

Stream Quality Assessment of Southern Manitowoc County -Summer 2017-



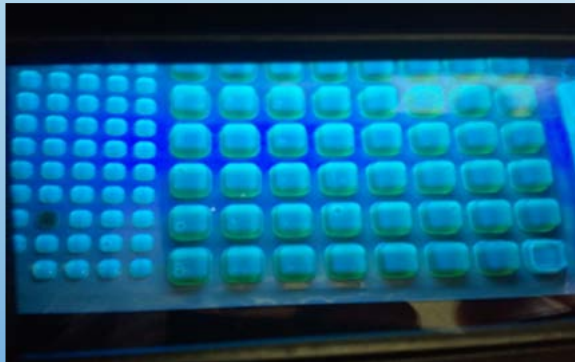
Student Interns: Abigail Adams, Paige Arneson, Bethanie Ebben, Matt Reed, Alec Seguin, Nick Wiedemann
Faculty Advisors: Dr. Rebecca Abler and Dr. Richard Hein



Friends of Hika Bay
Calvin, Pine, Point, Fischer, Centerville Creeks

Materials & Methods

- Weekly Sampling
 - Rain Events
- Physical Parameters
- Chemical Parameters
- Biological Parameters



Terms

Turbidity- Particles in water (dissolved or suspended) which scatter light causing a cloudy/murky appearance. High turbidity negatively affects aquatic life. Acceptable Range: 1 to 5 NTU

Dissolved Oxygen- Oxygen gas molecules present in water. High levels of dissolved oxygen are best for a healthy ecosystem. Acceptable Range: >5.0 mg/L

Phosphate- Phosphorus is essential for growth and metabolic reaction in plants in animals, though it is detrimental in large amounts. Acceptable Range: 0.01-0.03 mg/L (<0.10 mg/L max)

Ammonia Nitrogen NH₃/NH₄- Nitrogen containing compounds, which when found in excessive quantities are harmful to aquatic ecosystems. Acceptable Range: NH₃: <0.1 mg/L NH₄: <0.5 mg/L

E.Coli- A bacteria found in the intestines of animals. The presence of E.Coli in water indicates recent fecal contamination. Advisory: >235 Closed: >1000

Rain Data Comparison

- Rain increases surface runoff, which raises various parameters
 - Phosphate, E. coli, ammonia nitrogen, turbidity, etc.
- Precipitation from June-August:
 - 2014: 11.42"
 - 2015: 11.00"
 - 2016: 13.61"
 - 2017: 9.96"
- This year was relatively dry
 - Most rain events in June
- Expectation: lower parameters compared to 2016





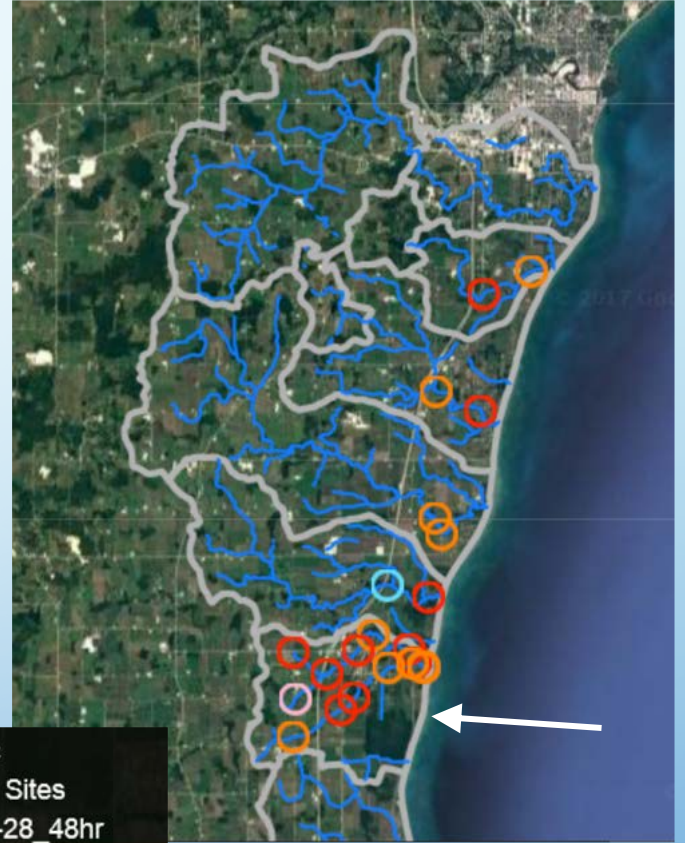
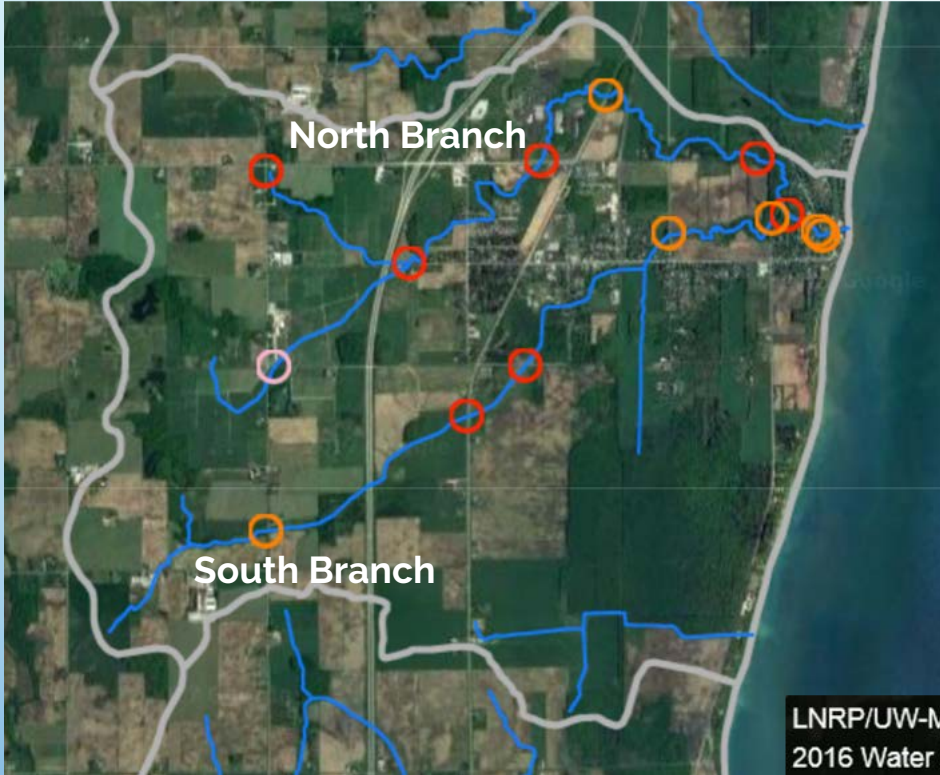
Journey
to a new
creek



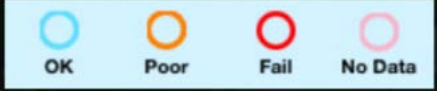
Centerville Creek



CE01	Centerville Flowage Dam
CE02	Centerville Flowage Midpoint
CE03	Centerville Flowage Confluence
CE04	Centerville South Branch Birch St.
CE05	Centerville South Branch Center Rd.
CE06	Centerville South Branch South Cleveland Rd.
CE07	Centerville North Branch Franklin Dr.
CE08	Centerville North Branch Dairyland Dr.
CE09	Centerville North Branch LTC
CE10	Centerville North Branch Washington Rd.
CE11	Centerville Union Road North
CE12	Centerville Union Road Mid
CE13	Centerville Union Road South
CE14	Centerville Hwy-Dairyland



LNRP/JW-Manitowoc
2016 Water Sampling Sites
E.coli Week: 2016-08-28_48hr

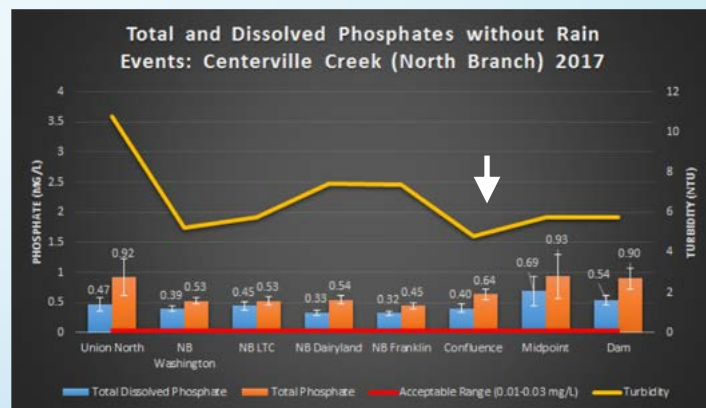
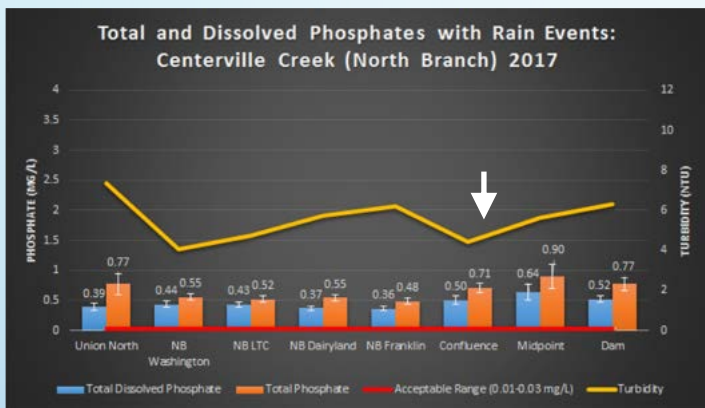


Centerville Creek Averages

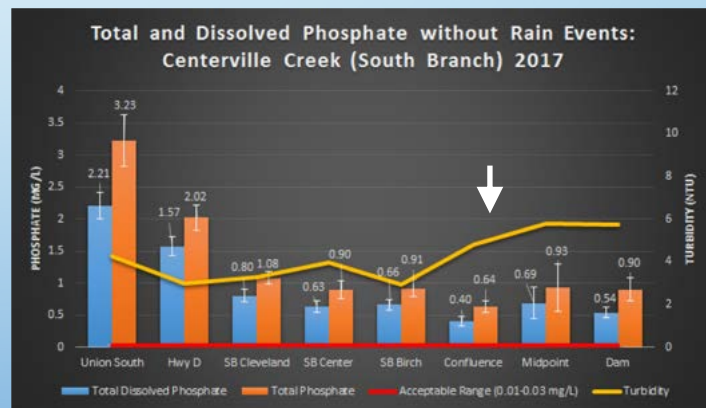
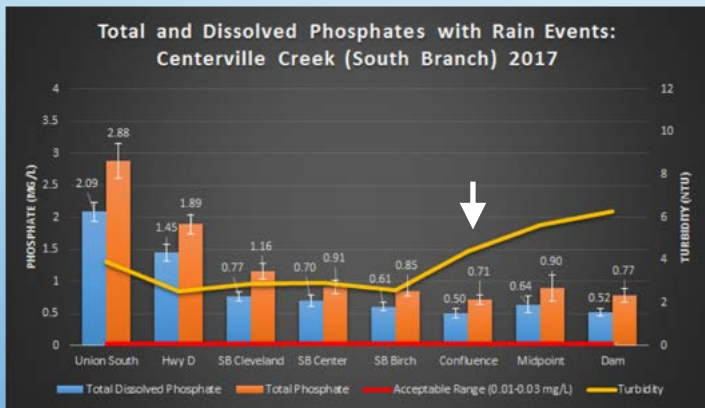
Averages of All Creek Sample Points	Summer 2013	Summer 2014	Summer 2015	Summer 2016	Summer 2017	Difference between Summers 2016 and 2017	Standard Acceptable Ranges During Summer
Water Temperature (°C)	17.75	17.76	17.28	18.35	17.50	-0.85	10-19°C
pH	8.63	8.38	8.73	8.07	7.80	-0.27	5.8-8.5
Turbidity (NTU)	15.10	10.28	9.33	5.11	4.46	-0.65	1 to 5 NTU
Stream Flow (m/s)	0.34	0.36	0.29	0.23	0.18	-0.05	N/A
Conductivity (µs)	846.5	899.2	913.6	814.7	926.0	+111.3	N/A
Dissolved Oxygen (mg/L)	8.4	13.2	11.2	5.4	9.5	+4.1	>5.0 mg/L
Total Dissolved Phosphate (mg/L)	0.06482	0.99129	0.98721	1.01365	0.69118	-0.32247	N/A
Total Phosphate (mg/L)	0.15381	1.32409	1.22249	1.36287	0.96994	-0.39293	0.001-0.003 mg/L (<0.1 ppm max.)
Ammonia Nitrogen (NH₃) (mg/L)	0.04008	0.02627	0.03371	0.05145	0.01011	-0.04134	<0.1 mg/L
Ammonia Nitrogen (NH₄) (mg/L)	0.37148	0.25772	0.17121	0.33838	0.37435	+0.03597	<0.5 mg/L
E. coli (MPN/100 mL)	925.1	1397.5	1333.7	1624.8	1263.3	-361.5	Advisory: >235 Closed: >1000

Centerville Creek 2017 Site Analysis

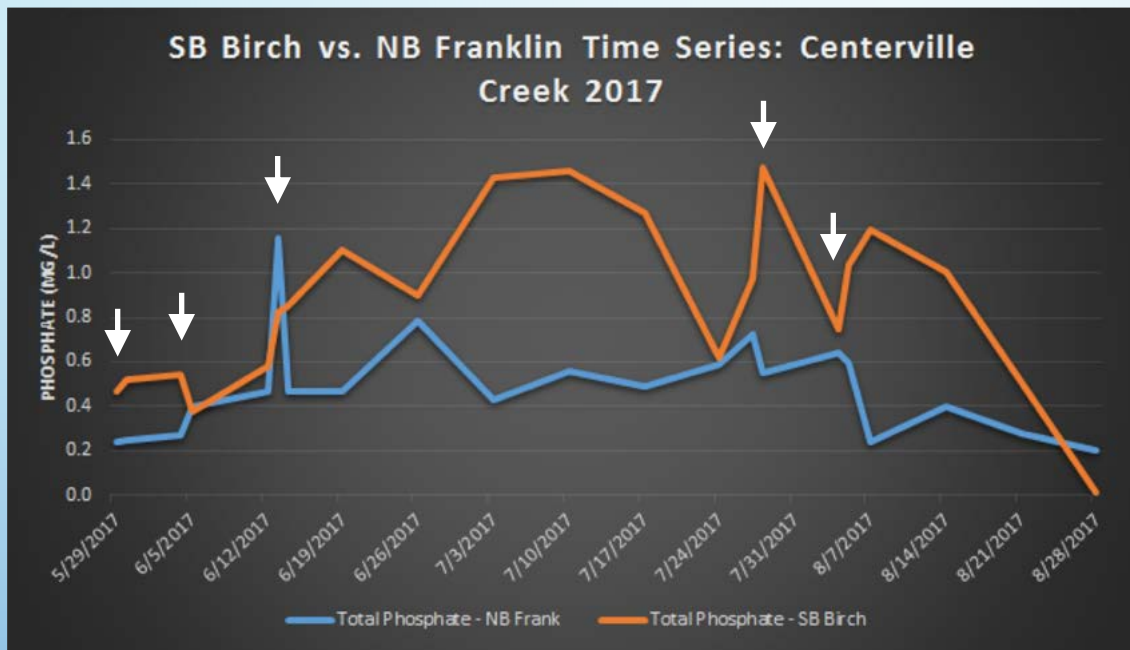
North Branch:



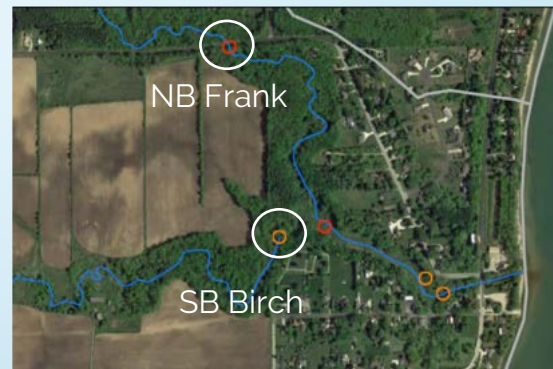
South Branch:



Centerville Creek 2017 Site Analysis



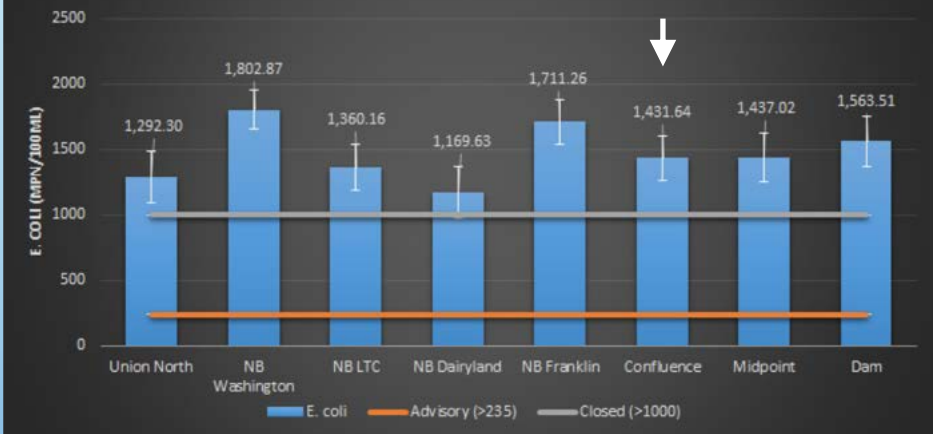
Total Phosphate over time plotting North Branch against South Branch



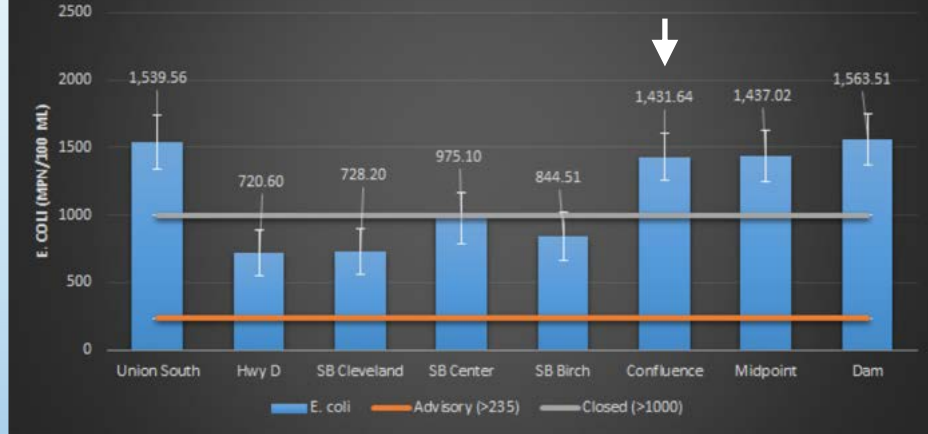
- Arrows point towards rain events
- 5 documented rain events this summer → however, there are more that we didn't test for

Centerville Creek 2017 Site Analysis

Centerville Creek - North Branch E. coli Averages: 2017



Centerville Creek - South Branch E. coli Averages: 2017



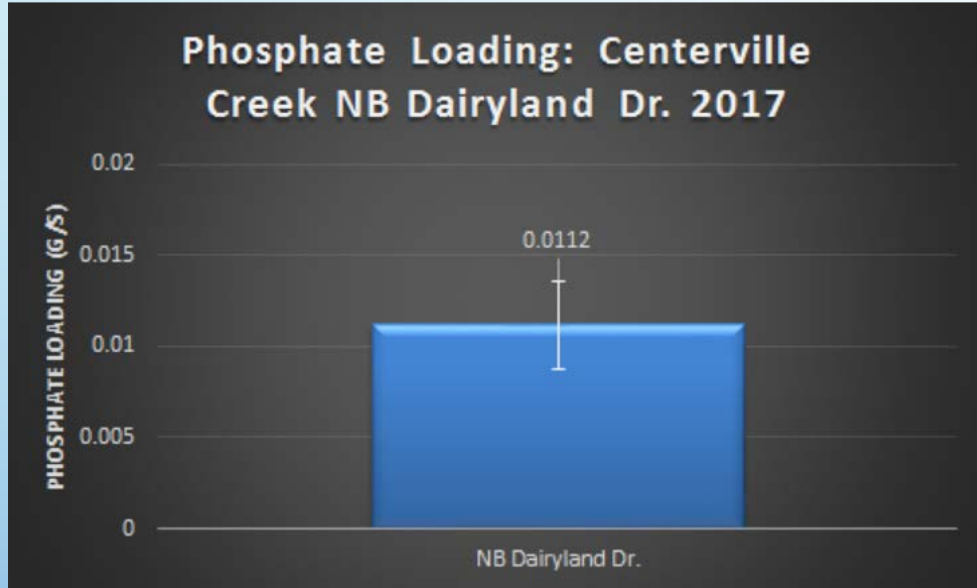
E. coli Averages

Centerville Creek 2017 Site Analysis

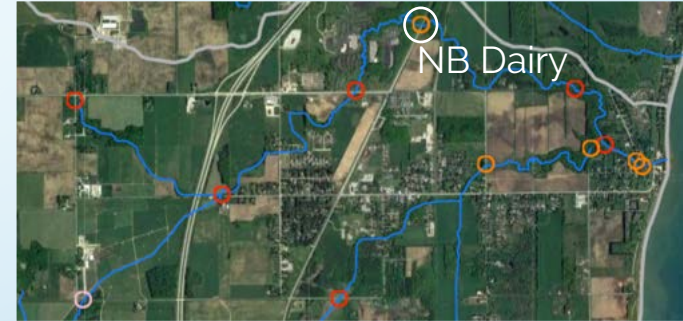


Dissolved Oxygen Averages

Centerville Creek 2017 Site Analysis



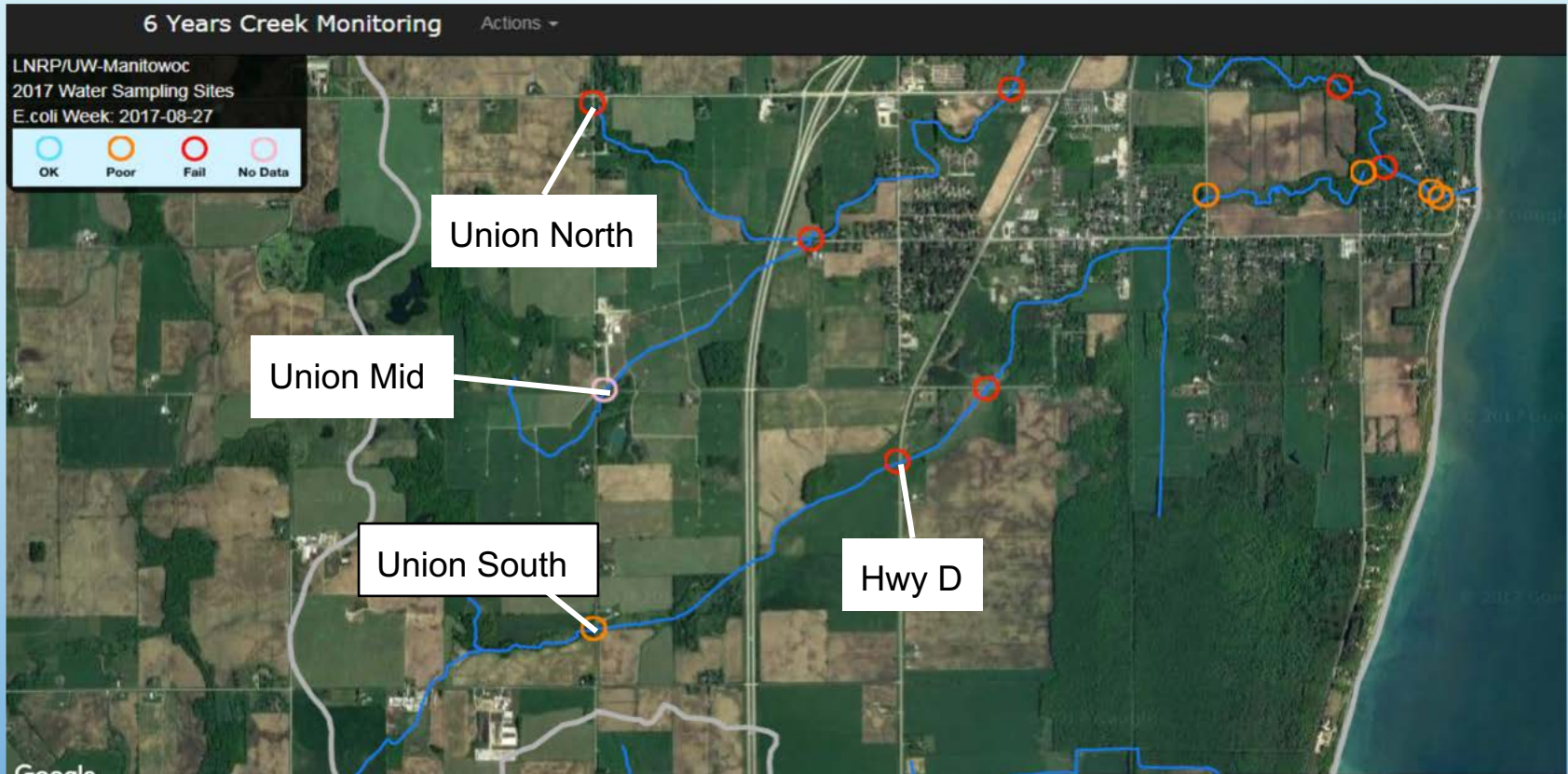
Phosphate Loading Averages



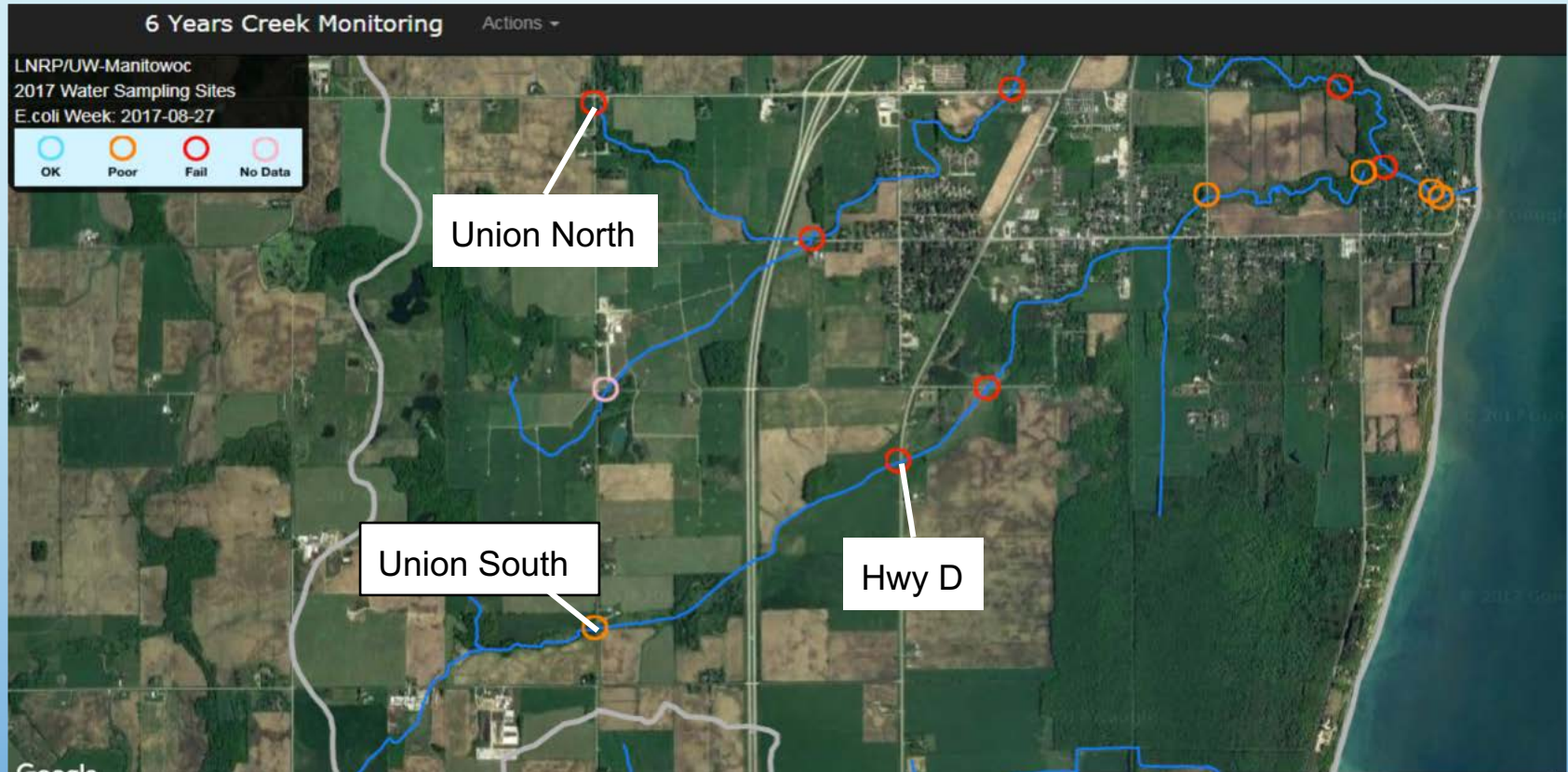
Centerville Creek Analysis

- 8/11 parameters decreased from 2016; 3/11 increased
 - E. coli fairly lower than 2016, but almost equal to 2014 & 2015
 - 2016 was a very wet summer → higher numbers
- Data without rain events were higher than with rain events.
 - Reasons: possible source other than surface runoff
- Trends for North and South Branch:
 - NB = high turbidity, low phosphate, high E. coli, steady PO₄ values downstream
 - SB = low turbidity, high phosphate, low E. coli, PO₄ steadily decreasing downstream
- Phosphate loading values for 2017 were twice as high as 2016
 - 2017: 0.0112 g/s → 14.9 lbs/wk → 178.9 lbs/summer
- Overall, SB is worse for phosphates and NB is worse for E. coli

Centerville Creek - Union Sites



Centerville Creek - Union Sites Focus



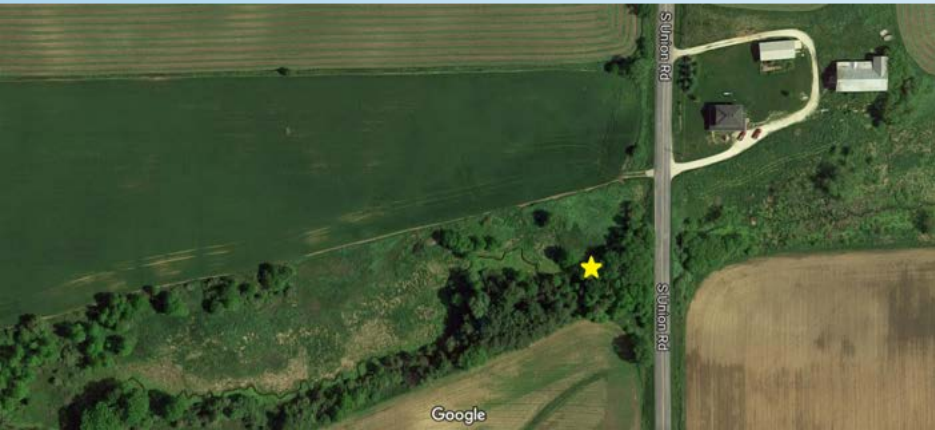
Centerville Creek - Union Sites Location

Union North in North Branch

Union South and Hwy D in South Branch

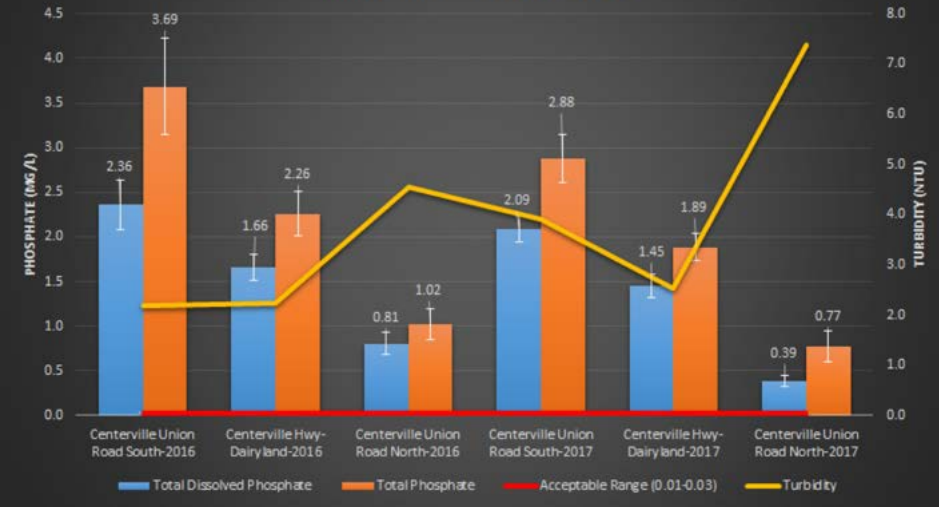
Union South is in a low-lying area

-no buffer zones



Centerville Union Sites Analysis

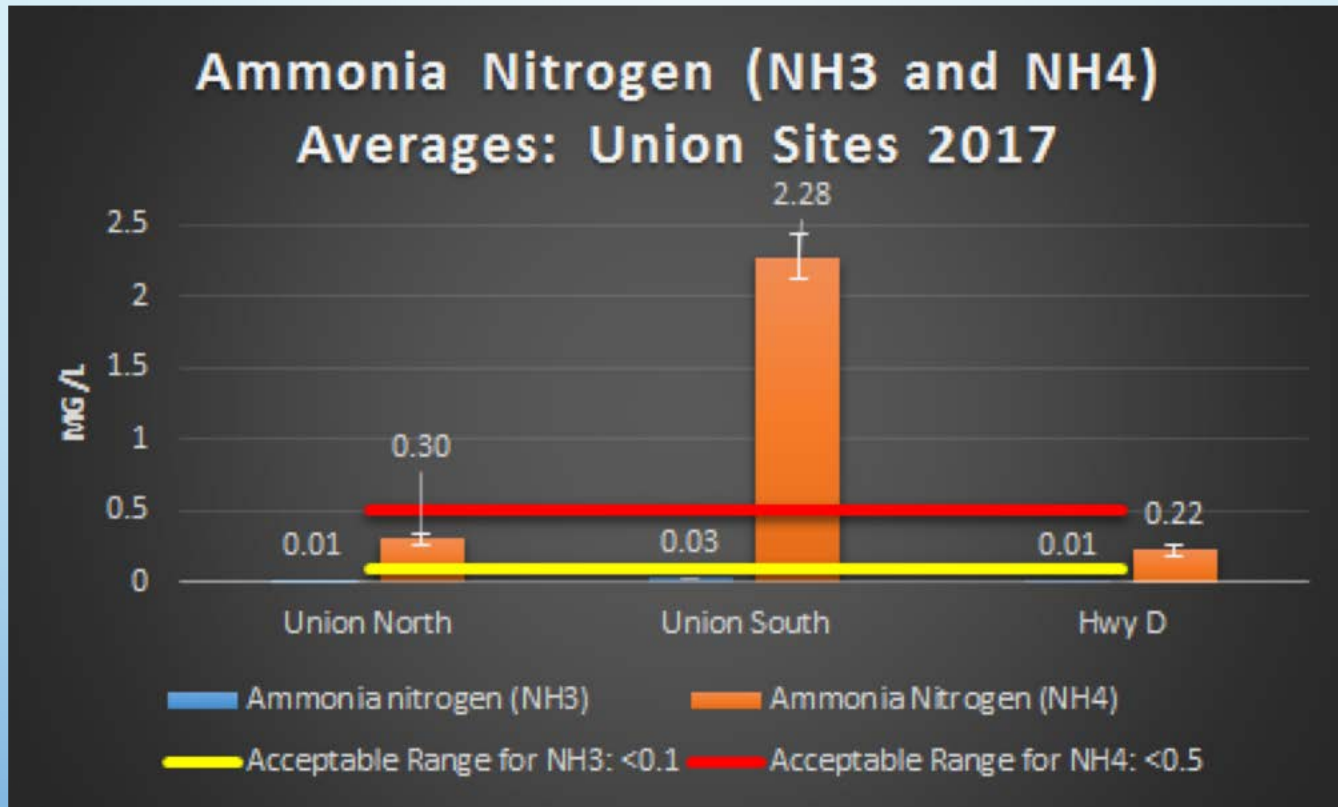
**Total Dissolved and Total Phosphates with Rain Events:
Union Sites 2016 vs 2017**



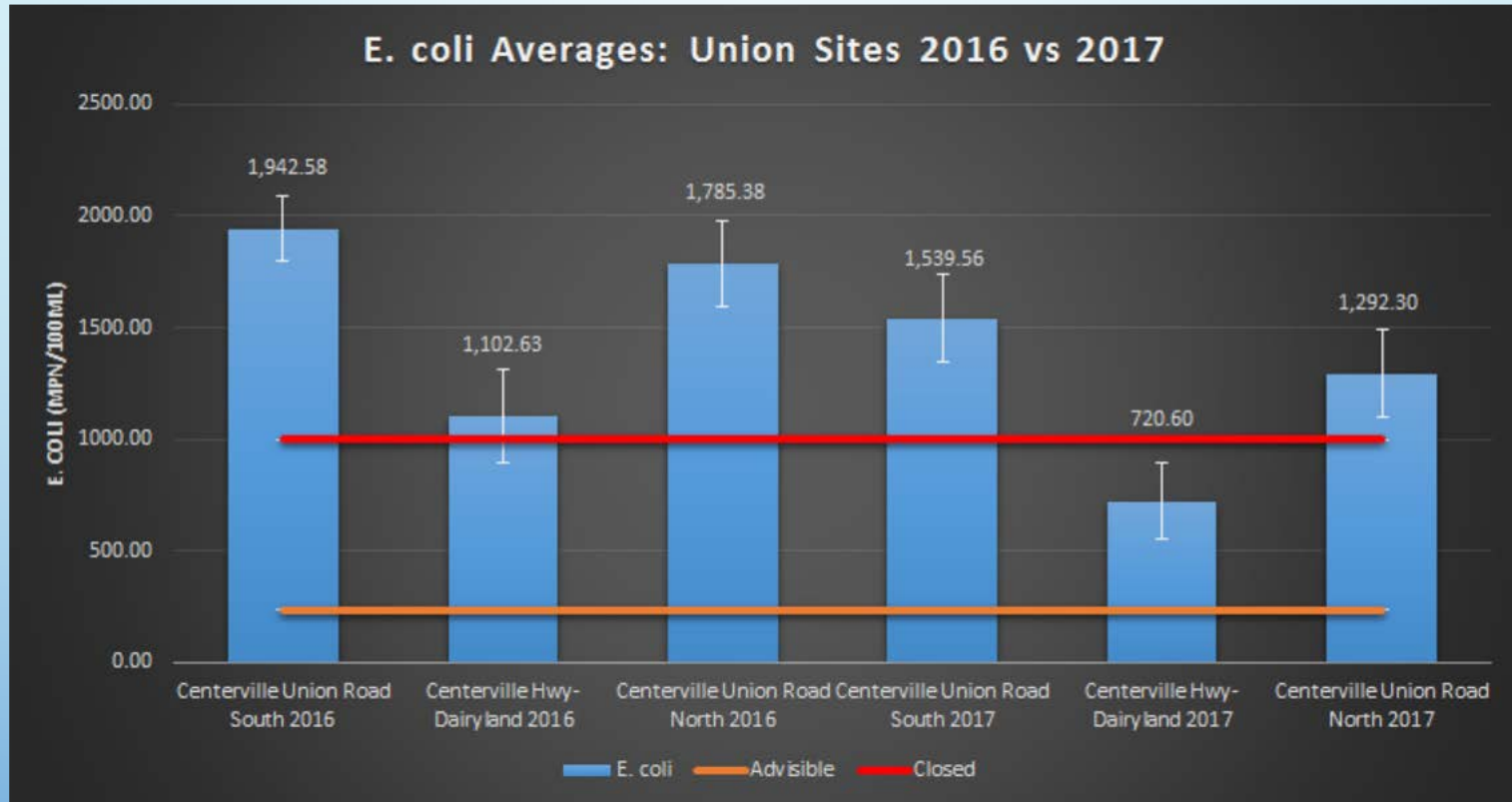
**Total Dissolved and Total Phosphates without Rain Events:
Union Sites 2016 vs 2017**



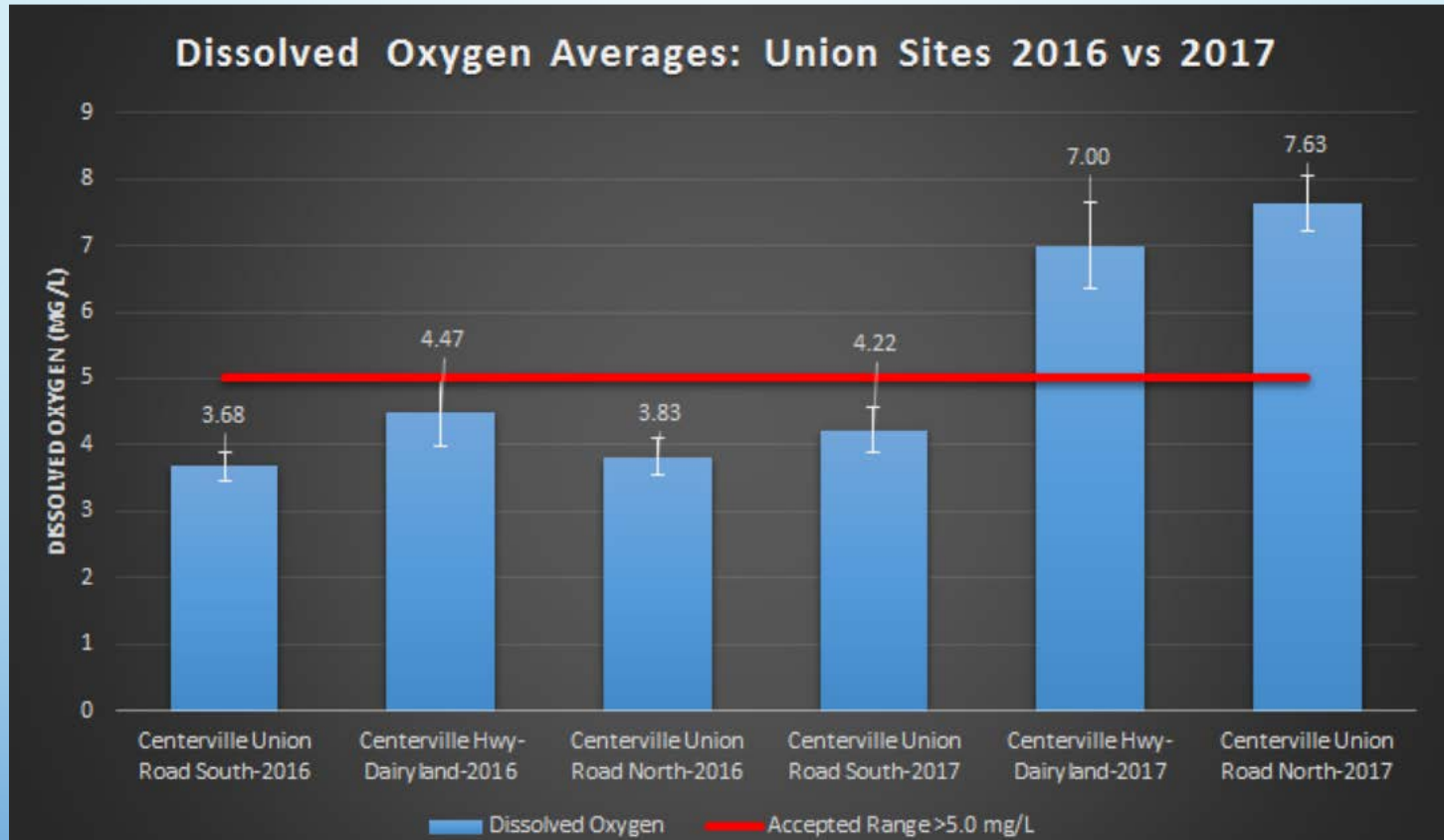
Centerville Union Sites Analysis



Centerville Union Sites Analysis



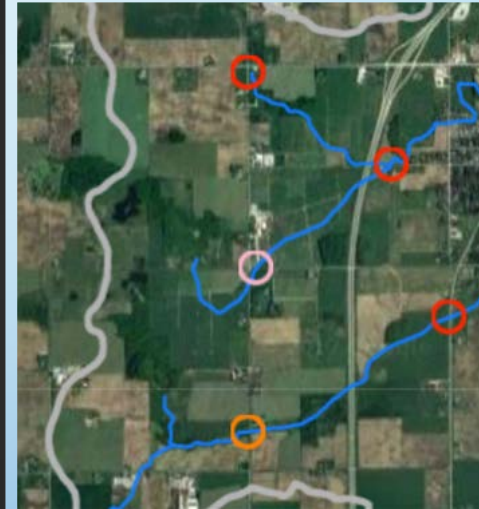
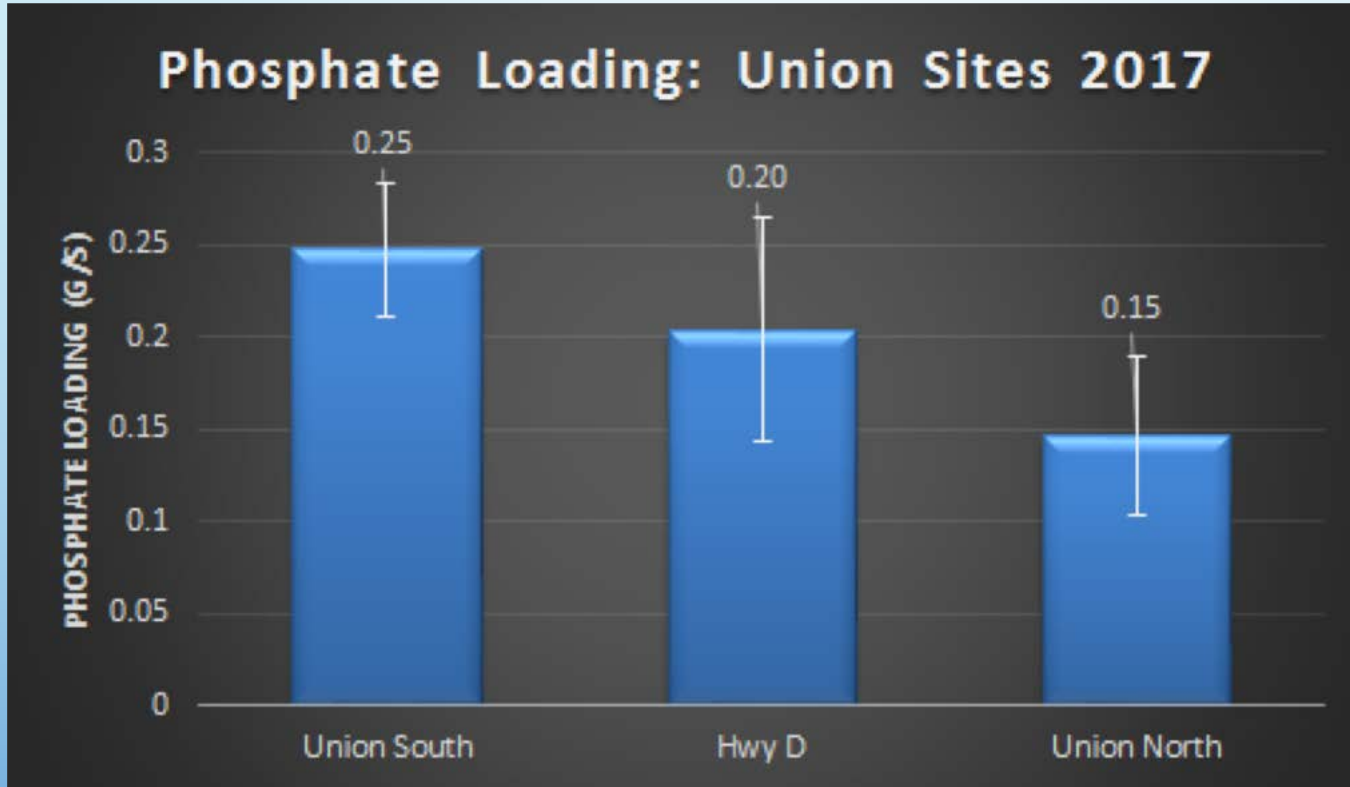
Centerville Union Sites Analysis



Centerville Union Sites Analysis



Centerville Union Sites Analysis



Centerville Creek - Union Sites Analysis

- Union North does not influence Union South
- Union South is upstream from Hwy D and sediment/contamination is being lost somewhere between the two sites
- Dissolved oxygen levels have improved for Union North and Highway D
 - Union South decomposition
- Turbidity doesn't line up with phosphate values
 - Data without rain events were higher than with rain events
 - Likely that there is another source besides surface runoff
- Phosphate loading:
 - Union South- 0.25 g/s, 333 lbs/week, 4,348 lbs/summer
 - Hwy D- 0.20 g/s, 267 lbs/week, 3,478 lbs/summer
 - Union North- 0.15 g/s, 200 lbs/week, 2,609 lbs/summer

Importance of Restoration

- *Health of the community and Great Lakes (~20% of planet's fresh water).
- *Our local watershed feeds directly into Lake Michigan.



Importance of Restoration

*High levels of phosphorus and nitrogen can lead directly to algal blooms and cladophora outbreaks.

-This can produce dangerous toxins that can sicken and kill people and animals.

-Create dead zones depriving water of oxygen and life.



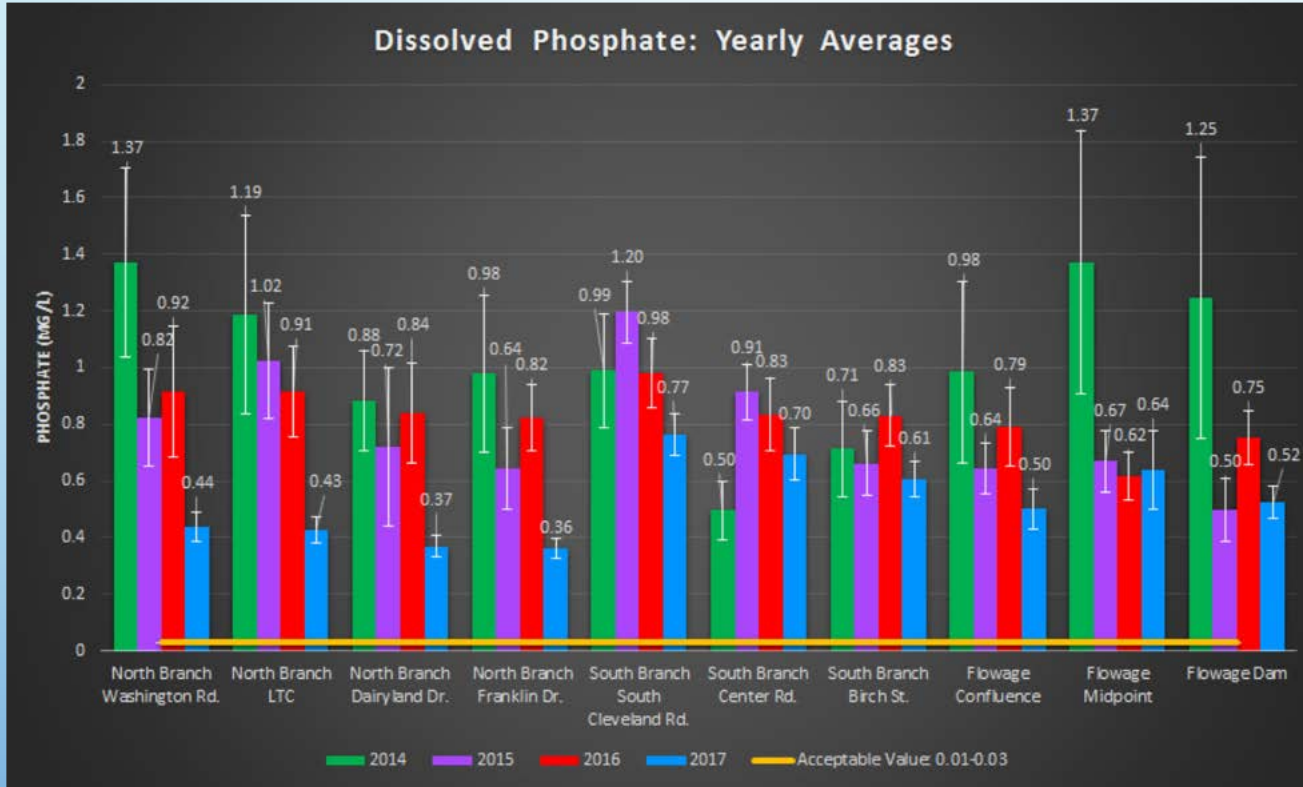
Importance of Restoration

*Economic Importance

- Raise treatment costs of drinking water.
- Hurt industries that depend on clean water.
- Limit or prevent recreational use.

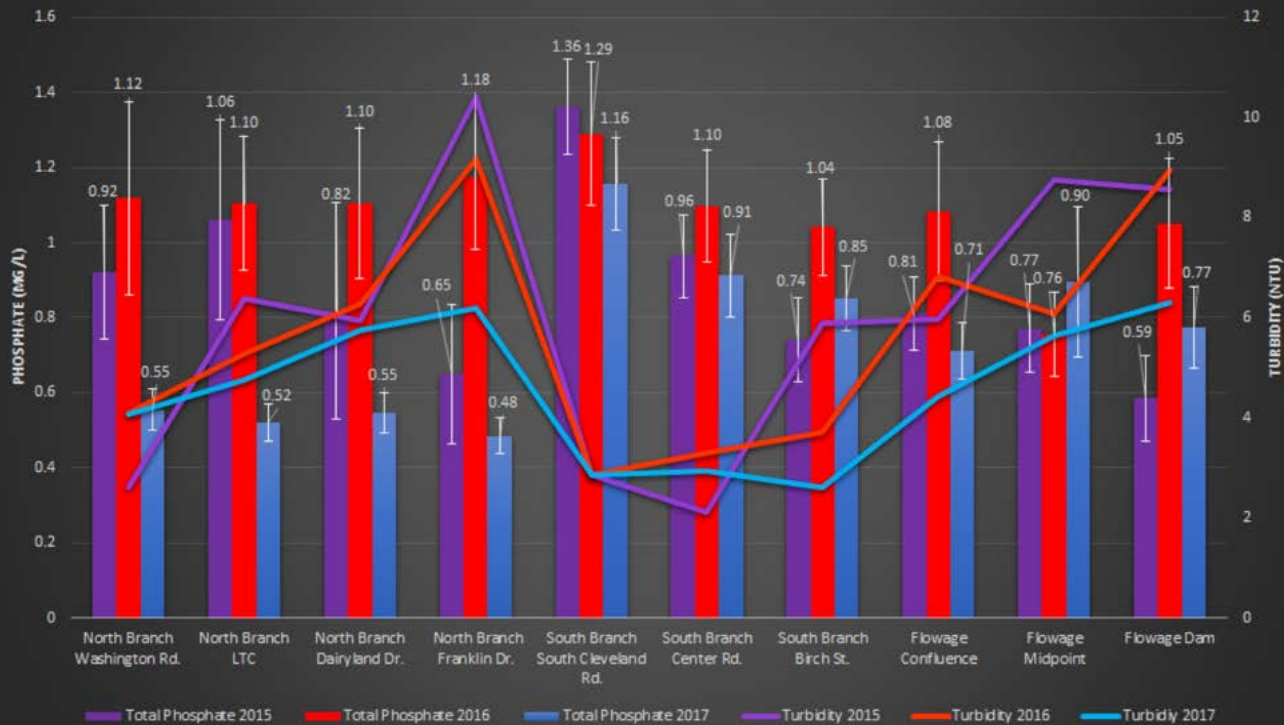


Restoration Data



Restoration Data

Total Phosphate vs. Turbidity: Yearly Averages



Restoration Data Analysis Summary

- *Phosphate is marginally trending down overall.
- *All North Branch sites are down significantly.
- *Phosphate levels at all sites are still beyond acceptable range.
- *Turbidity not following phosphate levels.

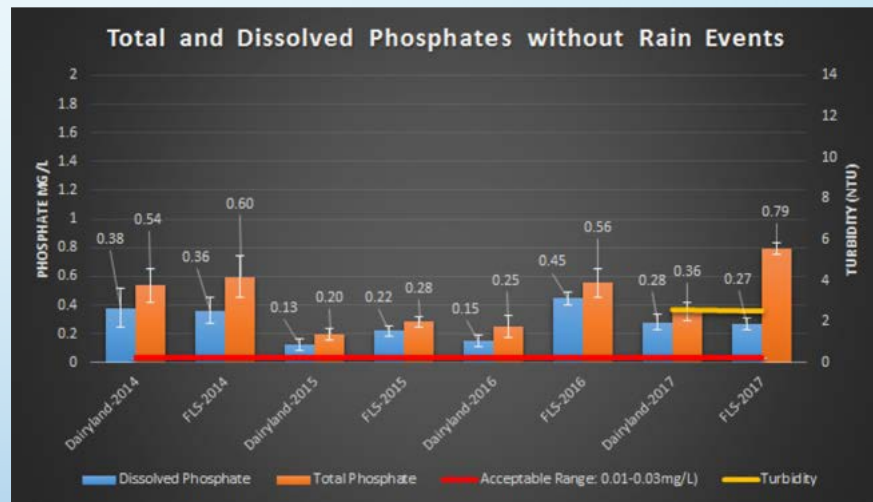
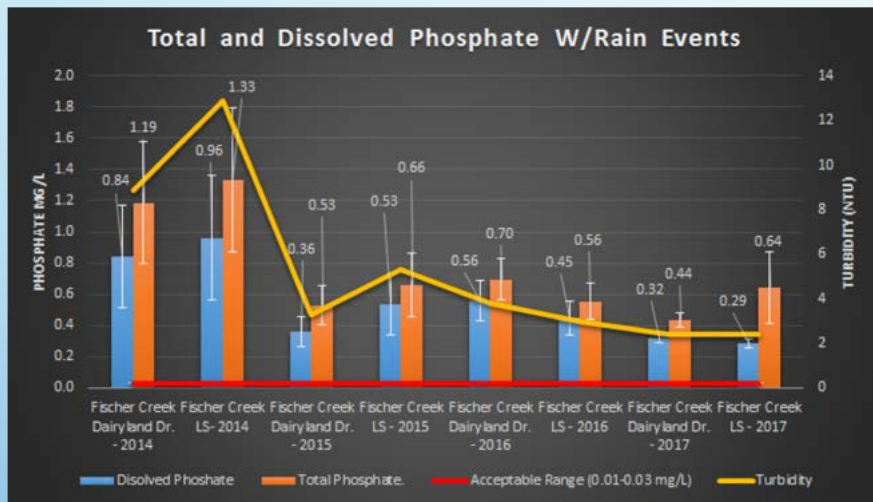


Fischer Creek

FI02	Fischer Creek LS
FI03	Fischer Creek Dairyland Dr.

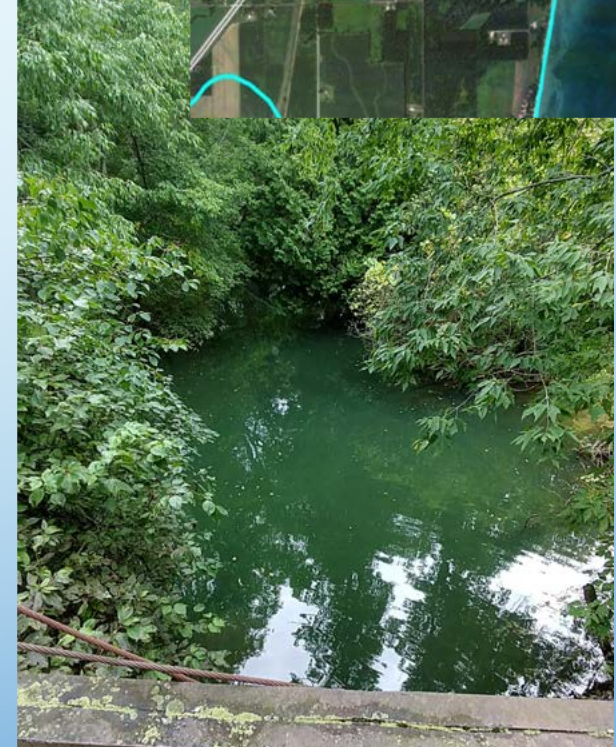
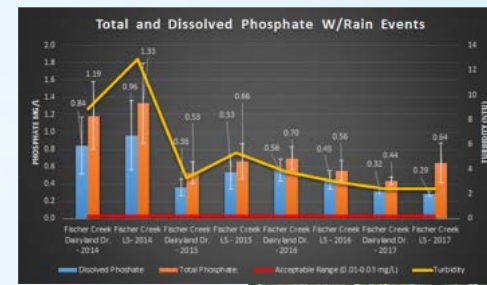


Fischer Creek Analysis

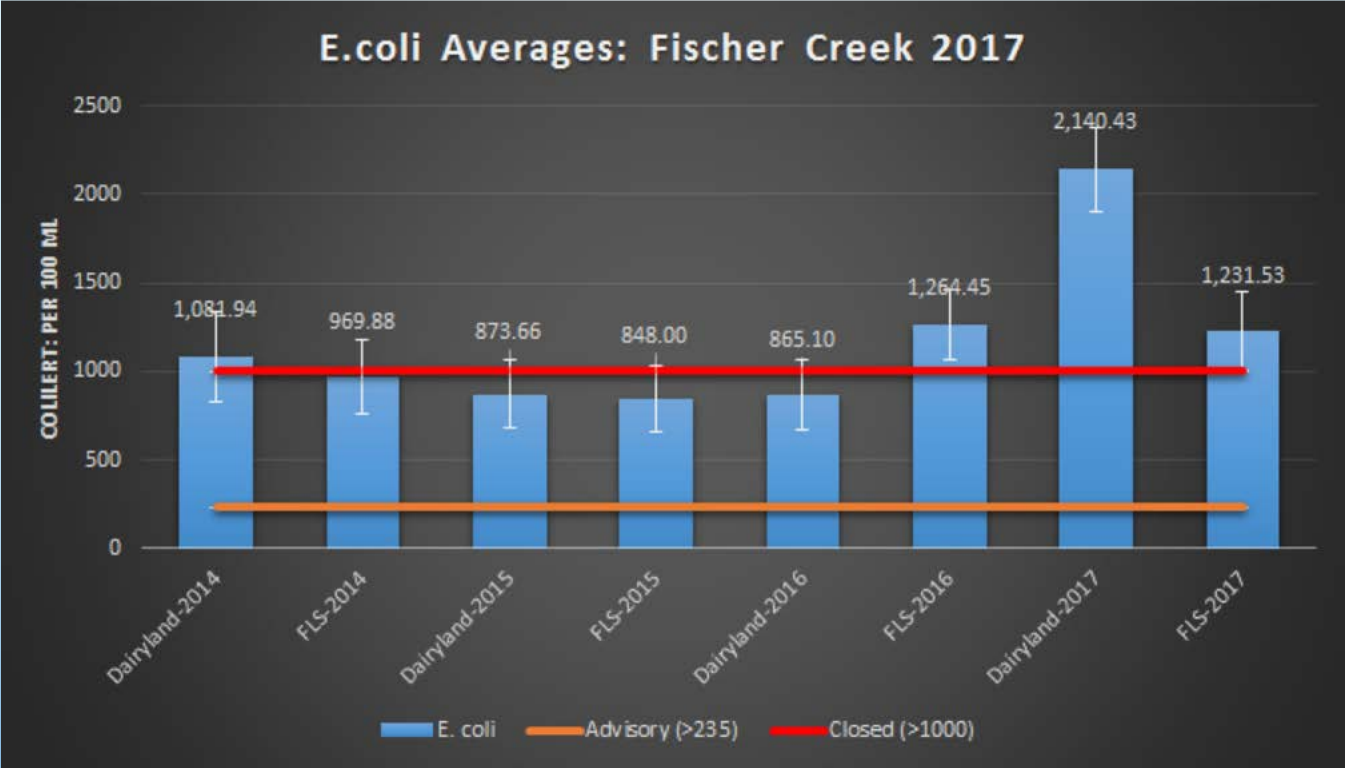


Fischer Creek LS Analysis

- Water turned emerald-green shade after rain events.
- Seemed to accumulate with time (greener as the time went on).
- The only site we sampled with a notable correlation between phosphate and turbidity.
- The fact that there is low flow and that the site is further downstream both likely attribute to the observed increase in green color.
- Increased turbidity with rain (turbidity trend follows phosphate trend).



Fischer Creek Analysis



Fischer Creek Analysis

- Turbidity and phosphates correlated with one another.
- The FLS total phosphate was more more than double the dissolved phosphate level. This means there may have been a point source of phosphate contamination either at the site site of FLS or between F-Dairy (the upstream site) and FLS.
- *E. coli* was more than double its value of last year at the site of Fischer Dairyland Dr., but both sites were above the closed value.
- No Phosphate loading data.



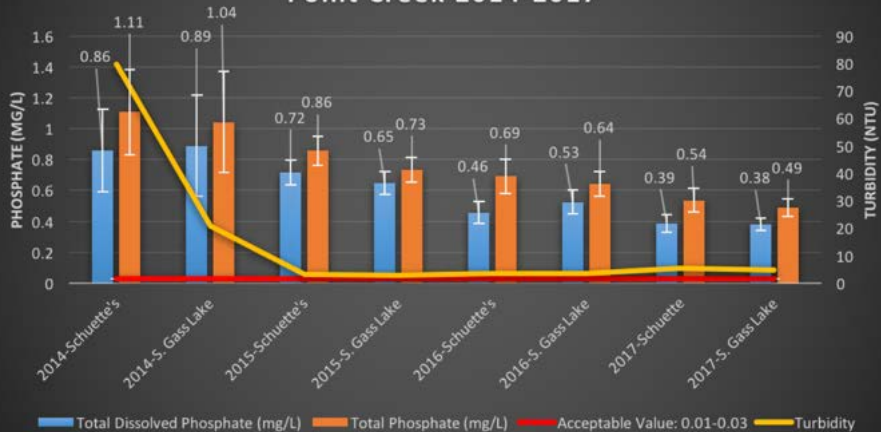
PO02	Point Creek Schutte's
PO03	Point Creek S. Gass Lake Rd.

Point Creek

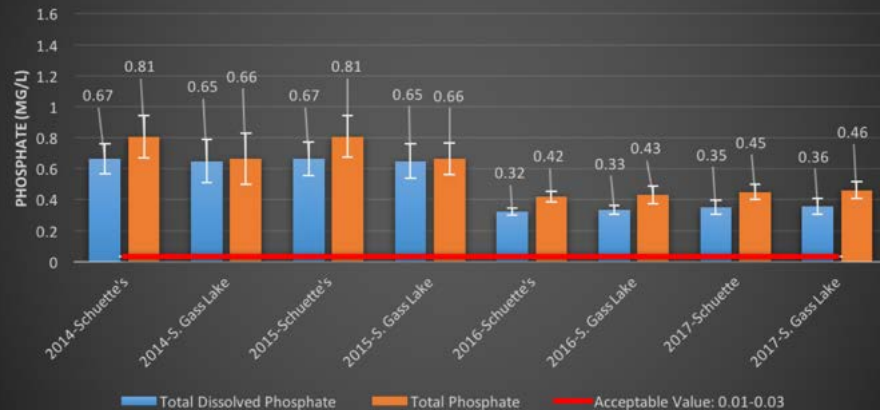


Point Creek Analysis

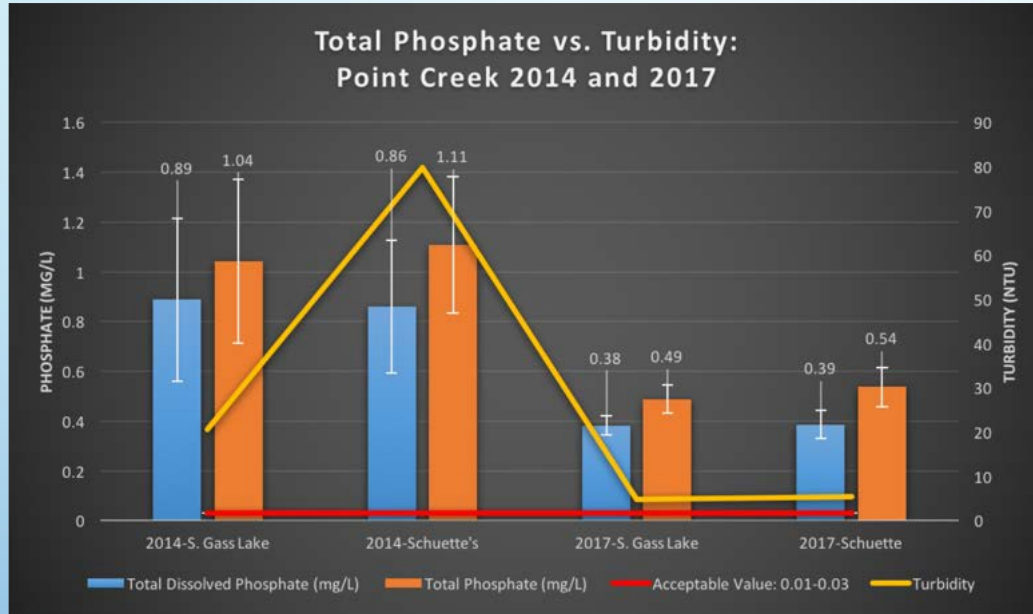
**Total and Dissolved Phosphates with Rain Events:
Point Creek 2014-2017**



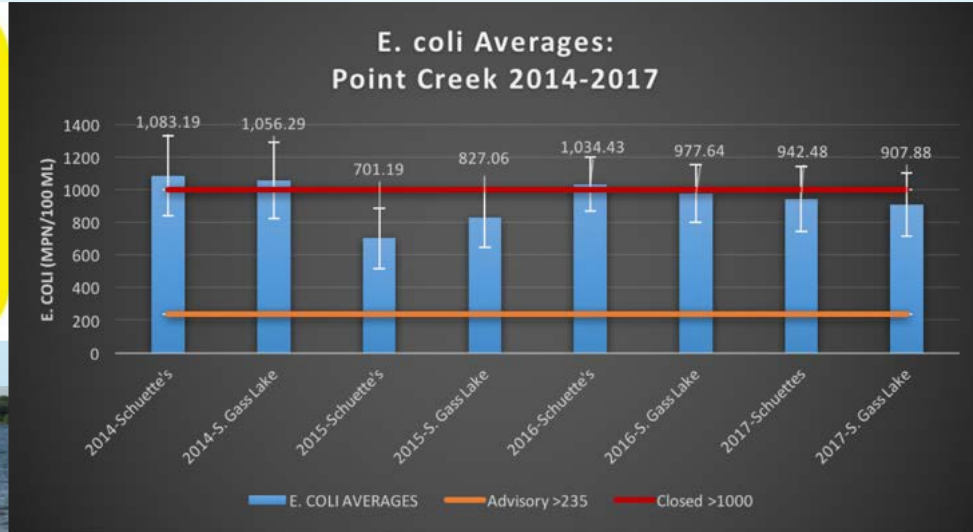
**Total and Dissolved Phosphates without Rain Events:
Point Creek 2014-2017**



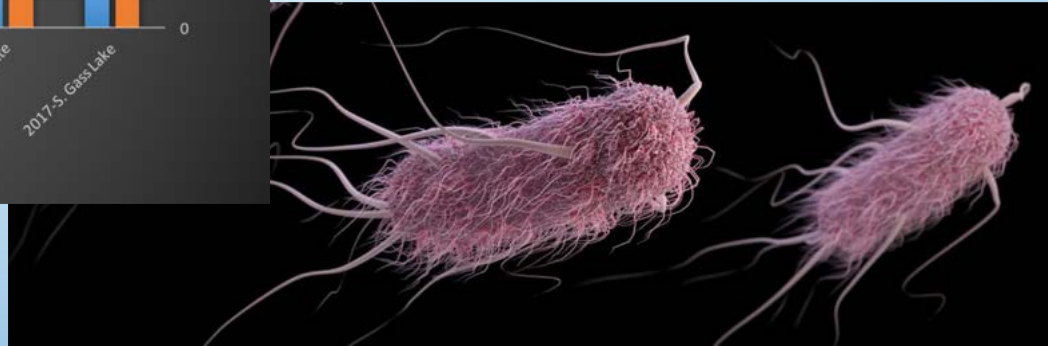
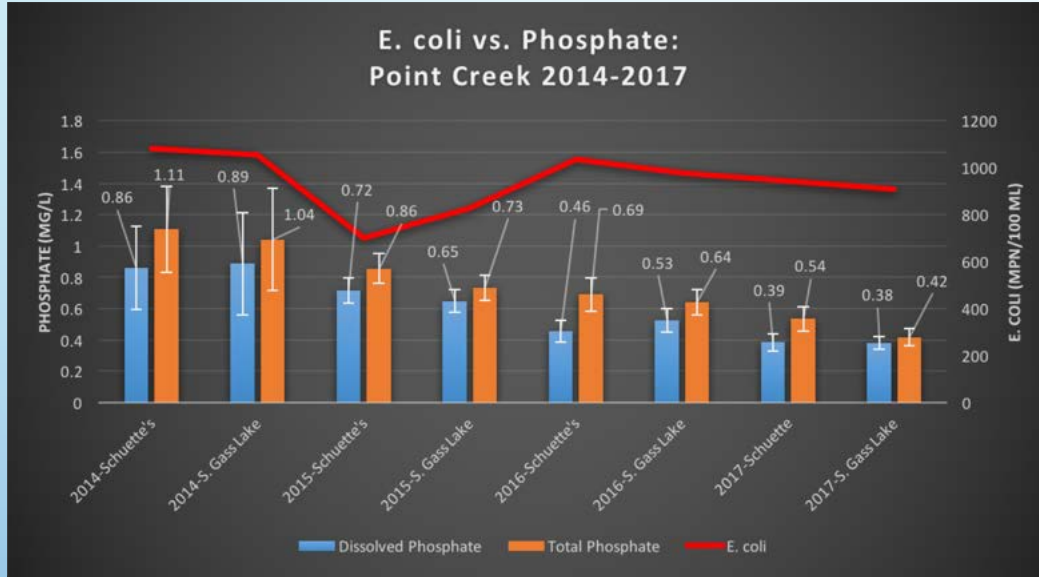
Point Creek Analysis



Point Creek Analysis



Point Creek Analysis



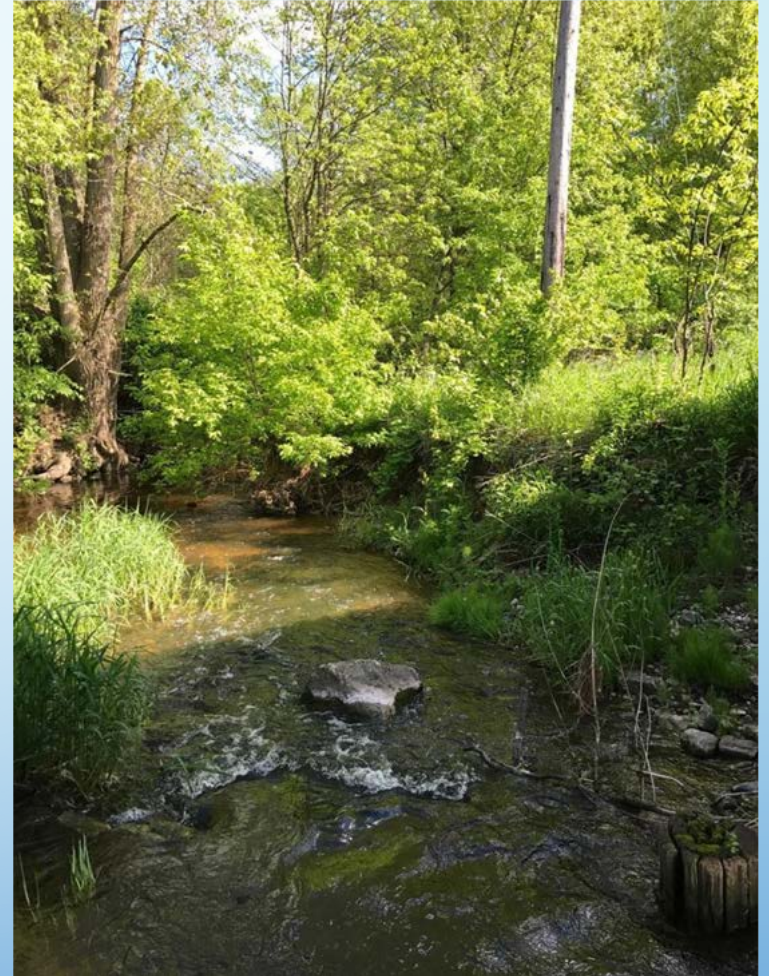
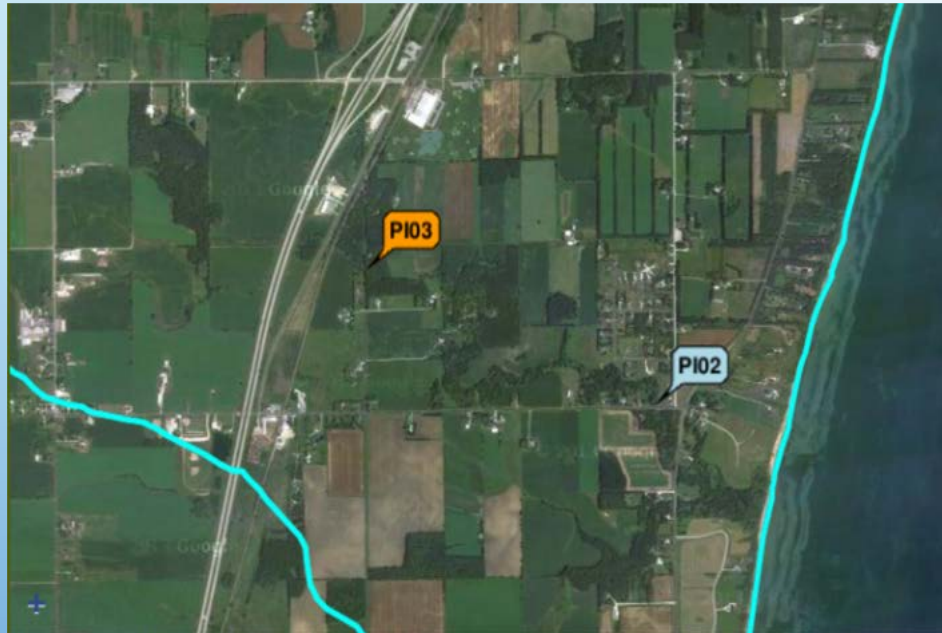
Point Creek Analysis Summary

- *Phosphate totals decreasing overall, but this trend slowing and still far from optimal range.
- **E. coli* is still well beyond advisory.
- **E. coli* is not decreasing like phosphate.
- *Phosphate levels with and without rain similar..
- *Low turbidity and yet high phosphate levels.
- *Possibly another source of contamination other than surface runoff.
- *No Phosphate loading data.

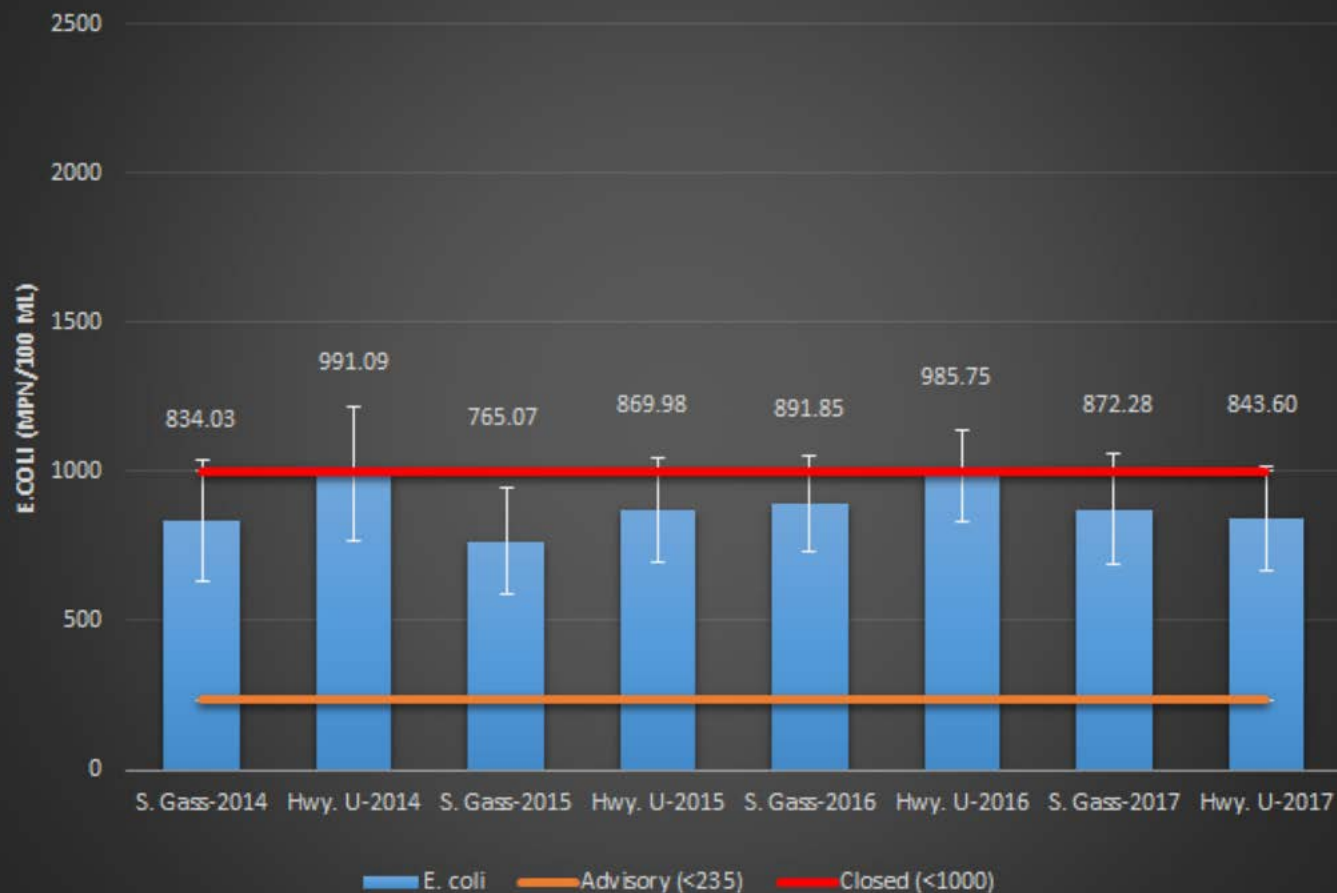


Pine Creek

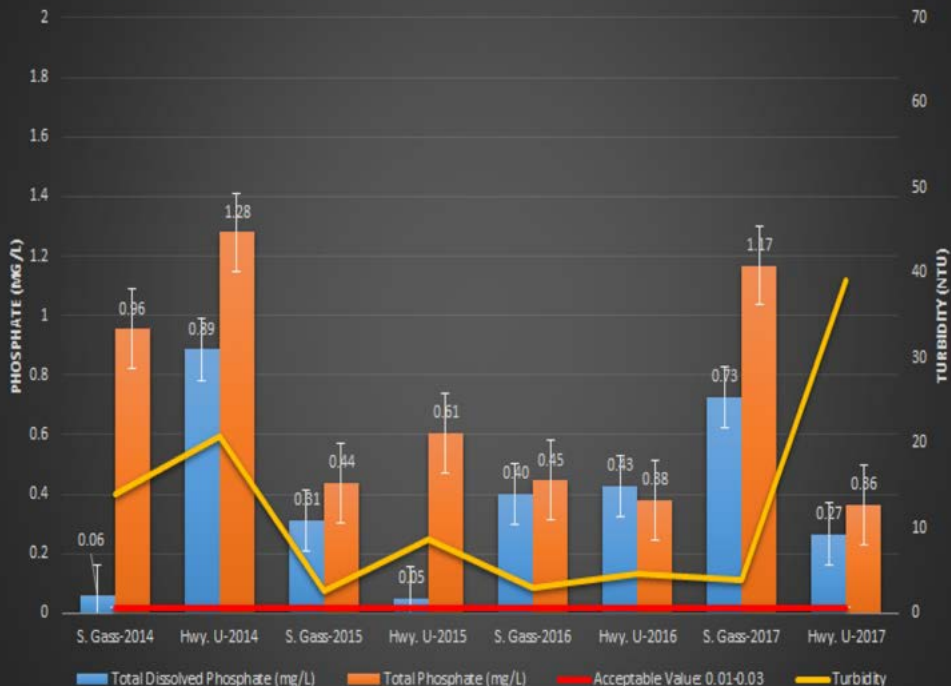
PI02	Pine Creek Hwy. U
PI03	Pine Creek South Gass Lake Rd.



E.Coli Averages: Pine Creek



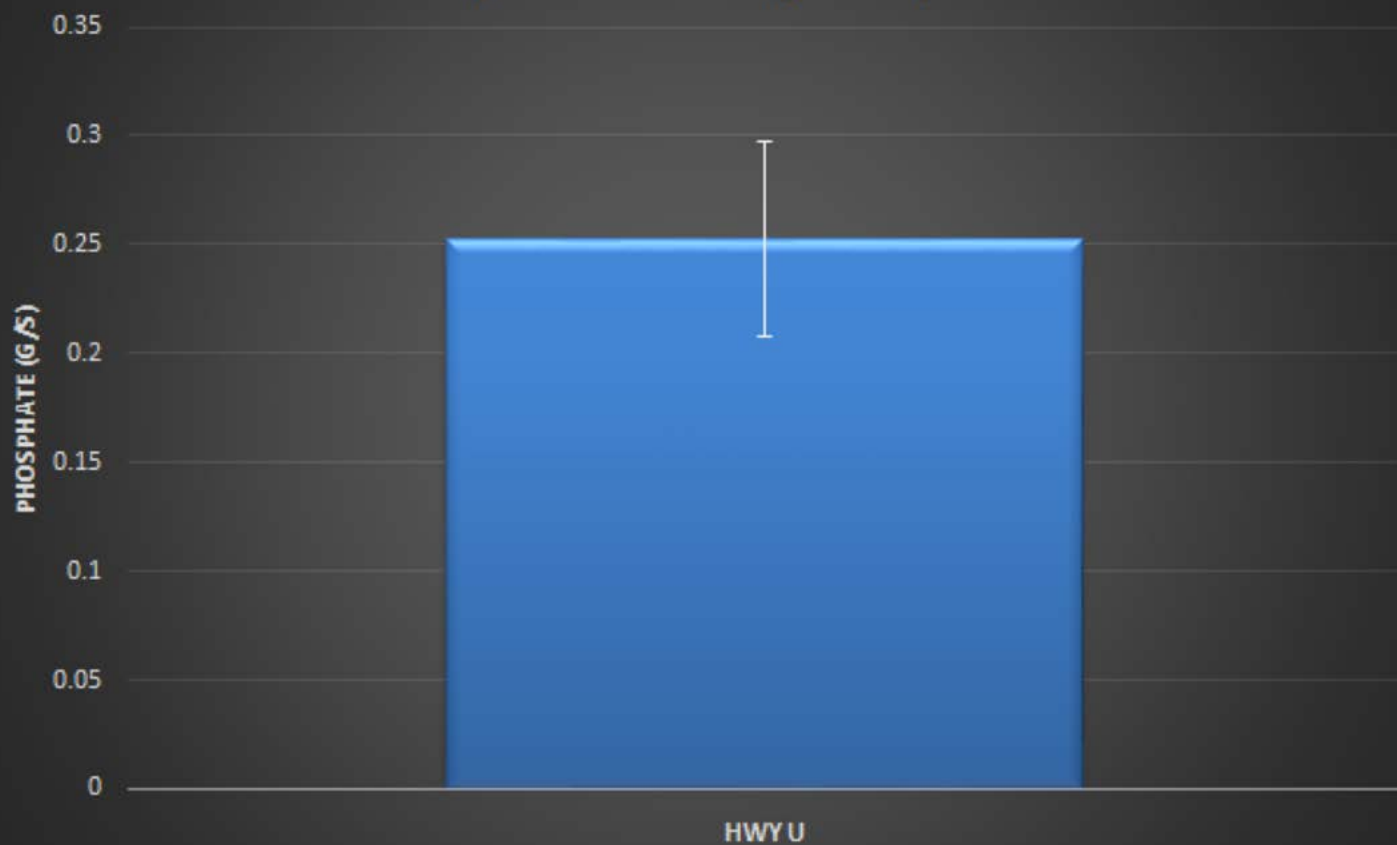
Total and Dissolved Phosphate with Rain Events: Pine Creek



Total and Dissolved Phosphate without Rain Events: Pine Creek

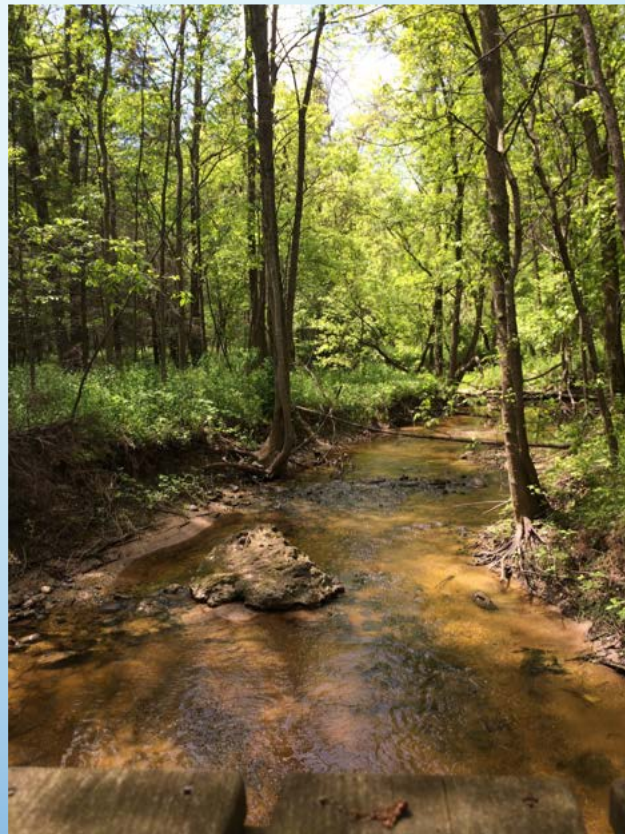


Phosphate Loading: Hwy U 2017

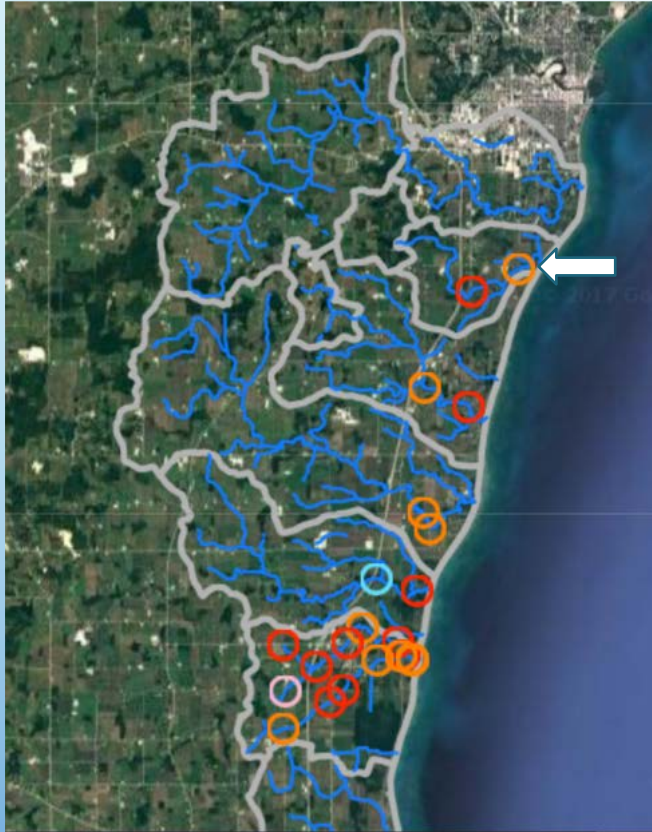


Pine Creek Analysis

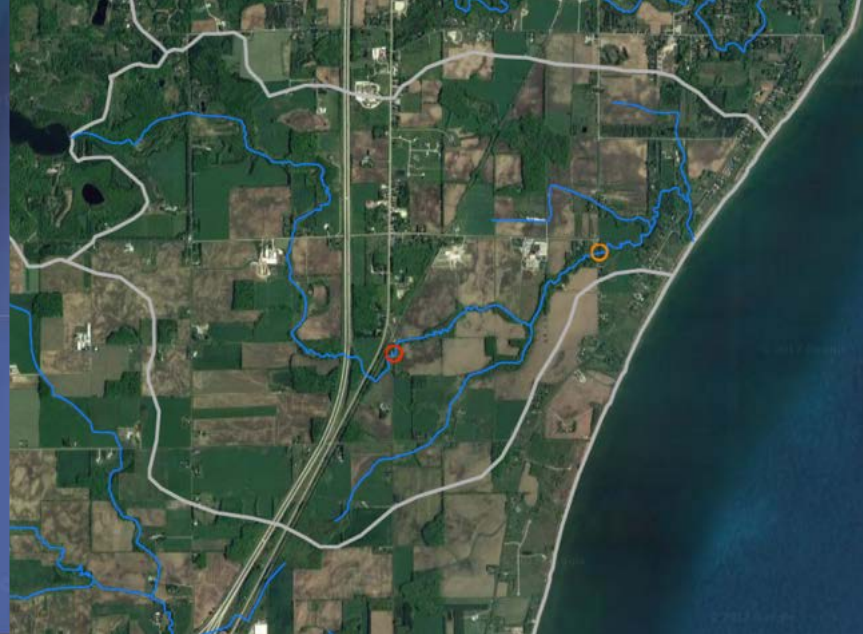
- Decrease in *E.coli* but still above advisory
- Drastic increase in total and dissolved phosphate, and ammonia nitrogen
- All other parameters similar to past years
- More to come...



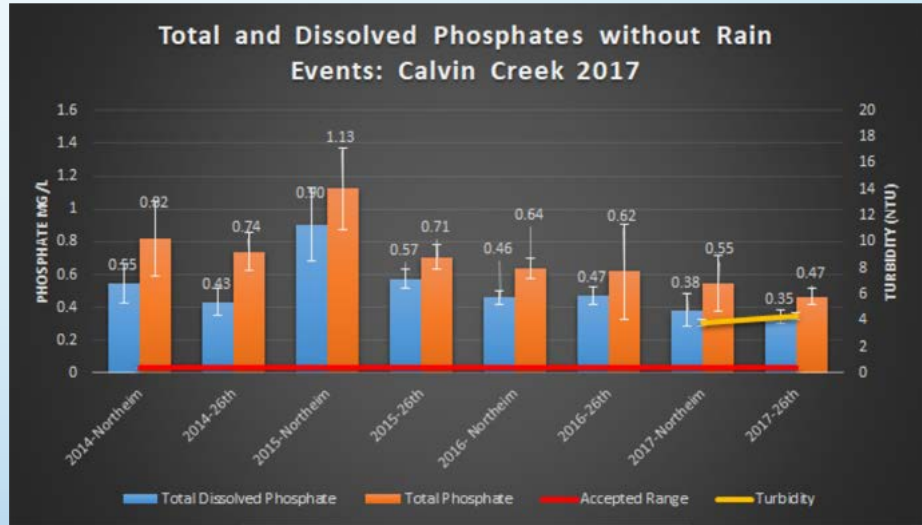
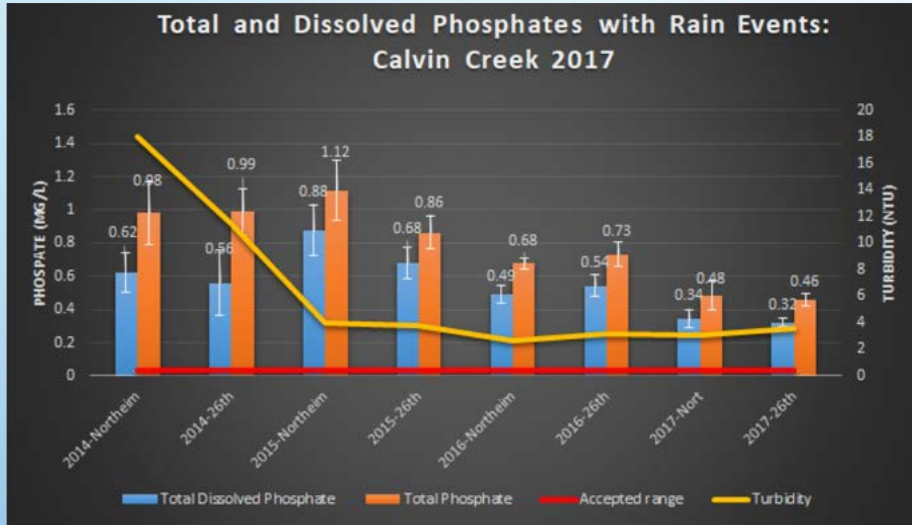
Calvin Creek



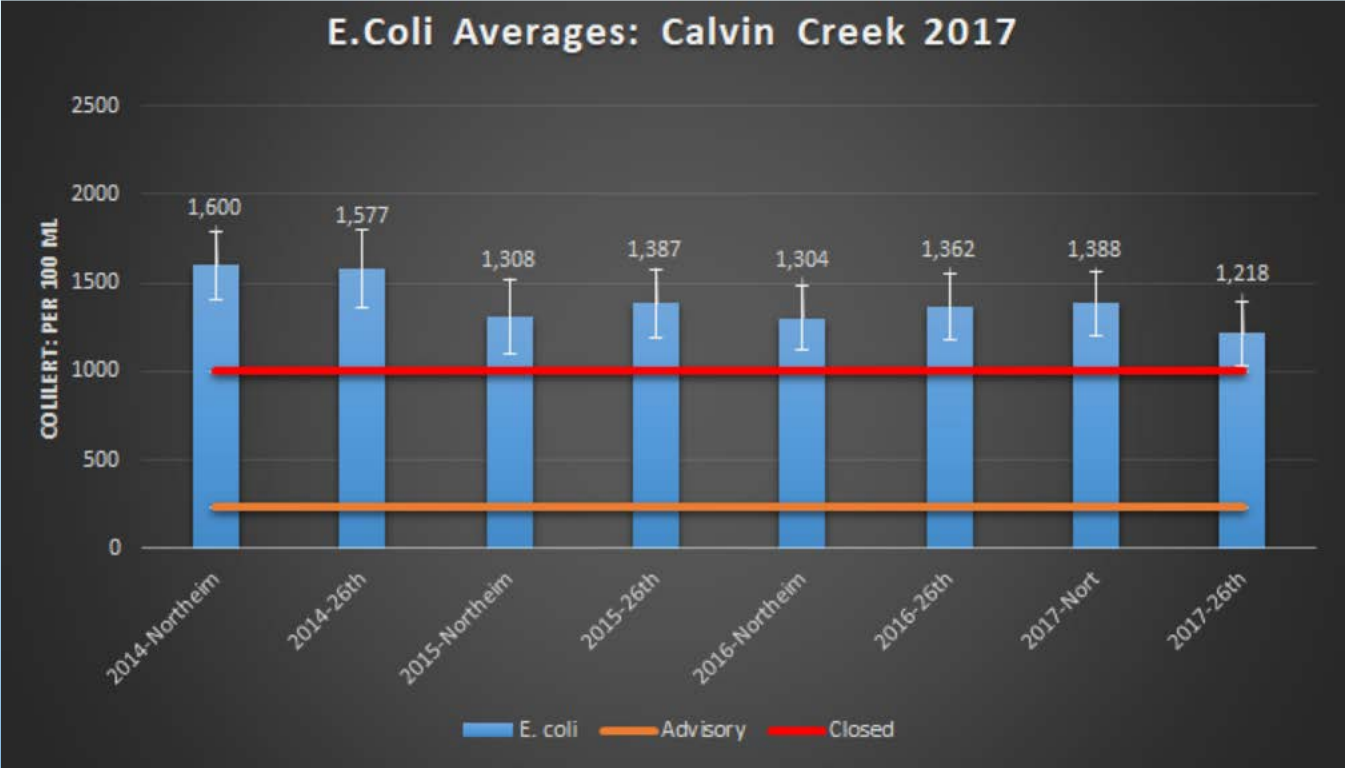
CA02	Calvin Creek South 26th St.
CA03	Calvin Creek Northeim Rd.



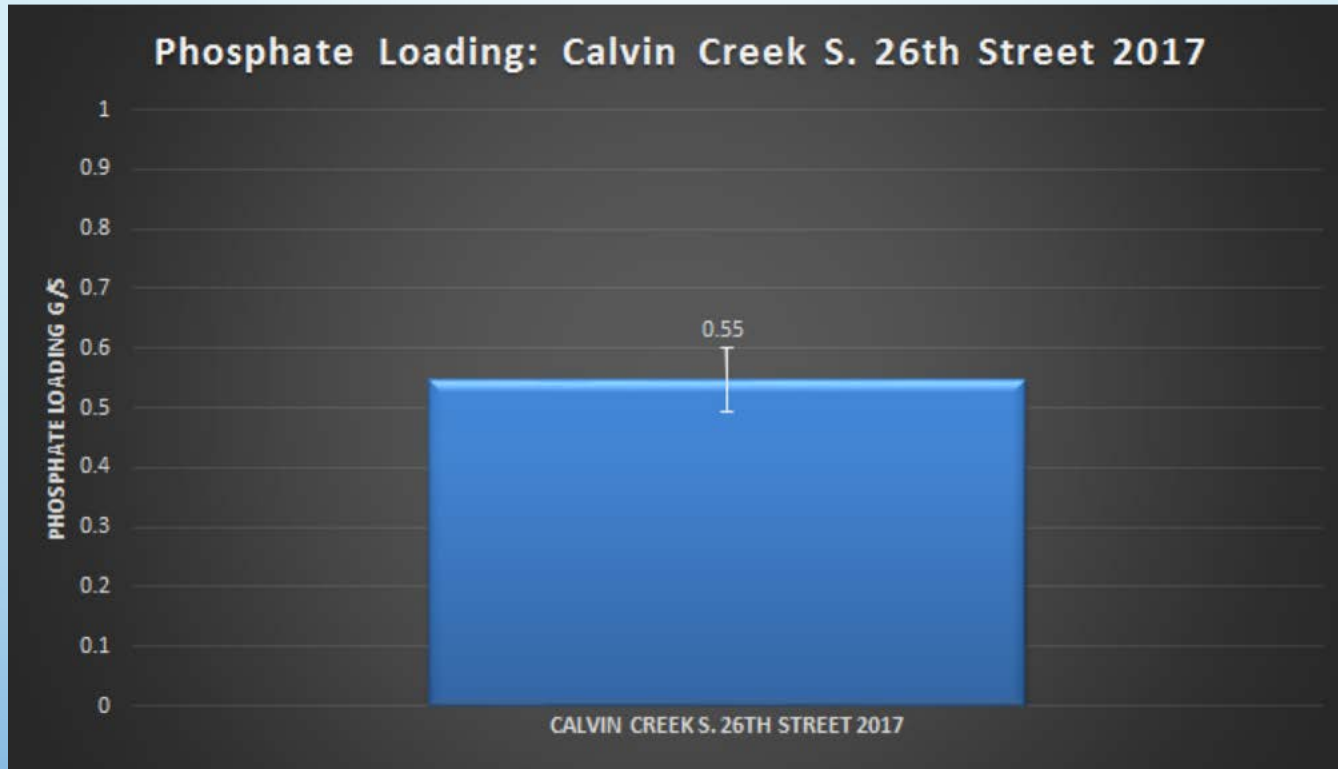
Calvin Creek Analysis



Calvin Creek Analysis



Calvin Creek Analysis



Calvin Creek Analysis

Phosphate Loading Data:

0.547 g/s

729 pounds/week

9,520 pounds/summer

E.Coli levels remained high and are past the closed range

Lower values for Total Phosphate and Dissolved Phosphate in a contin

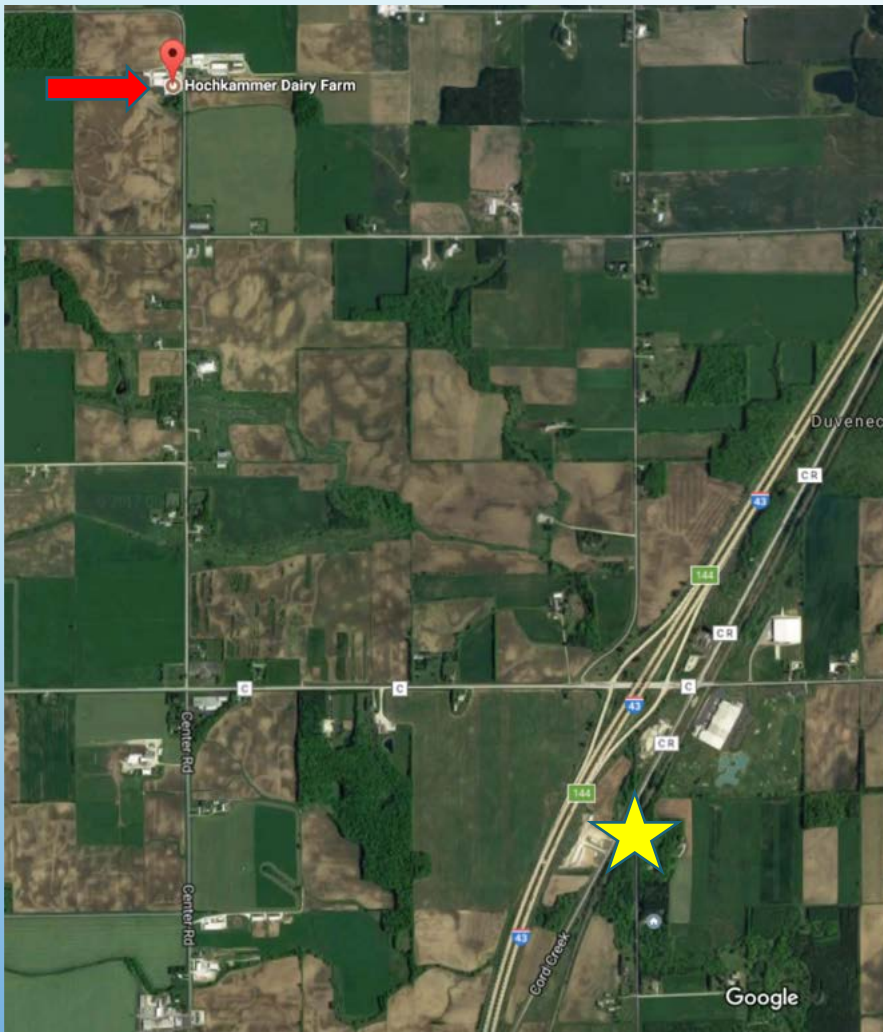
Phosphate levels did not show much correlation to turbidity

Low rain event impact on Phosphate for 2017



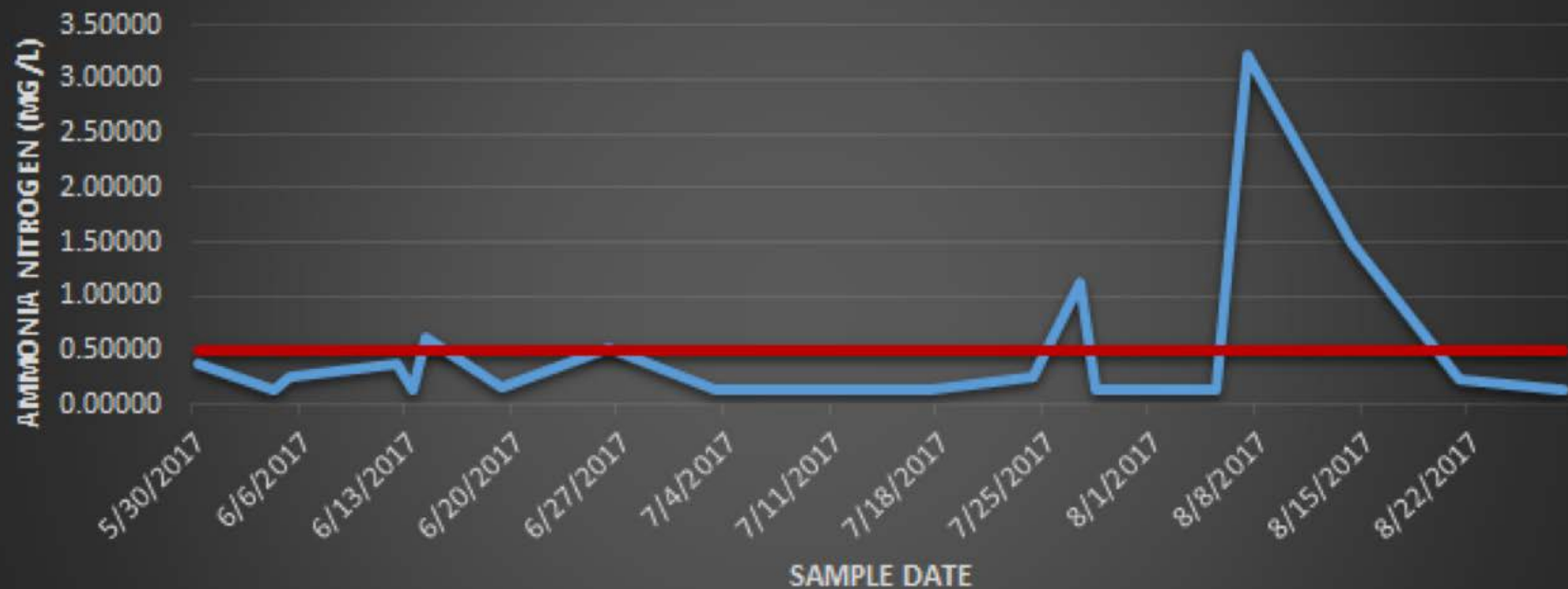
Pine Creek Manure Spill August 7th 2017





- Source: Hochkammer Dairy Farm
- Pine South Gass: 2.8 miles South East
- Concrete plug fail in manure pit
- Discovered early afternoon August 7th
- Manitowoc County lake testing

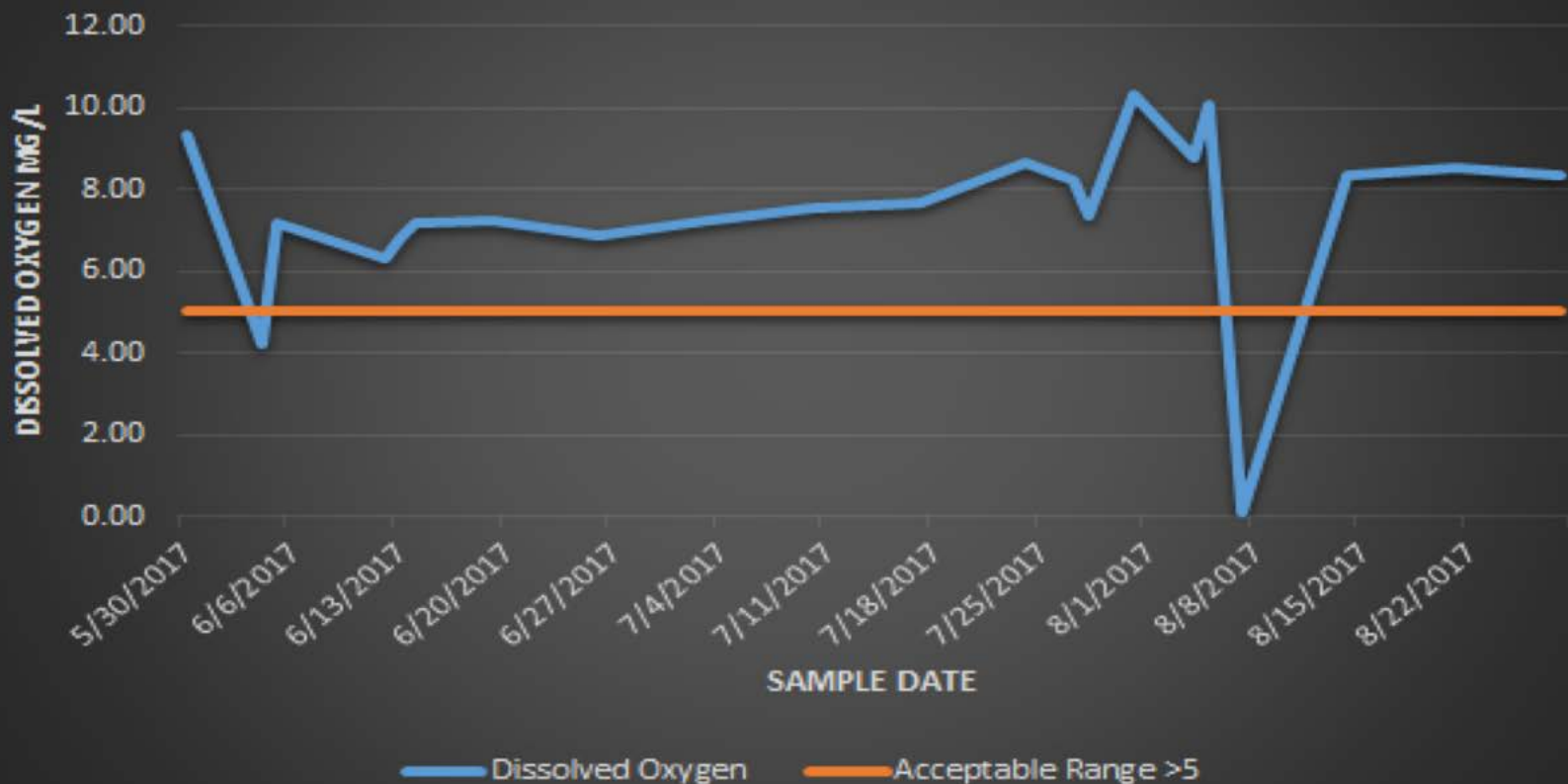
Ammonia Nitrogen (NH₄): Pine S. Gass Lake Rd



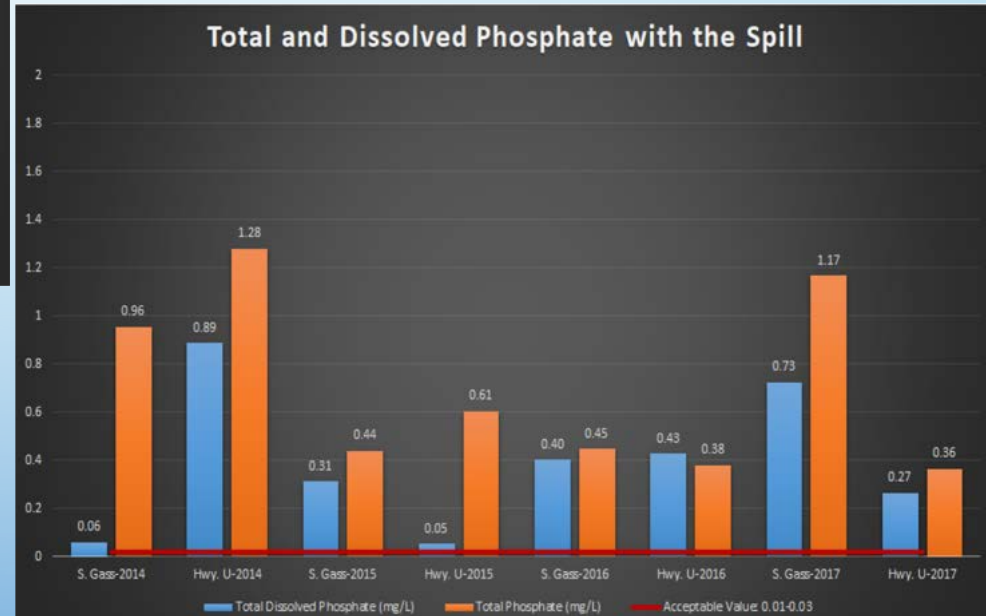
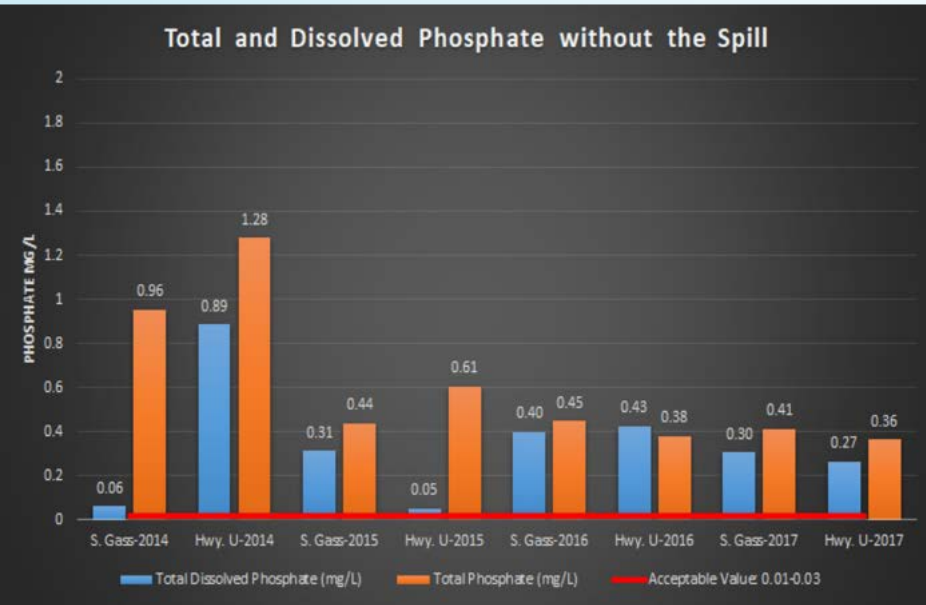
Ammonia Nitrogen (NH₄)

Acceptable Range <math>< 0.5</math>

Dissolved Oxygen: Point S. Gass Lake Rd



An interesting comparison...

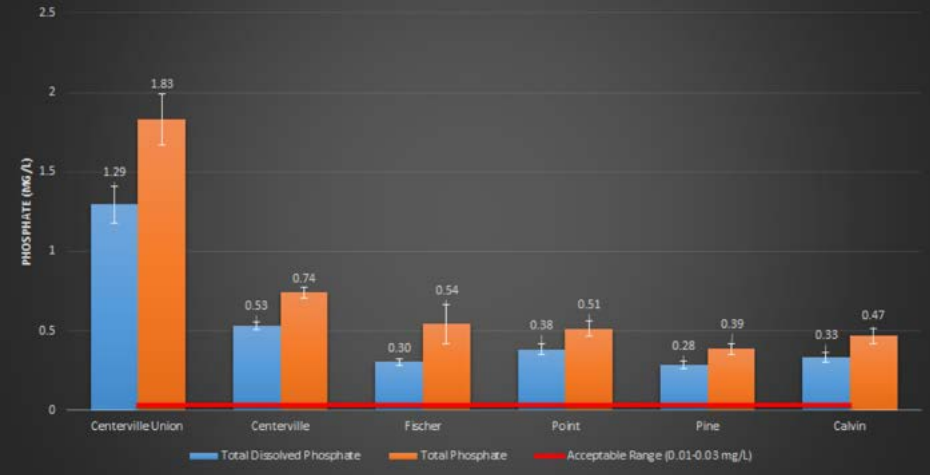


Overall Analysis

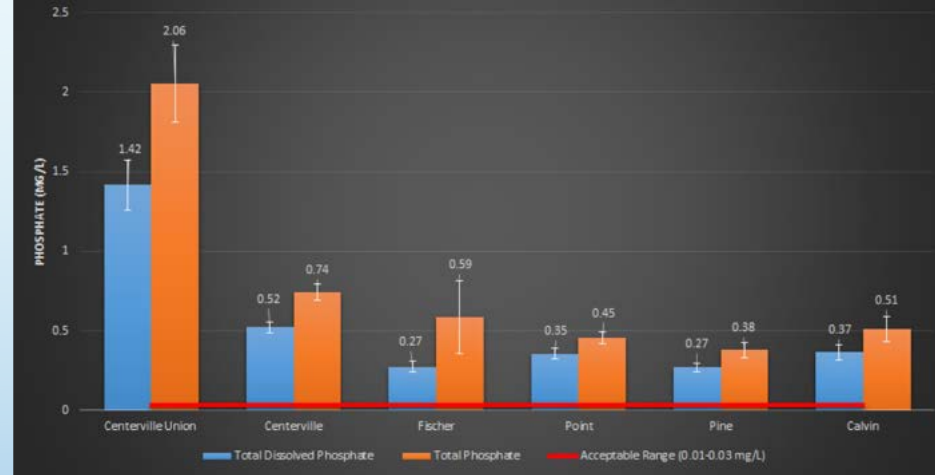
- Pine Creek spill and helping the community
- Union South has some of the highest nutrient input out of all our sites
- E. coli hasn't really changed much over time and remains above safe levels
- No phosphate correlation with rainfall like previous years
 - Phosphates entering stream without rain
 - Turbidity doesn't match up with phosphate levels
 - Not just surface runoff
 - Dissolved and totals are close together
 - Surface runoff would likely increase turbidity
 - Most of the phosphate we found was soluble

Overall Analysis

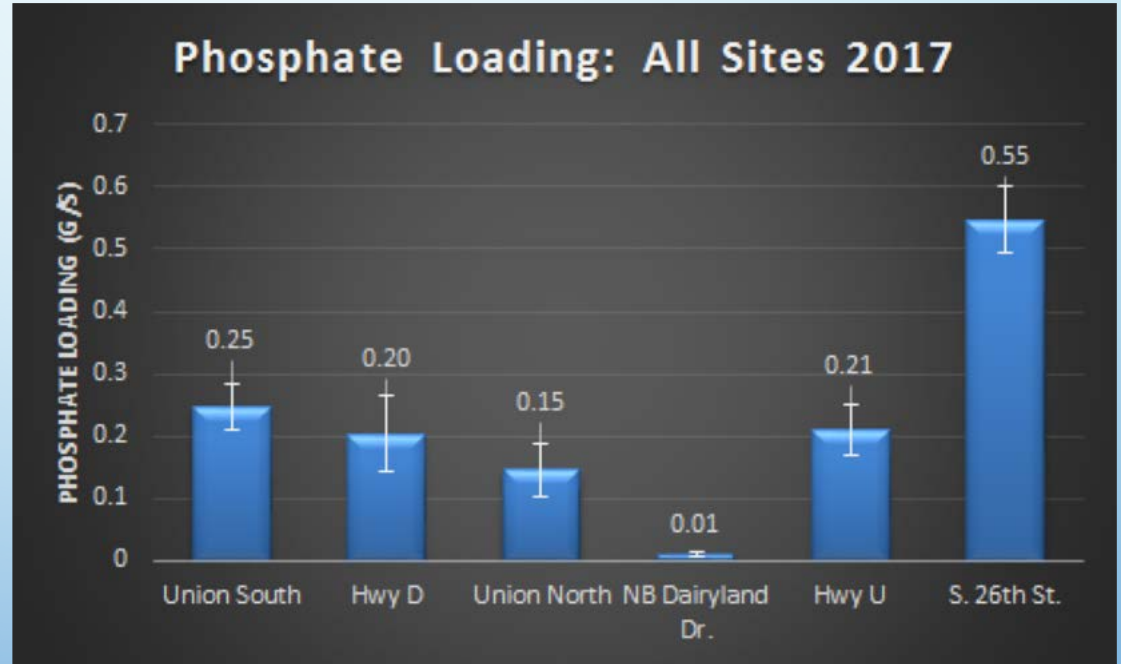
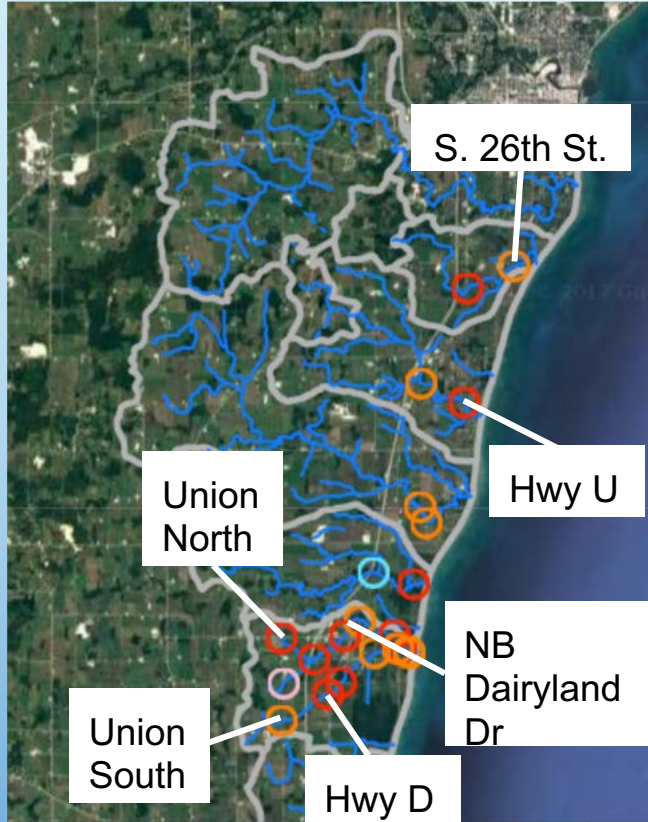
Phosphate Averages with Rain Events: All Creeks 2017



Phosphate Averages without Rain Events: All Creeks 2017



Overall Analysis



Course of Action

- Continued monitoring and analysis of stream sites
- Continued communication with collaborators
- Increased communication with community
- TMDL project.



Questions, Comments, & Concerns:

Fun Fact:

- This summer alone the Stream Team collected and analyzed 489 sample sets
- Total sample sets by the veterans
 - Paige: ~1,814
 - Abby: ~1,252

