Research, Education, and Service

IIHR—Hydroscience & Engineering

Senior College

Class 4

November 9, 2021

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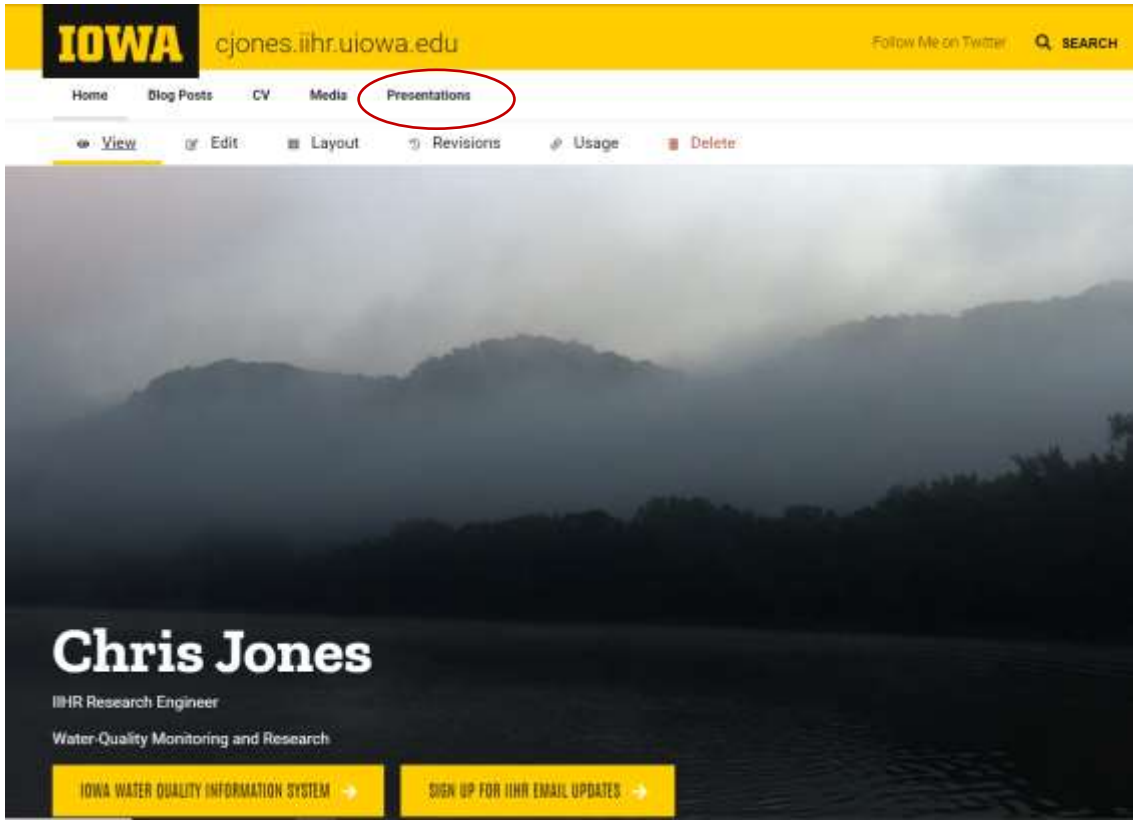
IIHR Hydroscience & Engineering

The University of Iowa College of Engineering

Slides Available at:

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



COMPARE ...

IOWADOT
GETTING YOU THERE

Source: Iowa Department of Transportation | 800 Lincoln Way | Ames, IA | www.iowadot.gov

CARGO CAPACITY

ONE BARGE
1,750 TON
58,333 BUSHELS
1,555,000 GALLONS

ONE 15-BARGE TOW
26,250 TON
874,995 BUSHELS
23,325,000 GALLONS

ONE RAIL CAR
110 TON
4,000 BUSHELS
33,870 GALLONS

ONE 108-CAR TRAIN
11,880 TON
432,000 BUSHELS
3,657,960 GALLONS

ONE LARGE SEMI
25 TON
910 BUSHELS
7,865 GALLONS

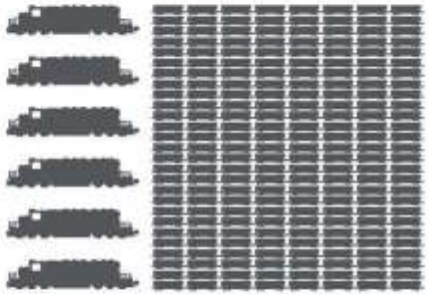
EQUIVALENT UNITS

ONE BARGE

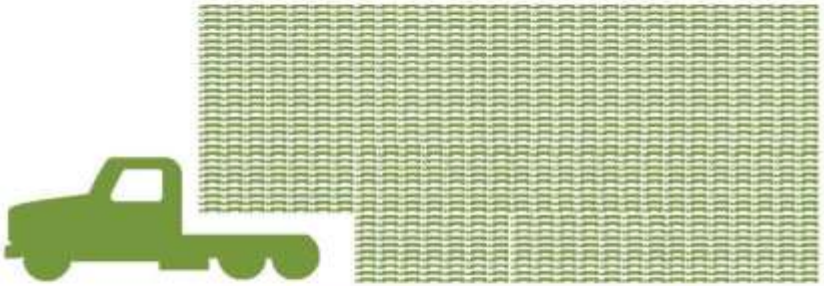
16 RAIL CARS

70 LARGE SEMIS/TRACTOR TRAILERS

ONE 15-BARGE TOW AND TOW BOAT



6 LOCOMOTIVES AND 216 RAIL CARS



1,050 LARGE SEMIS/TRACTOR TRAILERS

EQUIVALENT LENGTHS

ONE 15-BARGE TOW
0.25 MILE

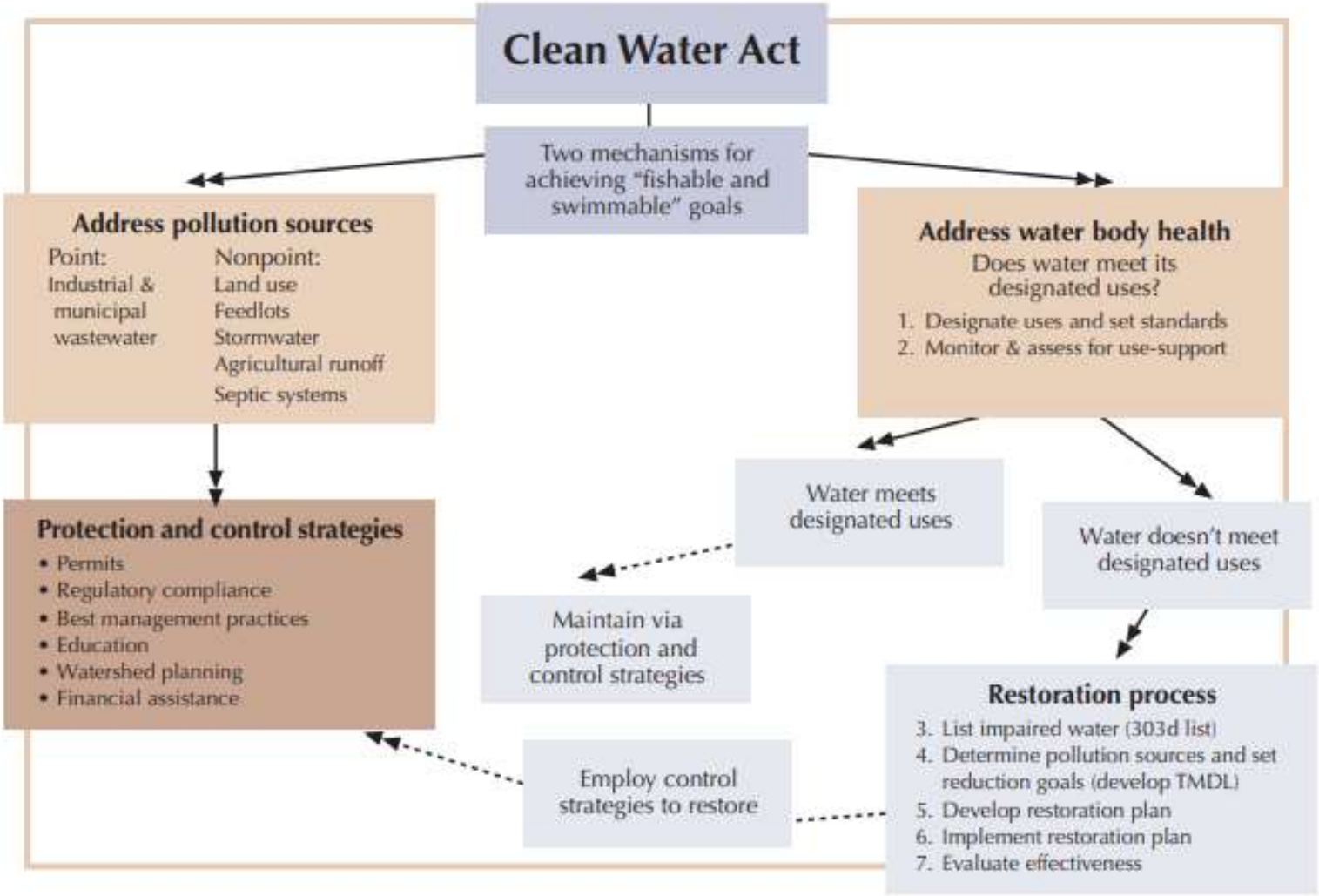
TWO 108-CAR TRAINS
2.6 MILES

1,050 LARGE SEMIS/TRACTOR TRAILERS
13.9 MILES (BUMPER TO BUMPER)

PM 444 02/25/2019

Class 4

- Iowa Impaired Waters
- Advancing solutions to water quality problems
- Costs to improving water quality
- What can the average person do to improve water quality

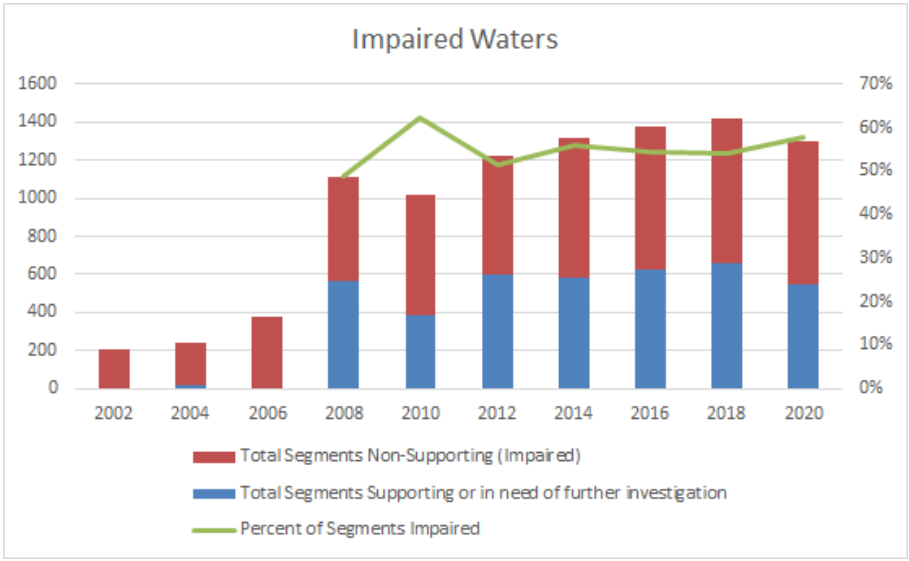

Clean Water Act
Two mechanisms for achieving "fishable and swimmable" goals
Address pollution sources
Point:
Industrial & municipal wastewater
Nonpoint:
Land use
Feedlots
Stormwater
Agricultural runoff
Septic systems
Address water body health
Does water meet its designated uses?
1. Designate uses and set standards
2. Monitor & assess for use-support
Protection and control strategies
• Permits
• Regulatory compliance
• Best management practices
• Education
• Watershed planning
• Financial assistance
Water meets designated uses
Water doesn't meet designated uses
Maintain via protection and control strategies
Restoration process
3. List impaired water (303d list)
4. Determine pollution sources and set reduction goals (develop TMDL)
5. Develop restoration plan
6. Implement restoration plan
7. Evaluate effectiveness
Employ control strategies to restore

Degrees/Categories of Impairment

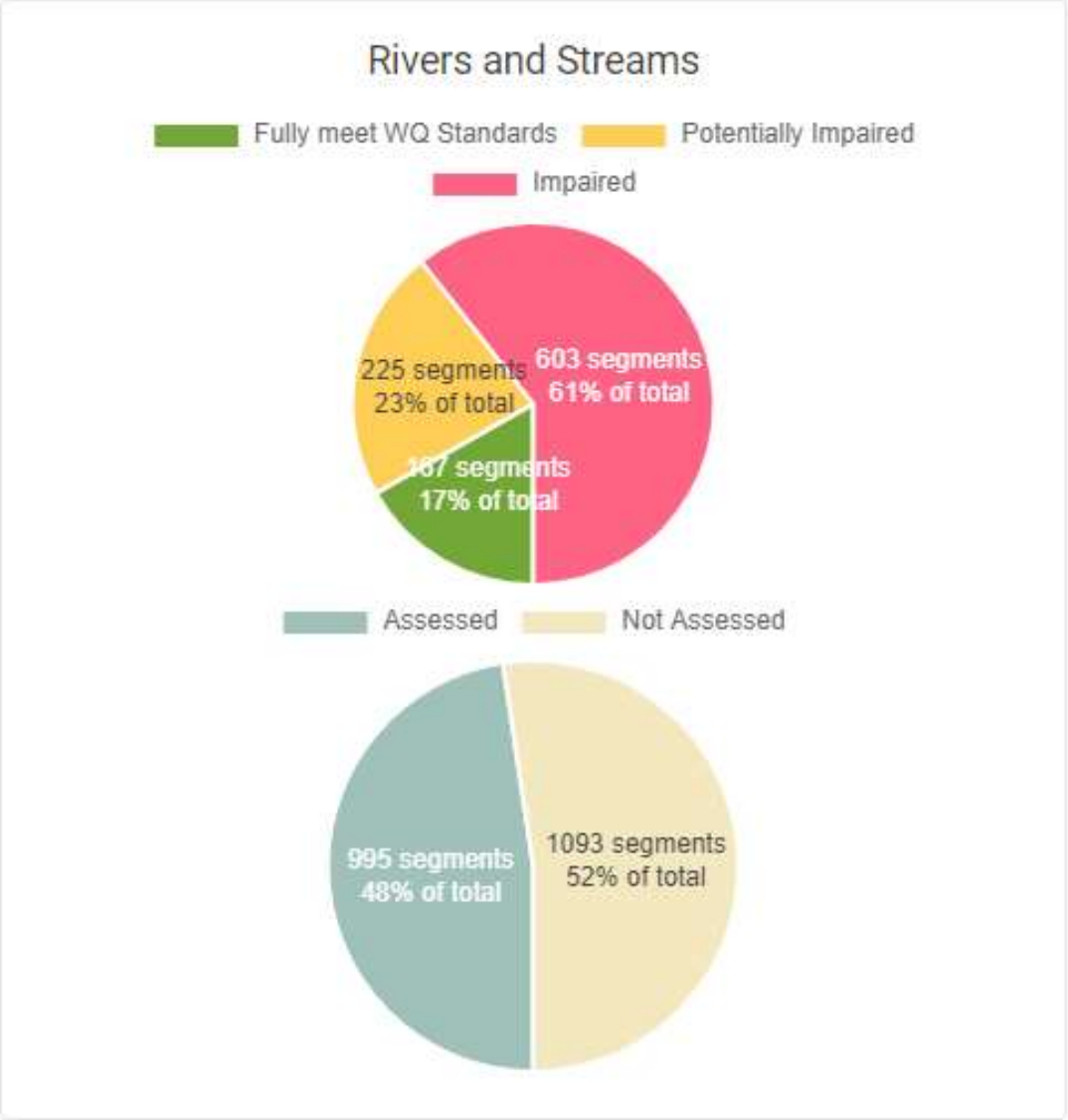
- Category 1: All designated uses (e.g., for water contact recreation, aquatic life, and/or drinking water) are met.
- Category 2: Some of the designated uses are met but insufficient information exists to determine whether the remaining uses are met.
- Category 3: Insufficient information exists to determine whether any uses are met.
- Category 4: The waterbody is impaired but a total maximum daily load (TMDL) is not required.
- Category 5: The waterbody is impaired and a total maximum daily load (TMDL) is required.

Impaired Waters

- **58% of Iowa stream lengths are impaired**
- **Why can we not make progress?**

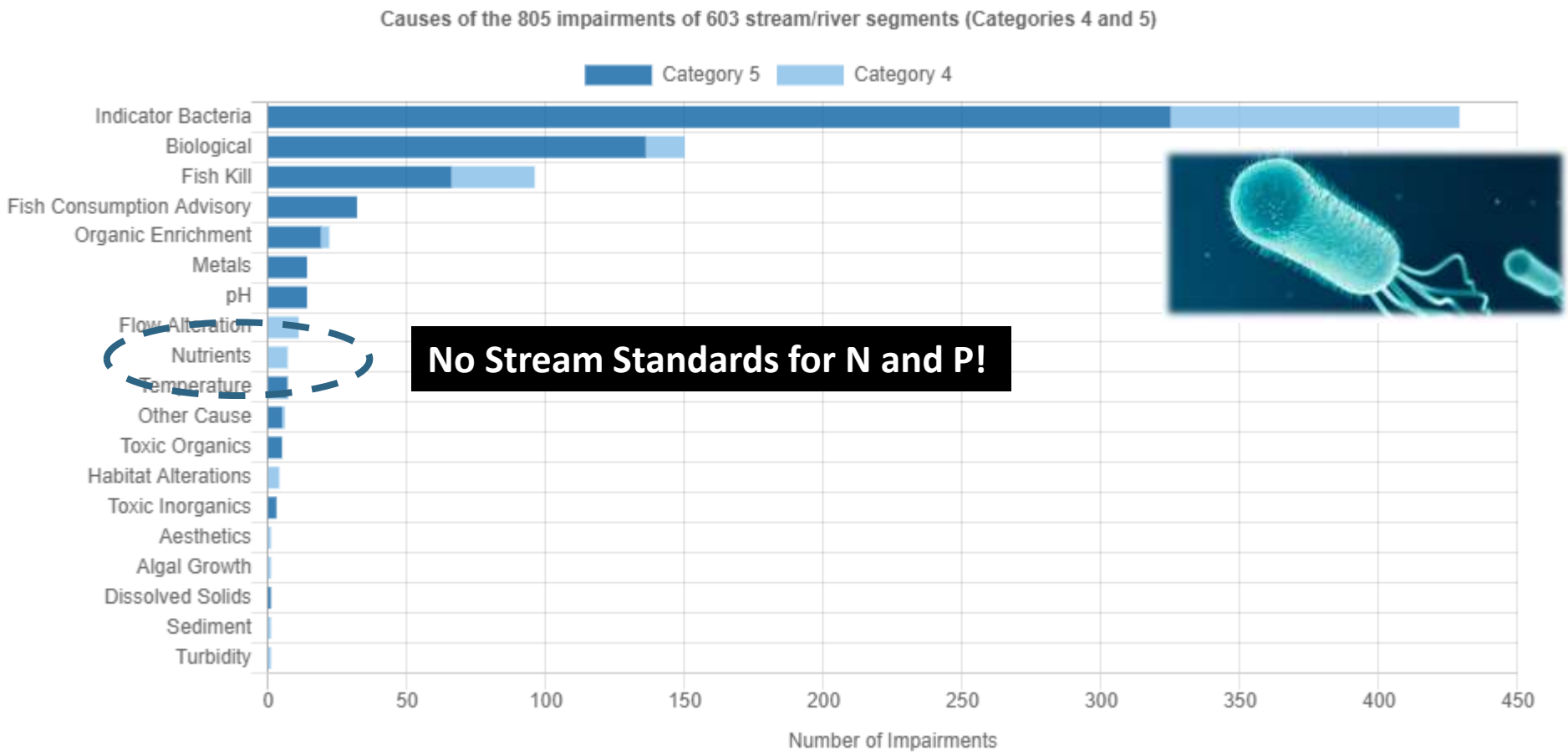


Impaired Waters: Rivers and Streams



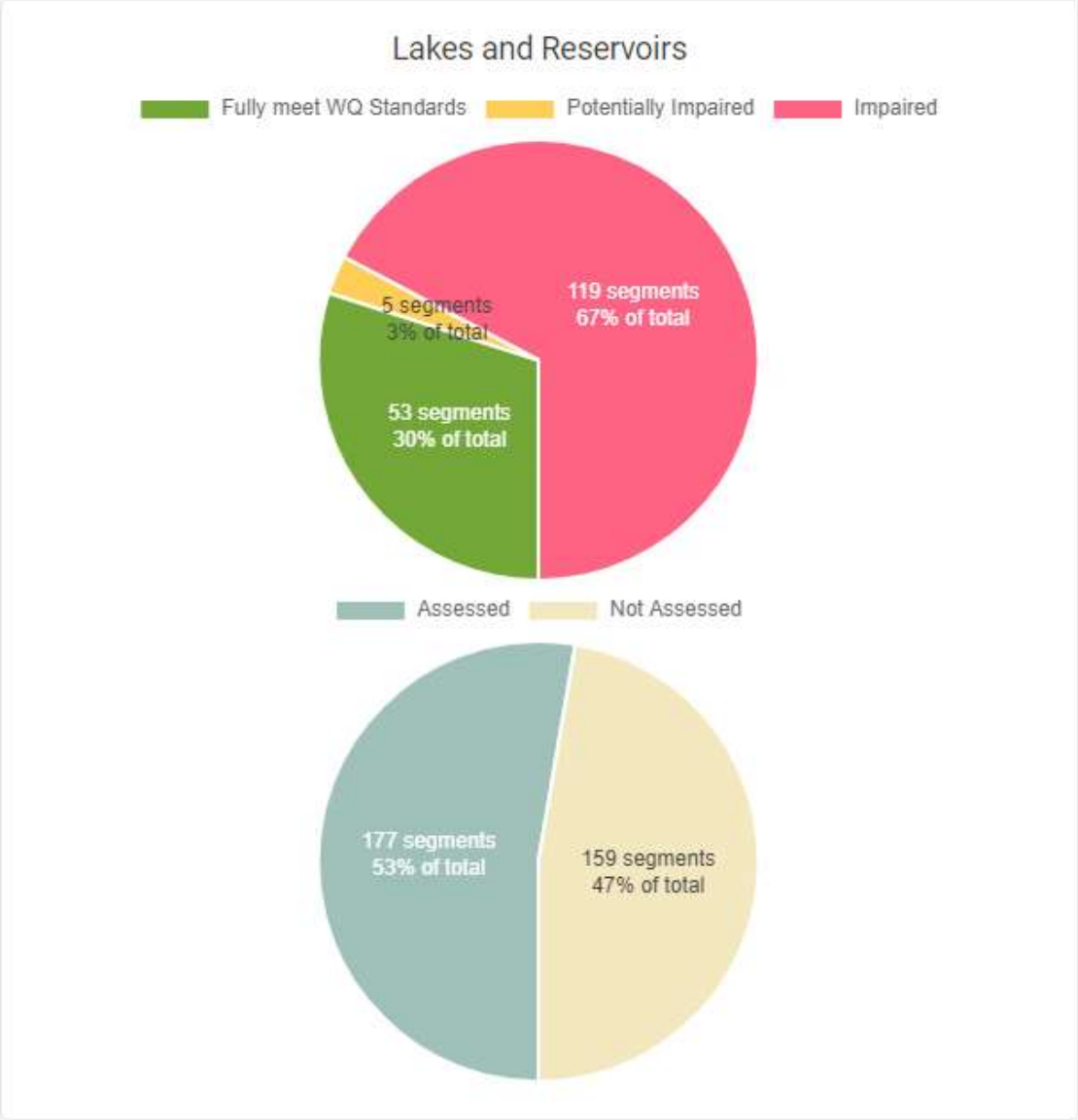
source: Iowa DNR

Stream Impairments



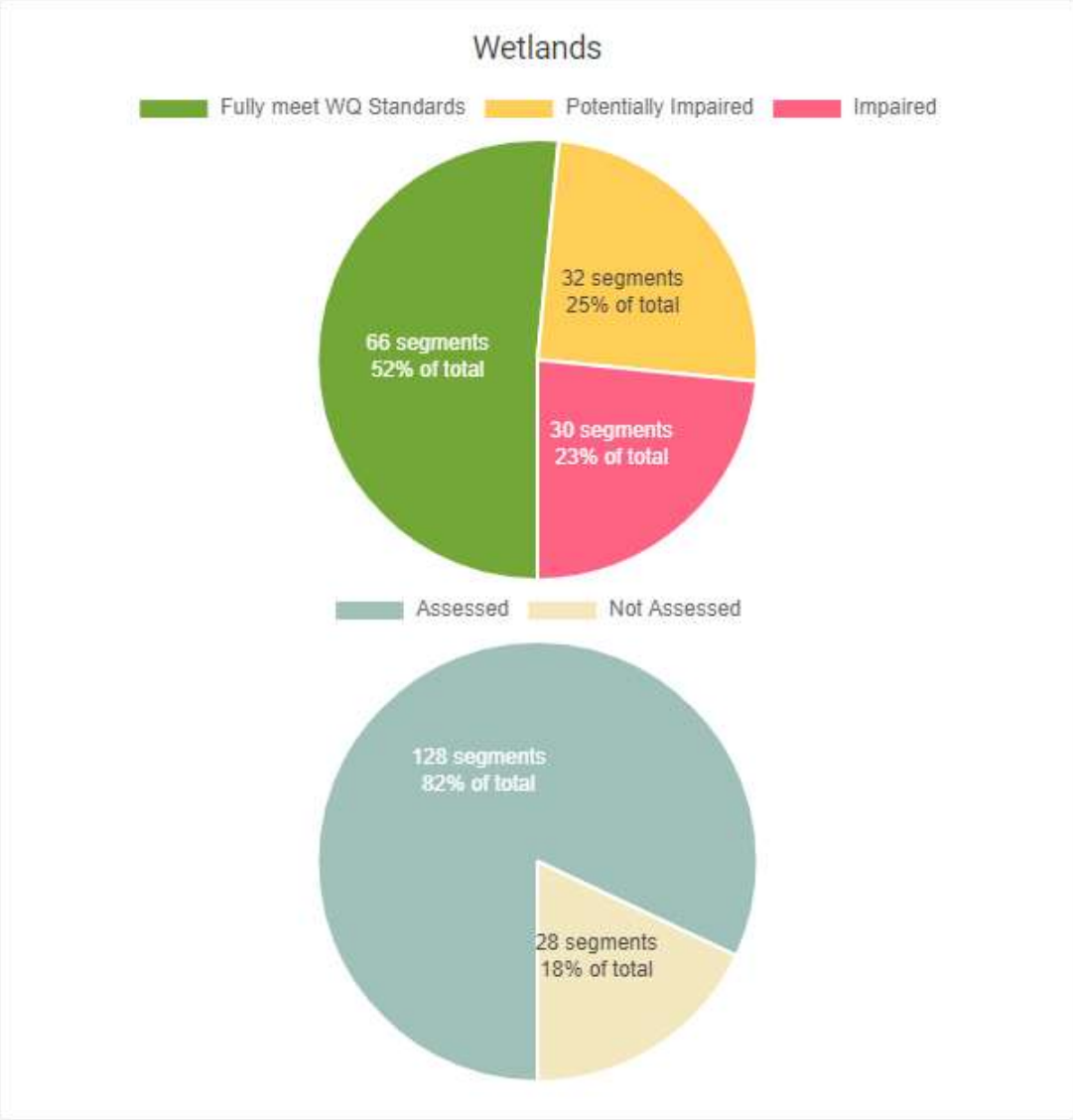
source: Iowa DNR

Lakes and Reservoirs

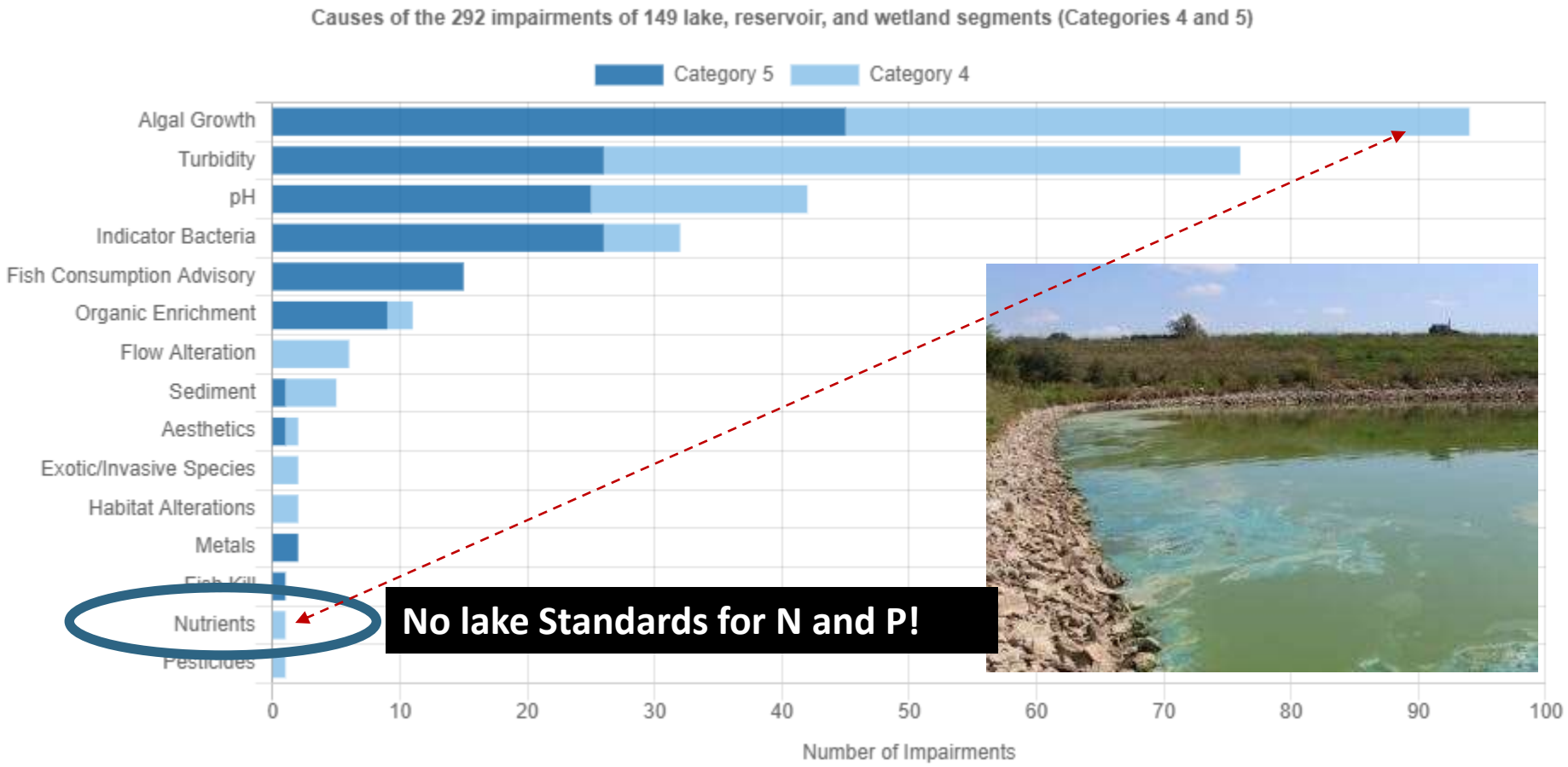


source: Iowa DNR

Wetlands


Wetlands
Fully meet WQ Standards
Potentially Impaired
Impaired
32 segments
25% of total
66 segments
52% of total
30 segments
23% of total
Assessed
Not Assessed
128 segments
82% of total
28 segments
18% of total

Lake, Reservoir and Wetland Impairments



Lake Nutrient Standards WERE proposed!!

Nutrient Criteria for Iowa Lakes

Recommended Criteria for Class "A" Recreational Uses

Report of the Nutrient Science Advisors

February 14, 2008

Michael Burkart, Assoc. Prof., Geological and Atmospheric Sciences, Iowa State University

Michael Birmingham, Limnologist, Hygienic Laboratory, University of Iowa

Edward Bottei, Clinical Assist. Prof., Department of Internal Medicine, University of Iowa

Edward Brown, Professor, Environmental Microbiology, University of Northern Iowa

John Downing, Professor, Ecology Evolution & Organismal Biology, Iowa State University

Christopher Jones, Laboratory Supervisor, Des Moines Water Works

Joe Larscheid, NW Regional Office, Spirit Lake, Iowa Department of Natural Resources

John Olson, Watershed Monitoring & Assessment, Iowa Department of Natural Resources

Michael Quist, Assist. Prof., Natural Resource Ecology and Management, Iowa State University

Peter Weyer, Assoc. Dir., Center for Health Effects of Environmental Contamination, Univ. of Iowa

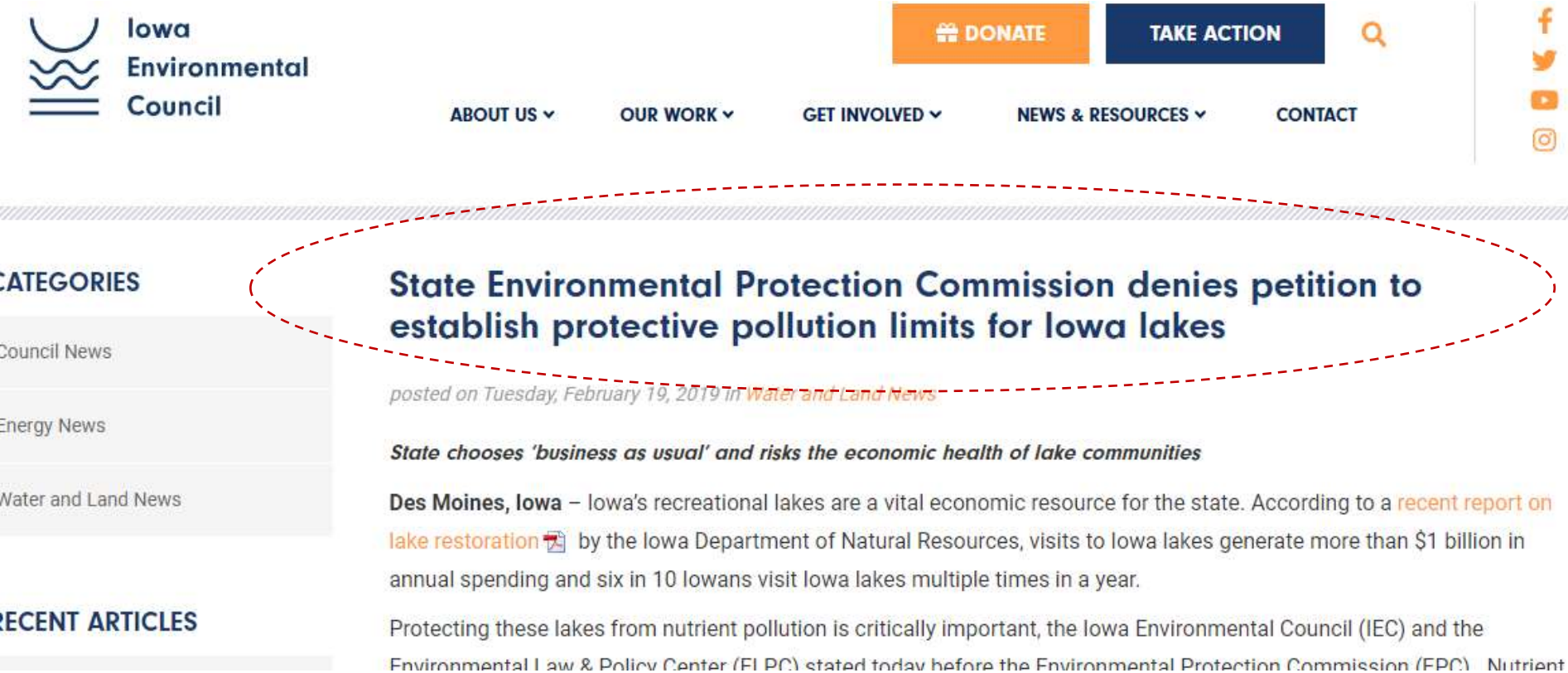
Tom Wilton, Lake Restoration, Iowa Department of Natural Resources

Secchi depth of 1.0 m minimum.

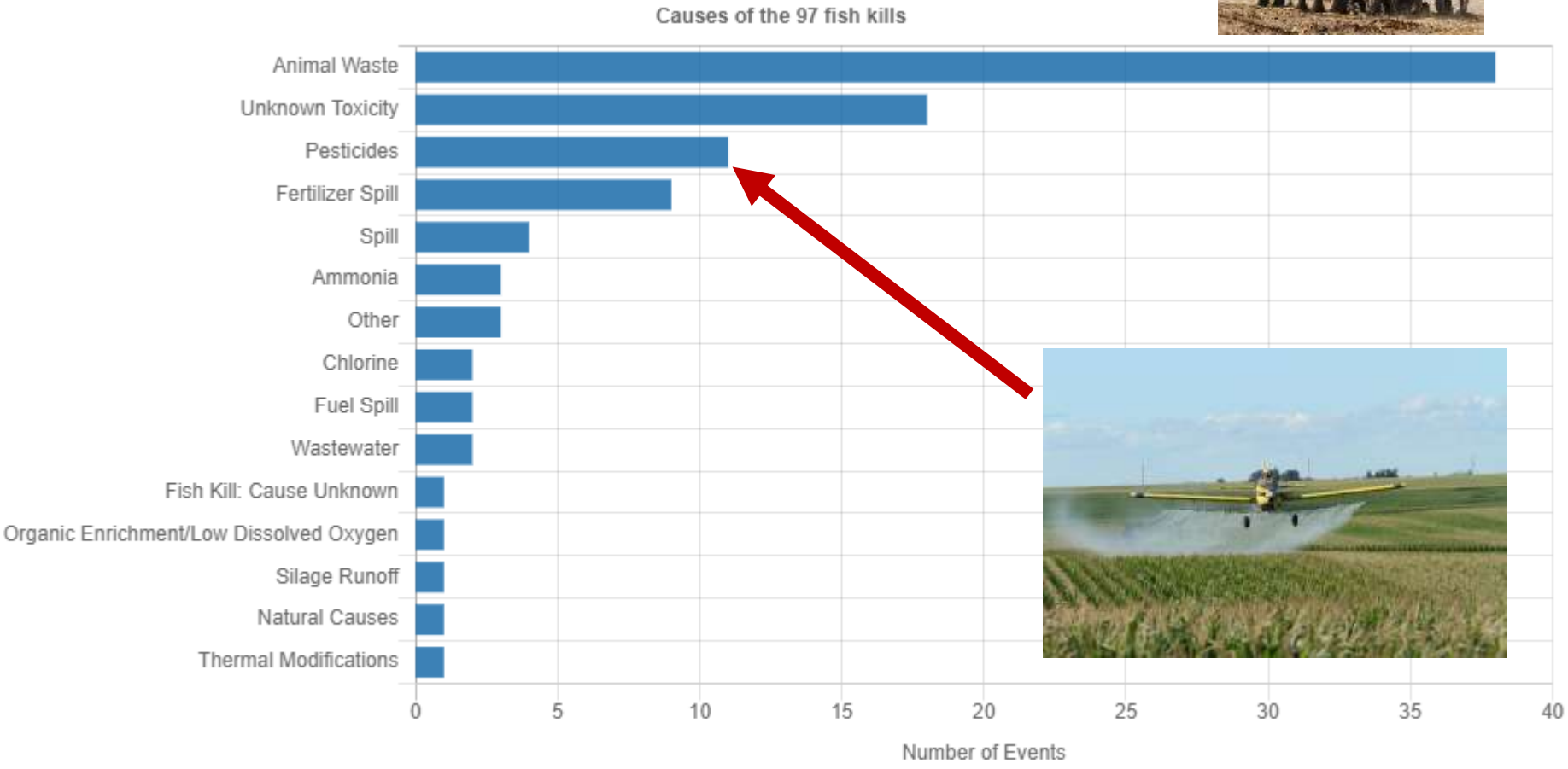
Chl-a concentration equal to or below 25 ppb (µg/L).

Mean TP concentrations equal to or below 35 ppb (µg/L).

TN concentrations less than or equal to 900 ppb (µg/L).


Iowa Environmental Council
DONATE
TAKE ACTION
ABOUT US
OUR WORK
GET INVOLVED
NEWS & RESOURCES
CONTACT
CATEGORIES
Council News
Energy News
Water and Land News
RECENT ARTICLES
State Environmental Protection Commission denies petition to establish protective pollution limits for Iowa lakes
posted on Tuesday, February 19, 2019 in Water and Land News
State chooses 'business as usual' and risks the economic health of lake communities
Des Moines, Iowa – Iowa's recreational lakes are a vital economic resource for the state. According to a recent report on lake restoration by the Iowa Department of Natural Resources, visits to Iowa lakes generate more than $1 billion in annual spending and six in 10 Iowans visit Iowa lakes multiple times in a year.
Protecting these lakes from nutrient pollution is critically important, the Iowa Environmental Council (IEC) and the

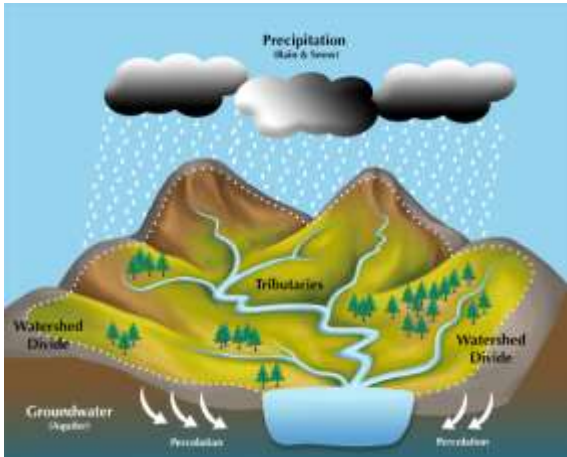
Fish Kills


Causes of the 97 fish kills
Animal Waste
Unknown Toxicity
Pesticides
Fertilizer Spill
Spill
Ammonia
Other
Chlorine
Fuel Spill
Wastewater
Fish Kill: Cause Unknown
Organic Enrichment/Low Dissolved Oxygen
Silage Runoff
Natural Causes
Thermal Modifications
0
5
10
15
20
25
30
35
40
Number of Events

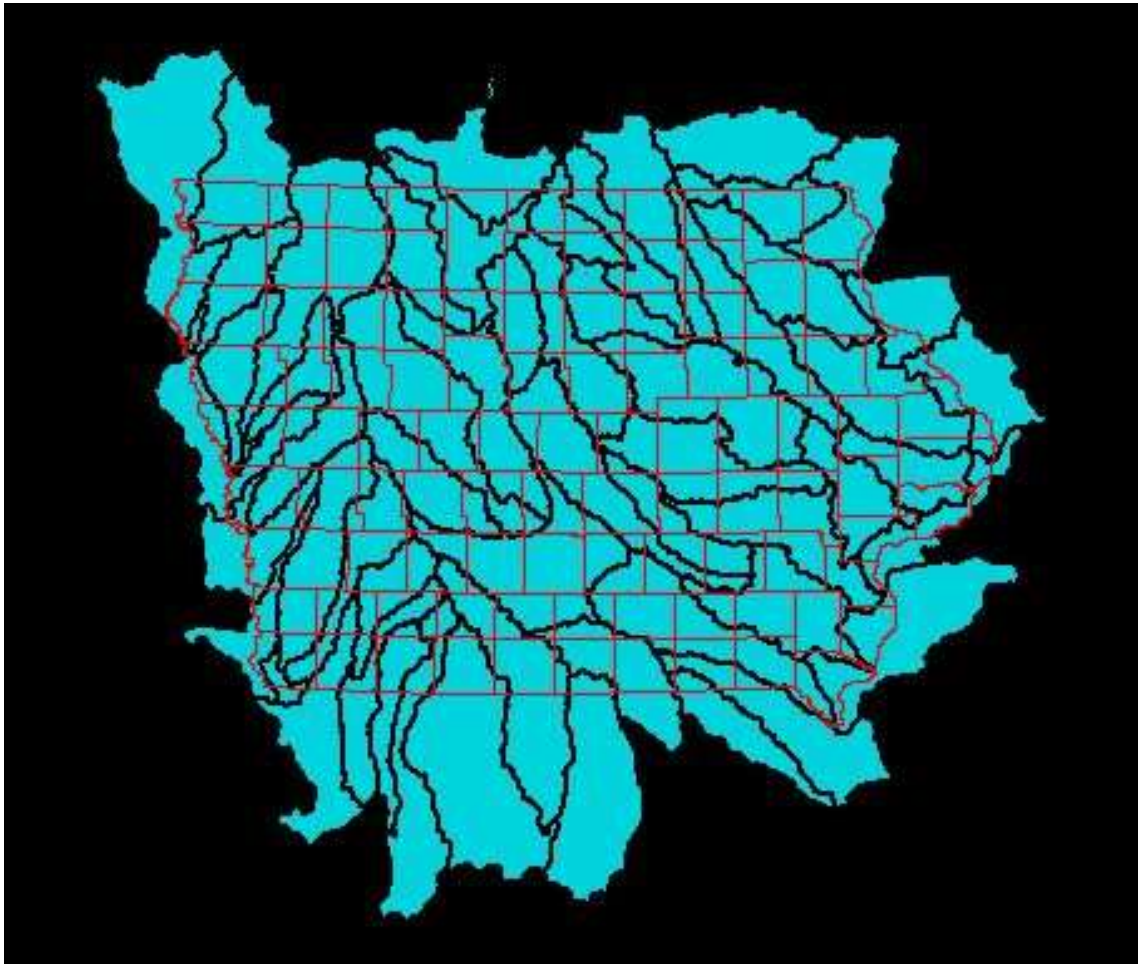
The Path Forward??

Watershed Approach

The watershed approach is a coordinating framework for environmental management that focuses public and private sector efforts to address the highest priority problems within hydrologically-defined geographic areas, taking into consideration both ground and surface water flow.



No Iowa County lies completely within a HUC 8 Watershed

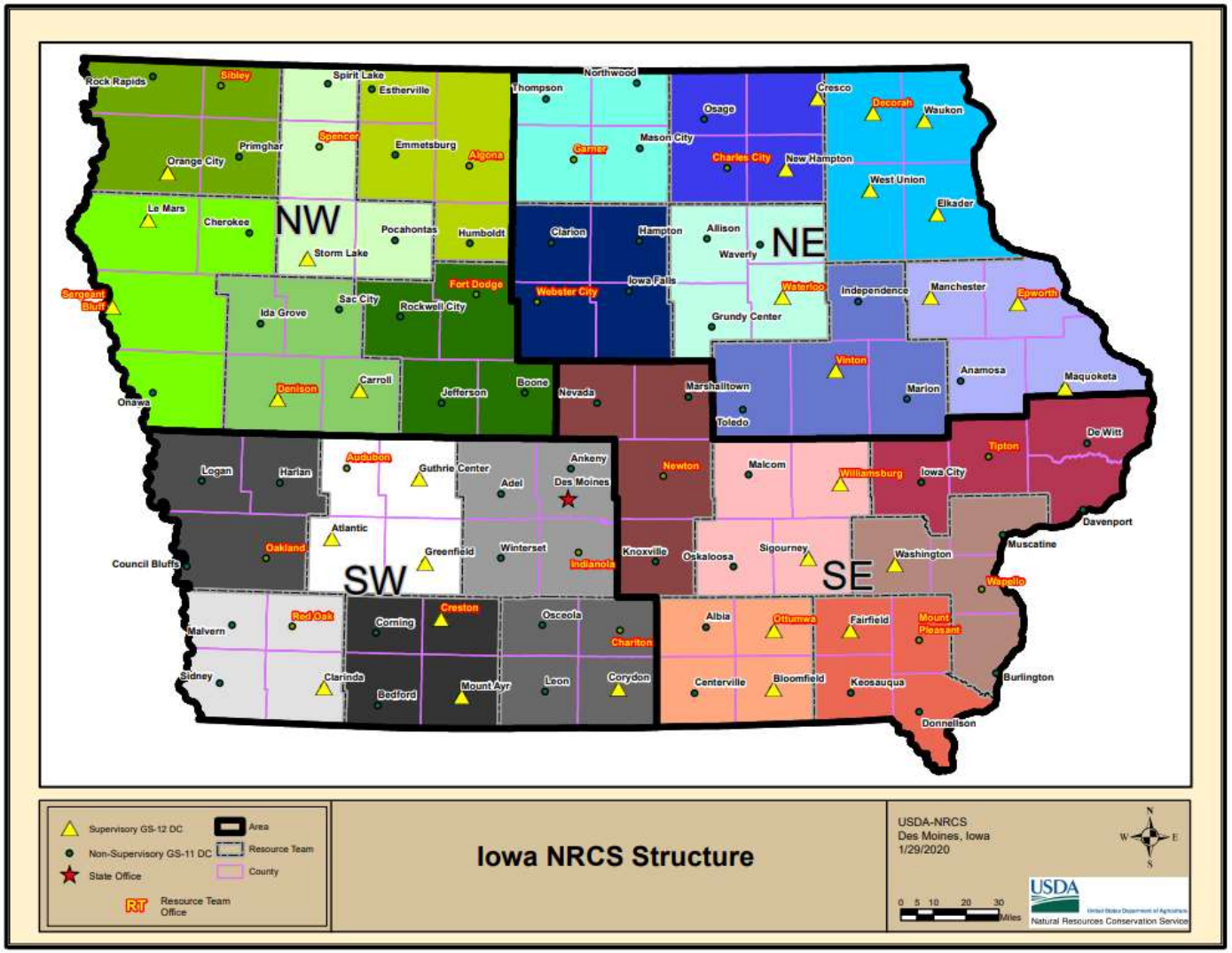


Watershed Approach Guiding Principles

Geographic Focus

- Activities are directed within specific geographic areas, typically the areas that drain to surface water bodies or that recharge or overlay ground waters or a combination of both.

Soil and Water Conservation Districts and NRCS Districts



Watershed Approach Guiding Principles

Partnerships

- Those people most affected by management decisions are involved throughout and shape key decisions.
- Ensures that environmental objectives are well integrated with those for economic stability and other social and cultural goals.
- Provides that the people who depend upon the natural resources within the watersheds are well informed of and participate in planning and implementation activities.

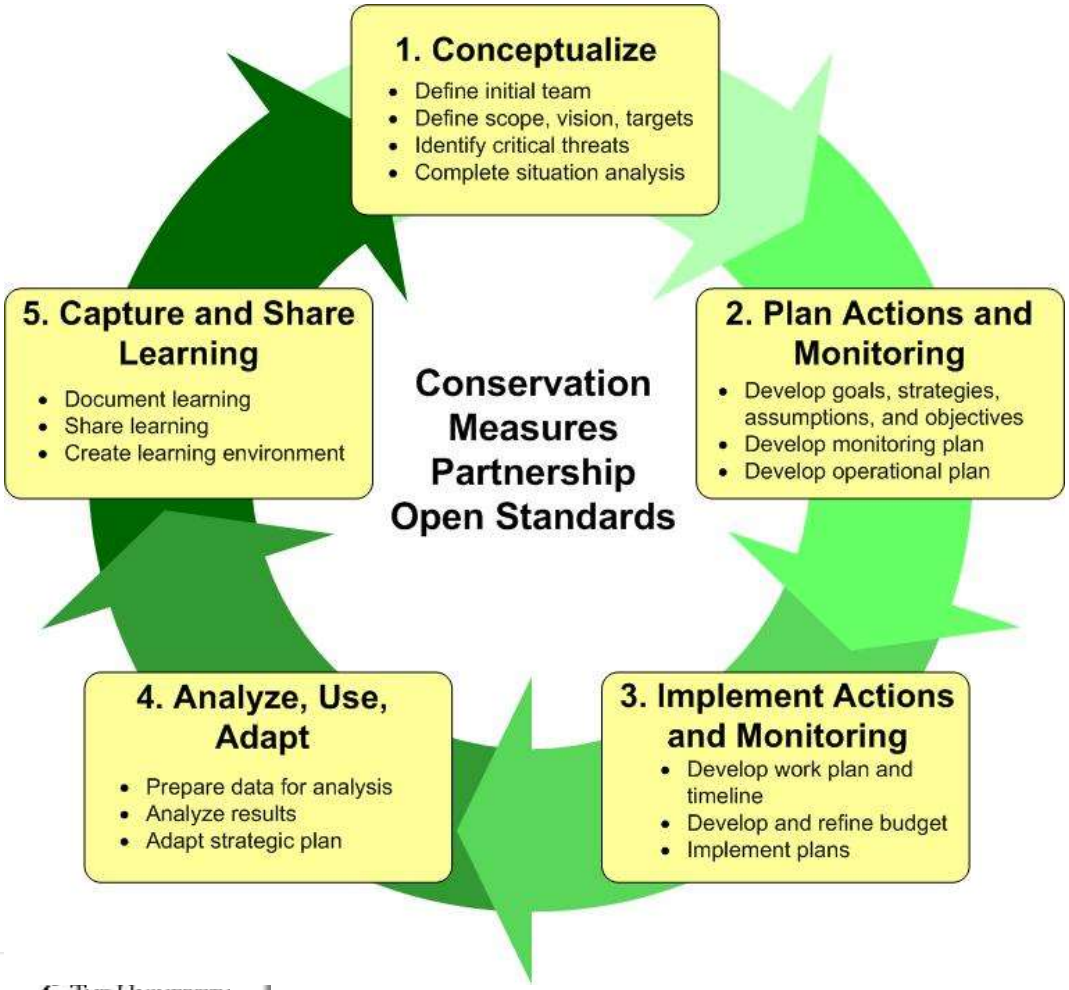
Watershed Approach Guiding Principles

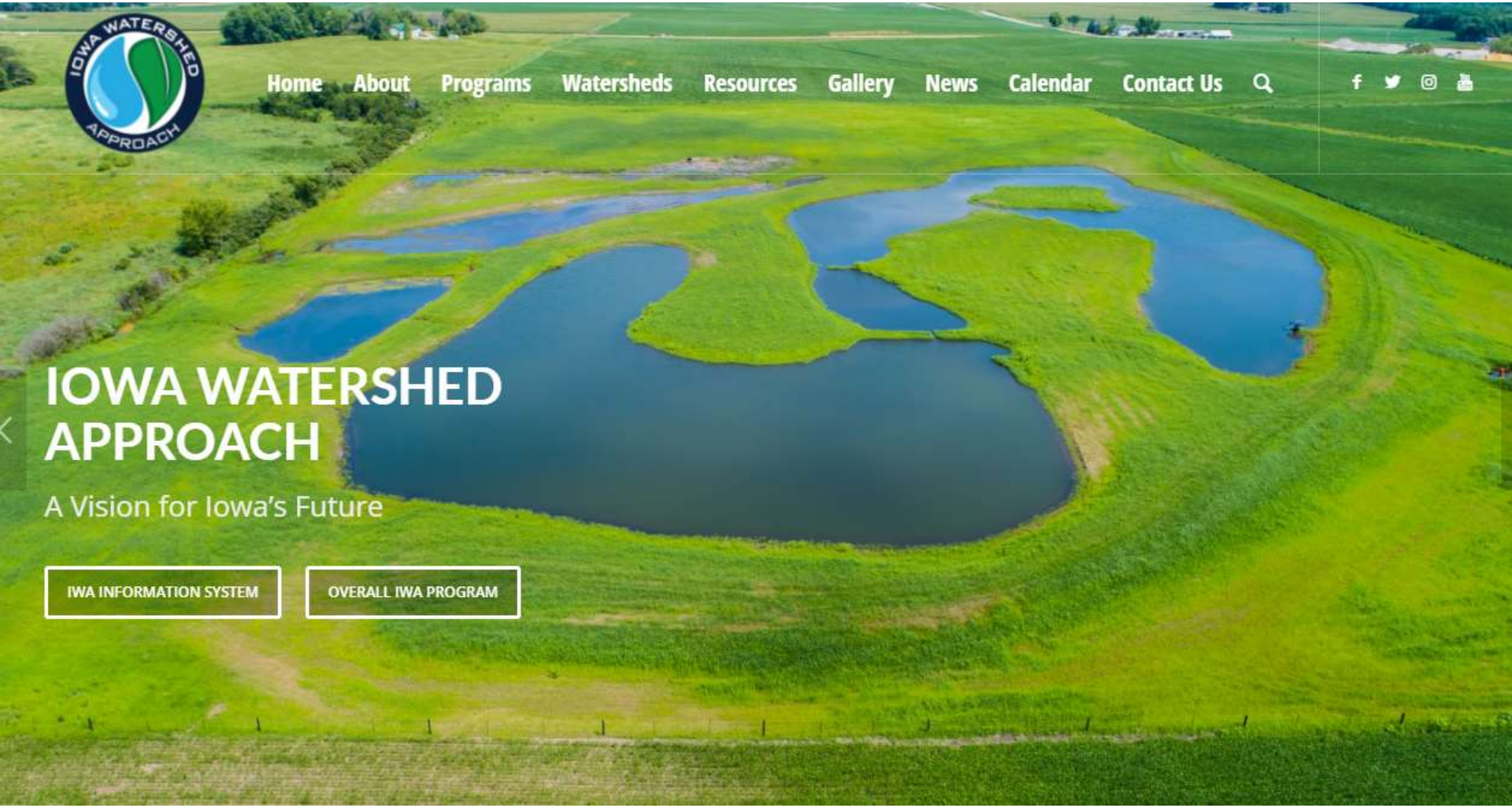
Sound Management Techniques based on Strong Science and Data -- Collectively, watershed stakeholders employ sound scientific data, tools, and techniques in an iterative decision-making process. This includes:

- **Assessment and characterization of the natural resources** and the communities that depend upon them
- **Goal setting and identification of environmental objectives** based on the condition or vulnerability of resources and the needs of the aquatic ecosystem and the people within the community
- **Identification of priority problems**
- **Development of specific management options and action plans**
- **Implementation**
- **Evaluation of effectiveness and revision of plans, as needed.**

Adaptive Resource Management

Adaptive Resource Management




IOWA WATERSHED APPROACH
Home
About
Programs
Watersheds
Resources
Gallery
News
Calendar
Contact Us
IOWA WATERSHED APPROACH
A Vision for Iowa's Future
IWA INFORMATION SYSTEM
OVERALL IWA PROGRAM

The Iowa Watershed Approach (IWA)

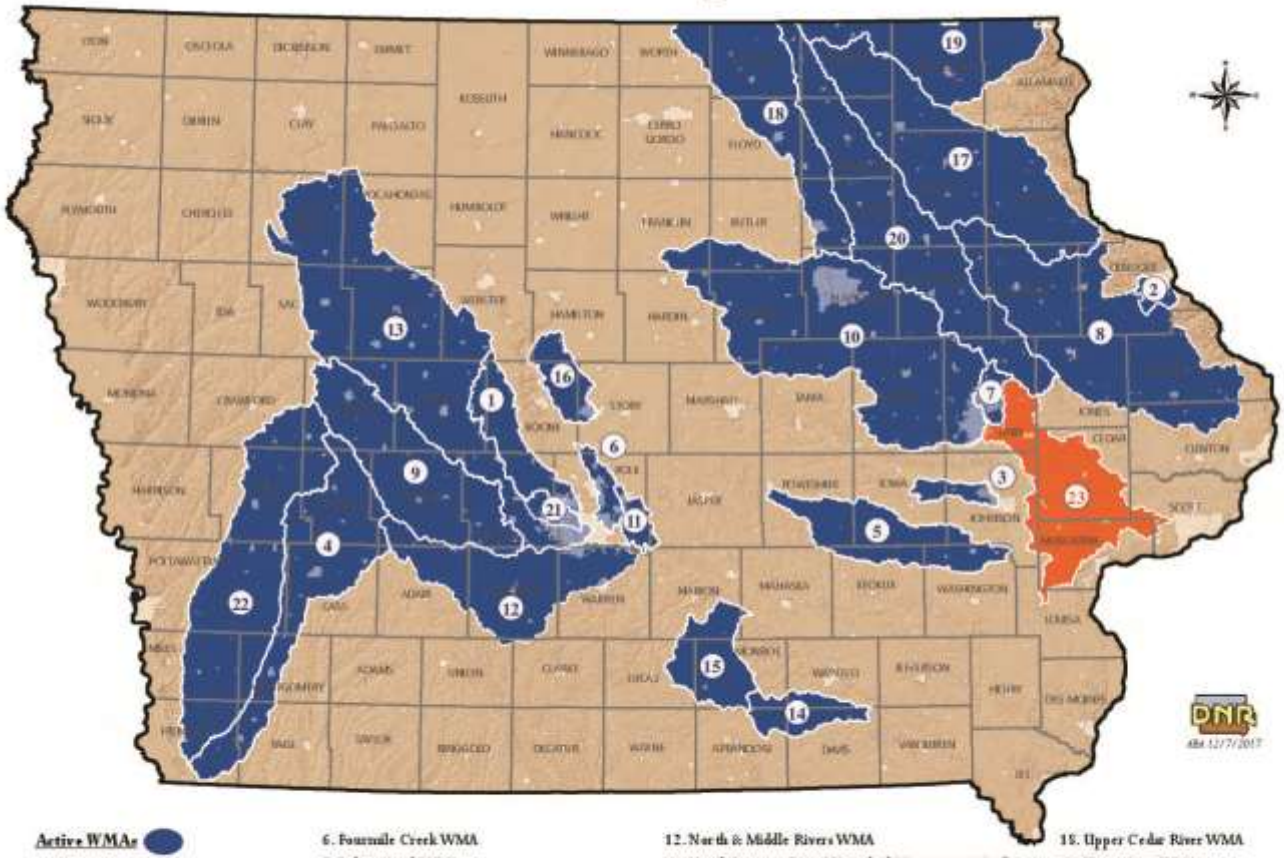
- **Vision for Iowa's future that voluntarily engages stakeholders throughout the watershed to achieve common goals**
- **Move toward a more resilient state.**
- **Replicable model for other communities where the landscape has lost its natural resilience to floods.**
- **Iowans helping Iowans, and demonstrating commitment to agricultural stewardship, to the environment, to their neighbors, and to the future.**

The goals of the IWA include the following:

- Reduction of flood risk;
- Improvement in water quality;
- Increased resilience;
- Engagement of stakeholders through collaboration, outreach, and education;
- Improved quality of life and health for Iowans
- Development of a replicable program.


Upper Iowa
Upper Wapsipinicon
Storm Lake
North Raccoon
Middle Cedar
Dubuque
Bee Branch
Clear Creek
Coralville
English River
East Nishnabotna
West Nishnabotna

Status of Iowa's Watershed Management Authorities



Active WMAs

1. Beaver Creek WMA
2. Catfish Creek WMA
3. Clear Creek Watershed Coalition
4. East Nishnabotna Watershed Coalition
5. English River WMA
6. Fourmile Creek WMA
7. Indian Creek WMA
8. Maquoketa River WMA
9. Middle-South Raccoon WMA
10. Middle Cedar WMA
11. Mud Creek, Spring Creek & Camp Creek WMA
12. North & Middle Rivers WMA
13. North Raccoon River Watershed Management Coalition
14. Soap Creek Watershed Board
15. South Central Iowa Cedar Creek WMA
16. Squaw Creek WMA
17. Turkey River WMA
18. Upper Cedar River WMA
19. Upper Iowa WMA
20. Upper Wapsipinicon River WMA
21. Walnut Creek WMA
22. West Nishnabotna Watershed Coalition

Developing WMA

23. Lower Cedar

What is a WMA?

Watershed Management Authorities in Iowa

In 2010, Iowa lawmakers passed legislation authorizing the creation of Watershed Management Authorities. A Watershed Management Authority (WMA) is a mechanism for cities, counties, Soil and Water Conservation Districts (SWCDs) and stakeholders to cooperatively engage in watershed planning and management.

Chapter 28E Agreement by two or more eligible political subdivisions within a HUC8. A board of directors governs the WMA, which may undertake the following activities:

- Assess and reduce flood risk;
- Assess and improve water quality;
- Monitor federal flood risk planning and activities;
- Educate residents of the watershed regarding flood risks and water quality; and
- Allocate moneys made available to the Authority for purposes of water quality and flood mitigation.

A WMA does not have taxing authority and it may not acquire property through eminent domain

Pitfalls

Good watershed coordinators are hard to keep

Money runs out before work is completed

Bad Faith Partners

North Raccoon Watershed

- $2.5M from IWA project
- Only $545,000 spent
- Northern counties wanted to exclude Polk and Dallas Counties using altered map—wanted two separate WMAs
- Watershed coordinator let go

No Accountability

The Storm Lake Times

News Sports Family & Friends Obituaries Opinion Arts & Entertainment E-Edition

Raccoon watershed authority can barely give it away

May 08, 2020

Of $2.5M allocated, just $500,000 spent

BY TOM CULLEN

The Storm Lake Times

News Sports Family & Friends Obituaries Opinion Arts & Entertainment E-Edition

RACCOON WATER COALITION FALLING APART

July 24, 2020

Trying to kick out Dallas, Polk counties

KEY VOTE SET FOR TODAY

BY TOM CULLEN

The Storm Lake Times

News Sports Family & Friends Obituaries Opinion Arts & Entertainment E-Edition

Raccoon watershed board ponders its future as few landowners are interested

May 15, 2020

With $2 million unspent, directors wonder what the point of it is

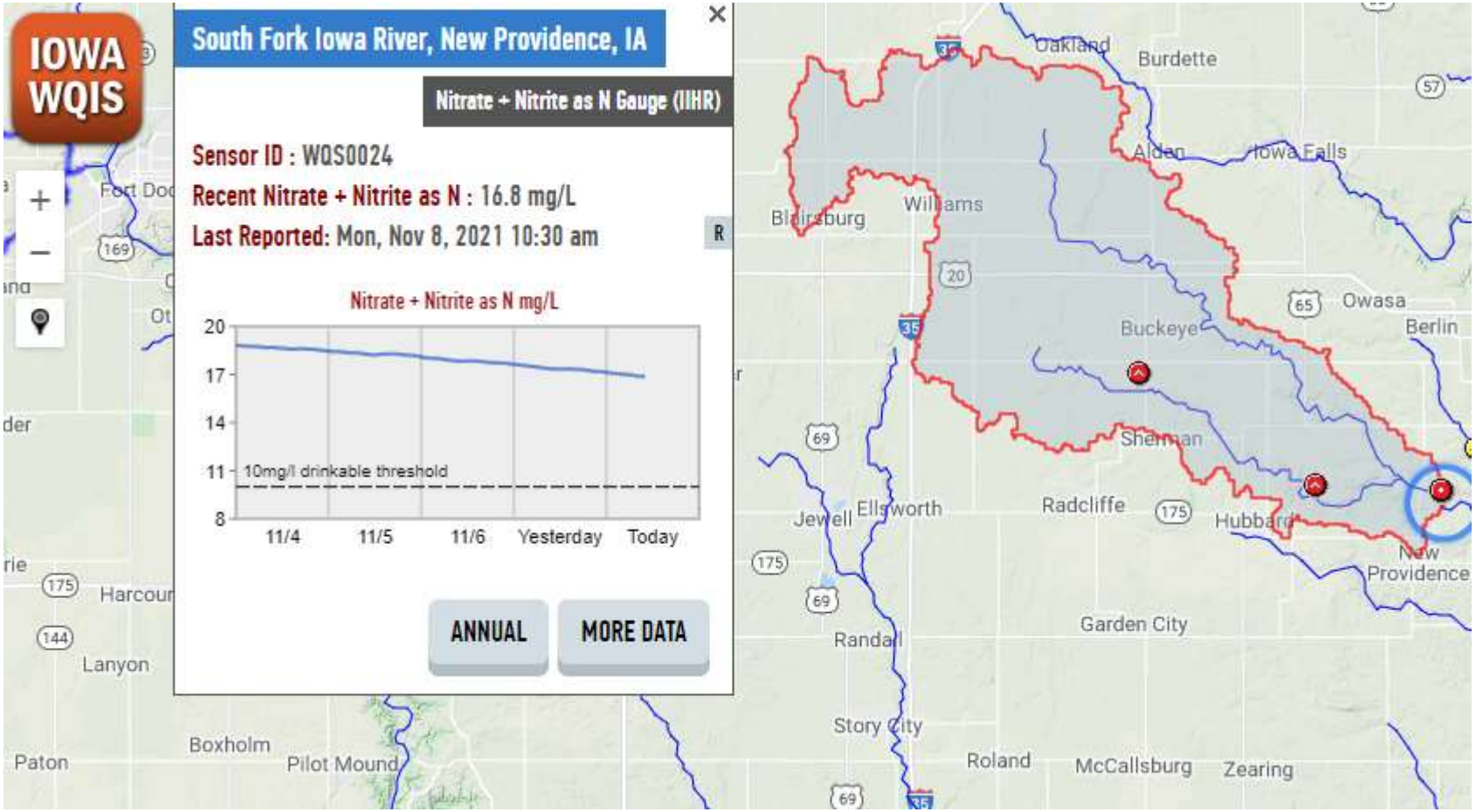
Diverging interests between north, south branches

BY TOM CULLEN

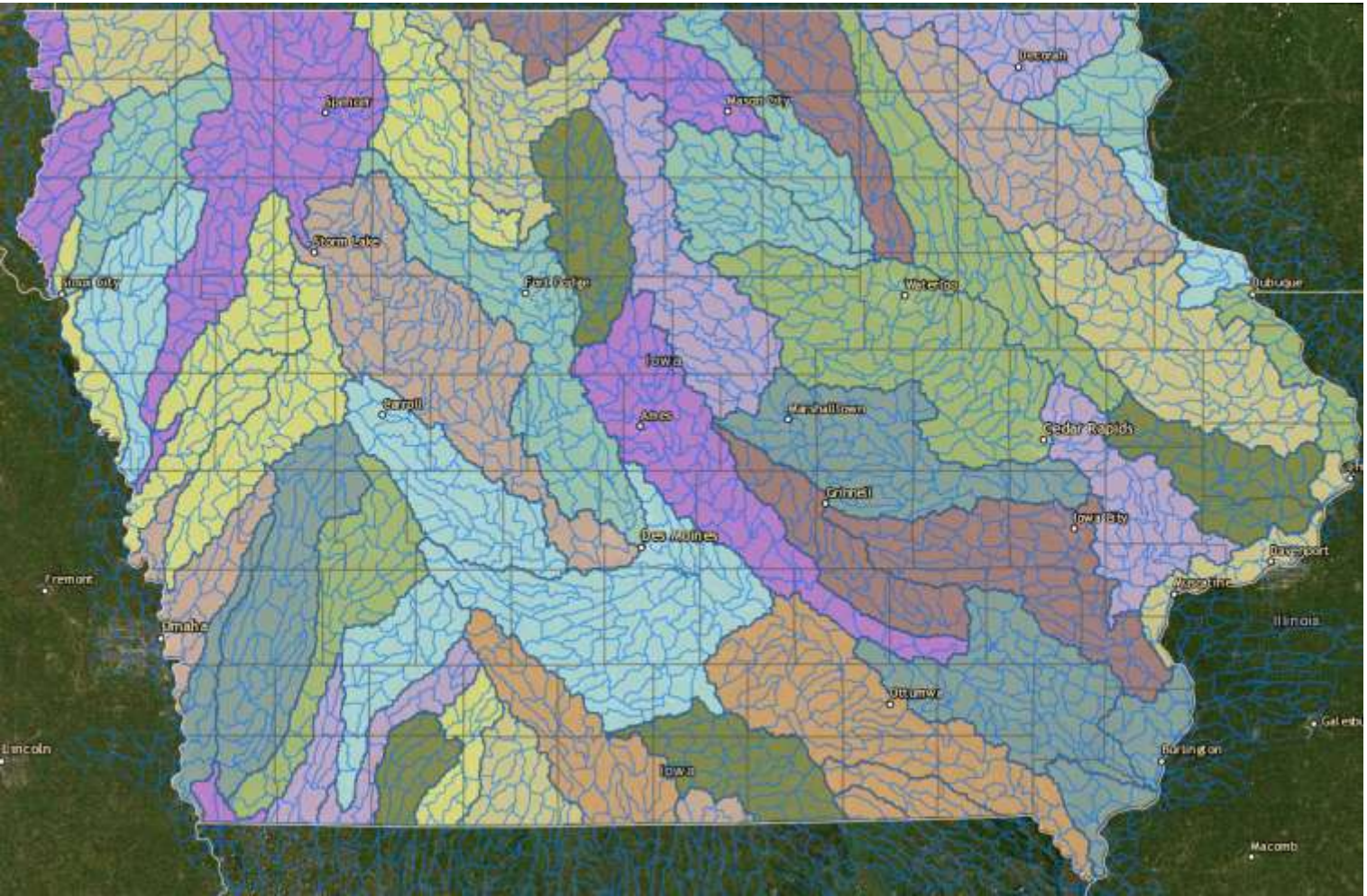
IIHR Hydroscience & Engineering

The University of Iowa College of Engineering


Southfork Watershed Alliance, Inc.
Our Mission: "To protect, preserve and enhance the natural resources of the watershed of the South Fork of the Iowa River and its tributaries through voluntary and community support."


IOWA WQIS
South Fork Iowa River, New Providence, IA
Nitrate + Nitrite as N Gauge (IIHR)
Sensor ID : WQS0024
Recent Nitrate + Nitrite as N : 16.8 mg/L
Last Reported: Mon, Nov 8, 2021 10:30 am
Nitrate + Nitrite as N mg/L
20
17
14
11
8
10mg/l drinkable threshold
11/4
11/5
11/6
Yesterday
Today
ANNUAL
MORE DATA
Oakland
Burdette
Alden
Iowa Falls
Blairsburg
Williams
Buckeye
Owasa
Berlin
Sherman
Jewell
Ellsworth
Radcliffe
Hubbard
New Providence
Garden City
Randall
Story City
Roland
McCallsburg
Zearing
Boxholm
Pilot Mound
Paton
Lanyon
Harcour
Fort Doc

Costs are largely borne by the taxpayer



1600 HUC 12s in Iowa

$1M/yr water quality

$1M/yr flooding

Costs to clean up water using this approach

Nitrate: Floyd County Example

68 kg N per day

Cost $500,000

Drains to Cedar River

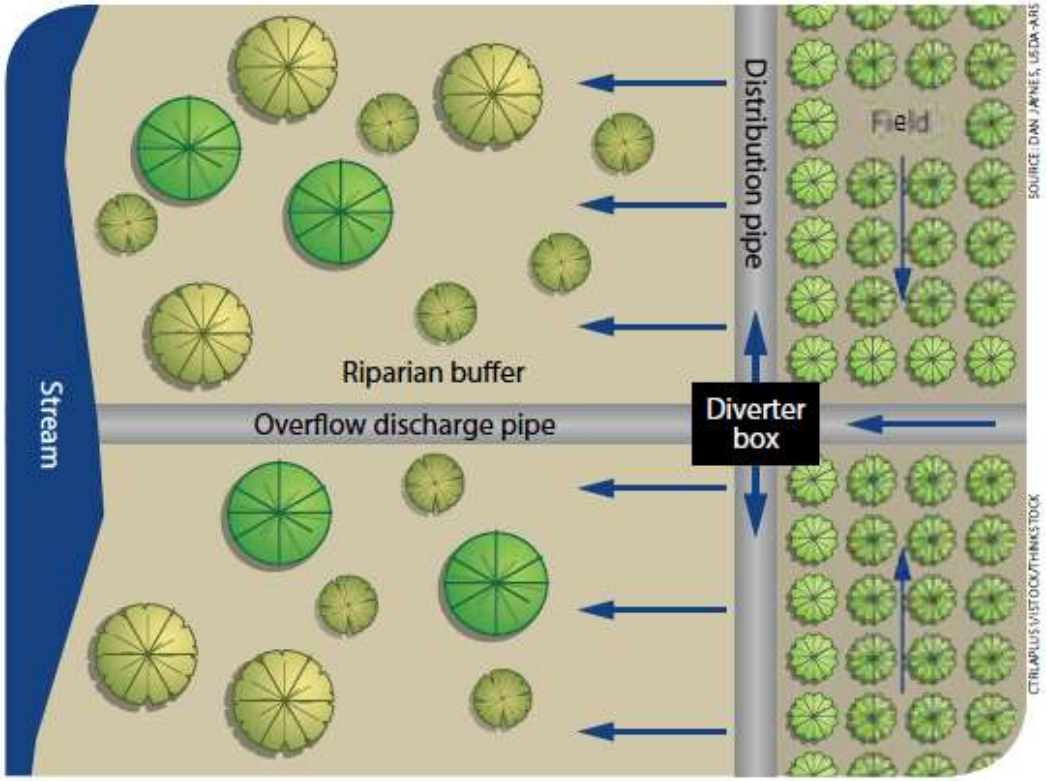
Cedar River N Load at Conesville (2020): 152,000 kg/day

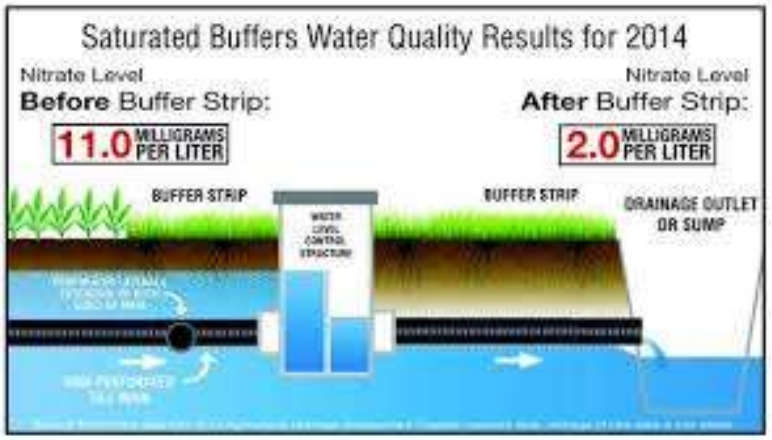
Economics of Nitrogen Loss

- **2016 production costs (labor, land, seed, machinery, chemicals, insurance, fertilizer) for corn following soybean, assuming a yield of 180 bushels per acre: $719/acre**
- **Value of N lost to streams ($17.74) was 2.5% of production cost during a wet year (2016)**
- **Cover Crops cost $30/acre, which increases production costs 4.2% for corn, 5.6% for soybean**
- **Cover Crops sequester 31% of lost nitrogen ($5.50).**
- **All Iowa C/SB acres in cover crops: $563M/year, $175/Iowan.**
- **Yield benefit would have to be 8 bushels of corn, 3 bushels of soybean**

Two Stage Ditch

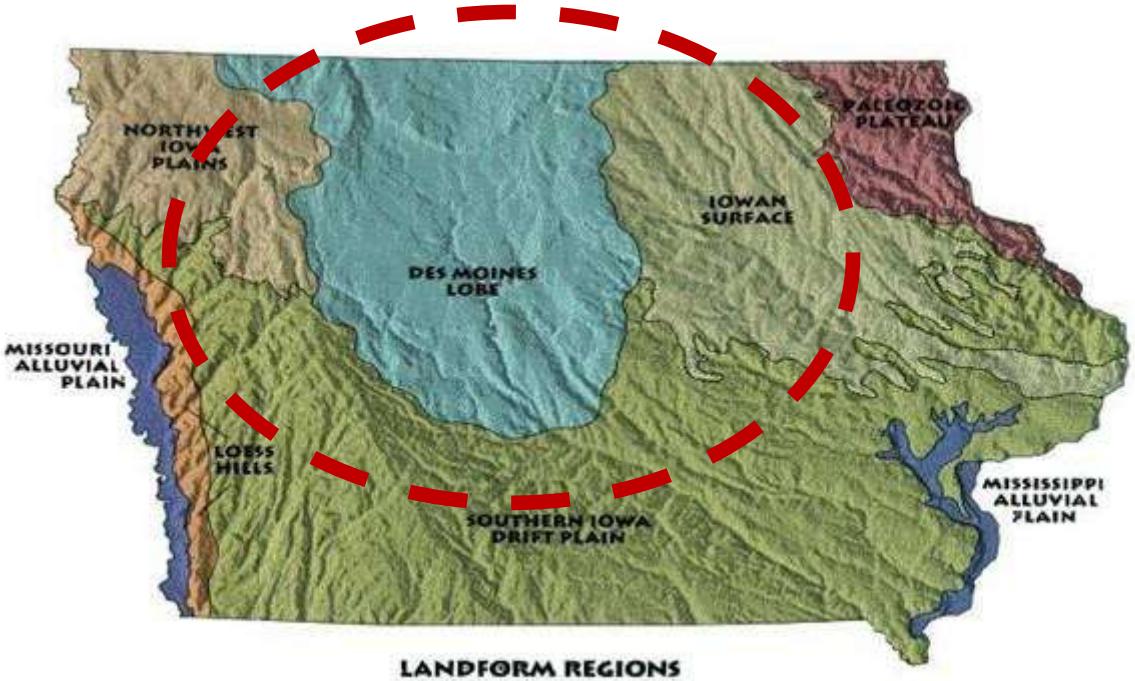
Saturated Buffers: $4000 to treat 80 Acres ($50/acre)





50% reduction

7.7 million acres



$400M to treat with saturated buffers

Economics of N loss

Cost of Nitrogen: today about $0.55/lb

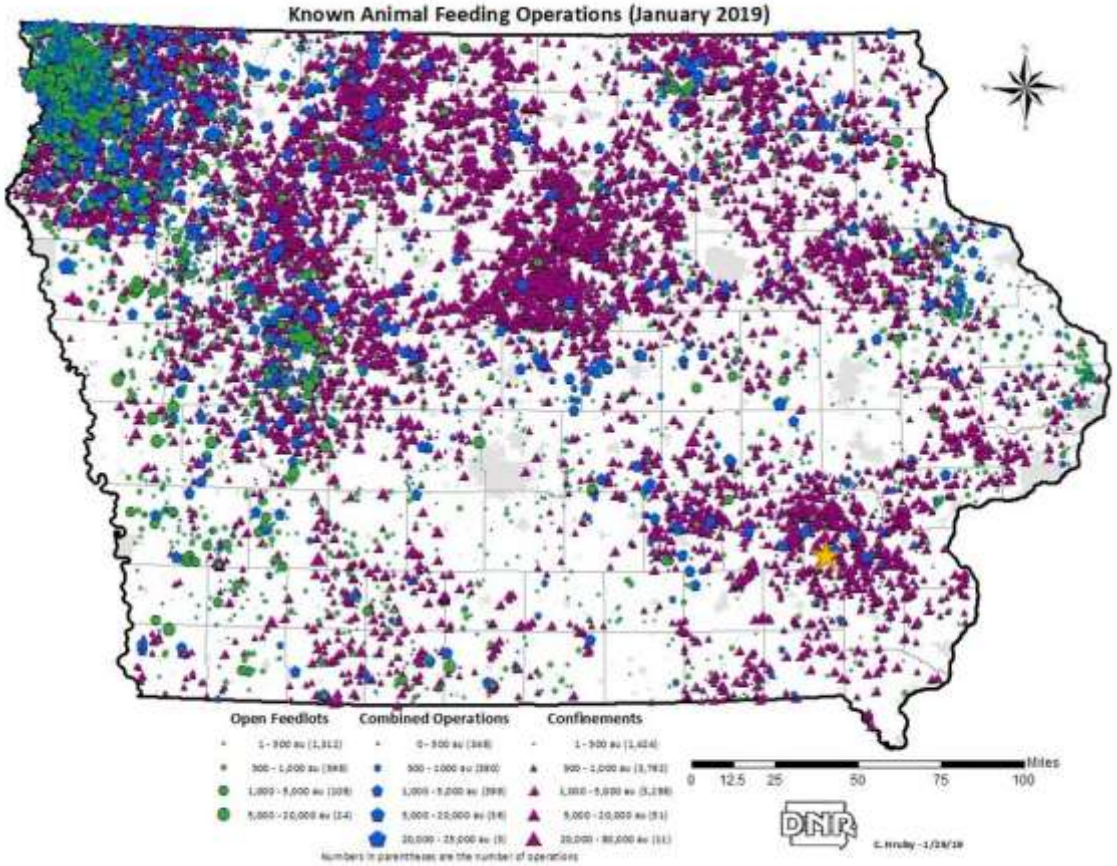
Cost to remove nitrogen using BMPs: $2-$10/pound

Average statewide load: 600 million lbs

45% reduction = 270 million lbs/year

$540M to $2.7B/year

How Do You Overcome Structural Drivers to Bad Water Quality?




Boyer


Skunk River Flats WMA
Skunk

What has happened to Iowa Ag since 1970?

- Loss of Crop Diversity
- Concentration of Livestock
- Decouple Livestock and Crop Production
- Huge increase in Hogs and Chickens
- Loss of Cattle—especially on pasture
- Fewer Farmers farming more land

Can farm a lot of acres in with an 8-10 week time commitment
Average age of Iowa farmer now is about 60

2018

Driverless tractor technology debuts at Farm Progress Show

Autonomous Tractors

One possible solution

More Diverse Farming Systems

Marsden Long Term Rotation Study-ISU

Matt Liebman

Corn/Soybean/Oat/Alfalfa/Alfalfa vs Corn/Soybean
N fertilizer use 91% lower
Herbicide use 97% lower
Weed biomass similar
Soybean sudden death syndrome much lower

Soil health is better
Tile nitrate 57% lower
Soil erosion 50% lower
Fossil Fuel use 60% lower
Net returns similar (revenue lower but input costs also lower)

More Work

Diverse systems usually require cattle

What do we want our production system to look like?

Commerce

Nutrition?

Regulation

Regulation

Pros:	**Cons:**
Inexpensive to taxpayer	Enforcement
Establishes water quality standards	No incentive to do better than the minimum
Applies to everybody	Politics

Chris Jones Five

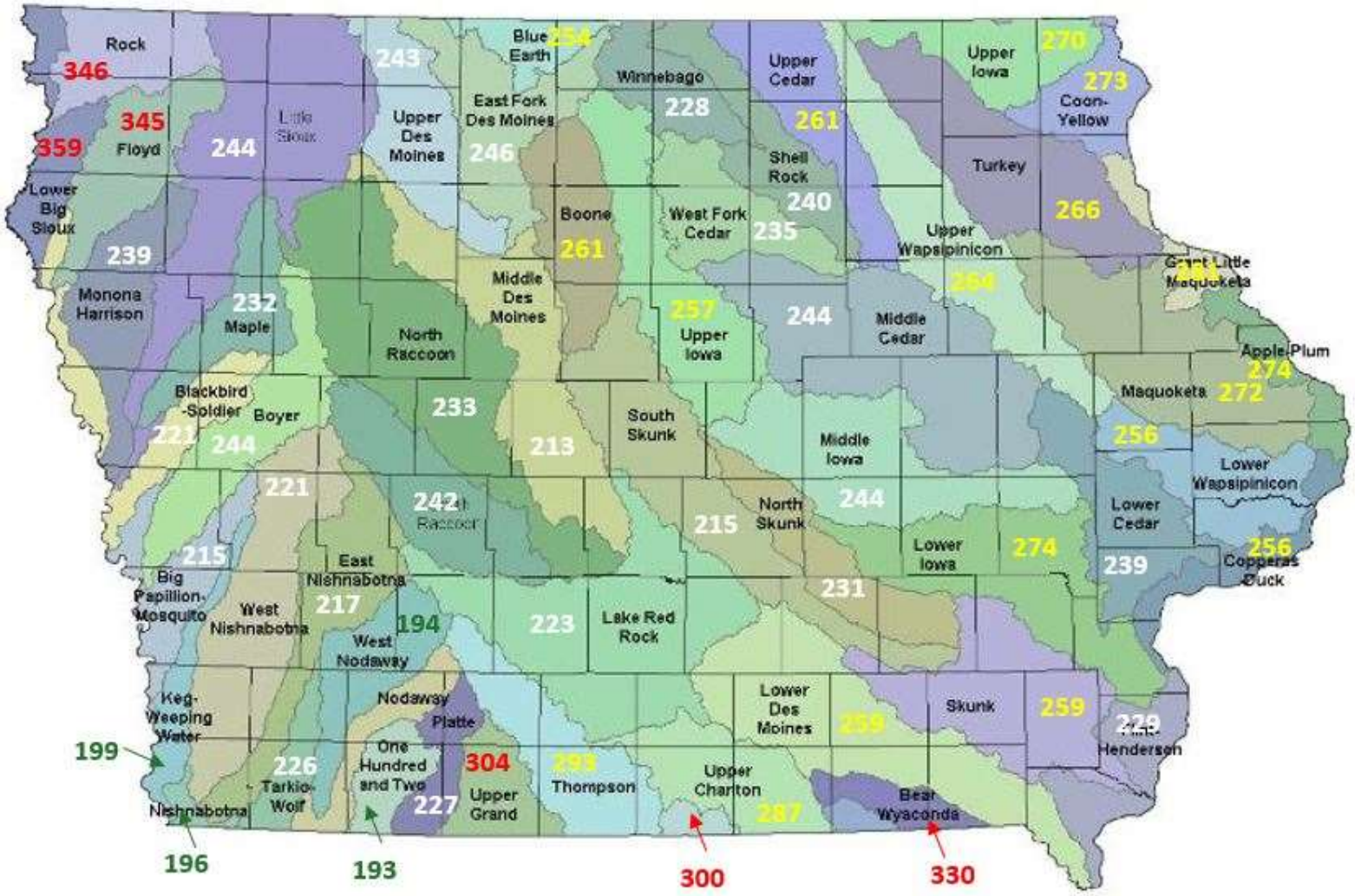
No manure on snow or frozen ground

Ban Fall Tillage

Ban Cropping in 2-year Flood Plain

Require farmers to adhere to Iowa State N rate recommendations

Rewrite the Master Matrix Livestock Regulations



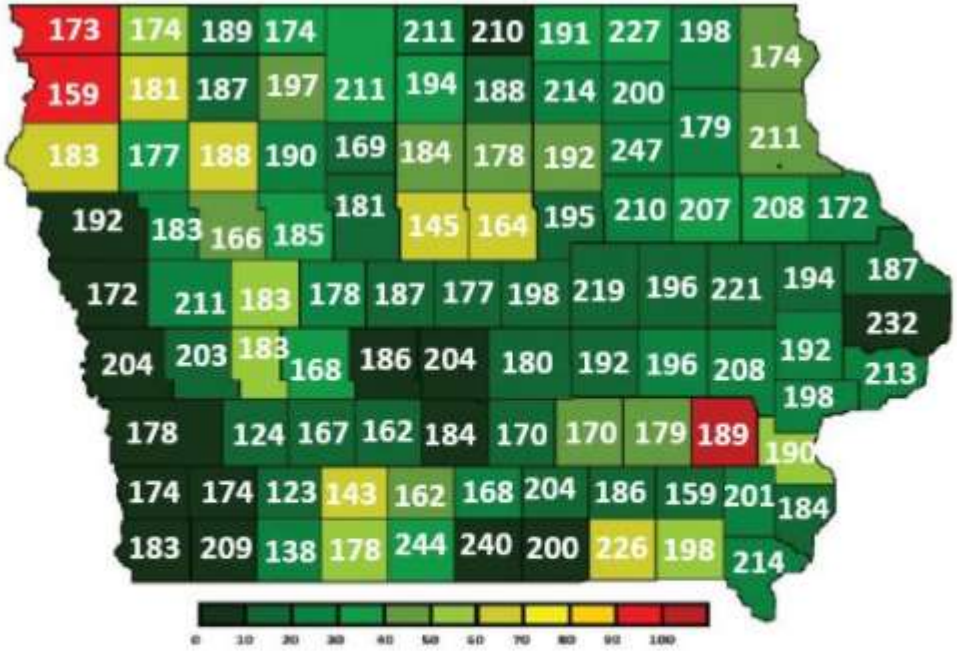


Fig. 6. The county's color indicates the available manure N relative to crop needs (%). For example, Lyon County in far northwest Iowa has enough manure to meet nearly 100% of the crop needs. The white number is the amount of N commercial fertilizer being sold in the county per corn acre.

Map credit: Dan Anderson, ISU

The county's color indicates the available manure P relative to crop needs (%). For example, Lyon County in far northwest Iowa has enough manure to meet nearly 100% of the crop needs. The white number is the amount of P commercial fertilizer being sold in the county per corn acre.

Map credit: Dan Anderson, ISU

Input management costs taxpayer $0

Rework Federal Farm Programs

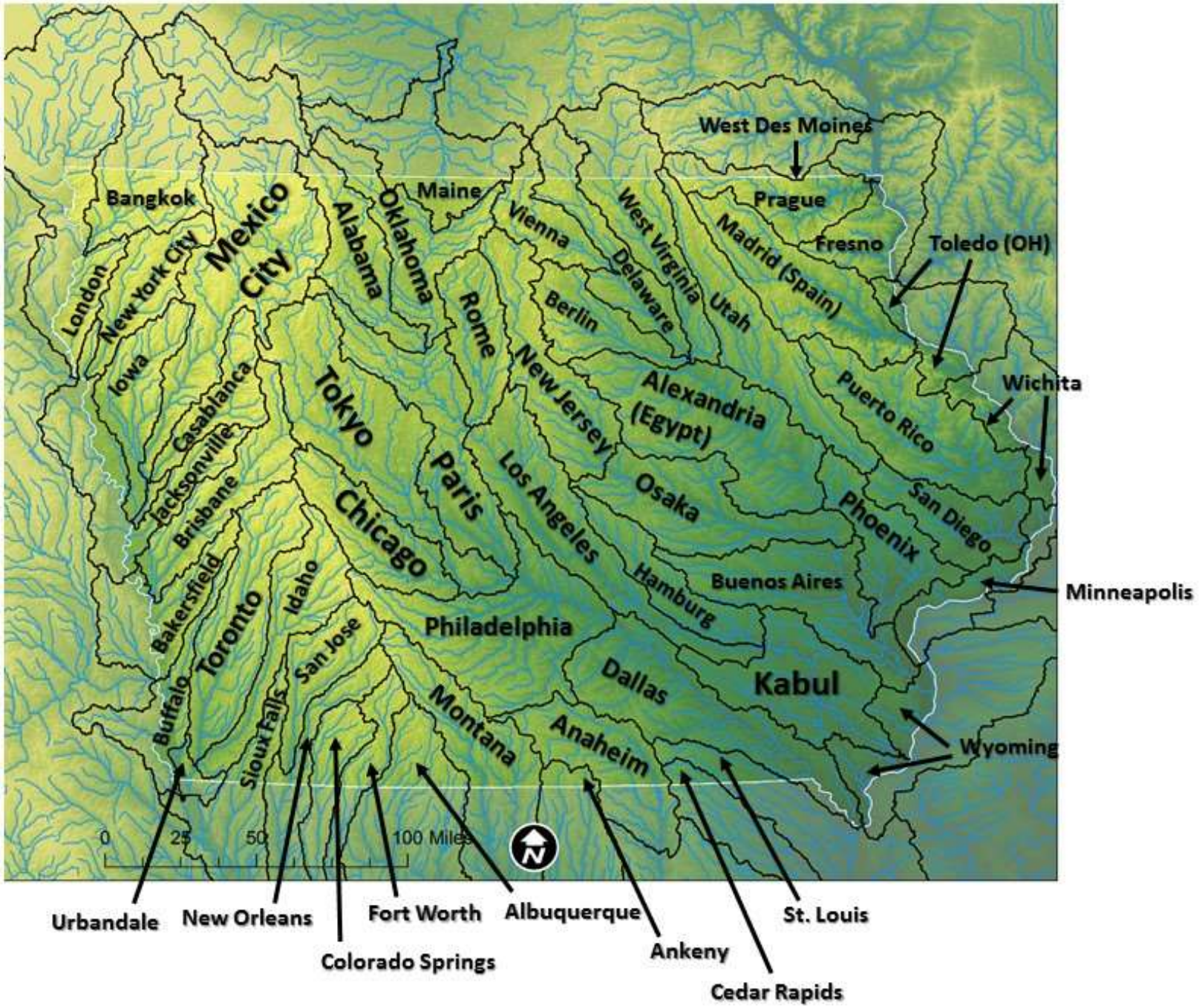
What can you do?


DUMP NO WASTE
DRAINS TO STREAM

Use Low or No Phosphorus

Grassroots

Demand elected leaders address water quality


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