A Proven Regulatory Strategy for Nutrient Removal at Water Resource Recovery Facilities

NEWEA Boston

January 22, 2024

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Grant@GrantTechSolutions.com

Four State Funded WWRF Nutrient Optimization Programs

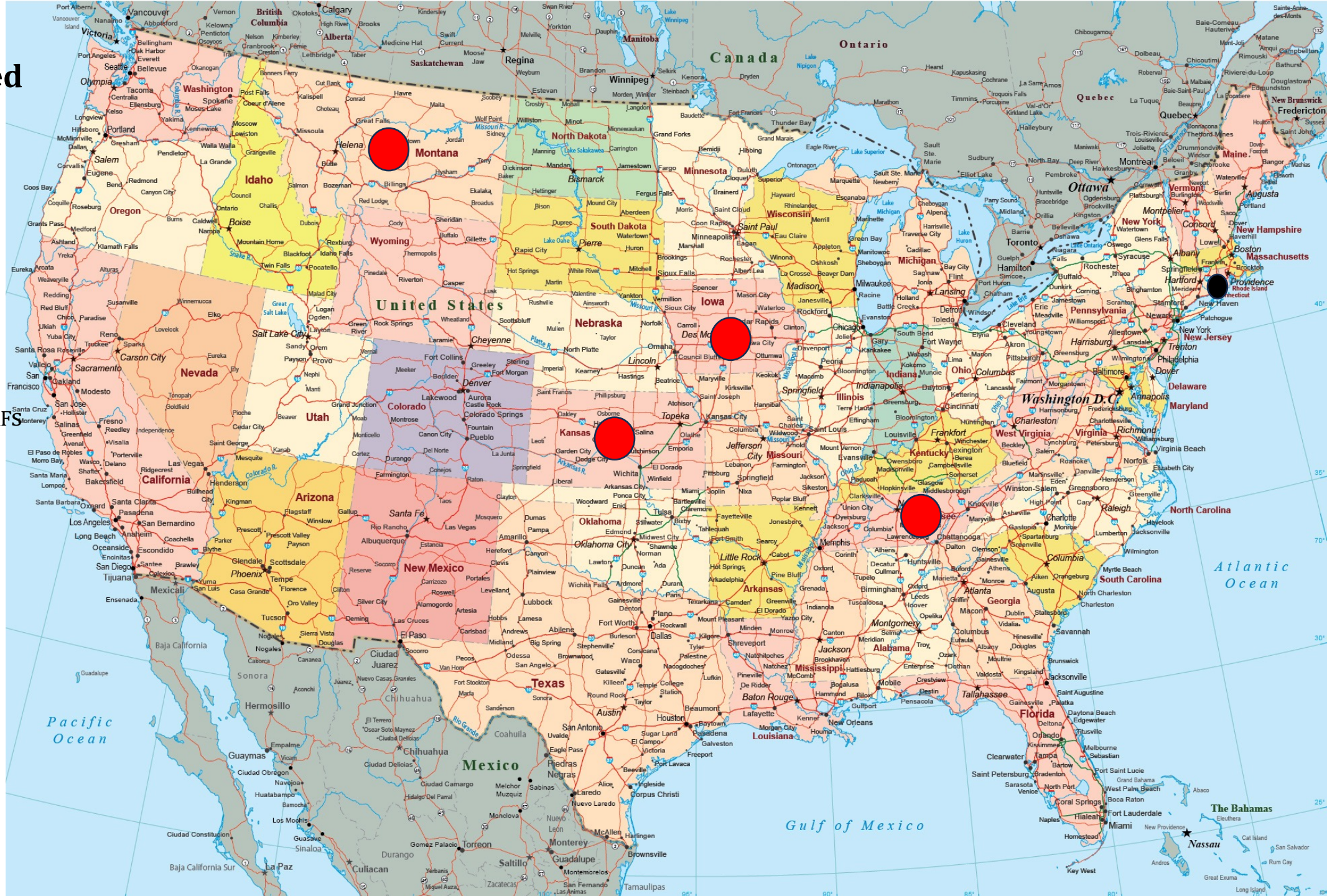
Montana 32 WWRFs

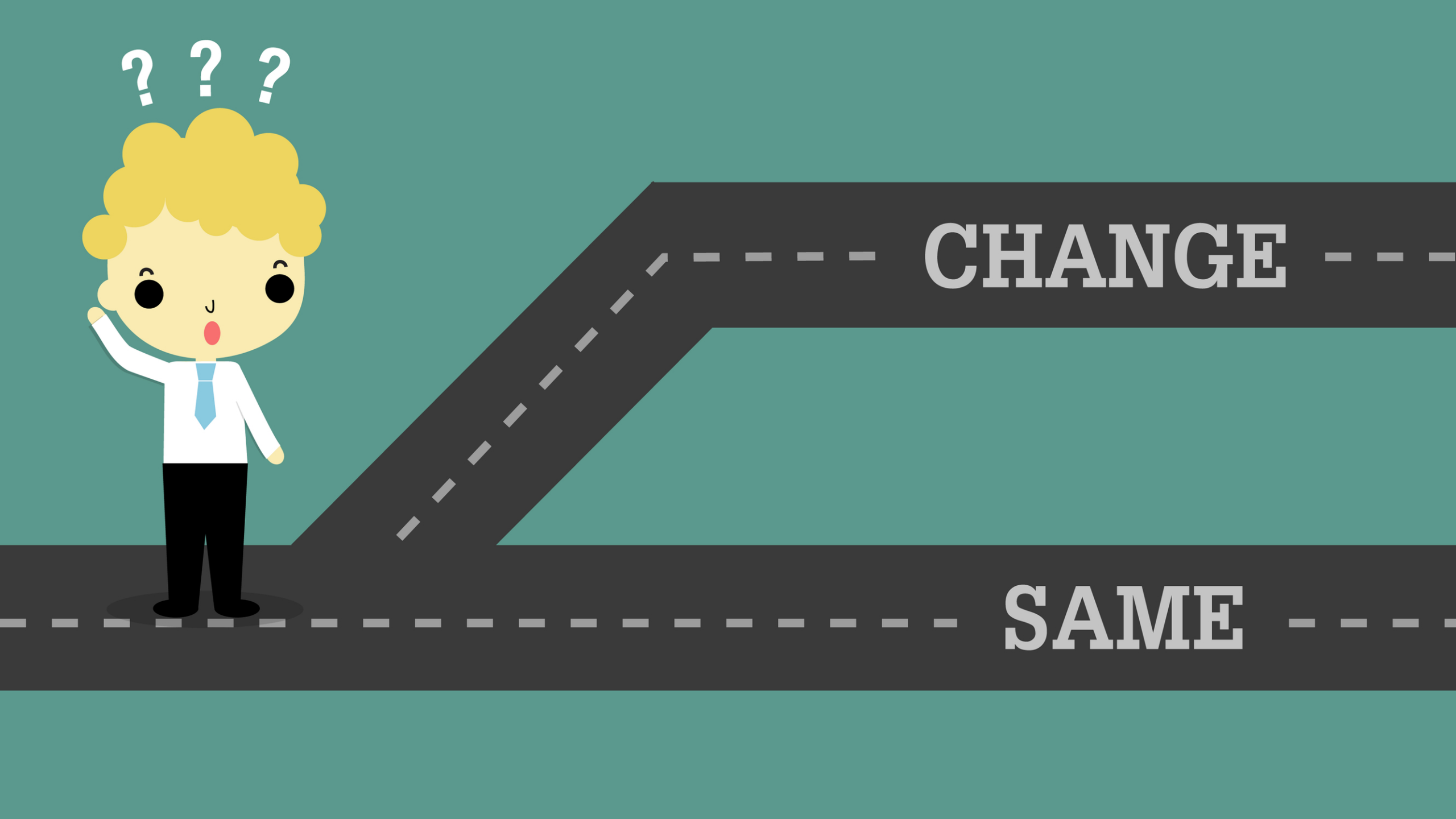
Kansas 73 WWRFs

Tennessee 21 WWRFs

Iowa 19 WWRFs

145 WWRFs




? ? ?
CHANGE
SAME

PROVEN REGULATORY STRATEGY

Before writing permit limits ...

Free **Operator Training** (in-class &/or webinar)

Free **WRRF Site Visits** (state regulators & consultant) ...

(a) review historical data

(b) discuss N&P removal science

(c) suggest optimization strategies

(d) listen to operator experiences / plant limitations

(e) select a lets-try-this strategy

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Free **Post-Visit Support** ...

(a) written step-by-step recommendations with monitoring protocols & process control targets
(b) ongoing support (in-plant and remote) including (in some cases) loaner field testing instruments

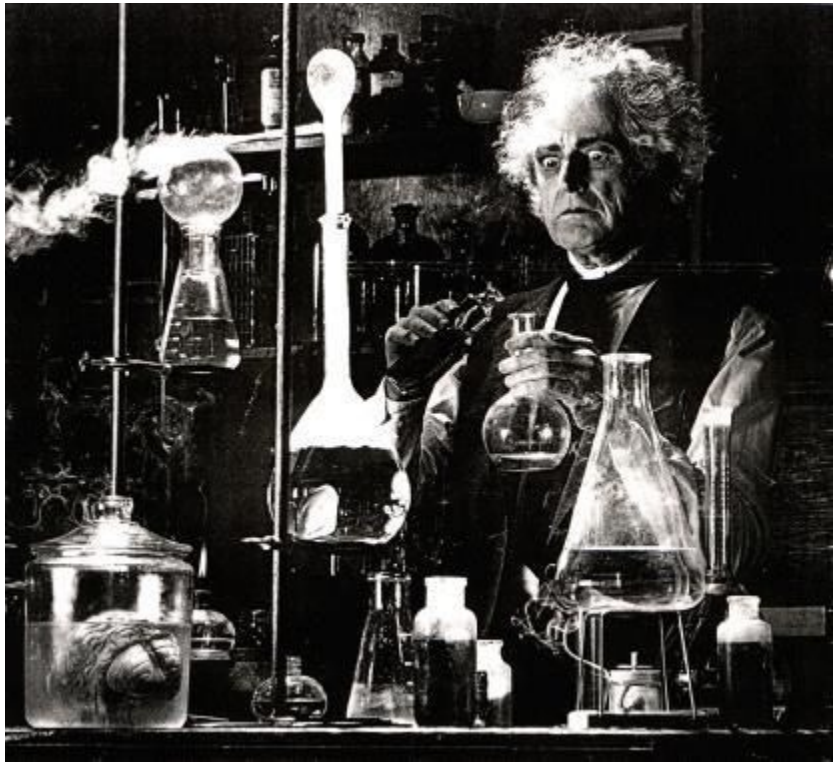
The Science behind Optimization:
Create the Five Habitats that Support Nitrogen and Phosphorus Removal

Nitrogen Removal

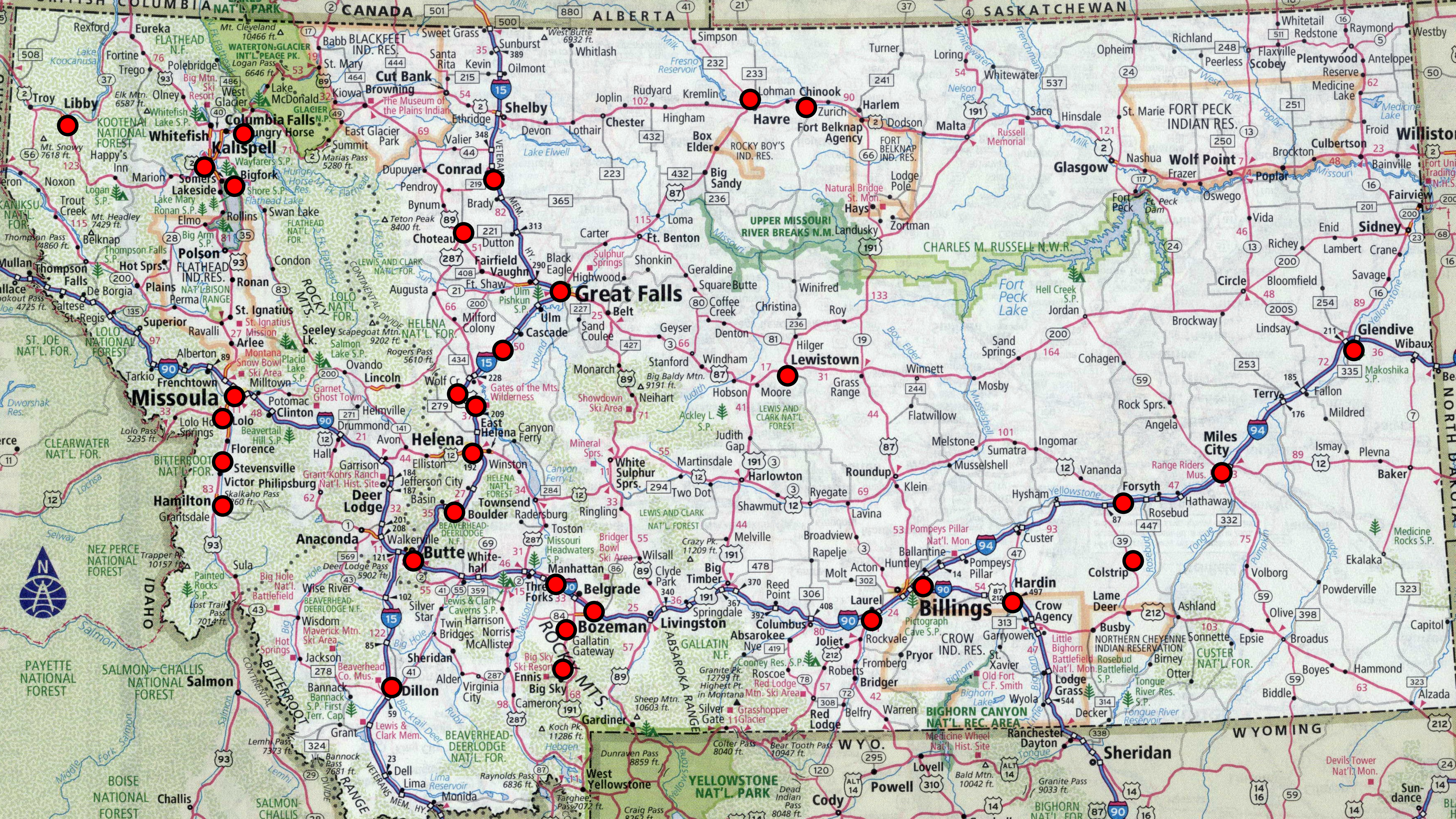
1. Oxygen-Rich / BOD-Poor Environment for Converting Ammonia to Nitrate
2. Oxygen-Poor / BOD-Rich Environment for Converting Nitrate to Nitrogen Gas

Phosphorus Removal

3. BOD-Rich Septic Environment for Creating VFAs
4. VFA-Rich Septic Environment to Energize PAOs
5. Oxygen-Rich / Moderate BOD Environment for Growing PAOs




MONTANA


CANADA
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Lolo
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Hamilton
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East Helena
Boulder
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Harlem
Malta
Glasgow
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Lewistown
Roundup
Harlowton
White Sulphur Sprs.
Circle
Jordan
Baker
Ekalaka
Broadus
Lame Deer
Crow Agency
Sheridan
Cody
Powell
West Yellowstone
YELLOWSTONE NAT'L. PARK
GLACIER NAT'L. PARK
CHARLES M. RUSSELL N.W.R.
UPPER MISSOURI RIVER BREAKS N.M.
FLATHEAD IND. RES.
BLACKFEET IND. RES.
FORT PECK INDIAN RES.
FORT BELKNAP IND. RES.
ROCKY BOY'S IND. RES.
CROW IND. RES.
NORTHERN CHEYENNE INDIAN RESERVATION
BIGHORN CANYON NAT'L. REC. AREA
CUSTER NAT'L. FOR.
GALLATIN N.F.
HELENA NAT'L. FOR.
LOLO NAT'L. FOR.
BITTERROOT NAT'L. FOR.
KOOTENAI NATIONAL FOREST
FLATHEAD N.F.
LEWIS AND CLARK NAT'L. FOREST
BEAVERHEAD-DEERLODGE NAT'L. FOR.
ROCKY MTS.
ABSAROKA RANGE
BITTERROOT RANGE

August 11, 2022

Low-Cost Nutrient Removal in Montana

Final Report

DEQ Montana Department of Environmental Quality

"Overall, ***18 of 20 facilities (90%) that were optimized, but not upgraded to further reduce nutrients realized a reduction in discharge of nitrogen and/or phosphorus*** to Montana's waters.

The reductions were significant - ***127 tons per year of nitrogen*** and ***19 tons per year of phosphorus***."

Conrad, Montana

(0.5 MGD Extended Aeration)

Nitrogen

Before: 30 mg/L

After: 8 mg/L

Phosphorus

Before: 3.0 mg/L

After: 0.5 mg/L

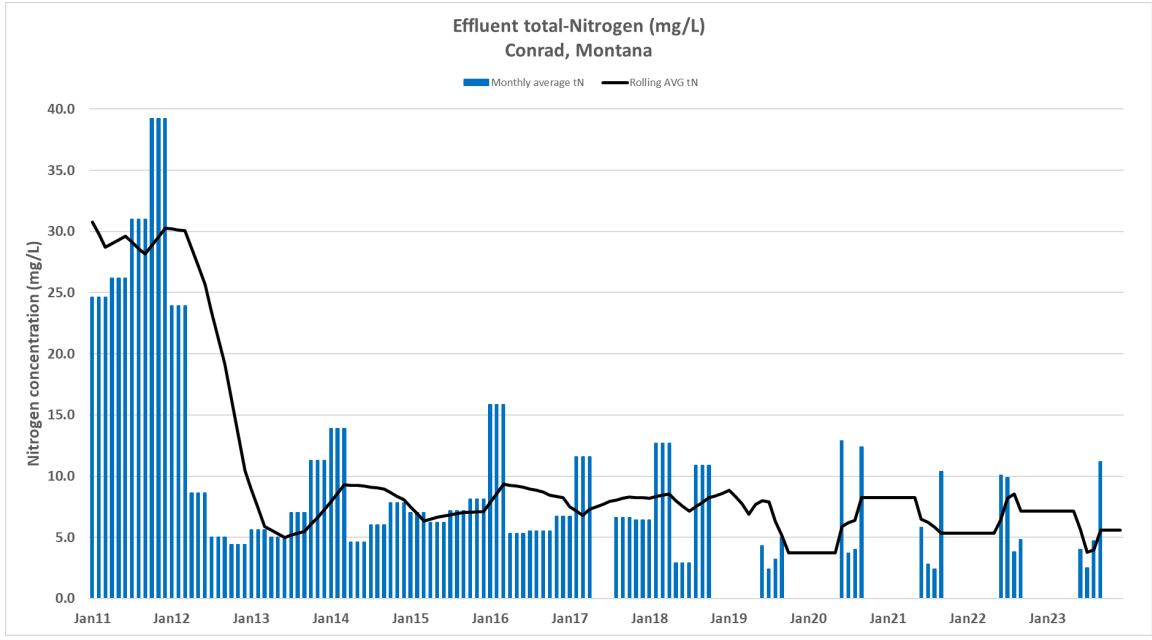
Costs / Savings

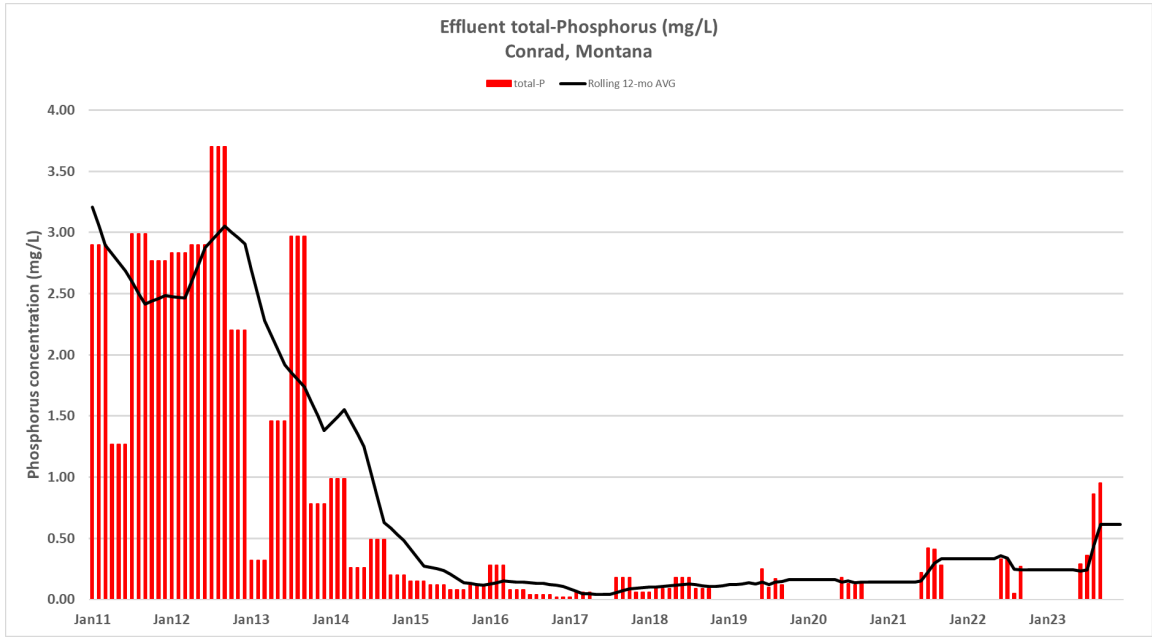
$1,500 spent on field testing equipment

Sustainable

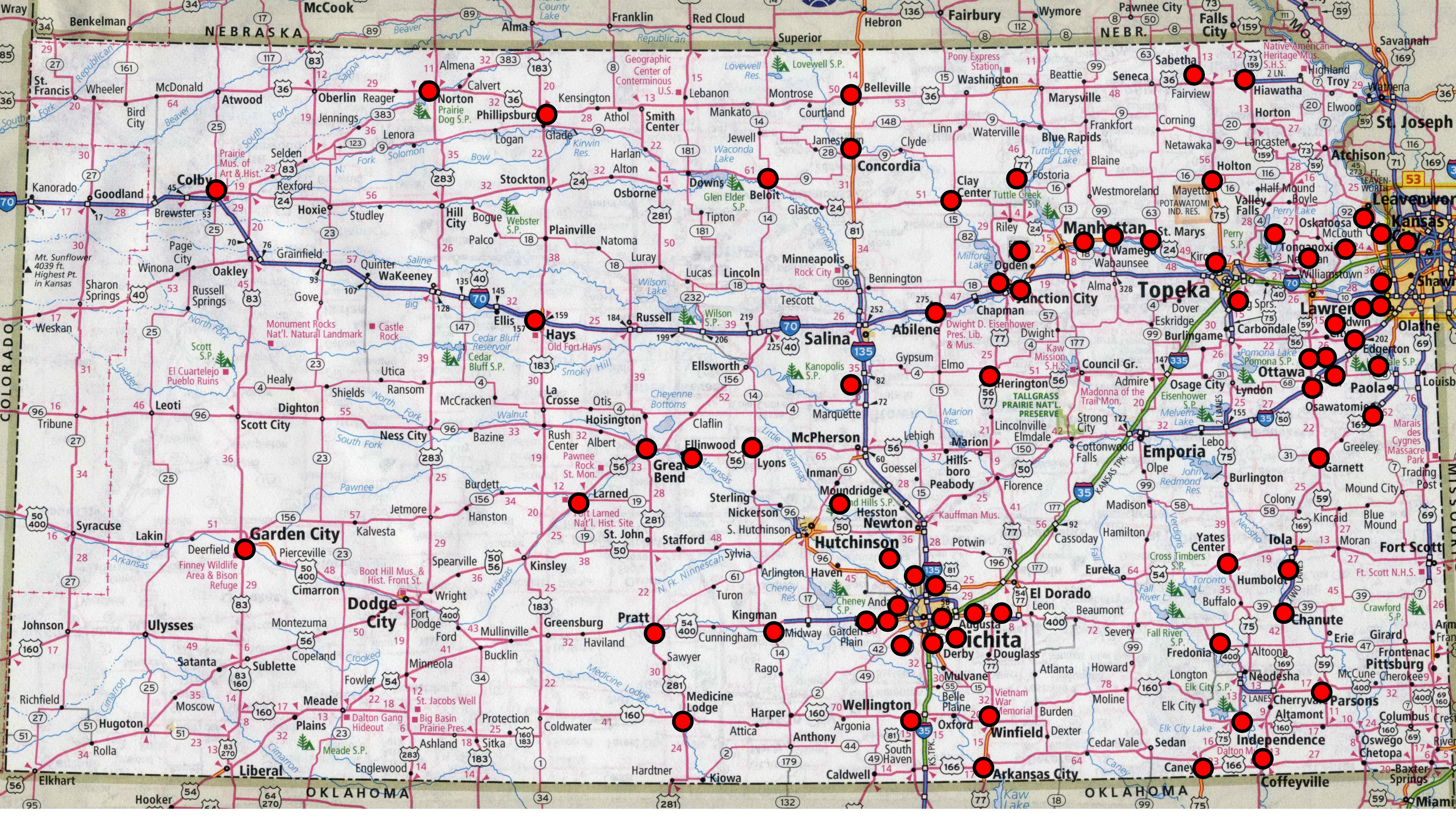
No new construction

Less electricity is used






KANSAS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Russell
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Great Bend
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Lakin
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Meade
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Caney
Howard
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Cedar Vale
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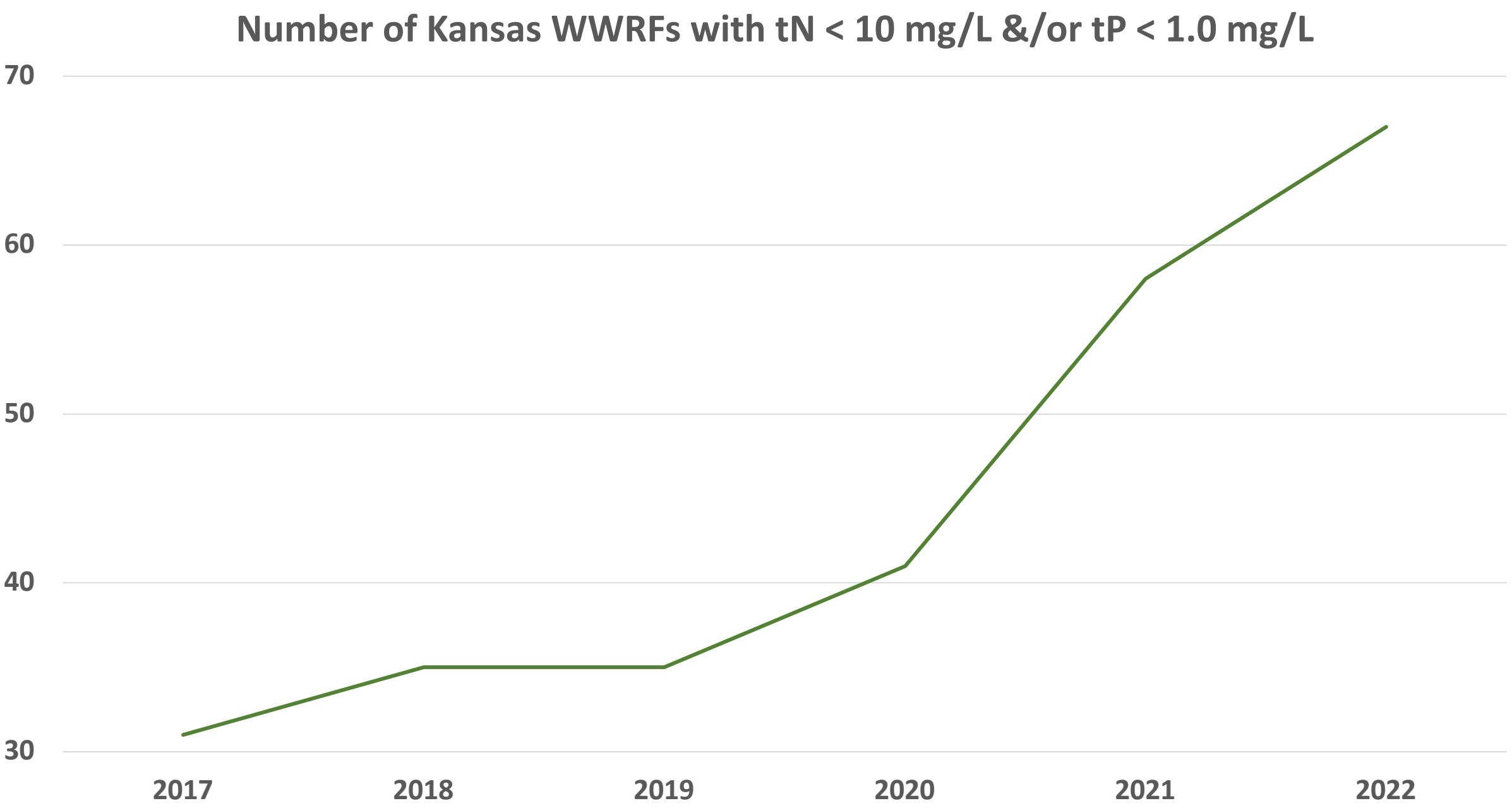
Cherryvale
Altamont
Oswego
Chetopa
Columbus
Baxter Springs
Erie
Mound City
Blue Mound
Moran
Yates Center
Toronto
Madison
Hamilton
Cassoday
Kiowa
Hardtner
Mt. Sunflower 4039 ft. Highest Pt. in Kansas
Dwight D. Eisenhower Pres. Lib. & Mus.
Monument Rocks Nat'l. Natural Landmark
Geographic Center of Conterminous U.S.
Tuttle Creek Lake
Milford Lake
Wilson Lake
Kanopolis S.P.
Cheney Res.
Cedar Bluff Reservoir
Perry Lake
Pomona Lake
Melvern Lake
Elk City Lake
Arkansas
Smoky Hill
Solomon
Republican
Saline
Cimarron
Neosho
Verdigris
Medicine Lodge
Walnut
Pawnee


Number of Kansas WWRFs with tN < 10 mg/L &/or tP < 1.0 mg/L
70
60
50
40
30
2017
2018
2019
2020
2021
2022


2nd St
Great Bend
Sewage Treatment

Great Bend, Kansas

(3.6 MGD Oxidation Ditch)

Nitrogen

Before: 12 mg/L

After: 5 mg/L

Phosphorus

Before: 2.5 mg/L

After: 0.6 mg/L

Costs / Savings

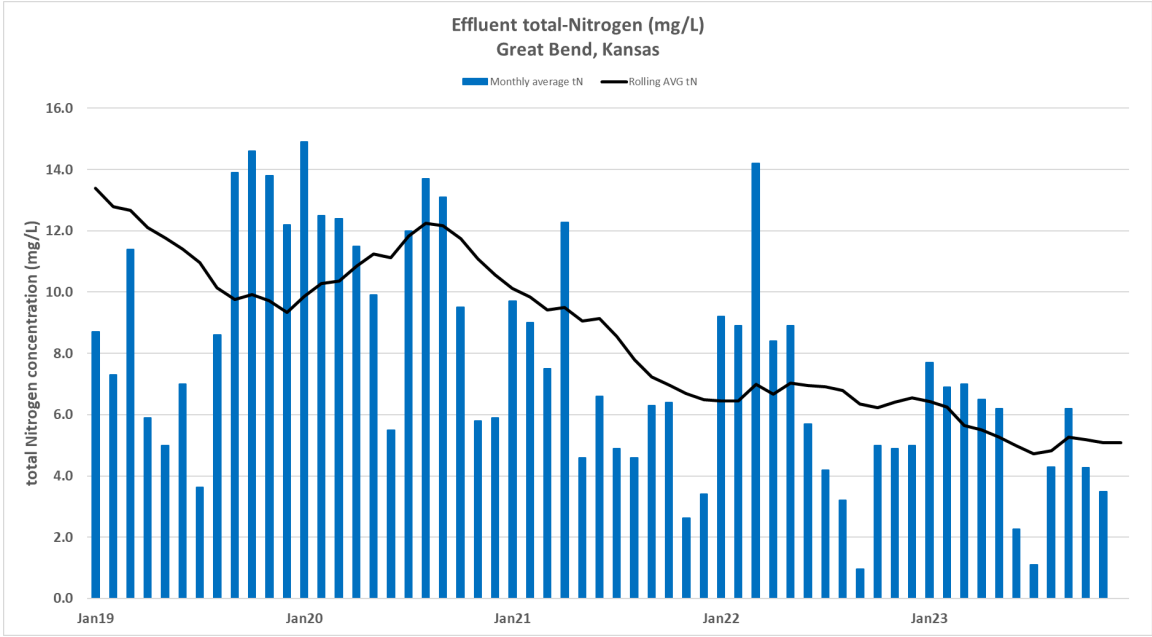
$50K spent on VFDs & SCADA programming

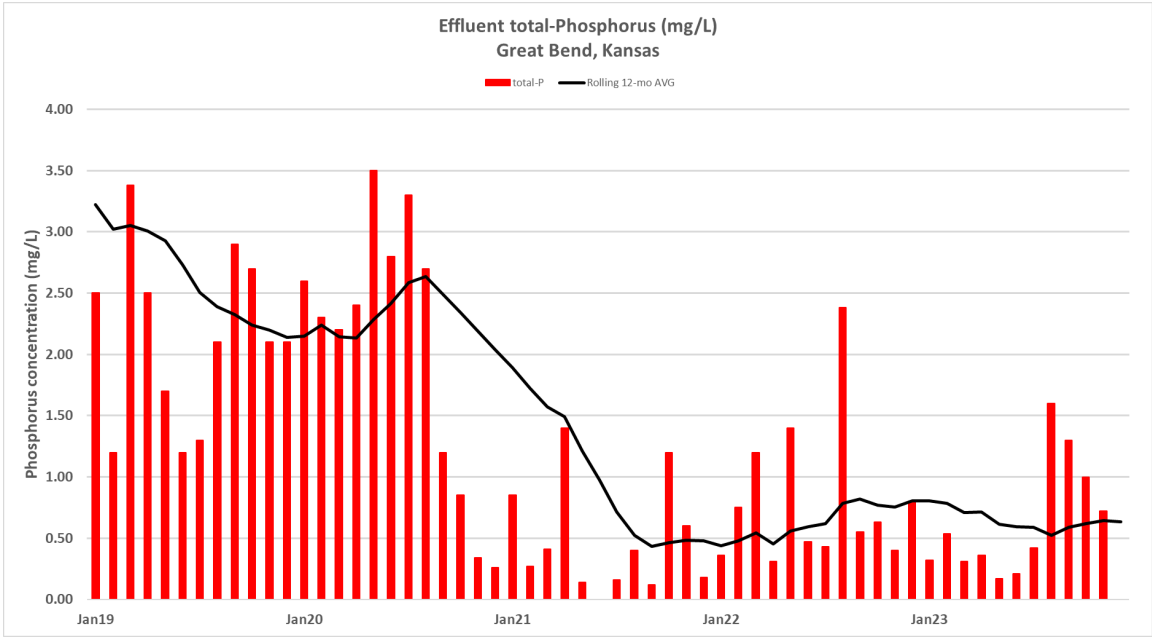
$6 million facility upgrade no longer necessary

Sustainable

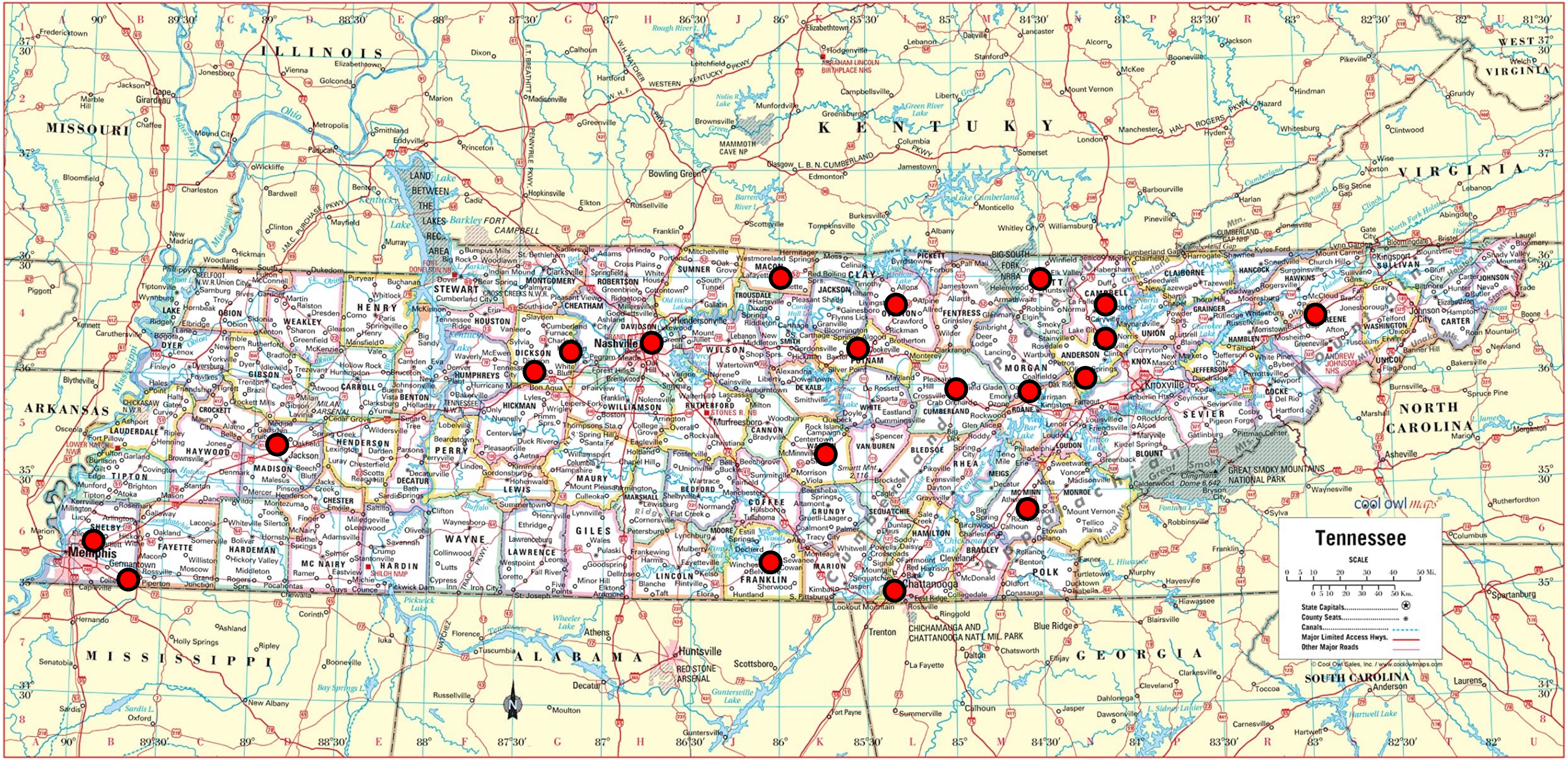
No new construction

Less electricity is used






TENNESSEE



Tennessee
SCALE
State Capitals
County Seats
Canals
Major Limited Access Hwys.
Other Major Roads
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cool owl maps
ILLINOIS
MISSOURI
KENTUCKY
VIRGINIA
WEST VIRGINIA
ARKANSAS
MISSISSIPPI
ALABAMA
GEORGIA
NORTH CAROLINA
SOUTH CAROLINA
Nashville
Memphis
Knoxville
Chattanooga
Jackson
GREAT SMOKY MOUNTAINS NATIONAL PARK
LAND BETWEEN THE LAKES REC. AREA
MAMMOTH CAVE NP
Huntsville
Bowling Green
Asheville

Cookeville, Tennessee

(15 MGD Oxidation Ditch)

Nitrogen

Before: 15 mg/L

After: 5 mg/L ... 10 mg/L

Phosphorus

Before: 1.75 mg/L

After: 1.25 mg/L ... 1.75 mg/L

Costs / Savings

$10K spent on aeration timers & in-house lab equipment

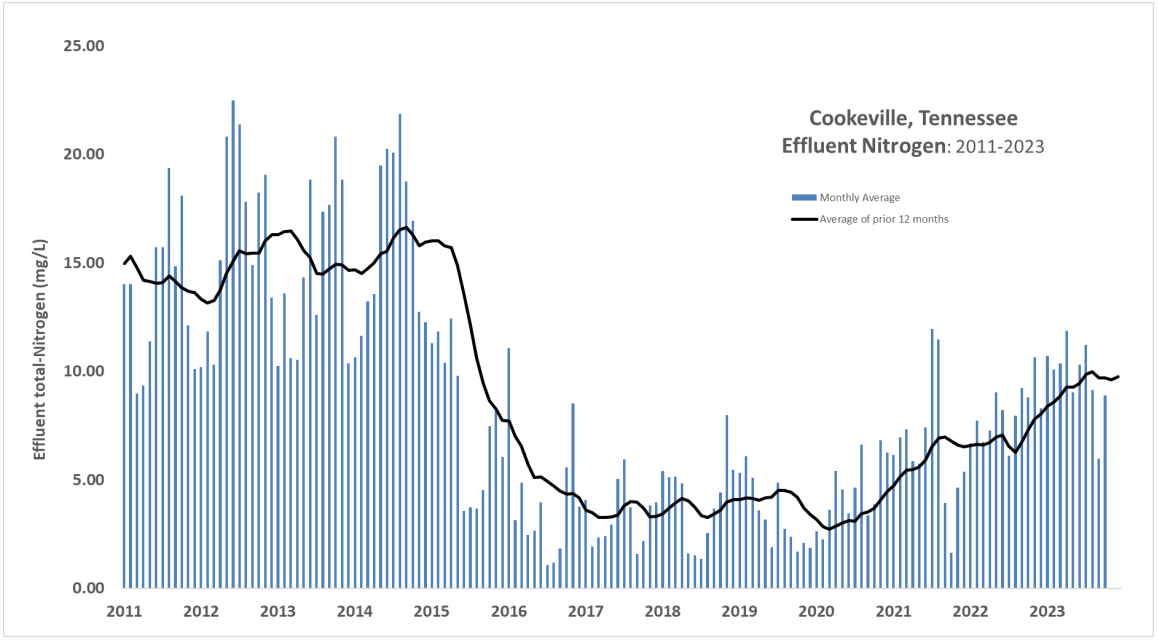
$250,000+ per year electrical savings

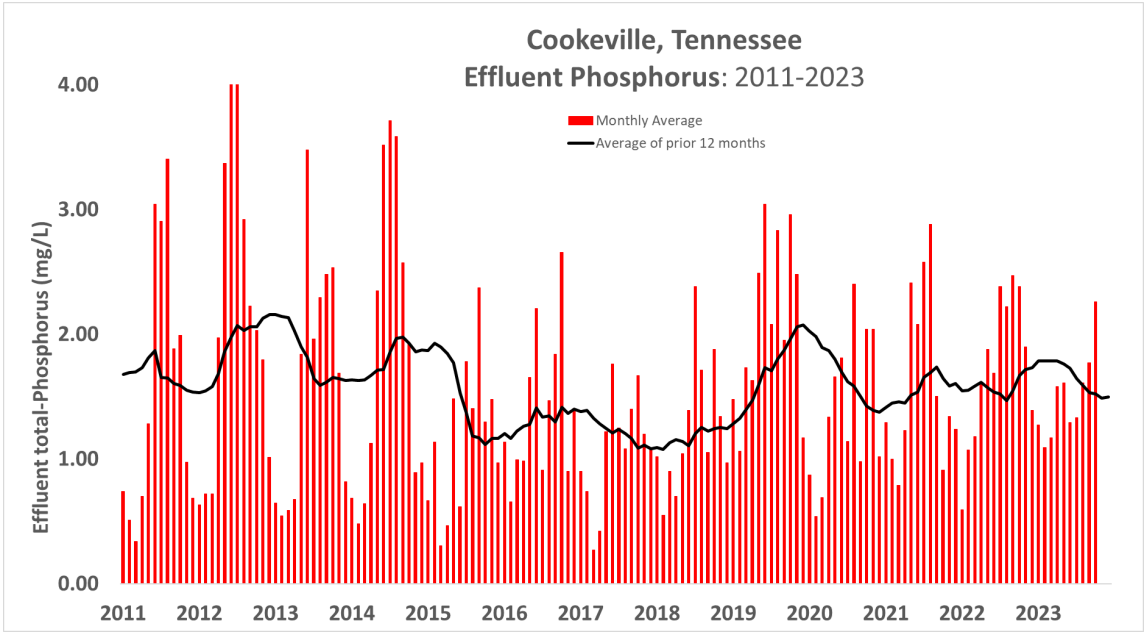
$4+ million facility upgrade no longer necessary

Sustainable

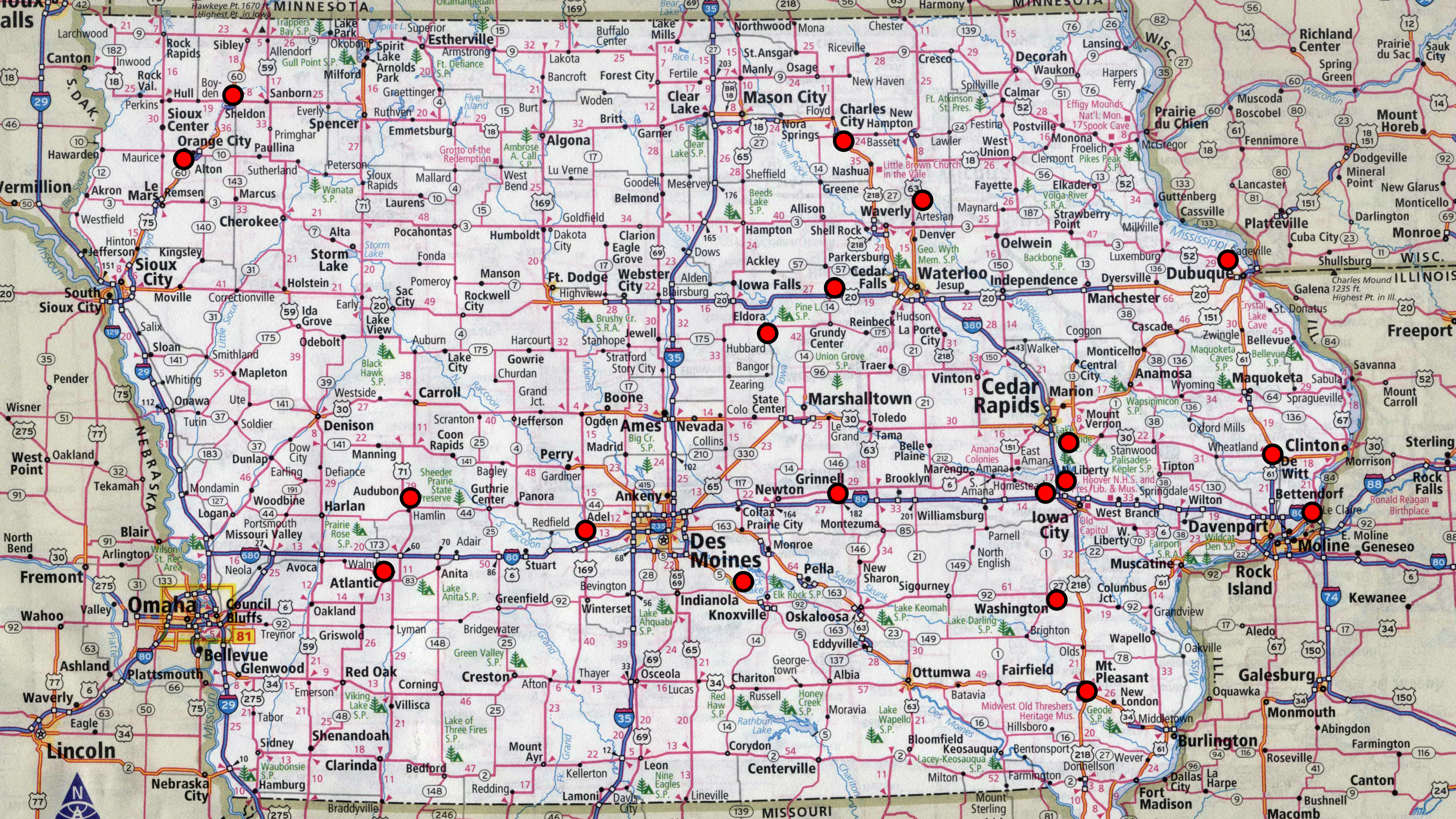
No new construction

Less electricity is used






IOWA


MINNESOTA
Hawkeye Pt. 1670 Highest Pt. in Iowa
S. DAK.
NEBRASKA
MISSOURI
WISC.
ILLINOIS
ILL.
Sioux Falls
Canton
Larchwood
Rock Rapids
Sibley
Inwood
Rock Val.
Hull
Boyden
Sheldon
Sanborn
Sioux Center
Orange City
Paullina
Primghar
Hawarden
Maurice
Alton
Sutherland
Akron
Le Mars
Remsen
Marcus
Cherokee
Westfield
Hinton
Kingsley
Sioux City
South Sioux City
Moville
Correctionville
Holstein
Salix
Sloan
Smithland
Whiting
Mapleton
Onawa
Ute
Turin
Soldier
Pender
Wisner
West Point
Oakland
Tekamah
Blair
North Bend
Arlington
Fremont
Wahoo
Valley
Omaha
Council Bluffs
Bellevue
Glenwood
Plattsmouth
Ashland
Waverly
Eagle
Lincoln
Nebraska City
Hamburg
Sidney
Tabor
Shenandoah
Clarinda
Bedford
Red Oak
Emerson
Villisca
Corning
Creston
Afton
Mount Ayr
Lenox
Griswold
Oakland
Treynor
Avoca
Neola
Missouri Valley
Logan
Woodbine
Harlan
Dunlap
Earling
Denison
Manning
Dow City
Defiance
Audubon
Hamlin
Atlantic
Anita
Walnut
Adair
Stuart
Greenfield
Guthrie Center
Panora
Redfield
Adel
Bagley
Coon Rapids
Scranton
Carroll
Westside
Lake City
Auburn
Sac City
Early
Lake View
Ida Grove
Odebolt
Storm Lake
Alta
Pocahontas
Fonda
Pomeroy
Manson
Rockwell City
Gowrie
Churdan
Harcourt
Jefferson
Grand Jct.
Perry
Gardiner
Boone
Ogden
Ames
Nevada
Madrid
Ankeny
Des Moines
Indianola
Winterset
Knoxville
Pella
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Montezuma
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Collins
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Humboldt
Dakota City
Eagle Grove
Clarion
Belmond
Goldfield
Algona
Emmetsburg
Estherville
Spirit Lake
Arnolds Park
Okoboji
Milford
Spencer
Graettinger
Ruthven
Burt
Bancroft
Lakota
Buffalo Center
Forest City
Lake Mills
Northwood
Mona
Fertile
Clear Lake
Mason City
Manly
Osage
Nora Springs
Charles City
New Hampton
Cresco
Decorah
Waukon
Calmar
Postville
West Union
Fayette
Nashua
Waverly
Greene
Allison
Hampton
Sheffield
Iowa Falls
Ackley
Eldora
Hubbard
Grundy Center
Parkersburg
Cedar Falls
Waterloo
Jesup
Independence
Oelwein
Manchester
Dubuque
Cascade
Monticello
Anamosa
Cedar Rapids
Marion
Mount Vernon
Belle Plaine
Marengo
Amana
Iowa City
Williamsburg
Sigourney
Washington
Wellman
Muscatine
Davenport
Clinton
De Witt
Maquoketa
Bellevue
Tipton
West Branch
Wilton
Columbus Jct.
Mt. Pleasant
Fairfield
Ottumwa
Albia
Chariton
Osceola
Centerville
Corydon
Lamoni
Bloomfield
Keosauqua
Farmington
Donnellson
Fort Madison
Keokuk
Burlington
Wapello
Moline
Rock Island
Galesburg
Kewanee
Geneseo
Sterling
Freeport
Galena
Platteville
Prairie du Chien
McGregor
Lansing
Harpers Ferry
Guttenberg
Dyersville
Manchester
Quad Cities
Effigy Mounds Nat'l. Mon.
Ft. Atkinson St. Pres.
Little Brown Church in the Vale
Grotto of the Redemption
Hoover N.H.S. and Pres./Lib. & Mus.
Amana Colonies
Midwest Old Threshers Heritage Mus.
Crystal Lake Cave
Ronald Reagan Birthplace
Charles Mound 1235 ft. Highest Pt. in Ill.

East Nishnabotna River

City of Atlantic
Animal Shelter

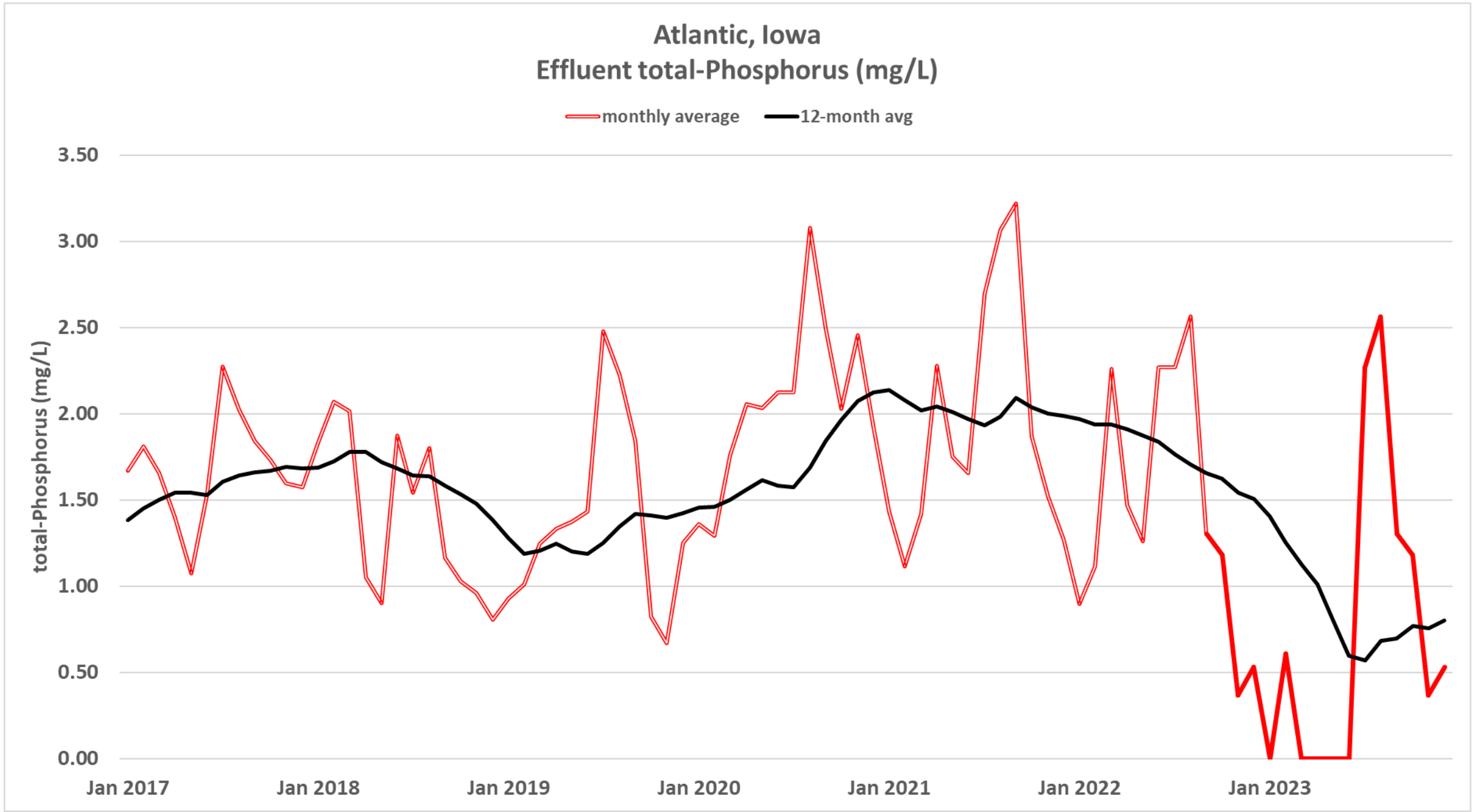
City of Atlantic WPCD

Sunnyside Ln

Sunnyside Ln

Sun

otna River


Atlantic, Iowa
Effluent total-Phosphorus (mg/L)
monthly average
12-month avg
total-Phosphorus (mg/L)
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Jan 2017
Jan 2018
Jan 2019
Jan 2020
Jan 2021
Jan 2022
Jan 2023

Results / Big Picture:

Up to one-third of municipalities embraced optimization

Statewide 25% Reductions in tN & tP (Montana)

Twice as many WRRFs meeting nutrient targets (Kansas)

Optimized WRRFs ...

- 50% reduction in effluent total-Nitrogen, up to 90%
- 50% reduction in effluent total-Phosphorus, up to 90%
- Energy savings as creating optimal habitats for tN & tP involves less aeration
- Facility Upgrade savings

Making for ...

- Cleaner water sooner
- Sustainably

Cost:

Less than $6,000 per WRRF

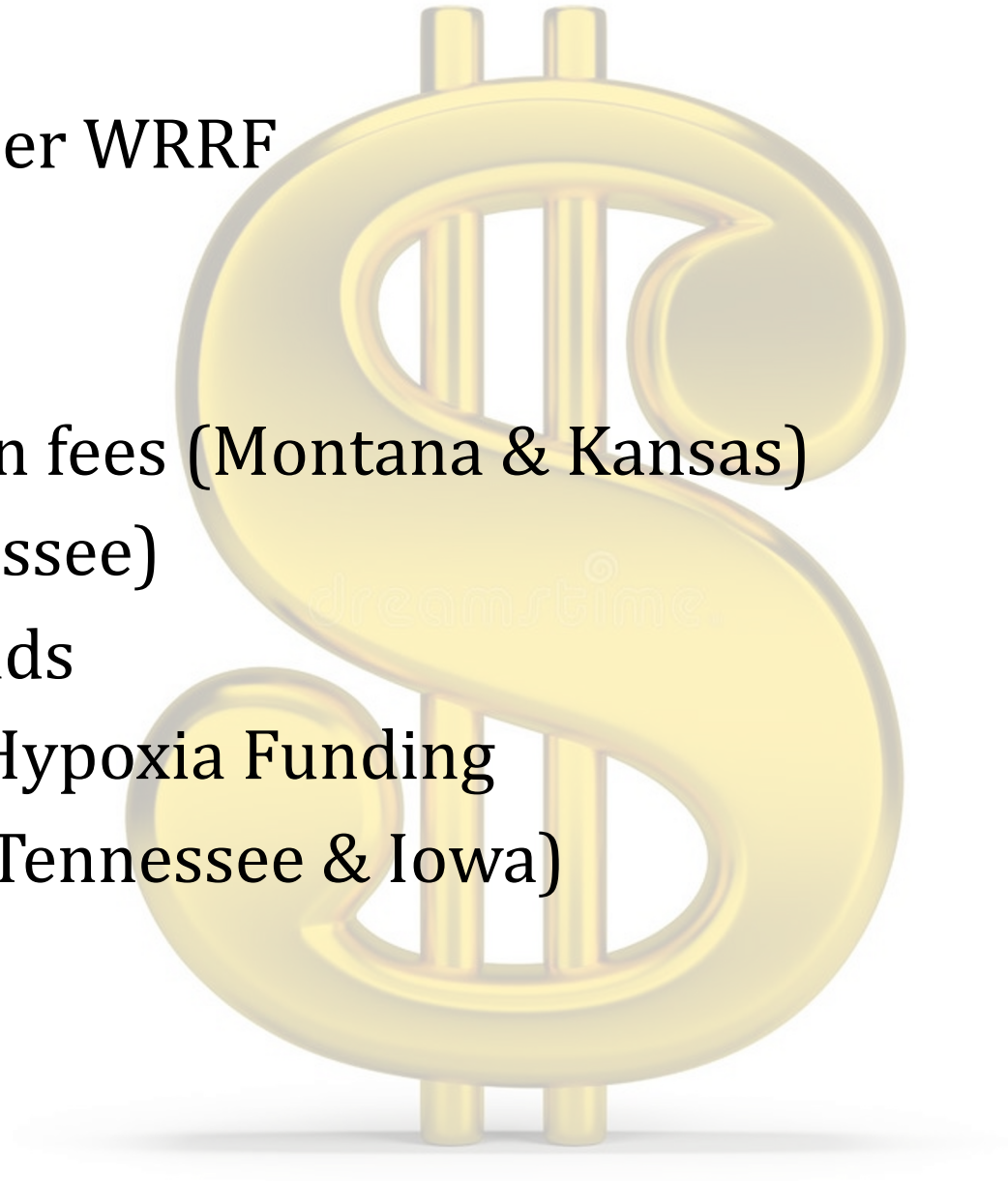
Funding Sources:

SRF Administration fees (Montana & Kansas)

EPA Grants (Tennessee)

- 604(b) SRF Funds
- Gulf of Mexico Hypoxia Funding

State Legislature (Tennessee & Iowa)



Regulatory take-aways

Before permit limits are written, Encourage Optimization by ...

Supporting Experimentation vs. Review and Approve Formal Plan

Discretionary Enforcement including "Safe Harbor" letters vs. Enhanced Enforcement

Reward Good Performance vs. Lower Permit Limits "because you can"

Regulatory Support makes for Clean Water

Grant Weaver
Grant@GrantTechSolutions.com

GRANT TECH
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Acknowledgements

MONTANA
Paul LaVigne (retired), Pete Boettcher (retired) & Josh Viall of ***Montana DEQ***
Keith Taut of ***City of Conrad***

KANSAS
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Nick Willis of ***Wichita State University***
Ruben Martin, Jason Cauley, James Gaunt & April Batts of ***City of Great Bend***

TENNESSEE
Sherry Wang (retired), Karina Bynum, & Jennifer Dodd of ***Tennessee DEC***
Tom Graham (retired) & John Buford of ***City of Cookeville***

IOWA
Adam Schnieders of ***Iowa DNR***
Craig Just & Maclaine Putney of ***University of Iowa***
Shane Metz of ***Iowa Rural Water***
Tim Snyder of ***City of Atlantic***

… and ***everyone who makes water clean!***