NRCS

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Chris Jones, *Research Engineer*

christopher-s-jones@uiowa.edu

Slides Available at:

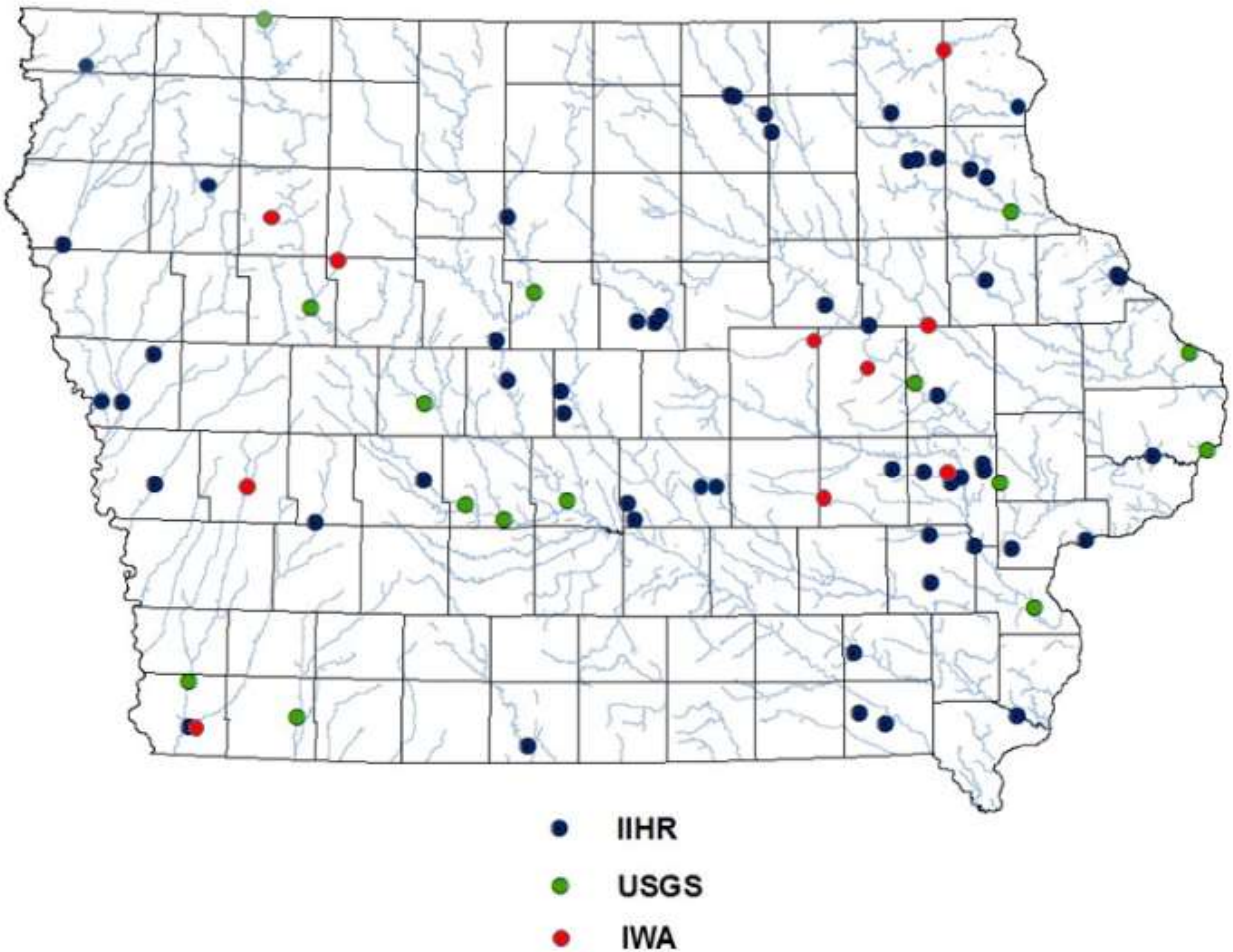
https://www.iihr.uiowa.edu/cjones/welcome/

IIHR Water Quality Sensor Network

Sites

70+ sites Nitrate-N

20-25 sites
- Temperature
- pH
- SC
- DO
- Turbidity

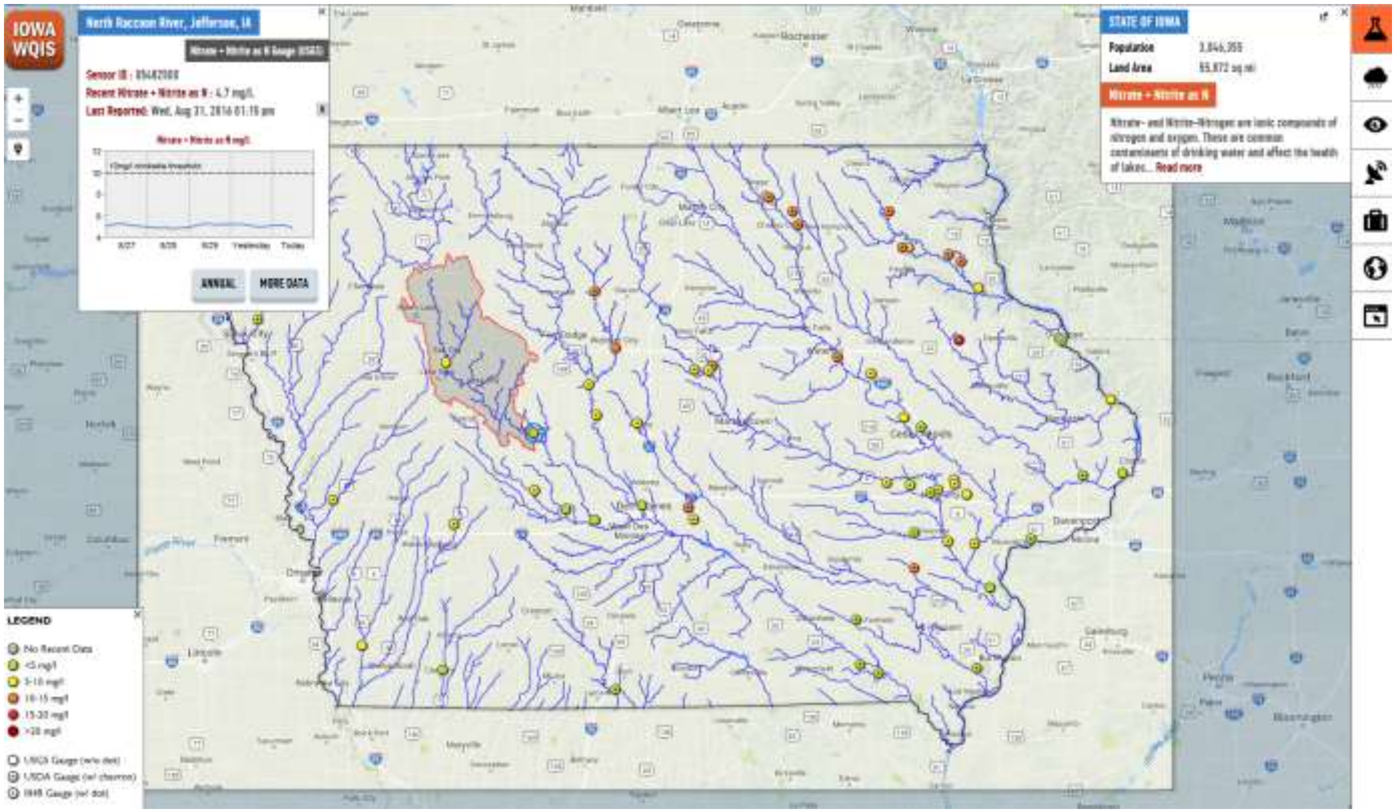


Site infrastructure

Small Streams


Storm Lake
Manson
Sac City
Rockwell City
Lake City
Carroll
Jefferson
Perry
Panora
Redfield
Van Meter
Des Moines
LEGEND
Raccoon River
North Raccoon
"lower" South Raccoon
Middle Raccoon
South Raccoon

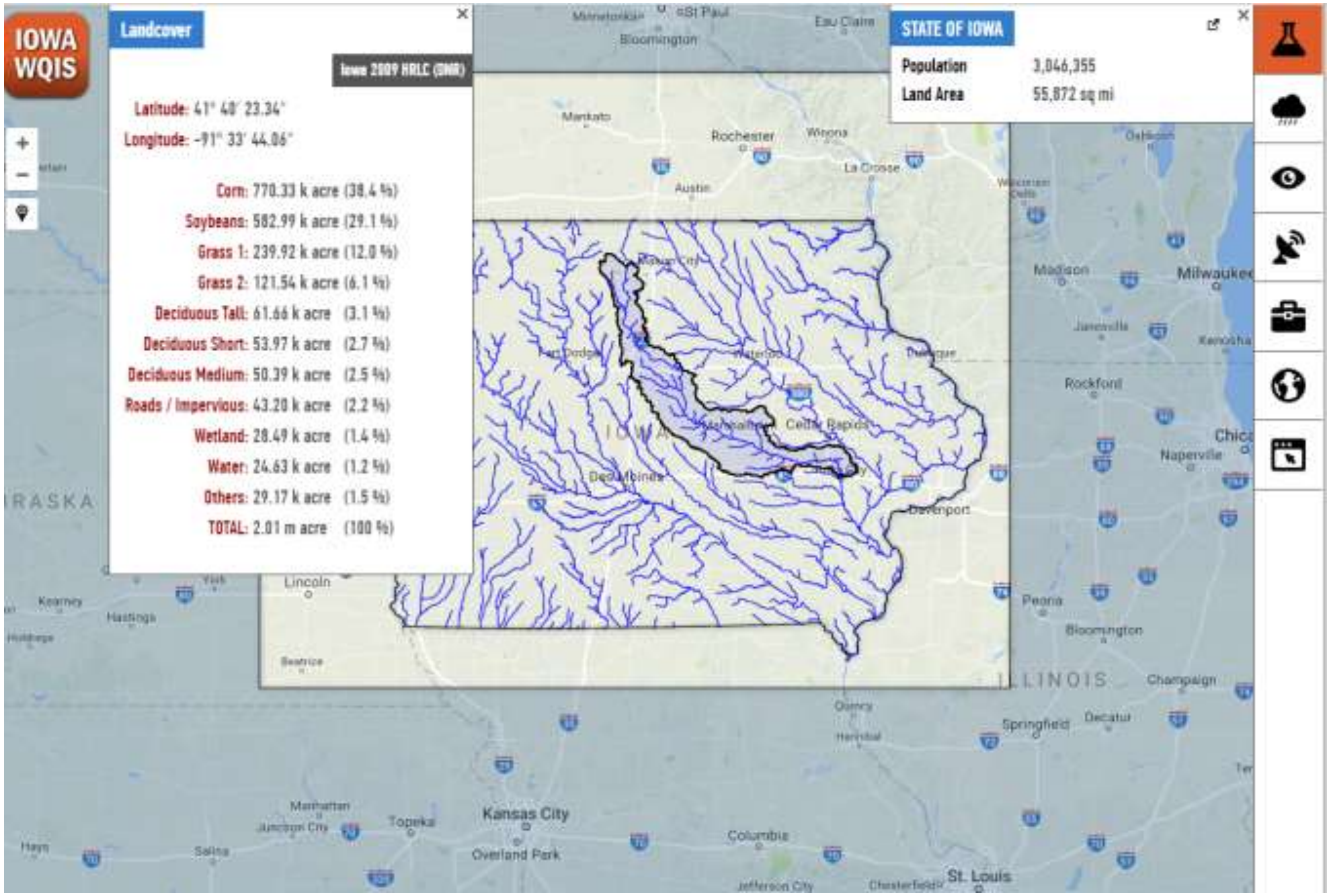
Iowa Water Quality Information System



iwqis.iowawis.org/

http://iwqis.iowawis.org/app/?datetime=2017-06-06T13:00

Landcover Tool



Publications

- Practice Assessment: 11
- Wetland Research: 10
- Stream and Tile Drainage Hydrology: 6
- Nitrate Dynamics Within Streams and Reservoirs: 5
- Policy: 4
- Golf Course Soils and Nutrients: 3
- Phosphorus Transport: 4
- Watershed Nitrate Loading: 3
- Livestock and Water Quality: 1
- Groundwater Nitrate Dynamics: 1
- Carbon Transport in Tile Drainage: 1

Hypoxia, Aquatic Life

IIHR
Hydroscience & Engineering

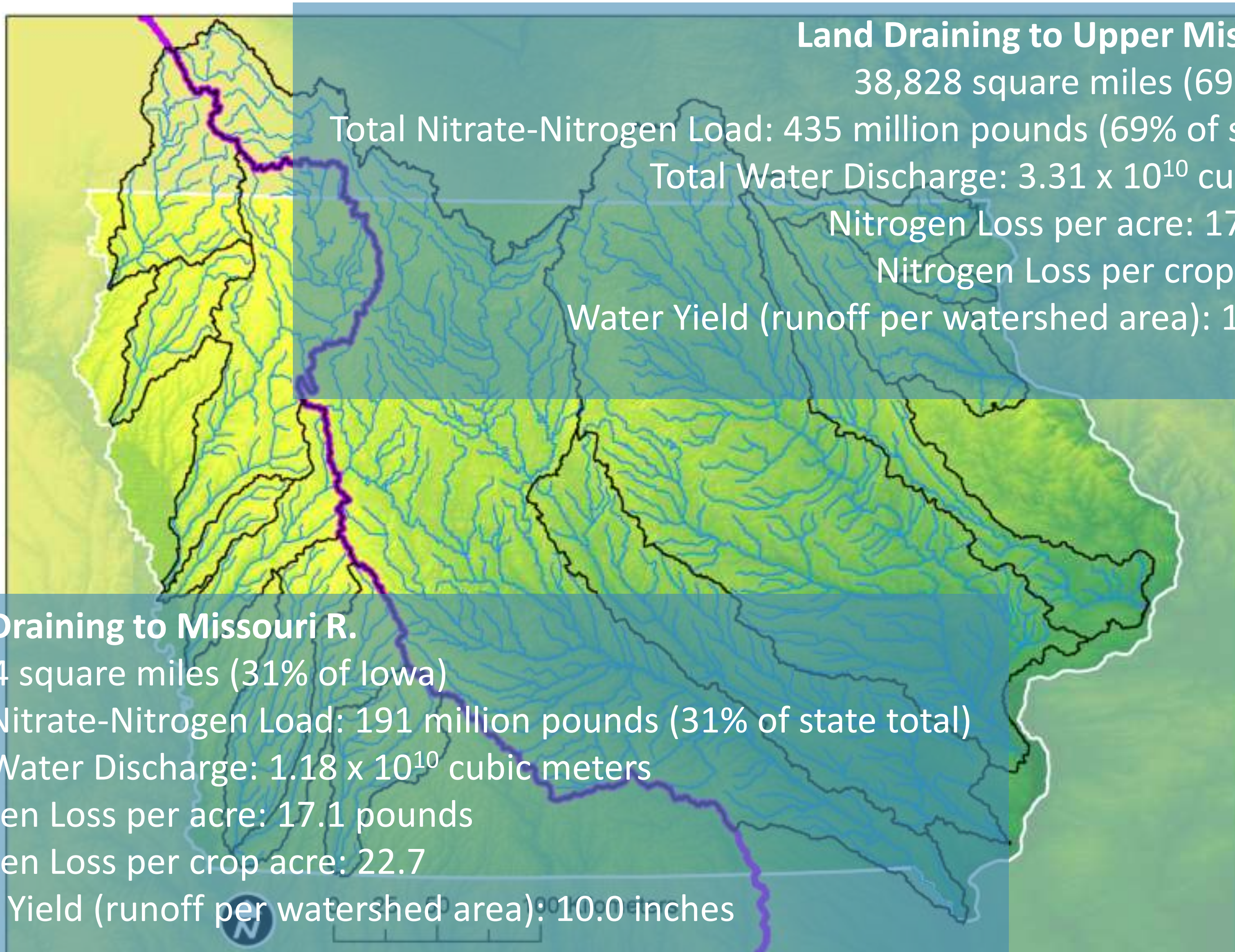
Drinking Water

Toledo, OH

Des Moines, IA

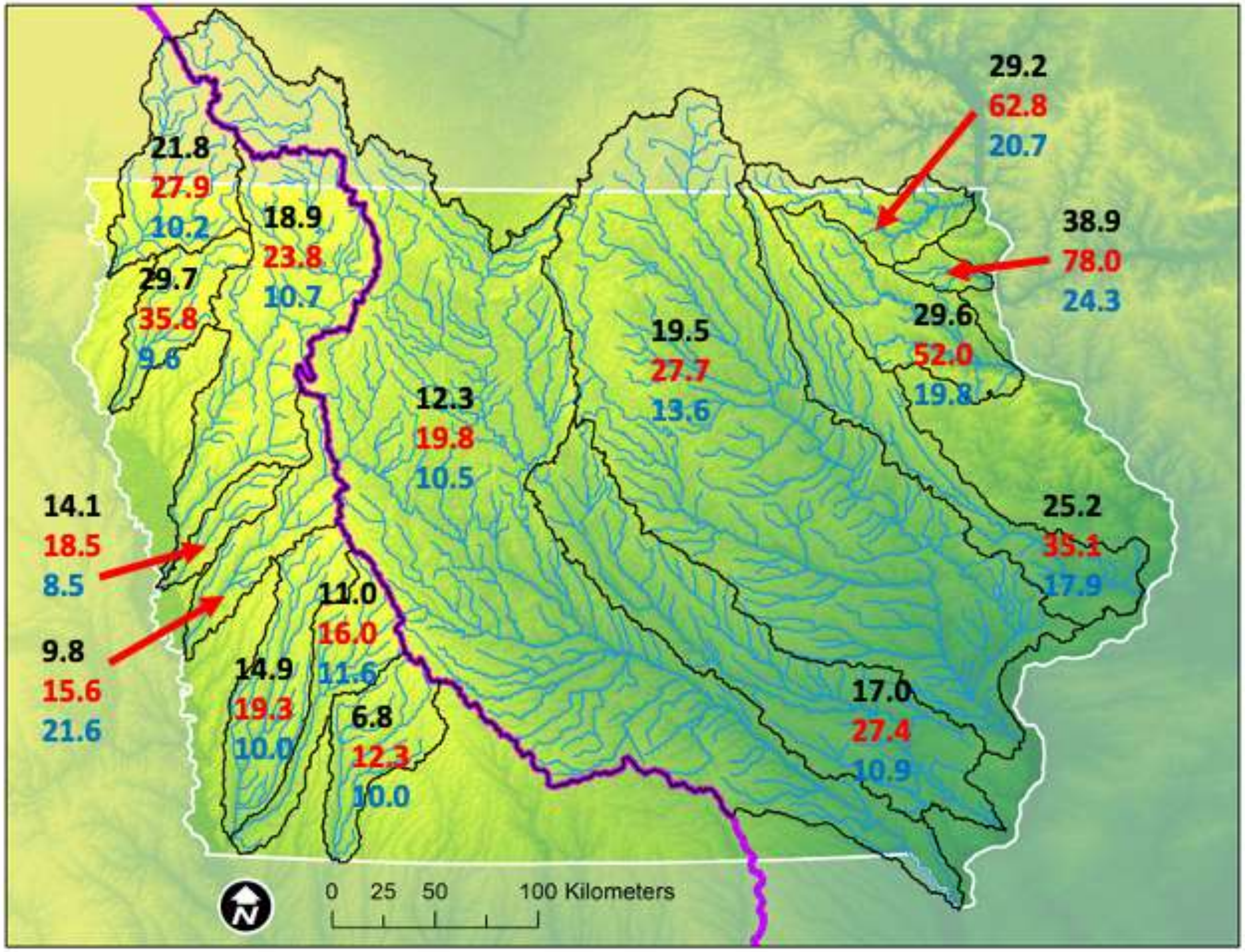
Hydroscience & Engineering

2020 Stream Nitrate Data



Land Draining to Upper Mississippi R.
38,828 square miles (69% of Iowa)
Total Nitrate-Nitrogen Load: 435 million pounds (69% of state total)
Total Water Discharge: 3.31×10^{10} cubic meters
Nitrogen Loss per acre: 17.5 pounds
Nitrogen Loss per crop acre: 27.0
Water Yield (runoff per watershed area): 13.0 inches

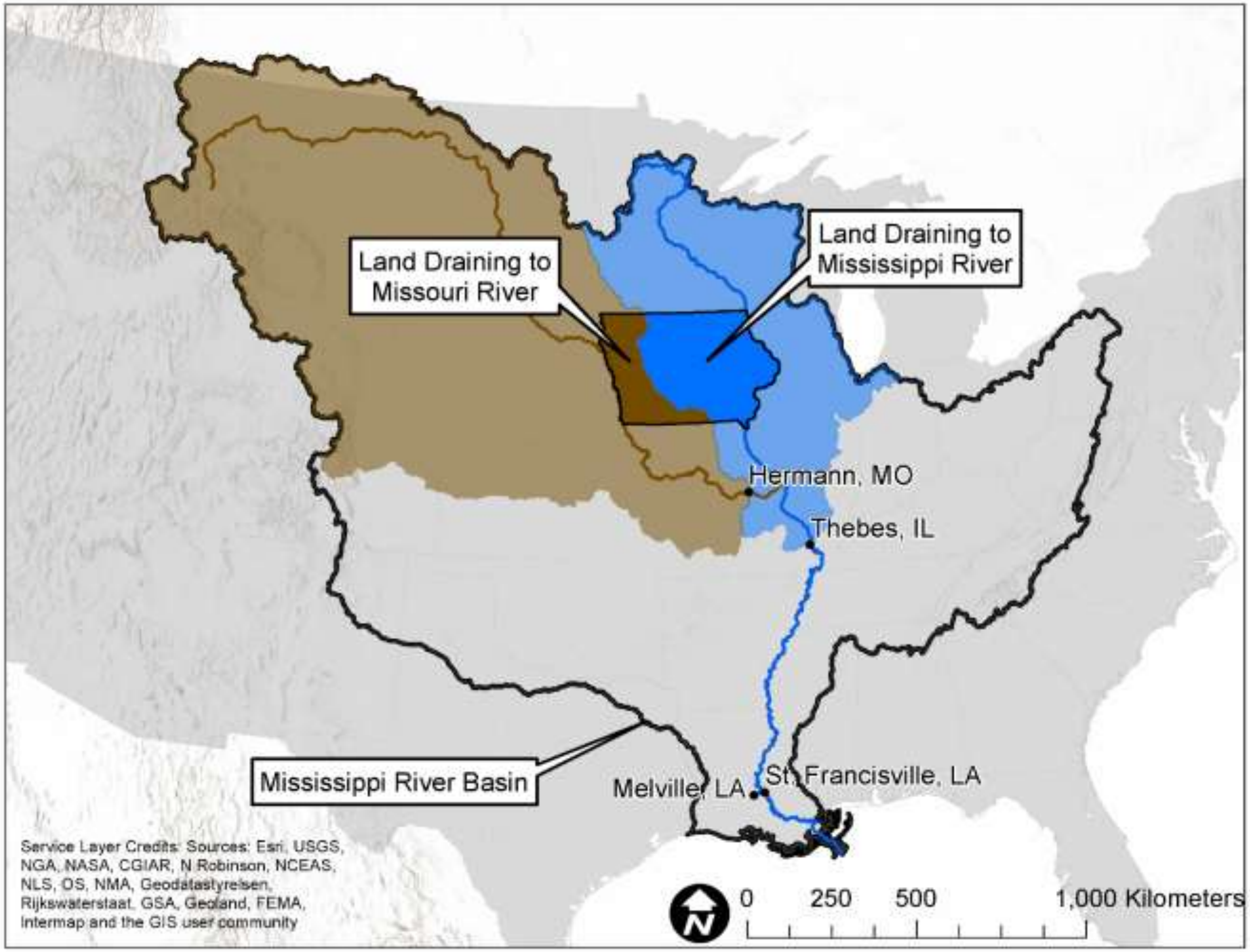
Land Draining to Missouri R.
17,444 square miles (31% of Iowa)
Total Nitrate-Nitrogen Load: 191 million pounds (31% of state total)
Total Water Discharge: 1.18×10^{10} cubic meters
Nitrogen Loss per acre: 17.1 pounds
Nitrogen Loss per crop acre: 22.7
Water Yield (runoff per watershed area): 10.0 inches



Black: lbs/acre

Red: lbs/crop-acre

Blue: Runoff (inches)


Land Draining to Missouri River
Land Draining to Mississippi River
Hermann, MO
Thebes, IL
Melville, LA
St. Francisville, LA
Mississippi River Basin
Service Layer Credits: Sources: Esri, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community
N
0 250 500 1,000 Kilometers


USGS
science for a changing world
National Water-Quality Assessment (NAWQA) Project
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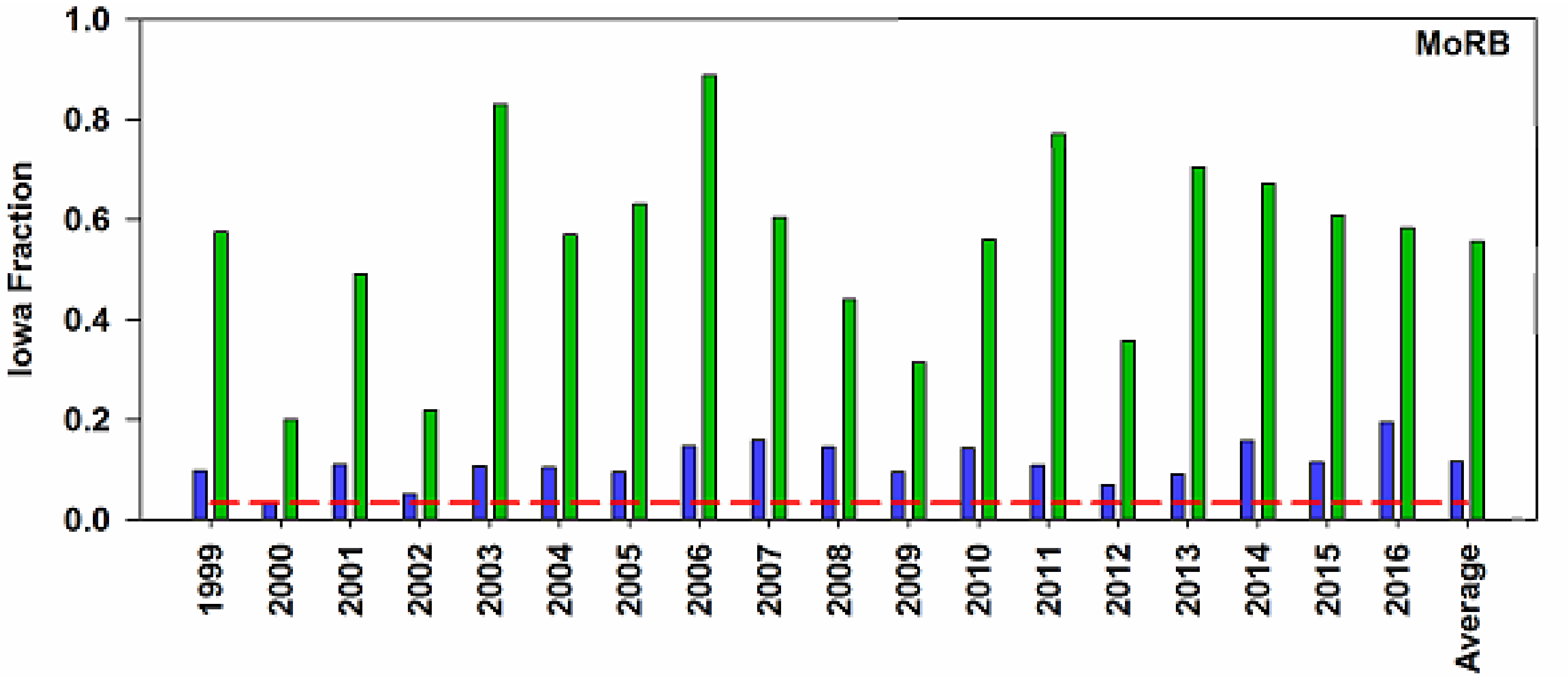
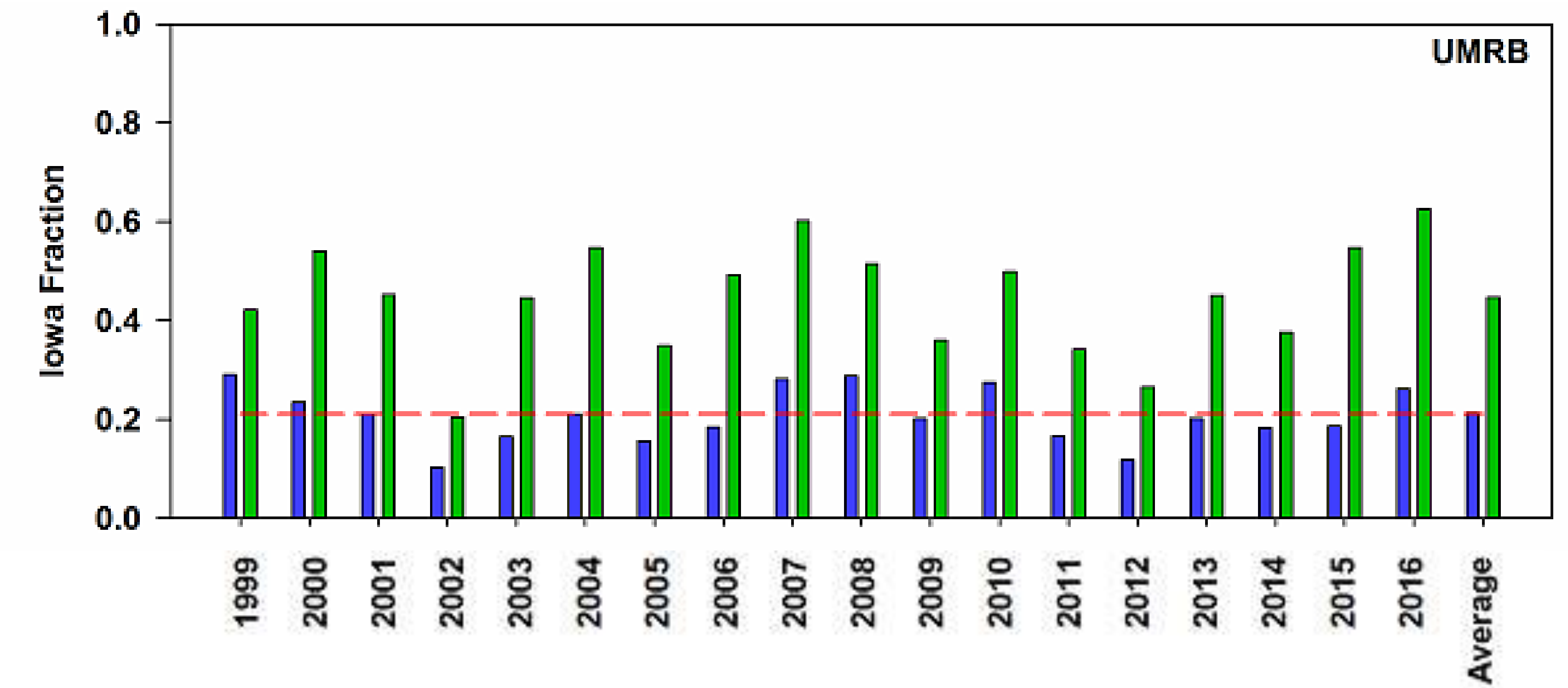
Informing Decision Make

Missouri



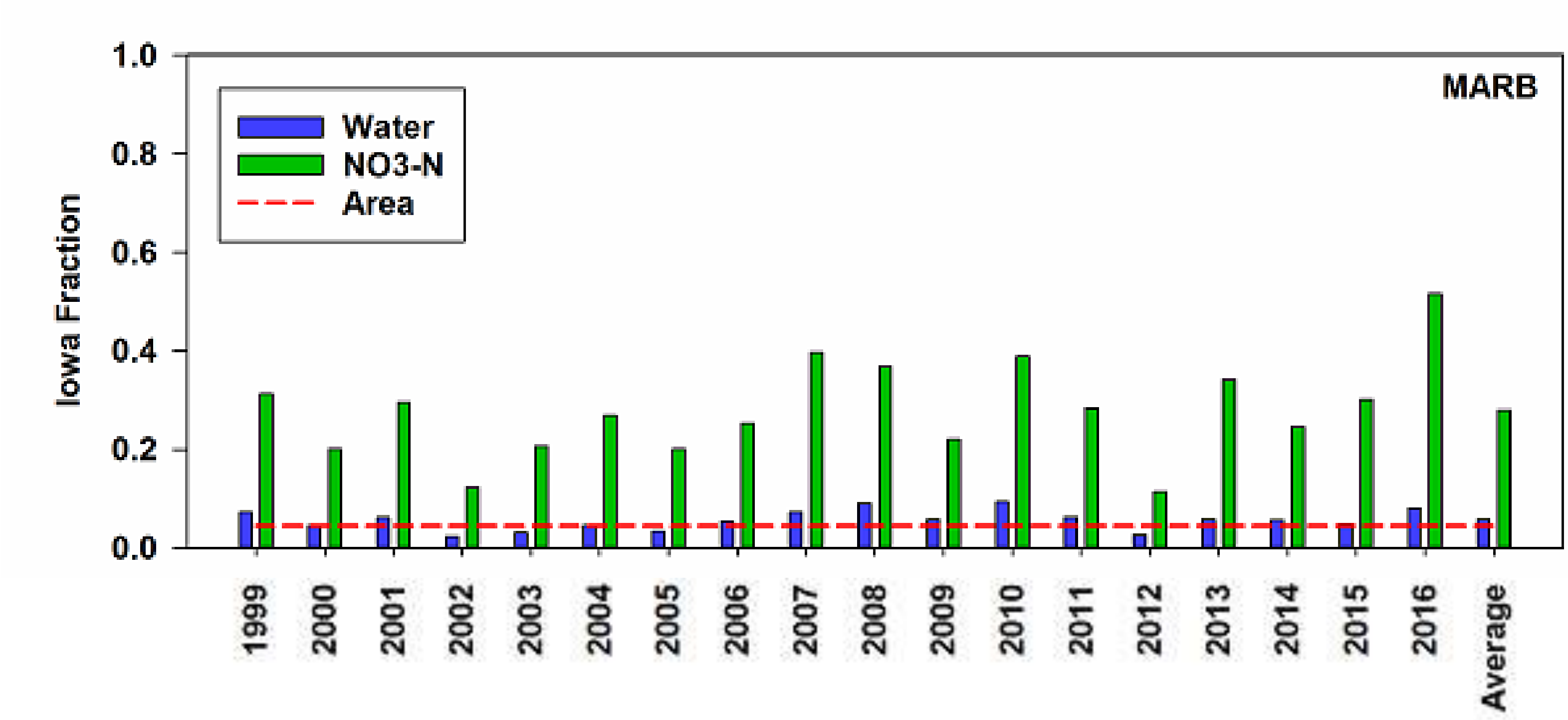
3.3% of the land
12% of the water
55% of the nitrate

Upper Mississippi



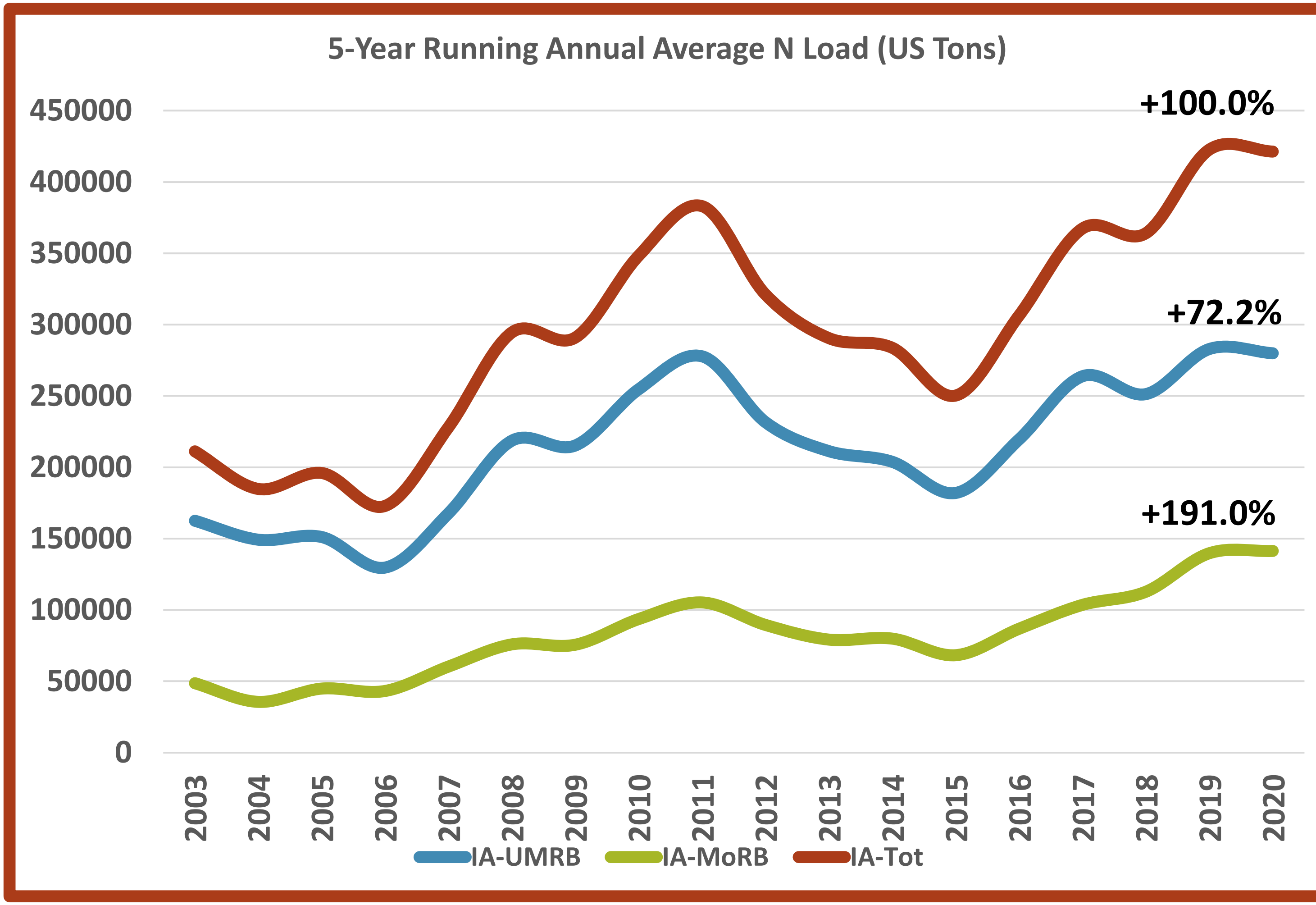
21% of the land
21% of the water
45% of the nitrate

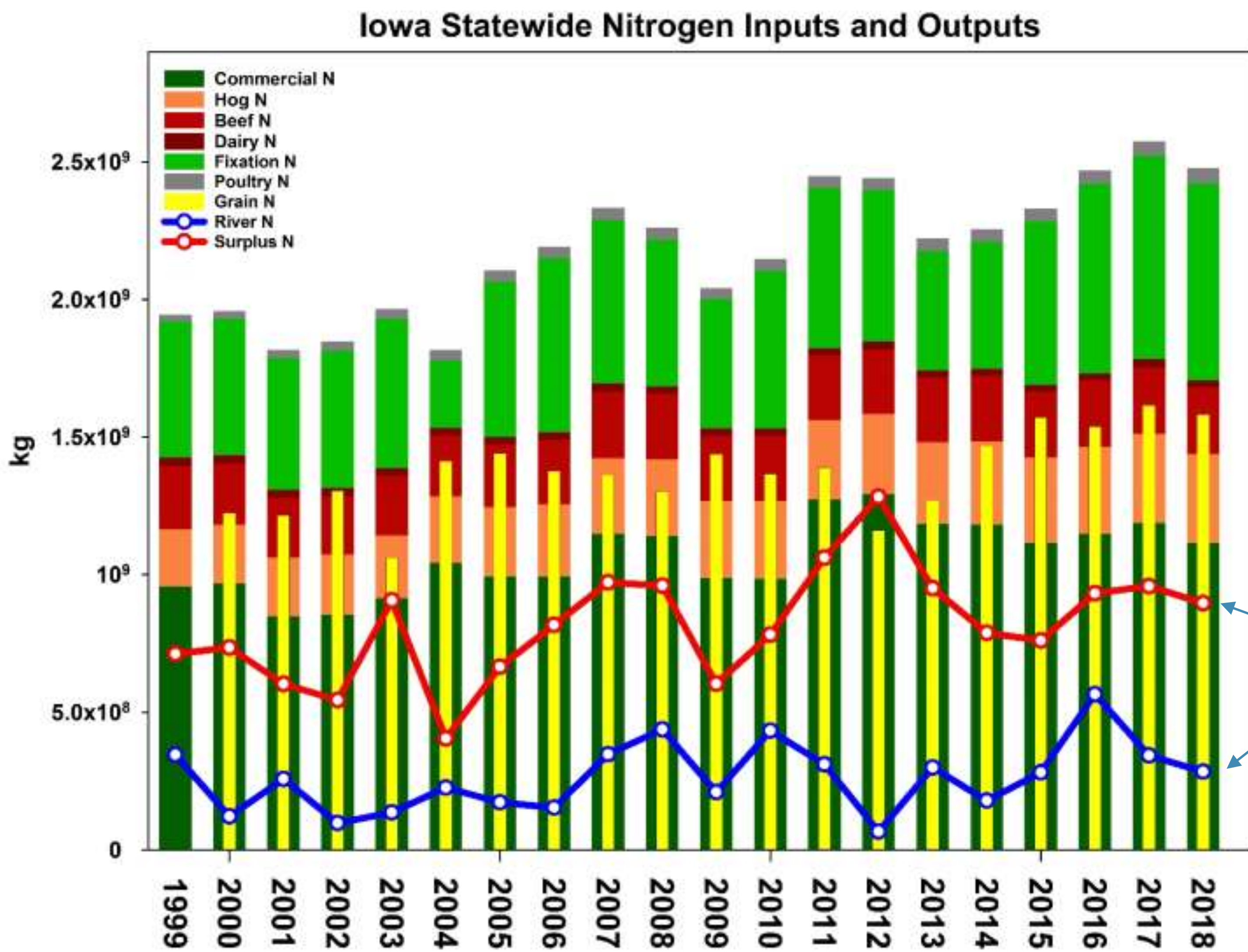
Mississippi-Atchafalaya-Gulf of Mexico



4.5% of the land
5.9% of the water
29% of the nitrate

How Much Nitrogen Leaves Iowa?



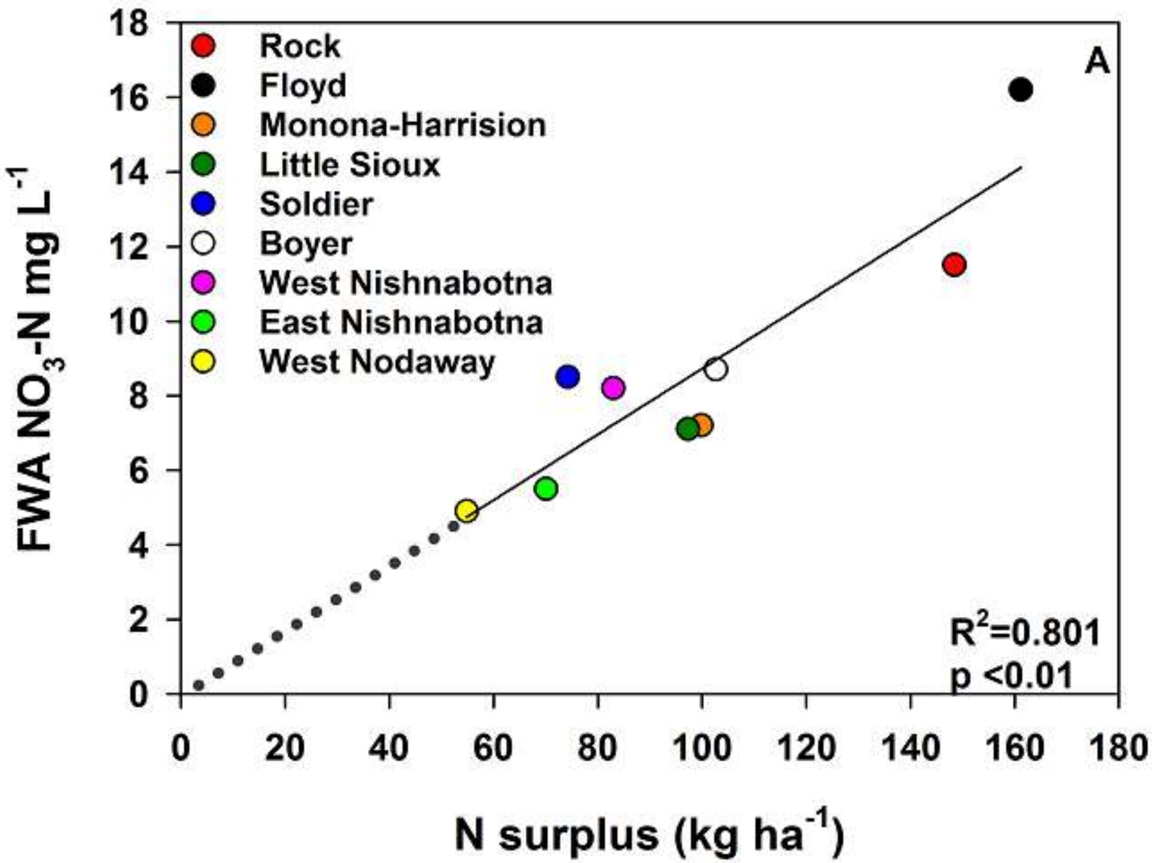


About 32% of “surplus” makes it to streams

Nitrogen Change (%) Since 1999

Can we "soil health" our way out of this?

N Category	% change
River	83
Chicken	76
Turkey	59
Hogs	59
Surplus	51
Fixation	41
total inputs	36
Commercial	34
Grain N	27
Beef	10
Dairy	-11



Surplus = Commercial N + Manure N + Fixation N – Grain N

INRS practices for N Reduction

Table 2. Nitrogen reduction practices – potential impact on nitrate-N reduction and corn yield based on literature review.

	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	Reduce to Maximum Return to Nitrogen value 149 kg N/ha (133 lb N/ac) for CS and 213 kg N/ha (190 lb N/ac) for CC	10‡	-1‡‡
	Nitrification Inhibitor	Nitrapyrin – 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)	-100ˣ
		Land Retirement (CRP) Compared to Spring- Applied Fertilizer	85 (9)	-100ˣ
	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***	NA
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 active zone below the buffer - a small fraction of all water that makes it to a stream.	91 (20)	

PERSPECTIVE
https://doi.org/10.1038/s41893-019-0393-0
nature sustainability

Sustainable intensification of agricultural drainage

Michael J. Castellano[1,2*], Sotirios V. Archontoulis[1], Matthew J. Helmers[3], Hanna J. Poffenbarger[4] and Johan Six[2]

Artificial drainage is among the most widespread land improvements for agriculture. Drainage benefits crop production, but also promotes nutrient losses to water resources. Here, we outline how a systems perspective for sustainable intensification of drainage can mitigate nutrient losses, increase fertilizer nitrogen-use efficiency and reduce greenhouse-gas emissions. There is an immediate opportunity to realize these benefits because agricultural intensification and climate change are increasing the extent and intensity of drainage systems. If a systems-based approach to drainage can consistently increase nitrogen-use efficiency, while maintaining or increasing crop production, farmers and the environment will benefit.

“Losses of SOC to CO2 cease within 10–20 years of changes in land use or management as the SOC pool re-equilibrates at a lower level”

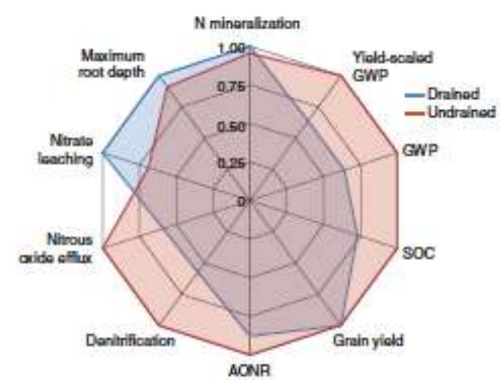
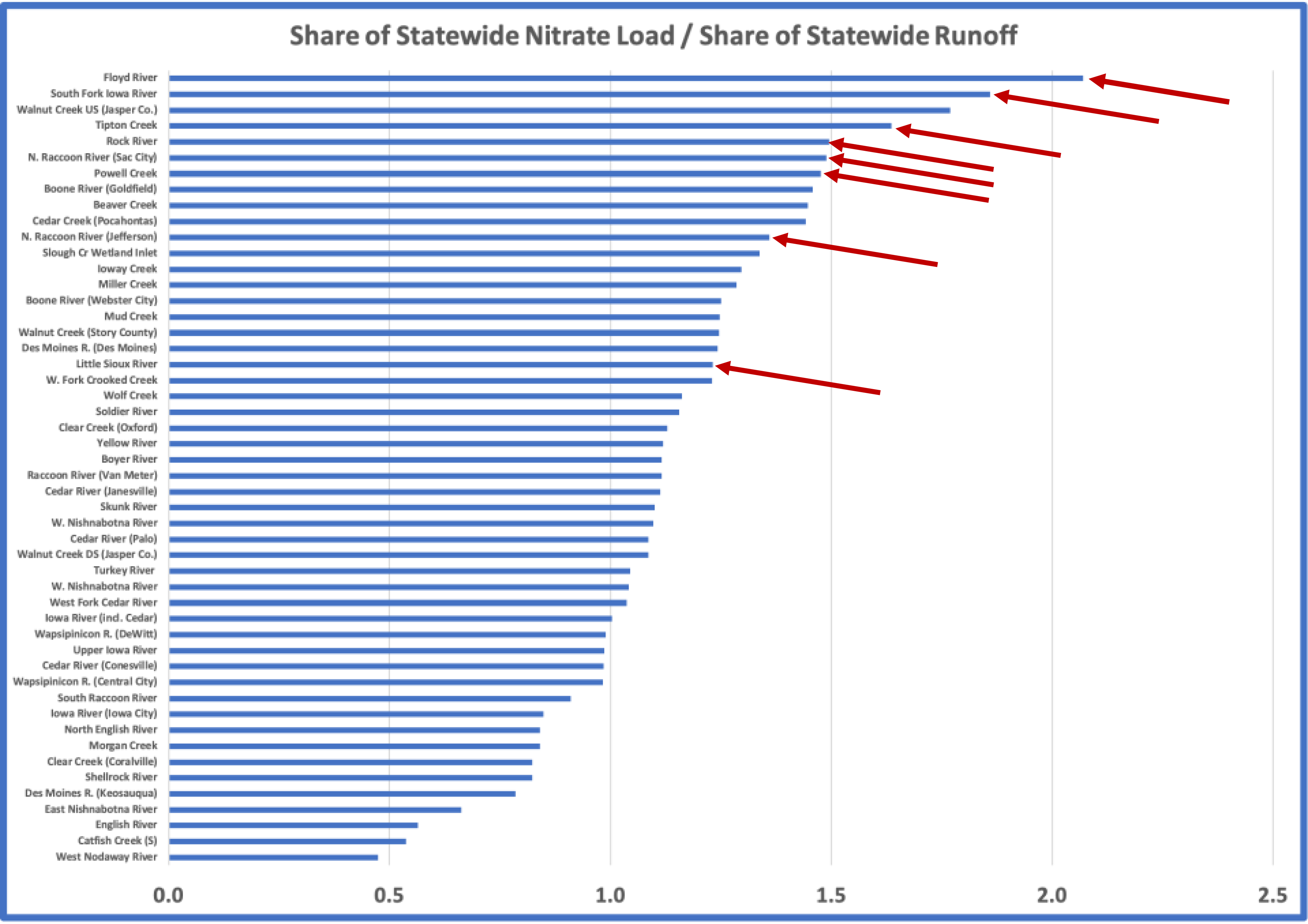
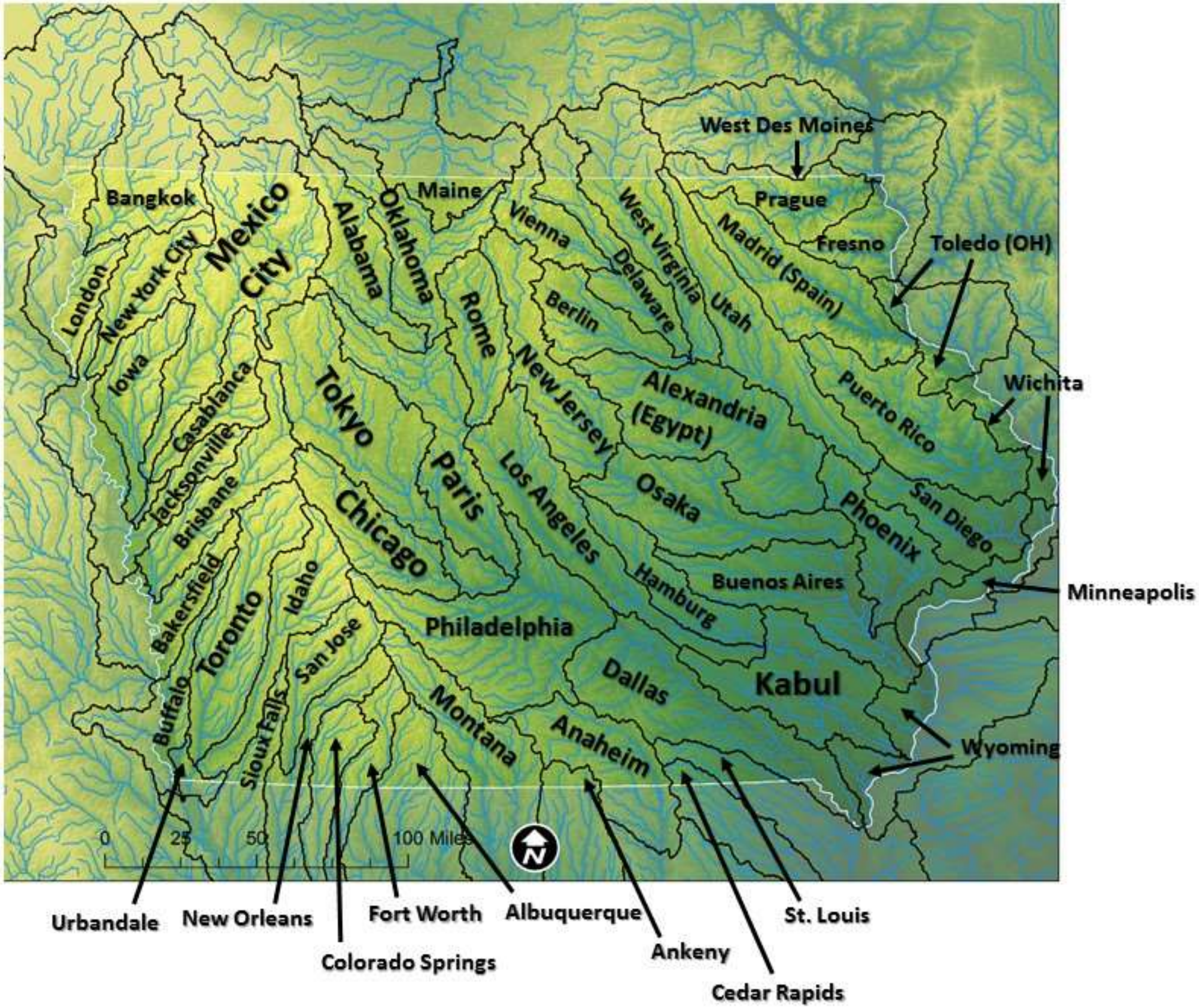


Fig. 3 | Relative differences in ecosystem properties and processes between drained and undrained continuous maize cropping systems in southeast Iowa, USA. All data other than SOC represent the mean annual simulated value across 18 weather-years. Relative differences in SOC represent the estimated difference in equilibrium SOC stock of 27,000 kg C ha^{-1} (Supplementary Information).


Share of Statewide Nitrate Load / Share of Statewide Runoff
Floyd River
South Fork Iowa River
Walnut Creek US (Jasper Co.)
Tipton Creek
Rock River
N. Raccoon River (Sac City)
Powell Creek
Boone River (Goldfield)
Beaver Creek
Cedar Creek (Pocahontas)
N. Raccoon River (Jefferson)
Slough Cr Wetland Inlet
Ioway Creek
Miller Creek
Boone River (Webster City)
Mud Creek
Walnut Creek (Story County)
Des Moines R. (Des Moines)
Little Sioux River
W. Fork Crooked Creek
Wolf Creek
Soldier River
Clear Creek (Oxford)
Yellow River
Boyer River
Raccoon River (Van Meter)
Cedar River (Janesville)
Skunk River
W. Nishnabotna River
Cedar River (Palo)
Walnut Creek DS (Jasper Co.)
Turkey River
W. Nishnabotna River
West Fork Cedar River
Iowa River (incl. Cedar)
Wapsipinicon R. (DeWitt)
Upper Iowa River
Cedar River (Conesville)
Wapsipinicon R. (Central City)
South Raccoon River
Iowa River (Iowa City)
North English River
Morgan Creek
Clear Creek (Coralville)
Shellrock River
Des Moines R. (Keosauqua)
East Nishnabotna River
English River
Catfish Creek (S)
West Nodaway River
0.0
0.5
1.0
1.5
2.0
2.5


West Des Moines
Bangkok
Mexico City
Alabama
Oklahoma
Maine
Vienna
West Virginia
Prague
Fresno
Toledo (OH)
London
New York City
Iowa
Madrid (Spain)
Delaware
Utah
Berlin
Rome
Casablanca
Tokyo
New Jersey
Alexandria (Egypt)
Puerto Rico
Wichita
Jacksonville
Brisbane
Paris
Los Angeles
Osaka
San Diego
Phoenix
Chicago
Bakersfield
Idaho
Toronto
Hamburg
Buenos Aires
Minneapolis
Philadelphia
San Jose
Buffalo
Sioux Falls
Dallas
Kabul
Montana
Anaheim
Wyoming
0
25
50
100 Miles
N
Urbandale
New Orleans
Fort Worth
Albuquerque
St. Louis
Colorado Springs
Ankeny
Cedar Rapids