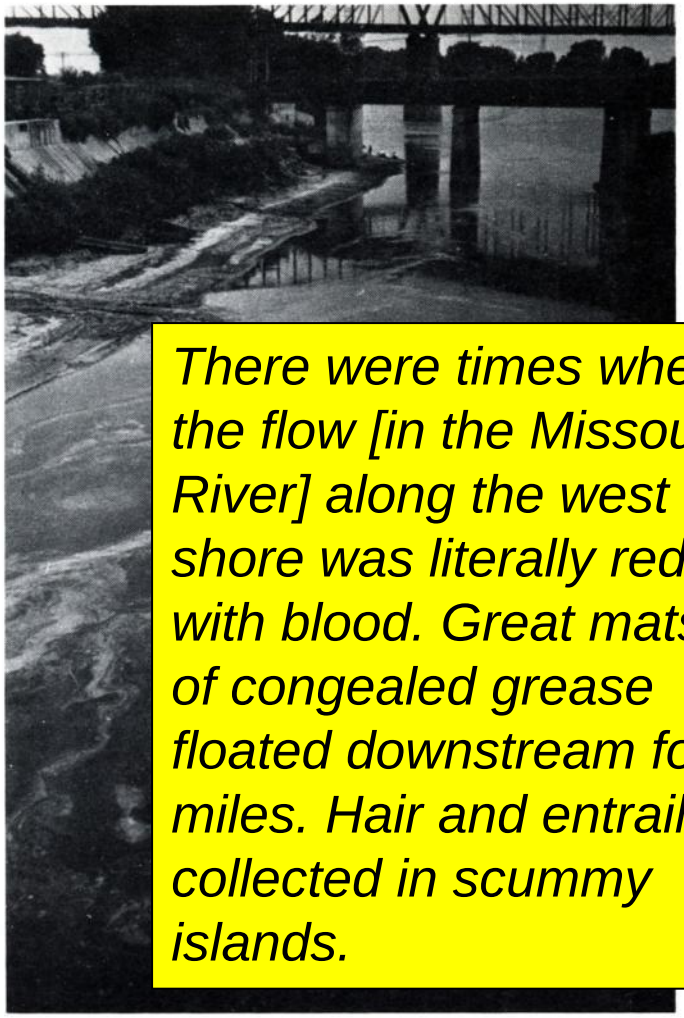
Iowa Point Source Nutrient Reduction Metrics: What We've Learned

May 3, 2023

When water quality was worse:



Packing house waste being discharged to the Floyd River in Sioux City, August 1952.

There were times when the flow [in the Missouri River] along the west shore was literally red with blood. Great mats of congealed grease floated downstream for miles. Hair and entrails collected in scummy islands.

Des Moines Register, November 19, 1969

Sewage Pre-Treatment Plant In Omaha Ends Bloody River

By a Staff Writer

OMAHA, NEB. — One of the worst pollution situations in the entire nation has been all but eliminated here with completion of a sewage pre-treatment plant for the huge Omaha livestock industry.

This city's stockyards and packing industry have been among the largest in the world since the mid-1950s. Since that time and before, all the waste — millions of gallons a day — has been dumped untreated into the Missouri River.

There were times when the flow along the west shore was literally red with blood. Great mats of congealed grease floated downstream for miles. Hair and entrails collected in scummy islands.

"The Worst"

"People who know have told me this was absolutely the worst pollution they have seen anywhere in the U.S.," says Carl Chloupek, area representative for the Federal Water Pollution Control Commission in Lincoln, Neb.

Now the bloody flow into the river has stopped, thanks to the unique pre-treatment plant which began its shakedown last week. The $5.5 million plant is expected to go into full operation later this month.

Federal efforts to end the flow of packinghouse wastes into the river began in 1956 — 13 years ago — Chloupek said. The river still is far from clean, he said, but Omaha passed a "real milestone" last week.

The City of Omaha still gives only primary treatment to its wastes, but has agreed in principle to construct secondary facilities, Chloupek said. No timetable has been established, he added.

Primary treatment removes sewage solids, about 35 per cent of the pollutants. Secondary treatment removes about 90 per cent.

Omaha's primary treatment plant went into operation only four years ago. Before that, it too dumped all its wastes untreated into the river.

As it was, Chloupek said, the city plant has been operating at only half of its capacity because, without pre-treatment, it was unable to handle the packinghouse wastes. So half of the plant has been idle for four years waiting for the packers to pre-treat their wastes.

This half was placed in operation for the first time last week, Chloupek said, when it began handling the effluent from the pre-treatment plant.

for retirement of $5.5 million in bonds sold for the construction of the plant and its operation.

The plant was designed and built by the Carver-Greenfield Corp. Kirkham, Michael & Associates were the consultants.

Omaha's primary treatment plant went into operation only four years ago [~1965]. Before that, it too dumped all its wastes untreated into the [Missouri] river.

Secondary
25 mg/l TN
4 mg/L TP

BNR
10 mg/l TN
1 mg/L TP

LOT
3 mg/l TN
0.05 mg/L TP

Who?

Focus on:

- **~100** major municipal wastewater treatment plants
- **~50** industries with biological treatment for process waste
- **Total of ~150 ----- (actual 161)**

Goal:

- To achieve BNR equivalent nutrient removal at each plant
  - **TN removal ~66%**
  - **TP removal ~75%**

Cost and Affordability

Estimated Costs for BNR Improvements for Muncipal Majors (Target Effluent TN = 10 mg/L, Target Effluent TP = 1 mg/L)

Treatment Type	# of Facilities	Combined Design AWW Flow (MGD)	Combined Annual Average Flow[1] (MGD)	Total Capital Cost ($M)	Total Annual O&M Cost ($M)	Total Present Worth Cost ($M)[2]	Total Annual Cost ($M)	$/1,000 gallons Treated[3]	Weighted Monthly Cost/Household[4]	Weighted % of MHI[4]
Activated Sludge	56	533	355	348	25	686	51	0.39	7.75	0.18%
Fixed Film	37	101	67	430	7	524	39	1.59	25.83	0.73%
Aerated Lagoon	9	11	8	110	3	147	11	3.92	85.16	2.13%
Totals	102	645	430	887	35	1,358	101	0.64	11.85[5]	0.29%[5]

Estimated Costs for BNR Improvements for all Industries with Biological Treatment (Target Effluent TN = 10 mg/L, Target Effluent TP = 1 mg/L)

Treatment Type	# of Facilities	Combined Design Flow (MGD)	Total Capital Cost ($M)	Total Annual O&M Cost ($M)	Total Present Worth Cost ($M)[1]	Total Annual Cost ($M)	$/1,000 gallons Treated[2]
Activated Sludge	20	44.2	29.3	2.0	56.1	4.2	0.26
Fixed Film	1	0.6	2.7	0.04	3.3	0.2	1.06
Aerated Lagoon	7	5.8	86.5	2.20	116.0	8.6	4.05
Totals	28	50.7	118.5	4.2	175.5	13.1	0.71

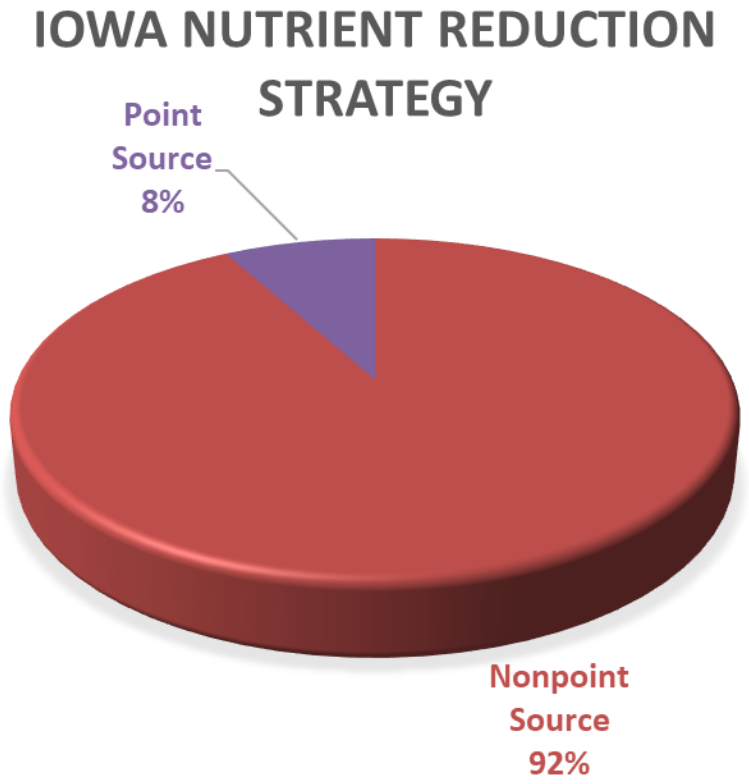
Total Present Worth Cost

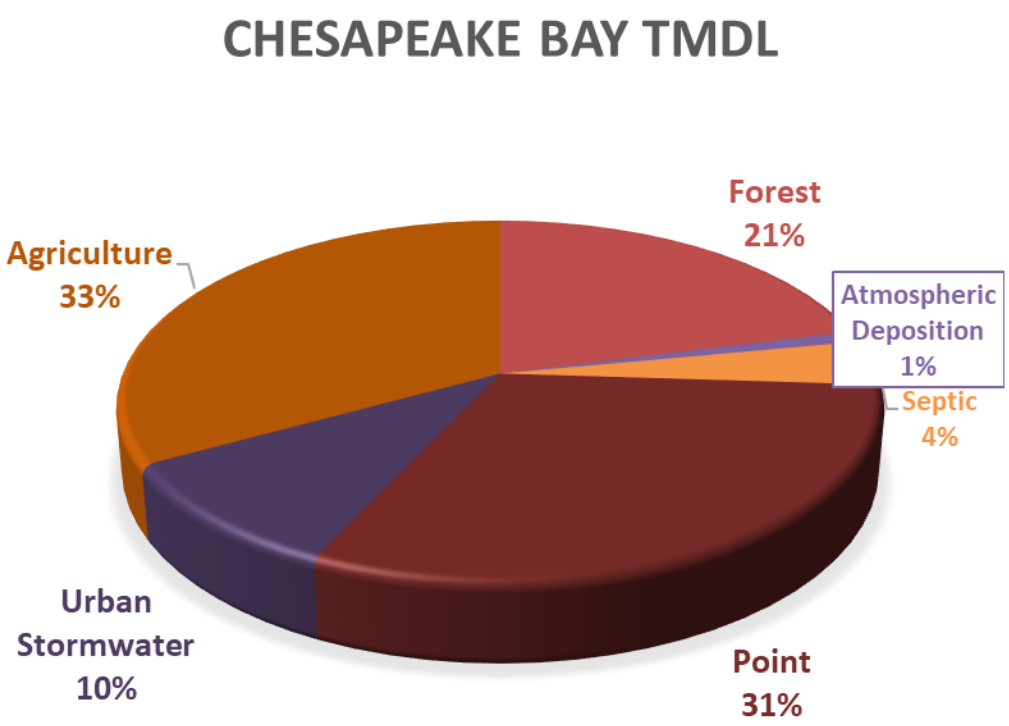
= 1.53 ($B)

Total Capital Cost

= 1.00 ($B)

NITROGEN MAKEUP IN IOWA





Source: Iowa Nutrient Reduction Strategy and Libra, R.D.,Wolter, C.F., and Langel, R.J. 2004. Nitrogen and Phosphorus Budgets for Iowa and Iowa Watersheds. Iowa Geological Survey Technical Information Series 47, 43p

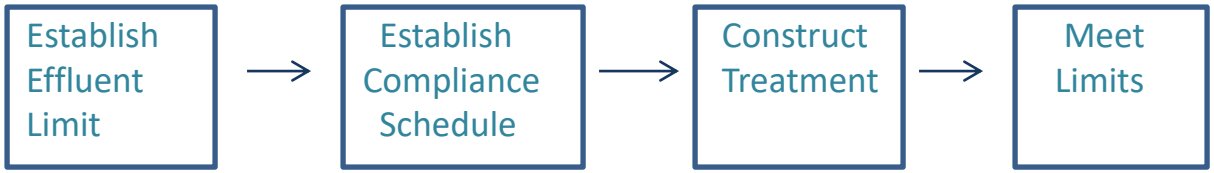
Point Source – Nonpoint Source Collaboration

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

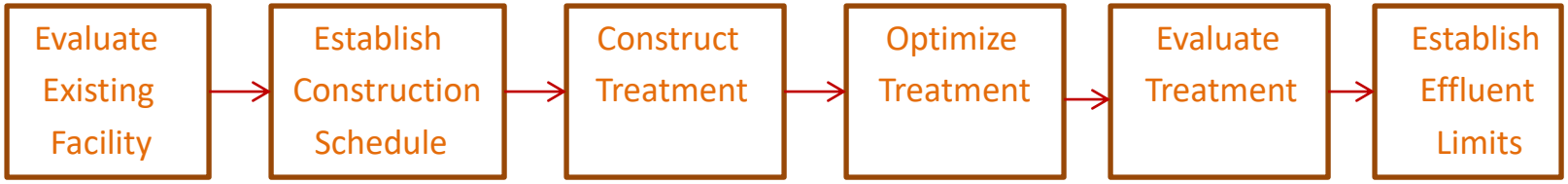
- Point sources
  - 4% reduction of statewide N load
  - 16% reduction of statewide P load

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

Normal Permitting Process



Nutrient Strategy Permitting Process



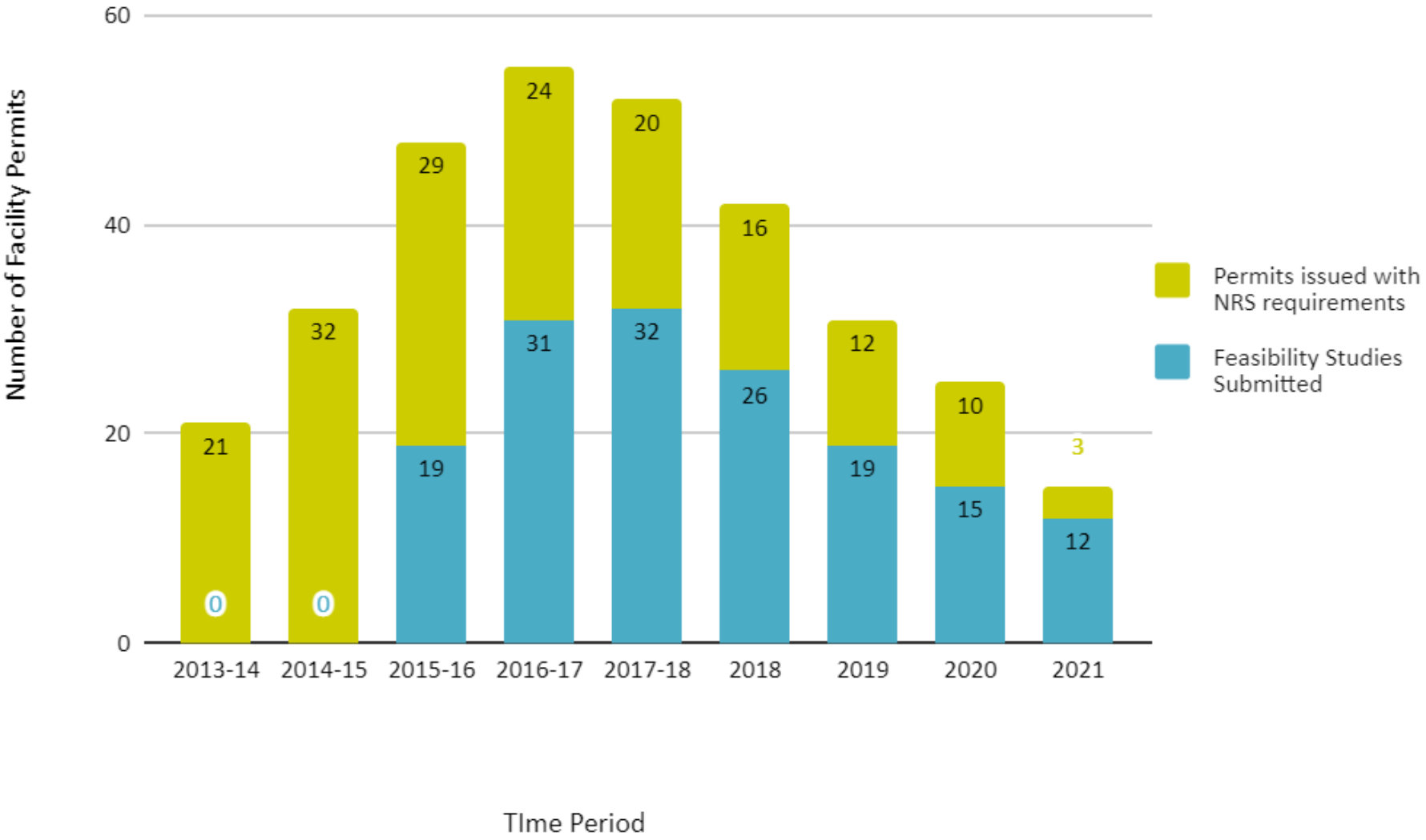
Time frame

2 years from permit issuance

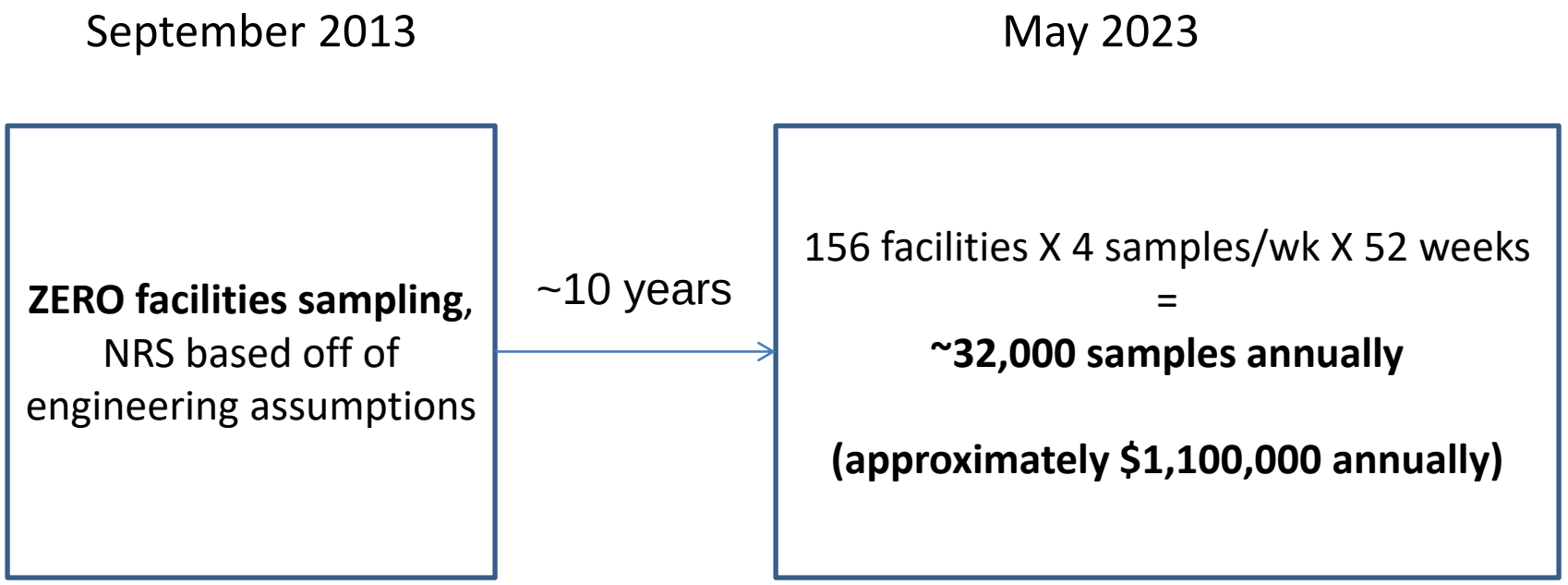
4.3 years for Cities to complete
3.4 years for Industries to complete

Total = 3.4 to 4.3 years from permit issuance

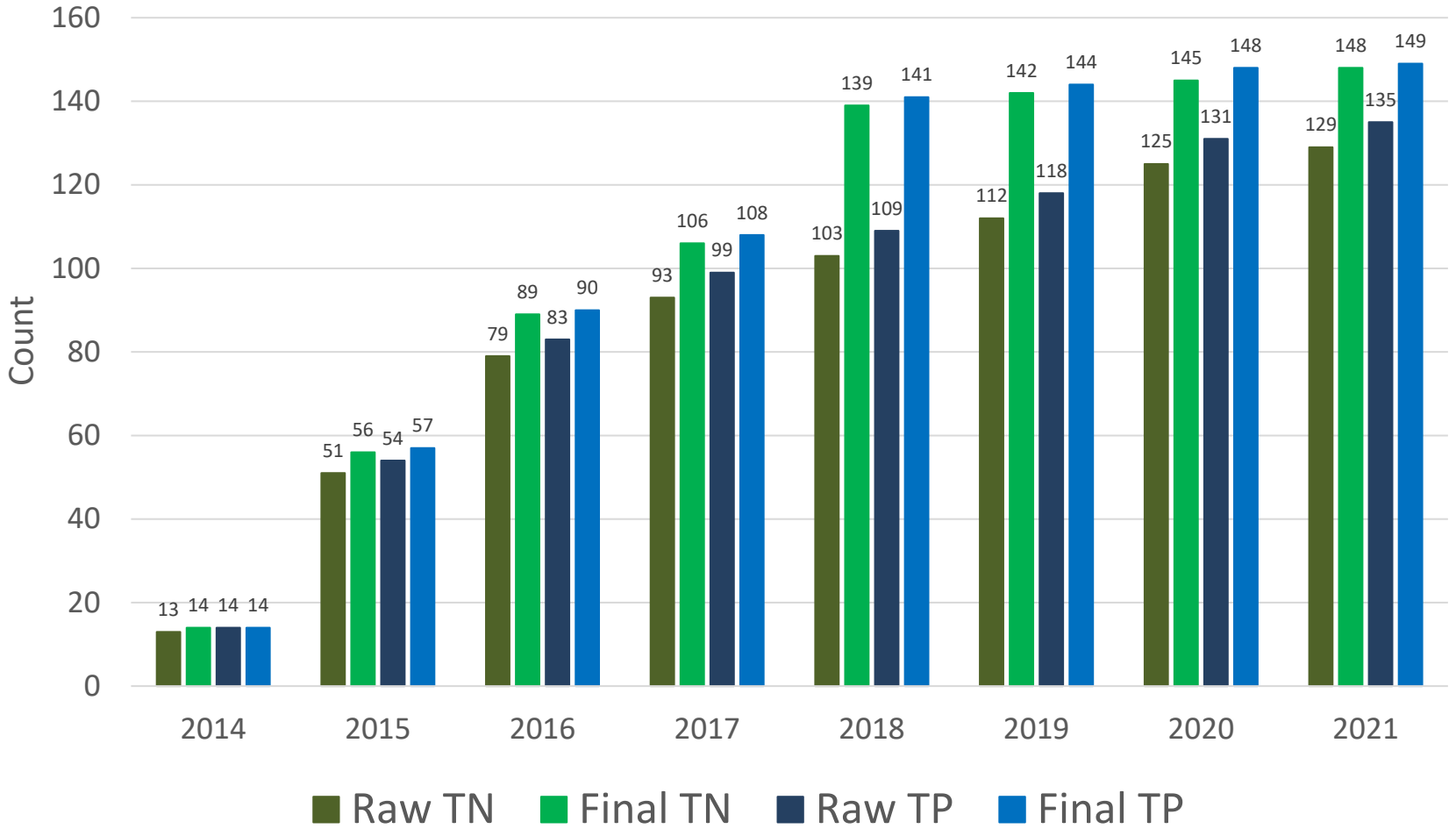
Annual Progress of Issuing Point Source Facility Permits
Note: Annual tracking cycle changed from fiscal year to calendar year in 2018



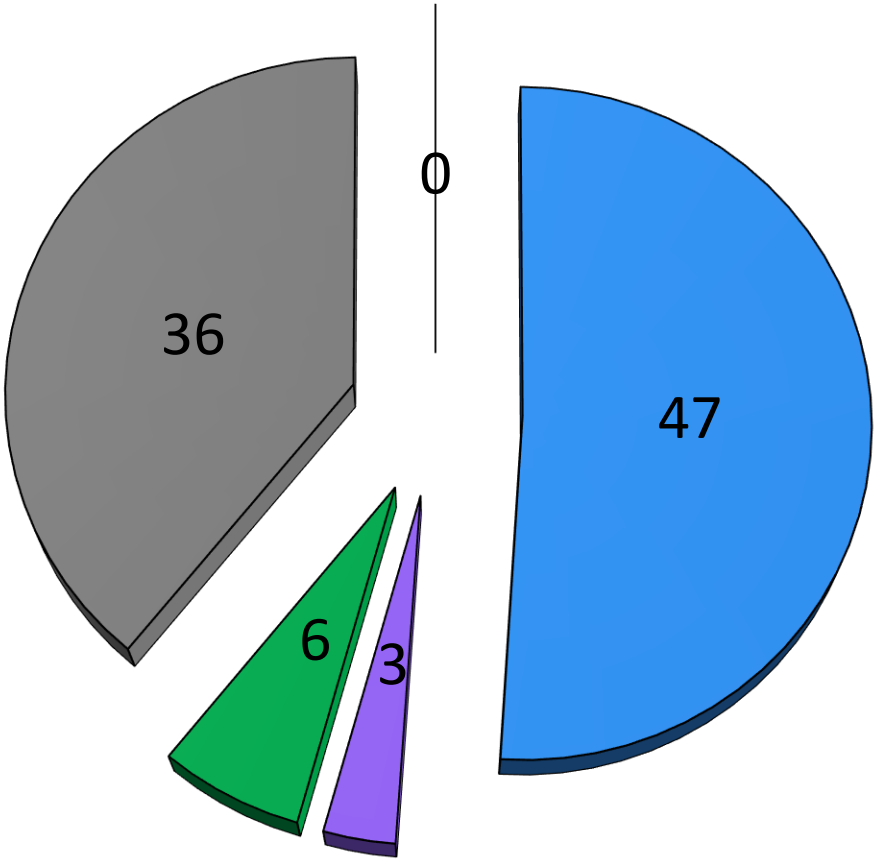
Iowa Point Source Monitoring



Count of Facilities with Total Nitrogen and Total Phosphorus Data Each Year



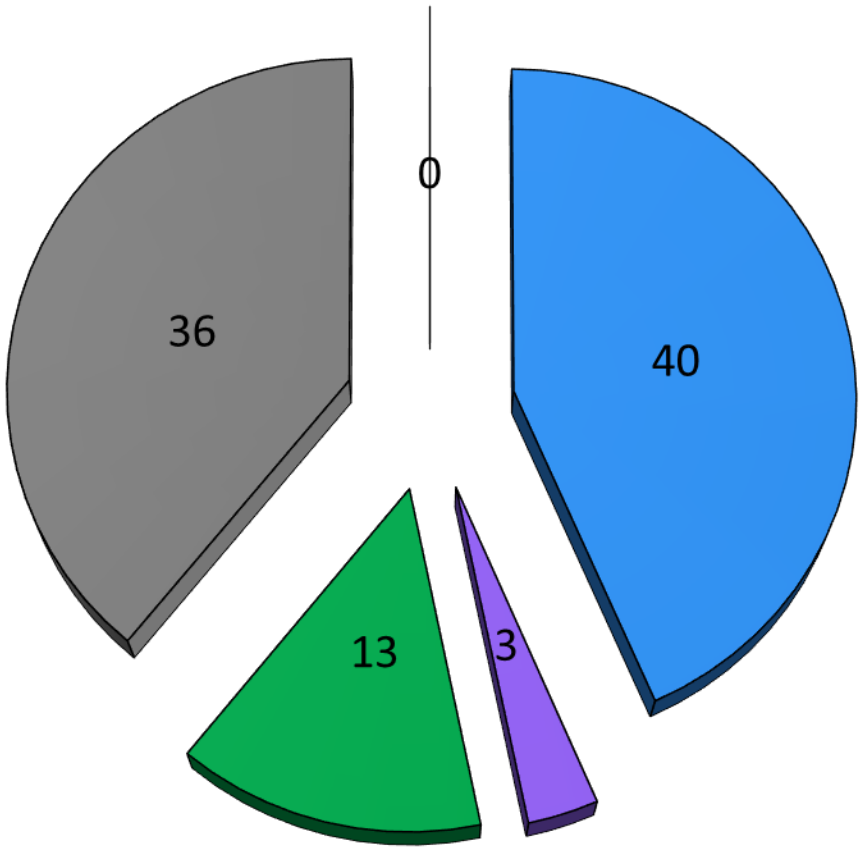
Phosphorus Municipal Commitments From Feasibility Studies



- Construct
- Optimize
- Meets Goals; add limits
- New FS
- FS still under review

Total Feasibility Studies Submitted: 95

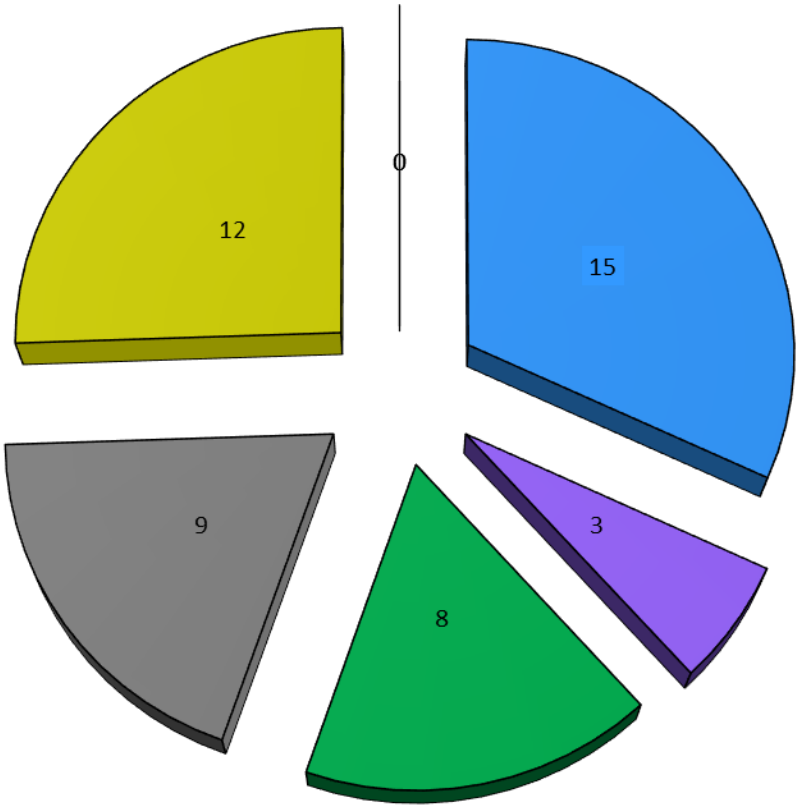
Nitrogen Municipal Commitments From Feasibility Studies



- Construct
- Optimize
- Meets Goals; add limits
- New FS
- FS still under review

Total Feasibility Studies Submitted: 92

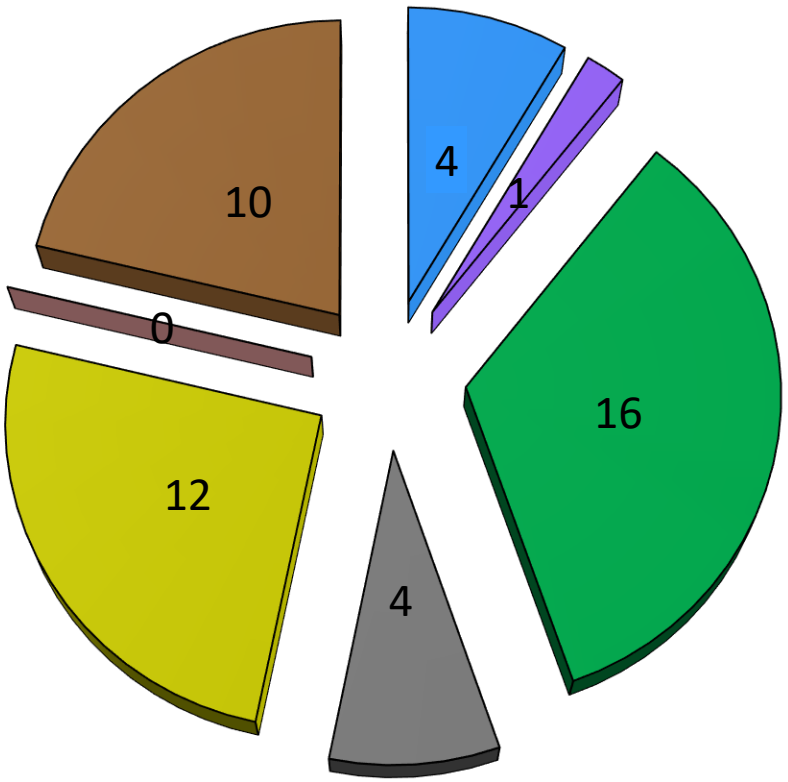
Phosphorus Industrial Commitments From Feasibility Studies



- Construct
- Optimize
- Meets Goals; add limits
- New FS
- Below Goals; NRS removed
- FS still under review

Total Feasibility Studies Submitted: 47

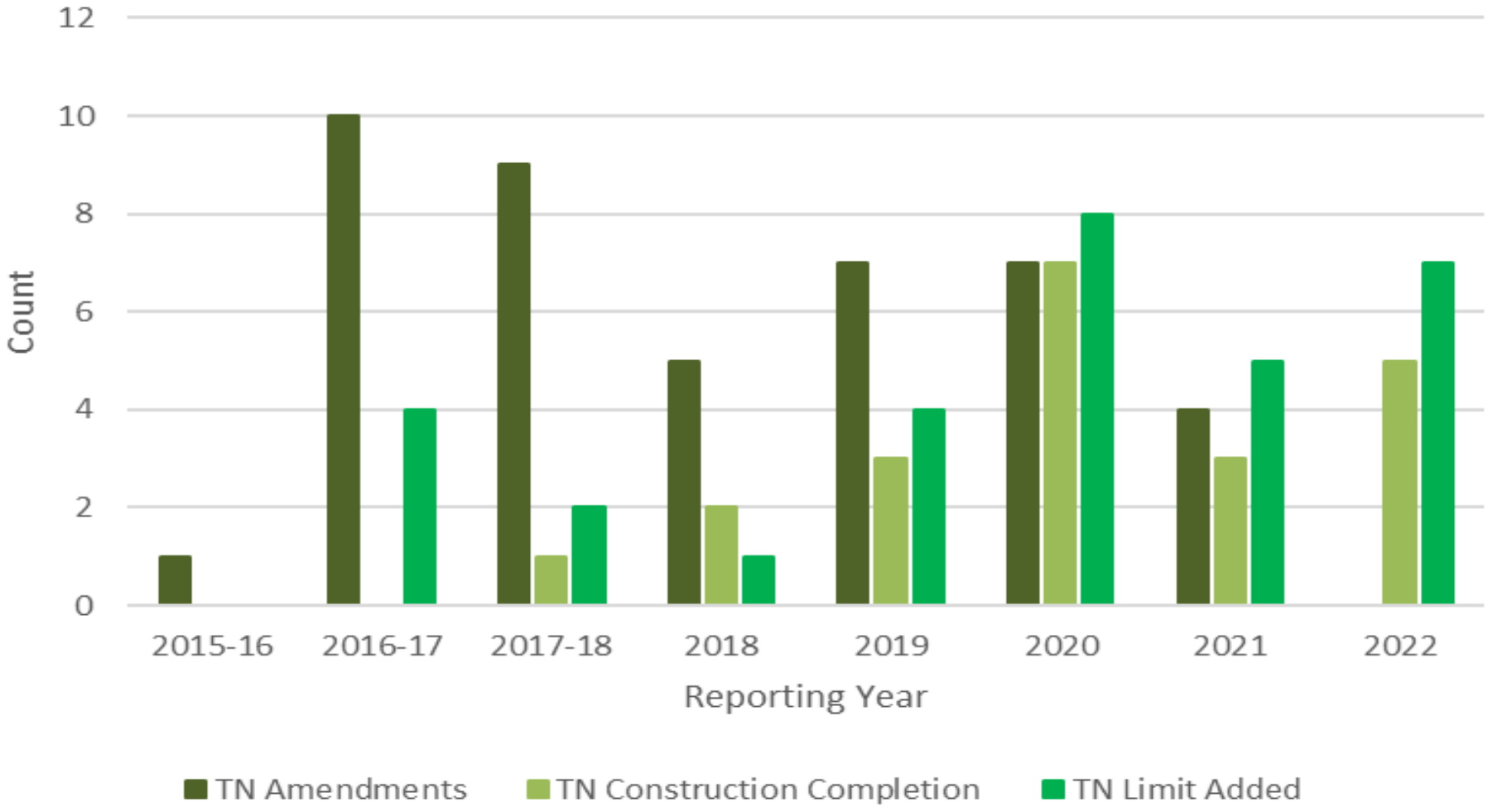
Nitrogen Industrial Commitments From Feasibility Studies



- Construct
- Optimize
- Meets Goals; add limits
- New FS
- Below Goals; NRS removed
- FS still under review
- NA

Total Feasibility
Studies Submitted: 47

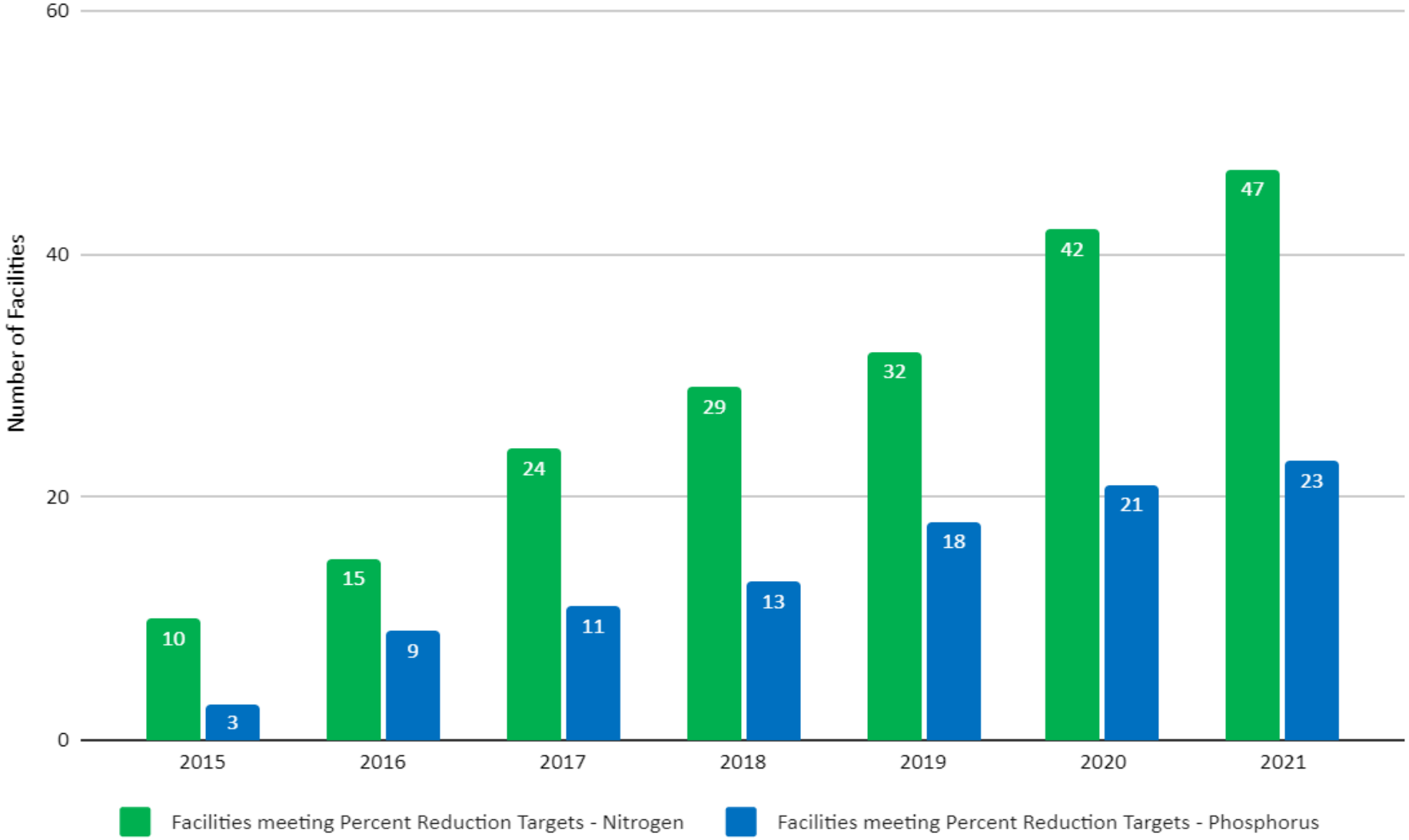
Municipal and Industrial Total Nitrogen - Amendments to Construct, Construction Completion & Permit Limit Addition



2020 Calendar Year Data

	Estimate (Target)	POTWs (w/ estimates)	Industry
Total Nitrogen (average)			
number of facilities		108	27
raw waste (mg/L)	25	35.5 (range 14.3 – 115.0)	123.7 (range 7.5 - 686.5)
final effluent (mg/L)	10	17.2 (range 3.0 – 70.3)	22.7 (range 0.4 - 138.6)
% removal (lbs)	66%	50.6% (range -5.5% - 91.8%)	71.5% (range -0.4% - 97.8%)
Total Phosphorus (average)			
number of facilities		108	33
raw waste (mg/L)	4	5.6 (range 1.8 – 17.7)	23.7 (range 0.4 - 93.4)
final effluent (mg/L)	1	3.2 (range 0.2 – 13.5)	12.0 (range 0.1 - 89.2)
% removal	75%	43.6% (range -4.0% - 93.7%)	39.6% (range -455.3% - 96.8%)
Annual Load Reduction (Calendar Year 2020)			
Total nitrogen (tons)	-	9,016	3,414
Total phosphorus (tons)	-	1,292	772

Point Source Facilities Meeting Reduction Targets by Year



Design Flow Considerations

Total Municipal Design Flow Under the Strategy:

655.5 MGD

FACILITY NAME	TREATMENT TYPE	Design Flow (MGD)	% of Overall Municipal Flow
DES MOINES	ACTIVATED SLUDGE	134	20.4%
CEDAR RAPIDS	ACTIVATED SLUDGE	56	8.54%
WATERLOO	ACTIVATED SLUDGE	34.8	5.31%
DAVENPORT	ACTIVATED SLUDGE	26	3.97%
IOWA CITY	ACTIVATED SLUDGE	24.2	3.69%
SIOUX CITY	ACTIVATED SLUDGE	17.6	2.68%
FORT DODGE	ACTIVATED SLUDGE	15	2.29%
MASON CITY	ACTIVATED SLUDGE	14.9	2.27%
COUNCIL BLUFFS	TRICKLING FILTER	14	2.14%
DUBUQUE	ACTIVATED SLUDGE	13.47	2.05%

Top 10 - 2021 Nitrogen Removal

1. ATLANTIC	**95.7%**
2. NORTH LIBERTY	**92.3%**
3. CLEAR LAKE SD	**91.4%**
4. ANAMOSA	**88.6%**
5. DYERSVILLE	**86.0%**
6. OELWEIN	**85.6%**
7. CORALVILLE	**85.4%**
8. WAPELLO	**84.7%**
9. WEST LIBERTY	**84.0%**
10. GRUNDY CENTER	**81.4%**

Met goals, outside top 10: Eagle Grove #22, Fort Dodge #26

Top 10 - 2021 Phosphorus Removal

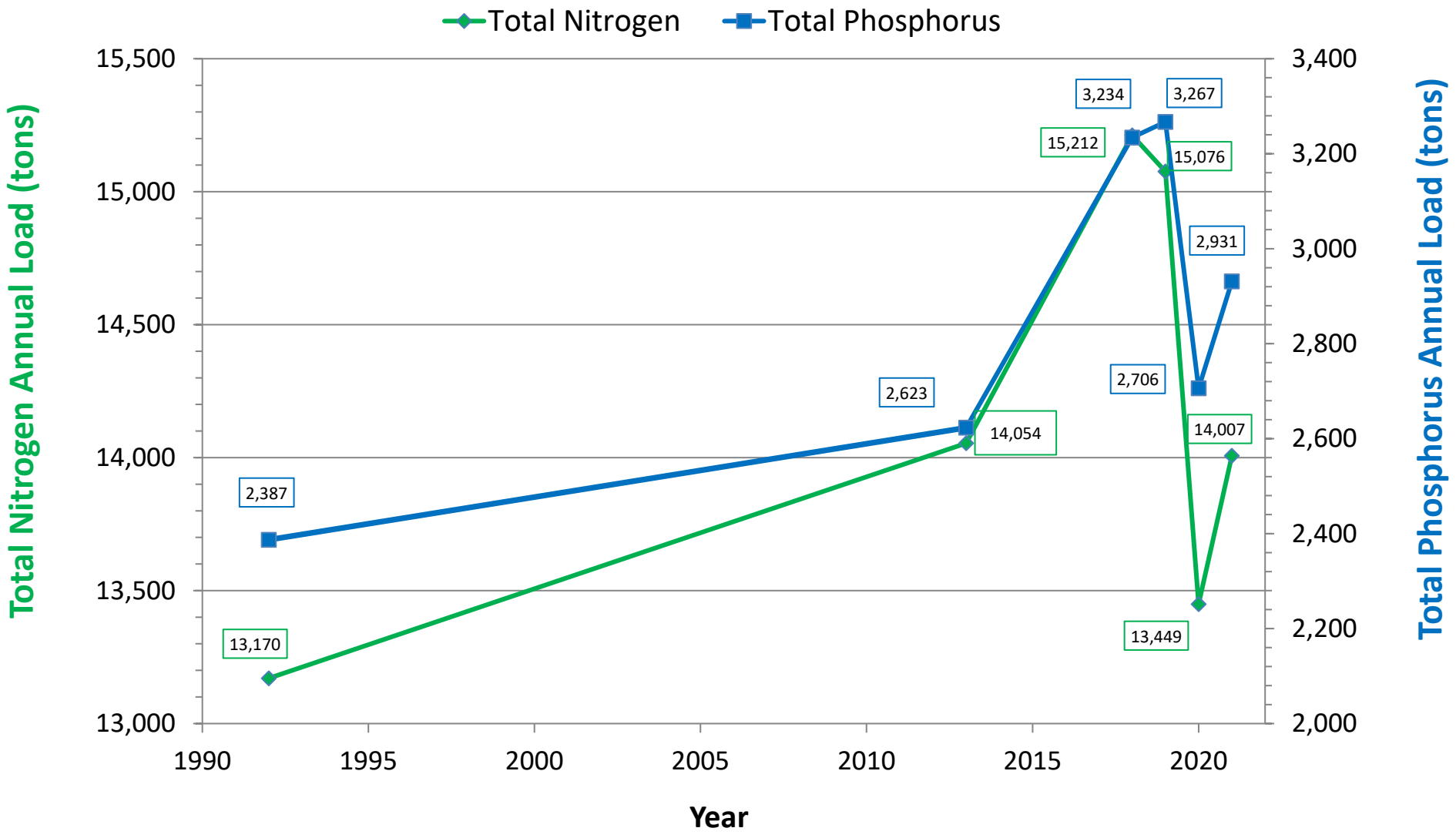
1. GRUNDY CENTER	**94.6%**
2. ATLANTIC	**89.5%**
3. EAGLE GROVE	**87.6%**
4. CARROLL	**83.4%**
5. CASCADE	**82.2%**
6. WEST LIBERTY	**82.0%**
7. NORTH LIBERTY	**80.4%**
8. DYERSVILLE	**79.3%**
9. SIOUX CITY	**79.1%**
10. CLINTON	**79.0%**


Banquet Hall in the
Famous Dry Run
Sewer,
Waterloo, Ia.
Wangler Bros., Dist. Waterloo, Ia.


Water Quality Benefits - Clean Water Investments in Wastewater Infrastructure
Ammonia Compliance Projects
E. Coli Compliance Projects
Select Fiscal Year to View
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
E. Coli Compliance Projects
244
Wastewater Flow Disinfected
100,932,000,000
cumulative gallons/year (adjusted for recreational season)
24
E. Coli Compliance Projects
added in selected fiscal year
61 Park LLC(dba Maplewoood Estates)
Design Average Wet Weather (AWW) Flow :
0.016300 million gallons per day
Ackley, city of
Design Average Wet Weather (AWW) Flow :
0.530000 million gallons per day
Allison, City of
Design Average Wet Weather (AWW) Flow :
0.200000 million gallons per day
Centerville, City of
Design Average Wet Weather (AWW) Flow :
1.500000 million gallons per day
South Dakota
Pierre
St Paul
Wisconsin
Sioux Falls
Michigan
Madison
Milwaukee
Grand Rapids
Lansing
Sarnia
London
Detroit
Windsor
Chicago
Iowa
Des Moines
Cleveland
Nebraska
Cheyenne
Lincoln
Illinois
Springfield
Indiana
Indianapolis
Ohio
Columbus
Denver
UNITED STATES
Esri, HERE, Garmin, NGA, USGS, NPS
Powered by Esri
The Iowa DNR Field Services and Compliance Bureau includes six field offices (1-6) located throughout Iowa.

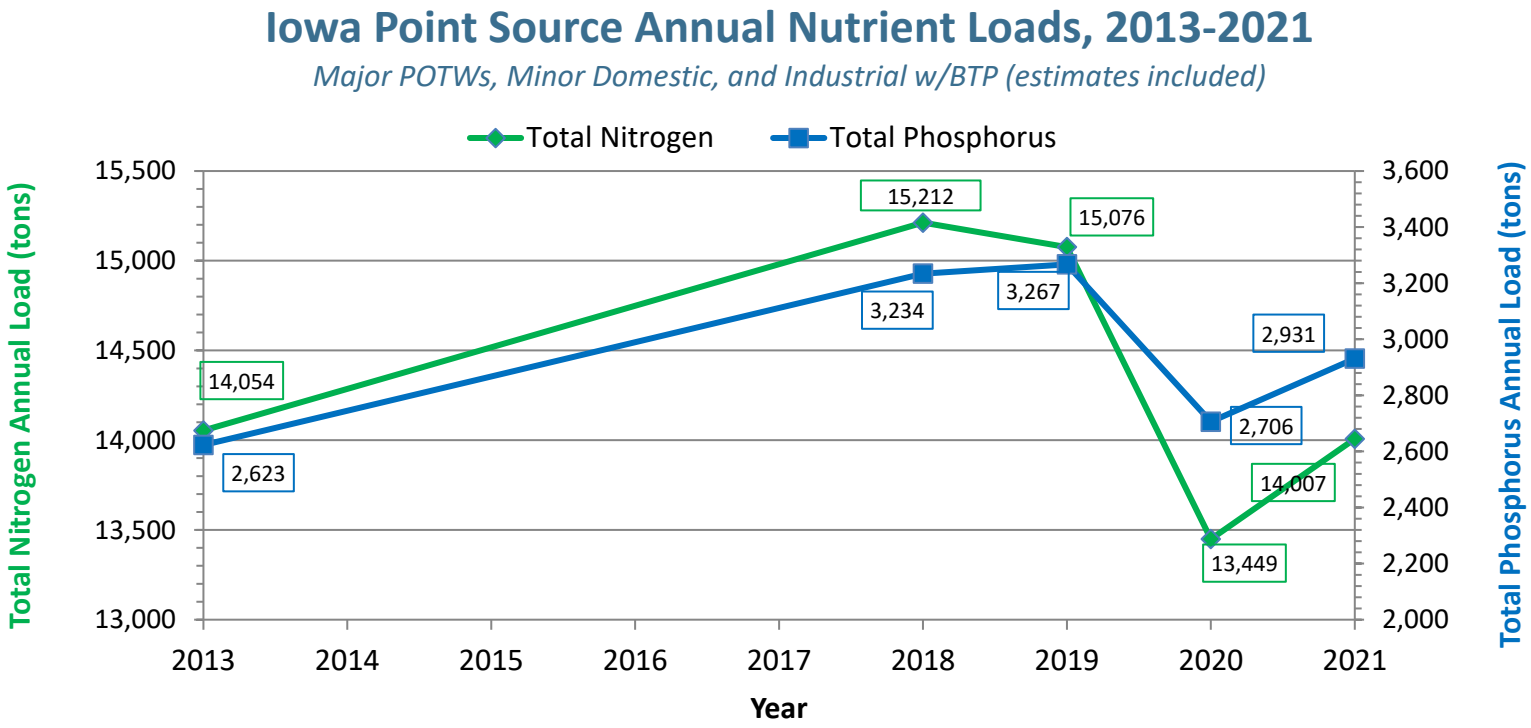
Iowa Point Source Annual Nutrient Loads

Major POTWs, Minor Domestic, and Industrial w/BTP (estimates included)



What Happened Between 2019 and 2020?

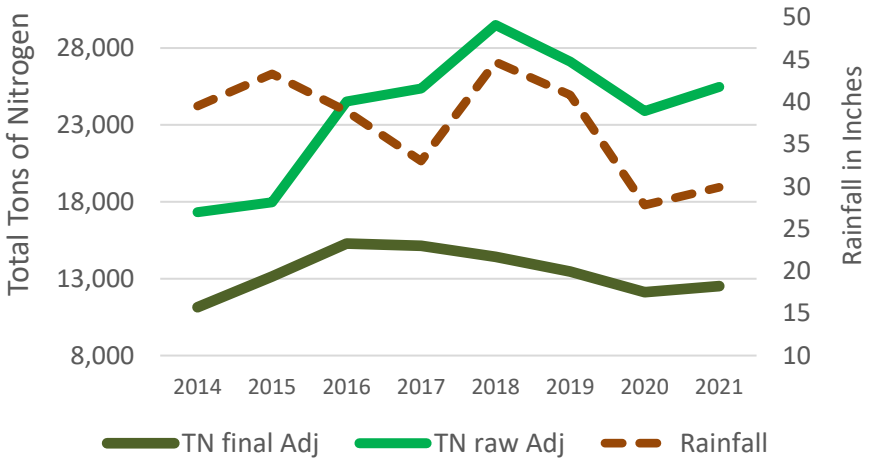
- Below is a closer look at the loadings from 2013 and 2018 to 2021
- The TN load dropped by 11% between 2019 and 2020, and the TP load dropped by 17%
- The loading increased again in 2021, but this drop is surprising



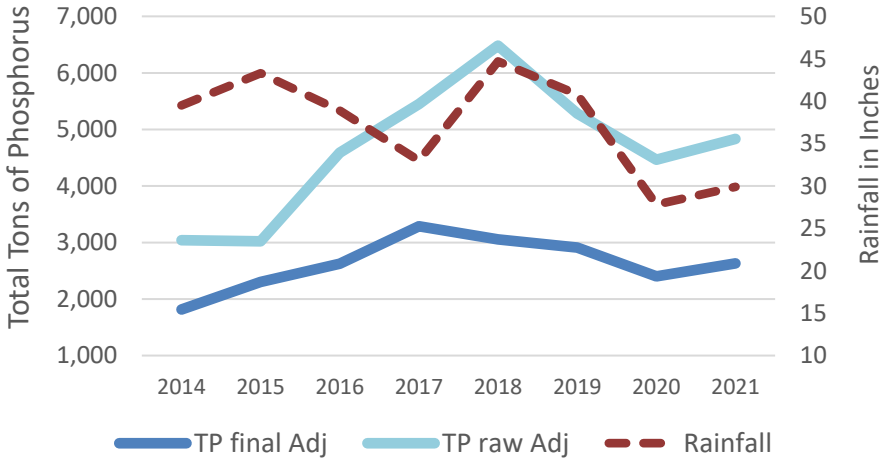
Rainfall Comparison Charts

- Beginning in 2017, the adjusted raw loading data corresponds well with Iowa's annual average rainfall totals
- Data from the two largest facilities in Iowa were added in 2016 (Des Moines) and in 2017 (Cedar Rapids)

Rainfall, TN Raw & Final Load Discharged in Tons Adjusted by # of Facilities, 2014-2021



Rainfall, TP Raw & Final Load Discharged in Tons Adjusted by # of Facilities, 2014-2021



Things To Be Excited About!!!

Point Source

- Nutrient Reduction Exchange – Watershed Investments
- Optimization Efforts
- More BNR facilities coming online, funding

Nonpoint Source

- Funding (SF512, RCPP, WQI, Gulf of Mexico, etc)
- Innovations in Delivery (Batch and Build)
- Iowa Nutrient Research Center

What questions do you have?

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