glaciation
Poorly drained soils
Artificial drainage

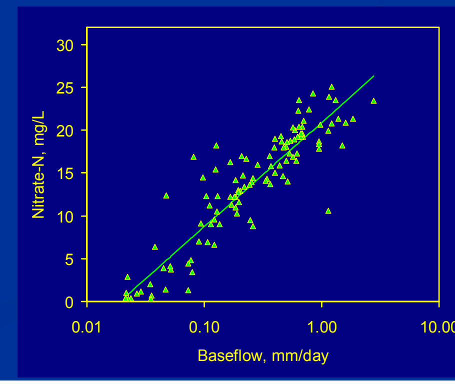


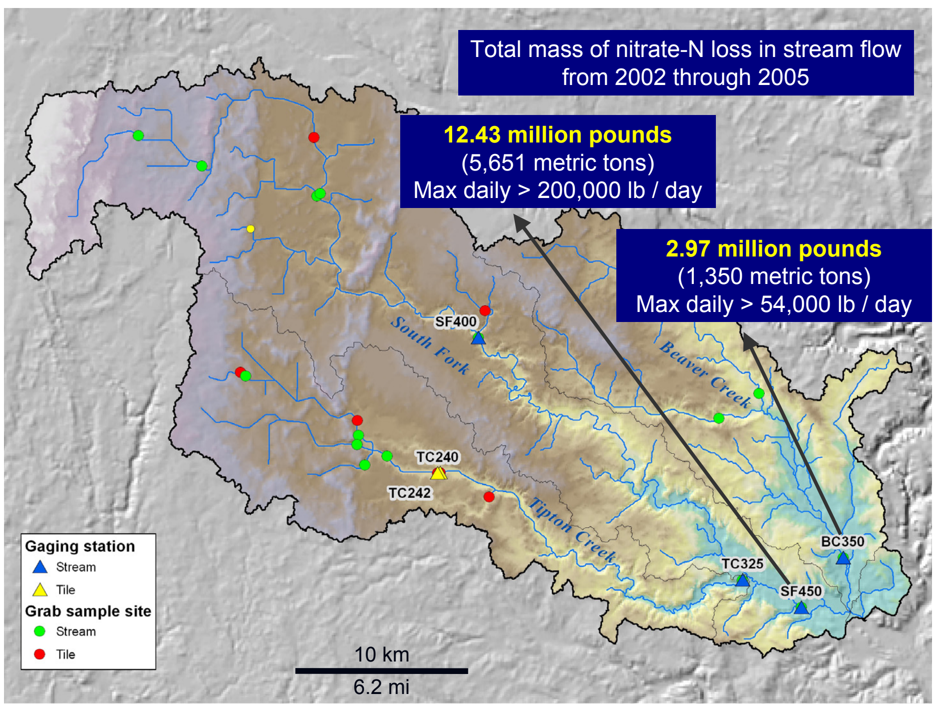


Nitrate-nitrogen

- Loads averaged 18-26 kg N/ha (16-23 lb N/ac) annually from 2002 through 2005.
- Concentrations averaged 14-20 mg/L among gauging stations, on flow-weighted basis.
- Peak concentrations late spring-early summer.
- Concentrations increase with increased rate of baseflow discharge

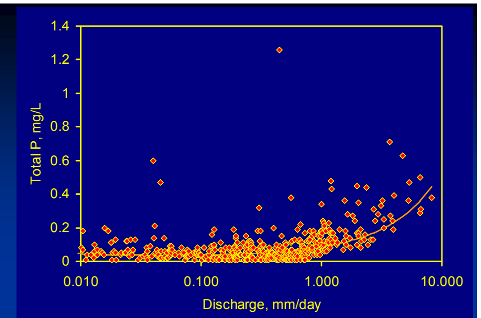


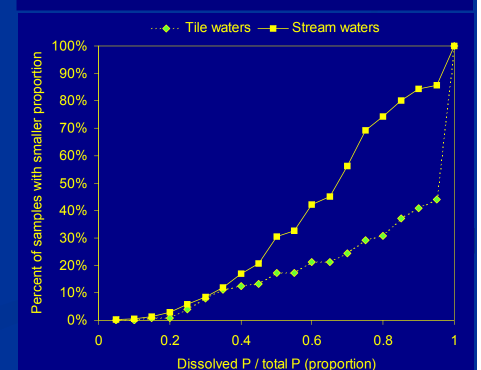




Phosphorus

- Stormflow has highest total concentrations
- Tiles: in most samples, >90% of total P was in dissolved form.
- Streams: mean dissolved to total P ratios 0.55 - 0.68.
- Unexpected seasonal dynamic - highest concentrations in summer and winter.
- Exceeded 0.1 ppm total P (eutrophication threshold) about 1/3 of the time, but averaged about 0.06 ppm.

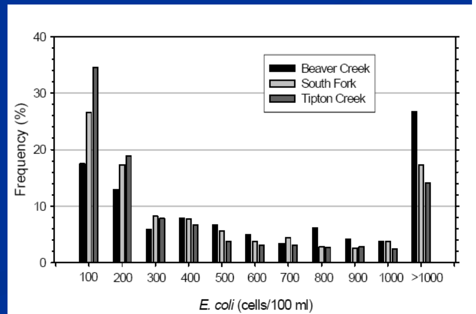




Escherichia coli

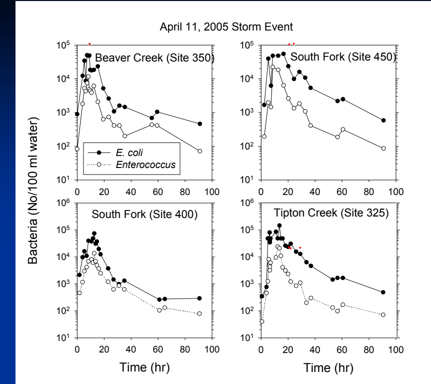
- Largest populations in late summer.
- Beaver Creek had greatest populations in summer, and fewest CAFOs. Suggests multiple sources are important.
- Rate of discharge and temperature account for half the variation in *E. coli*.

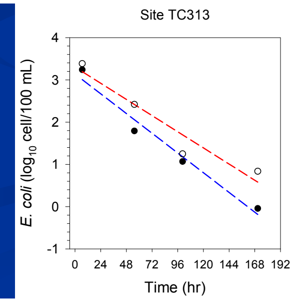
Season	Beaver Cr.	South Fork	Tipton Cr.
	---------------- *E. coli* (cells/100 ml)[1] ------------		
Spring	232 a	201 a	104 b
Summer	1047 a	649 b	500 b
Autumn	208 a	139 a	87 b
Winter	21 a	19 a	14 a
Annual	182	136	90

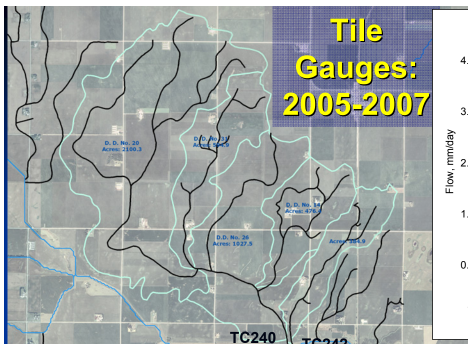


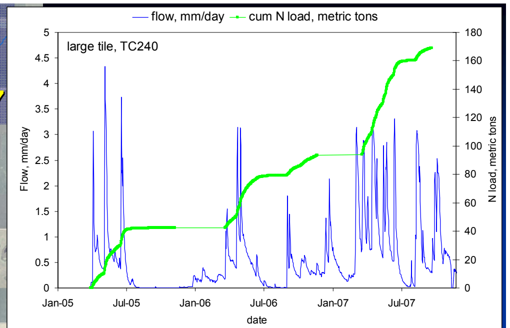
Recent results

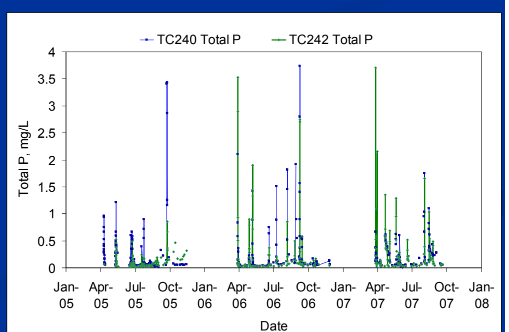
- Large loads during events
- Fairly rapid die off in stream and stream sediment
- Variable die off rates in soil after manure application
- *E. coli* found in surface runoff from manured and <u>non-manured</u> fields.

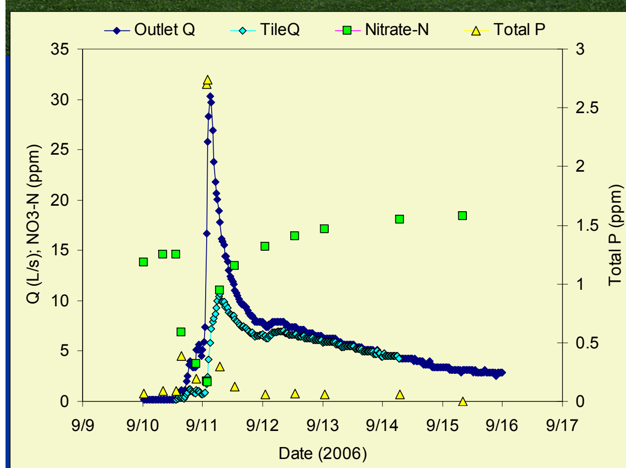












Separating inlet and tile components of drainage discharge

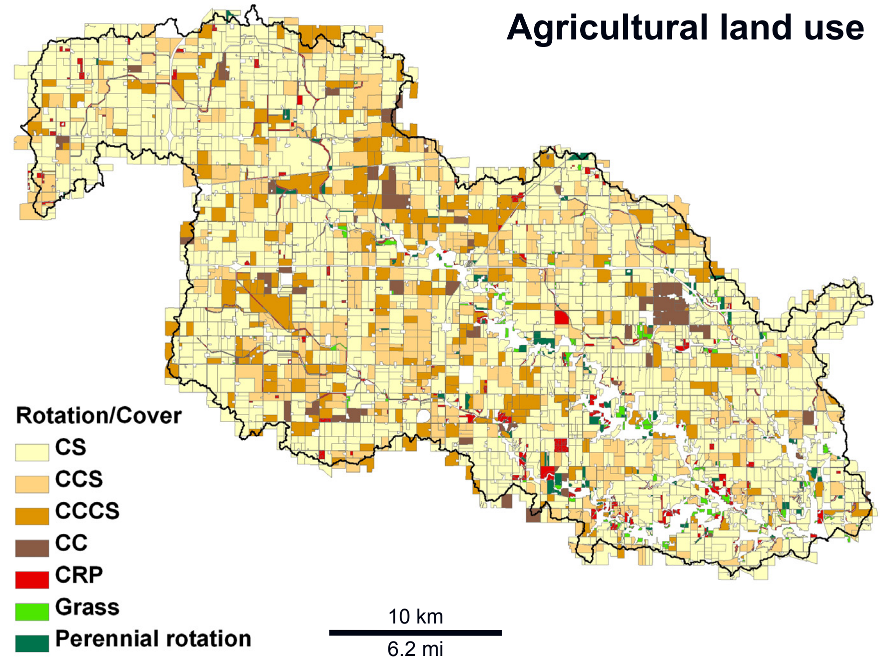
Water quality recap

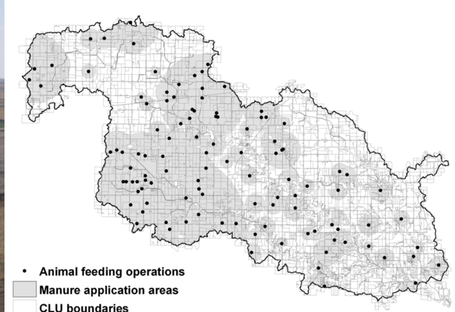
- Seasonal dynamics of NO_3, P, and *E. coli* are distinct from one another.

Ongoing work to determine:

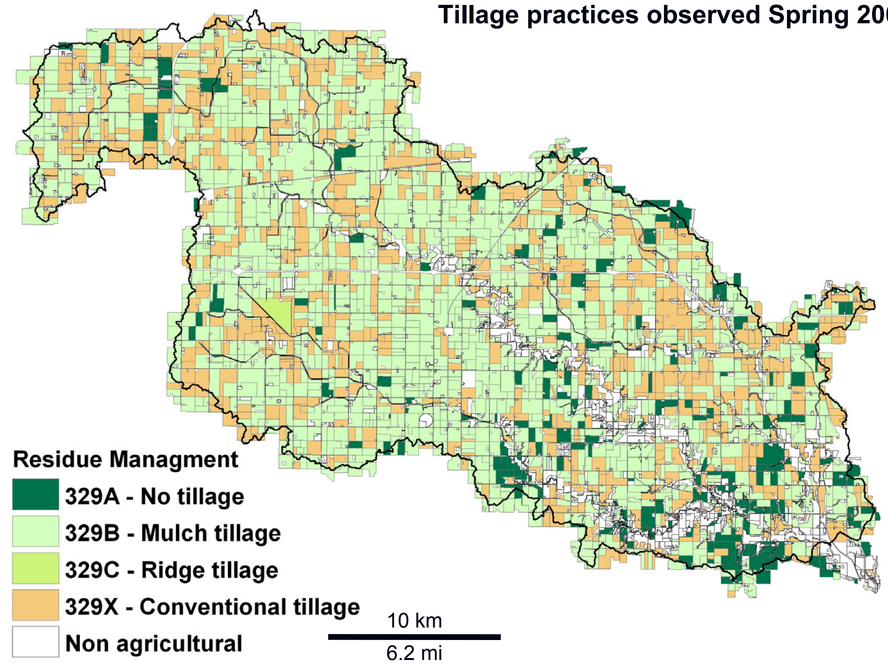
- Surface runoff, stream banks and tile flows as sources of P transport.
- Sources, transport, and survival of E. coli in surface waters.

Agricultural land use

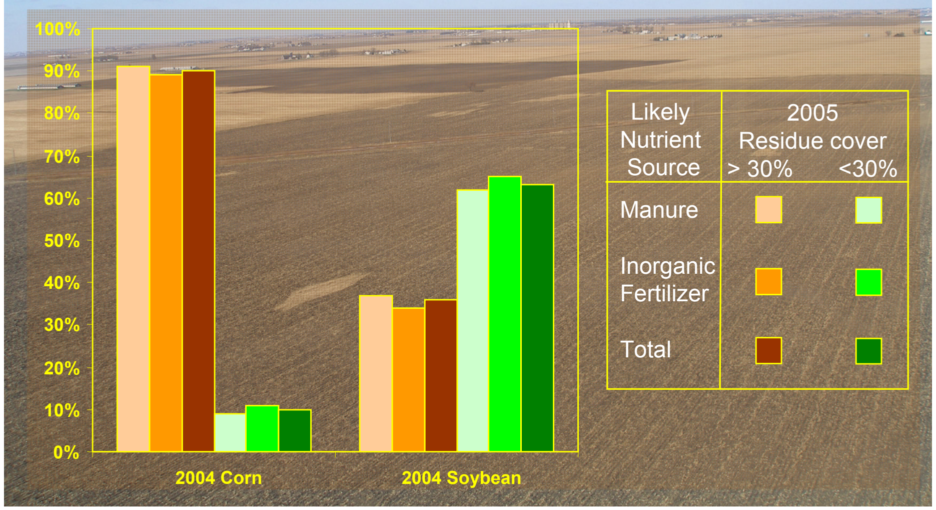


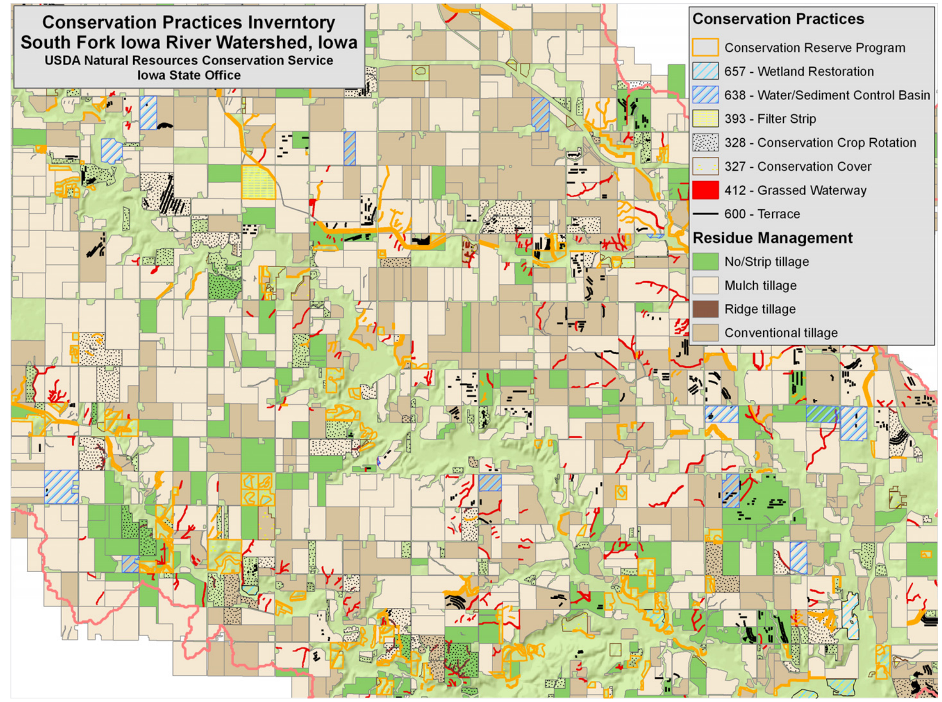


Tillage practices observed Spring 2005

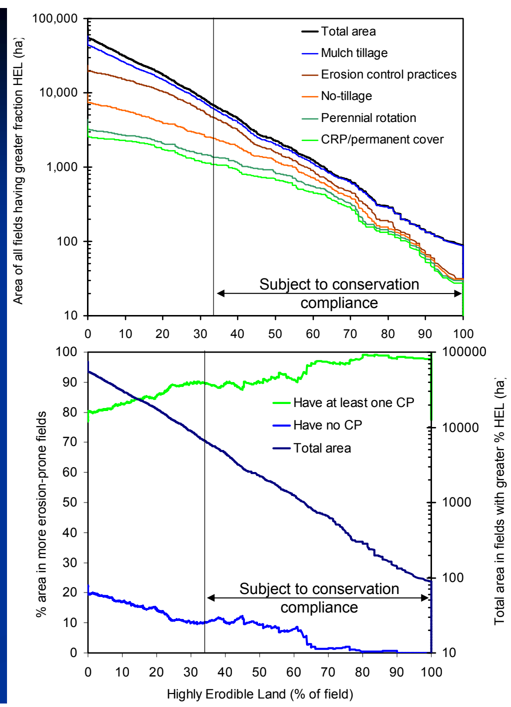


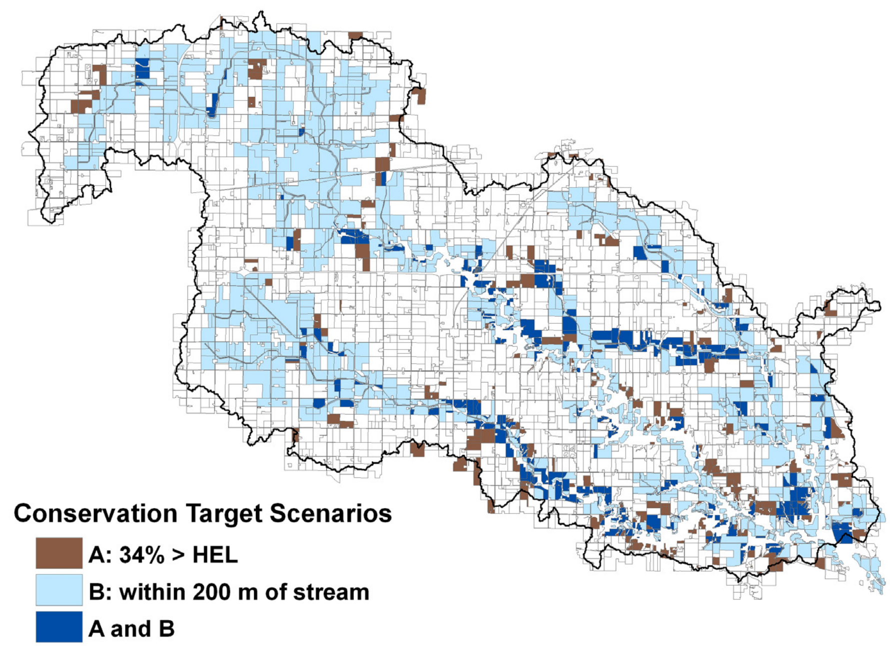
2005 residue cover was determined by 2004 crop





Distribution of conservation practices across the South Fork Watershed, sorted according to erosion risk





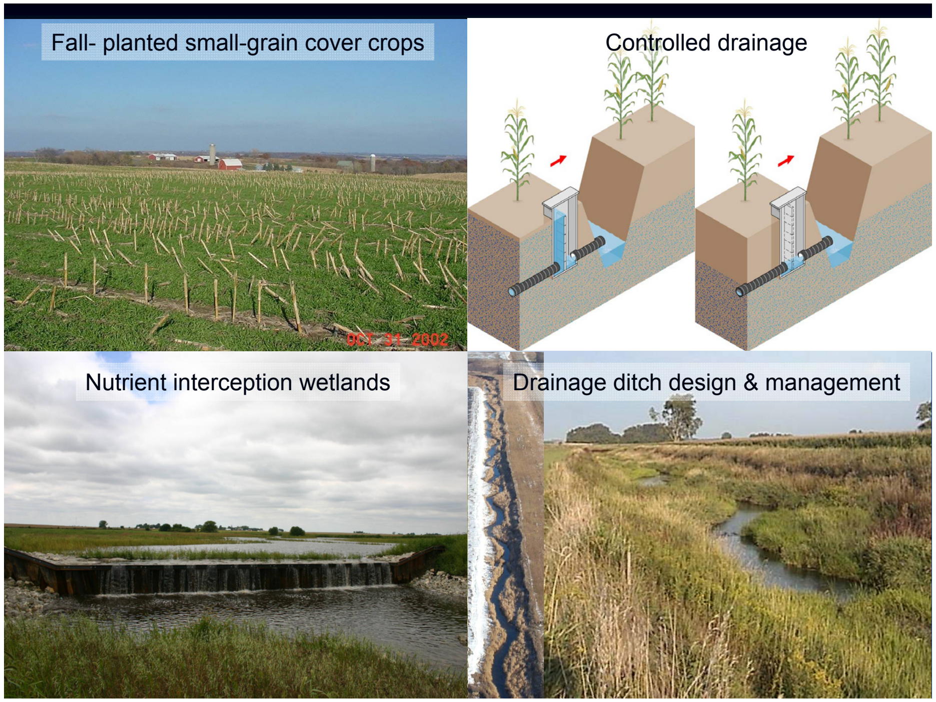
Extent of conservation practices within "targeted" areas

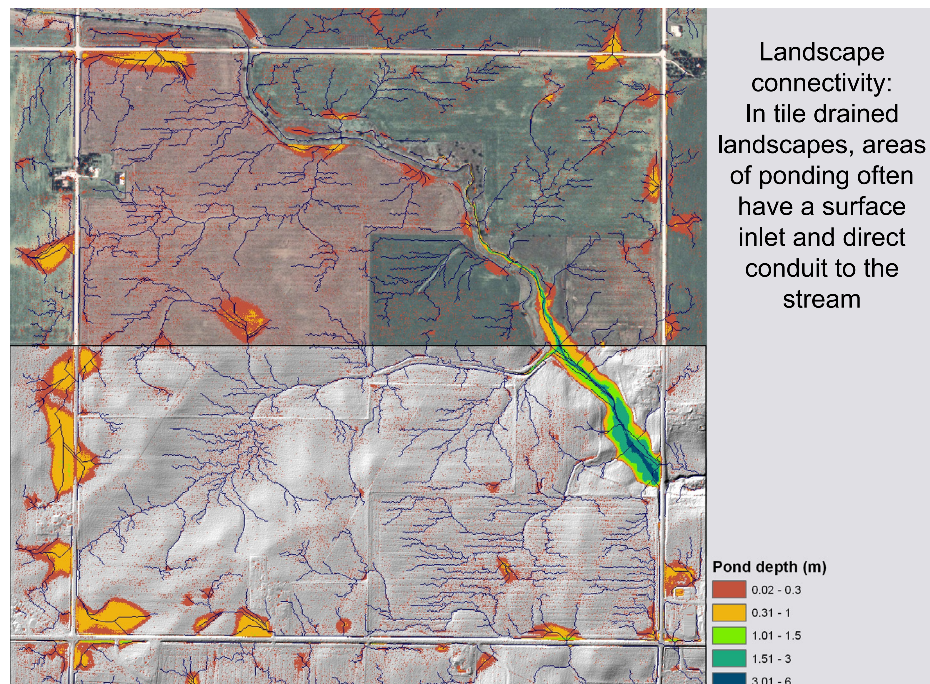
Practices / condition observed	Watershed	Within 200 m of stream	>34% HEL	HEL and near stream
All agricultural land (ac, 100% of column)	185,065	63,044	16,344	8,914
Conservation using perennial species (incl. CRP, permanent cover, hay rotations)	5.3%	9.2%	18.7%	24.1%
Combinations of practices*				
No tillage & "in-field" structure	2.6%	3.5%	10.4%	9.3%
Mulch/ridge tillage & "in-field" structure	11.4%	12.5%	21.9%	19.5%
Conventional tillage & no CP observed	21.0%	18.5%	9.9%	9.8%

* "in-field" structures include grassed waterways, terraces, sediment control structures.

Nearly 80% rate of conservation-practice adoption, yet significant WQ problems. Why?

1. Legacy of pre-conservation agriculture.
   (Solution: Riparian assessment and management)
2. Gaps in conservation: Practices needed to address management of soybean residue, and improve nutrient retention.
   (Solutions: diversified cropping, e.g., cover crops; technologies to allow true valuing of manure nutrients)
3. Most practices aimed to control runoff, but tile drainage is the dominant hydrologic pathway.
   (Solutions: nutrient removal wetlands, modified or controlled drainage systems)





Landscape connectivity:
In tile drained landscapes, areas of ponding often have a surface inlet and direct conduit to the stream

Conservation systems to support multiple resources