# Stream Quality Assessment of Southern Manitowoc County -Summer 2017-

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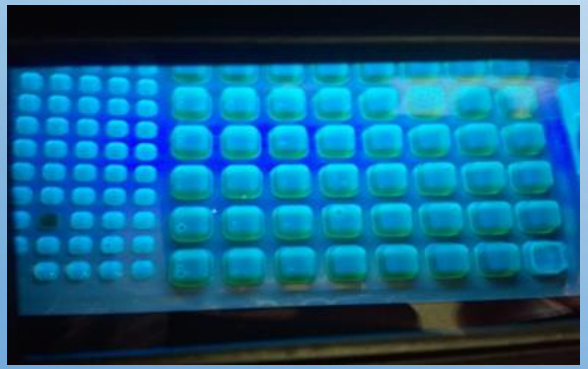
Faculty Advisors: Dr. Rebecca Abler and Dr. Richard Hein




# 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

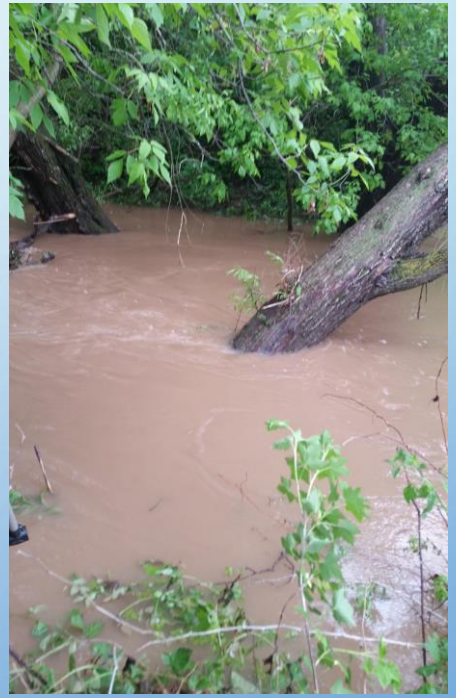
**Phosphate**- Phosphorus is essential for growth and metabolic reaction in plants in animals, though it is detrimental in large amounts. Acceptable Range: 0.01-0.03 mg/L (<0.10 mg/L max)

**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

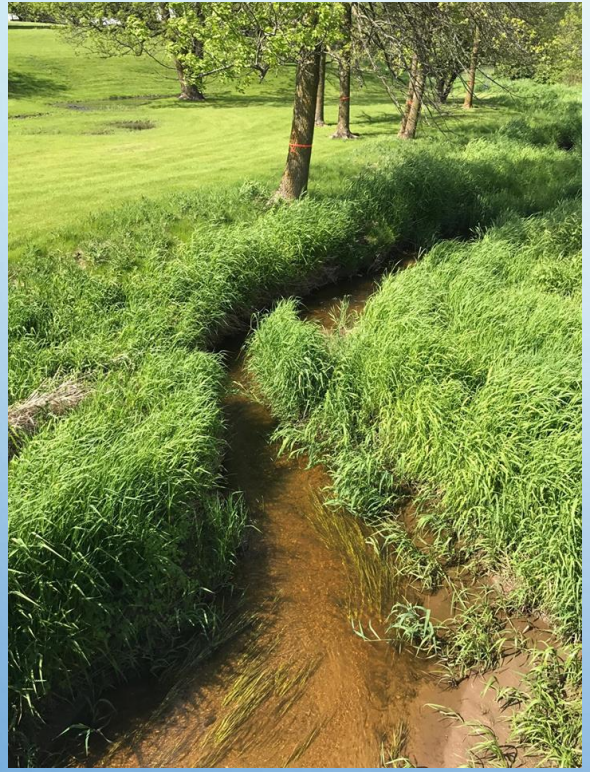
# Rain Data Comparison

- 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

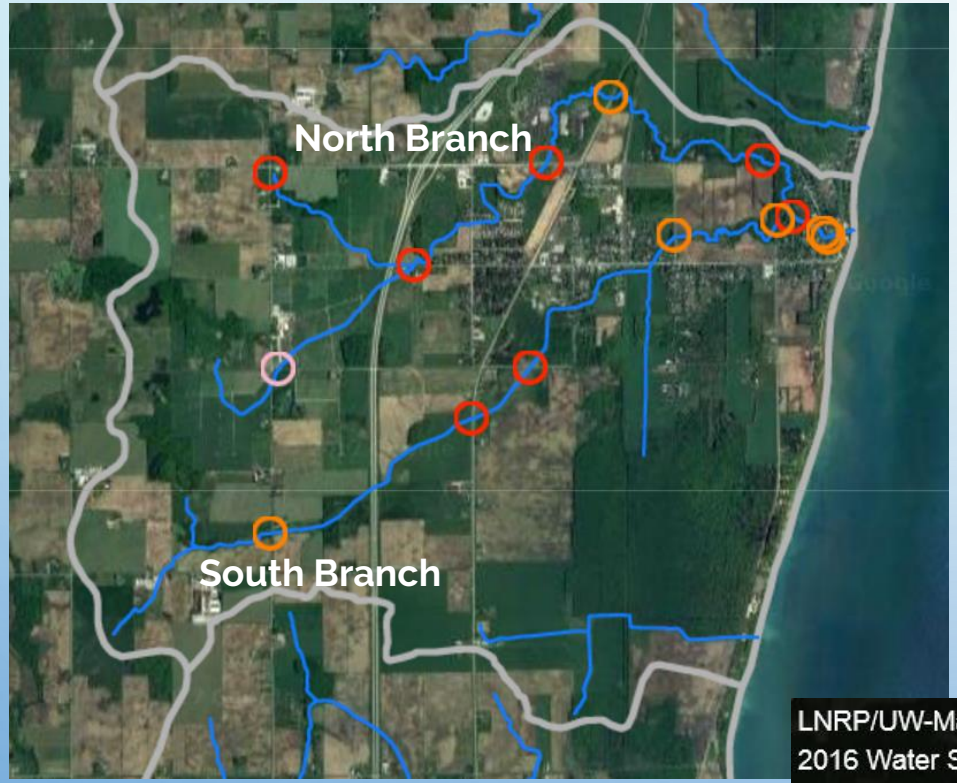


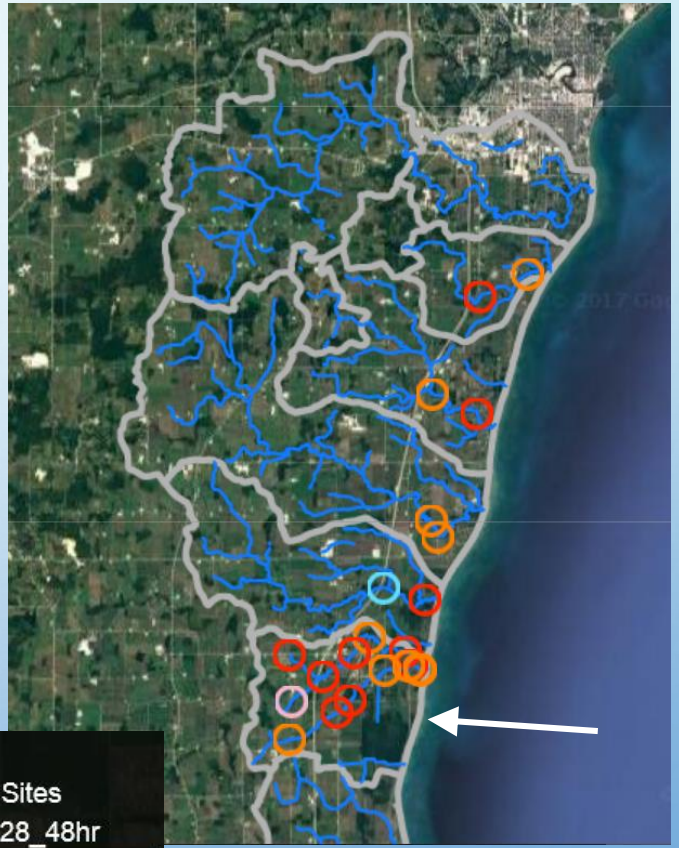
Journey to a new creek

# 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/UW-Manitowoc
2016 Water Sampling Sites
E.coli Week: 2016-08-28_48hr

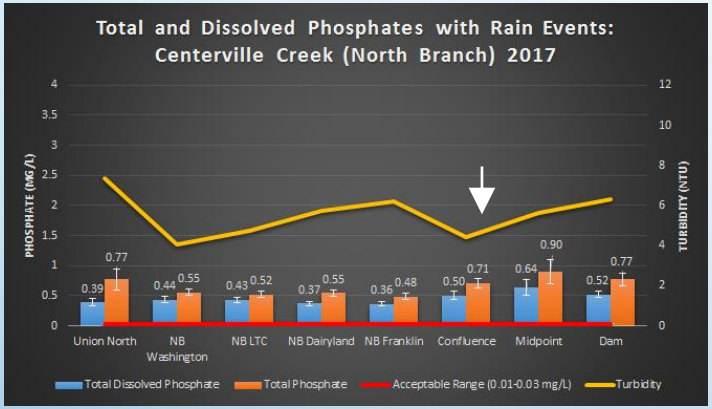
OK | Poor | Fail | No Data

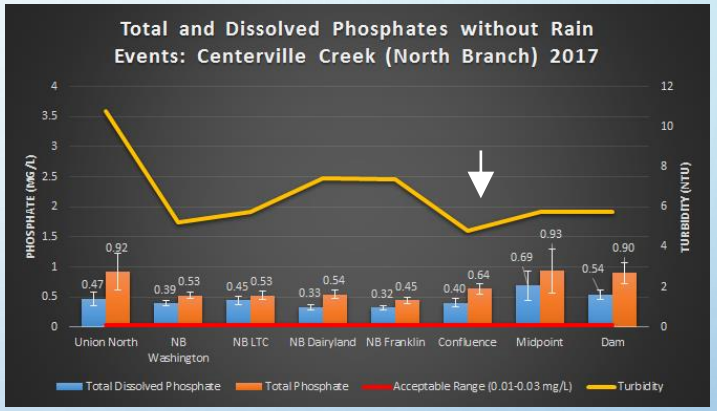
# Centerville Creek Averages

| 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 ($NH_3$) (mg/L) | 0.04008 | 0.02627 | 0.03371 | 0.05145 | 0.01011 | -0.04134 | <0.1 mg/L |
| Ammonia Nitrogen ($NH_4$) (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 |

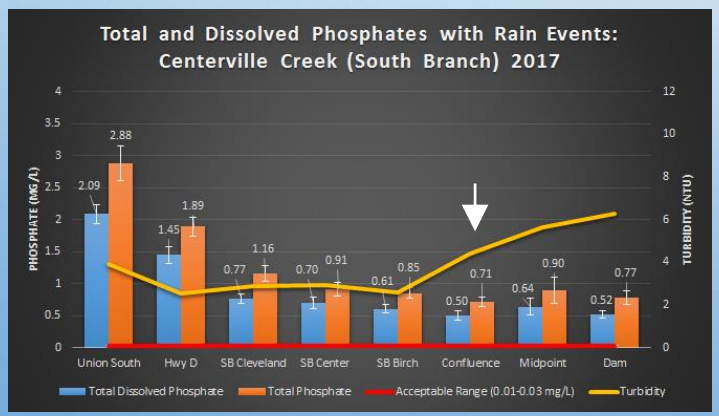
# Centerville Creek 2017 Site Analysis

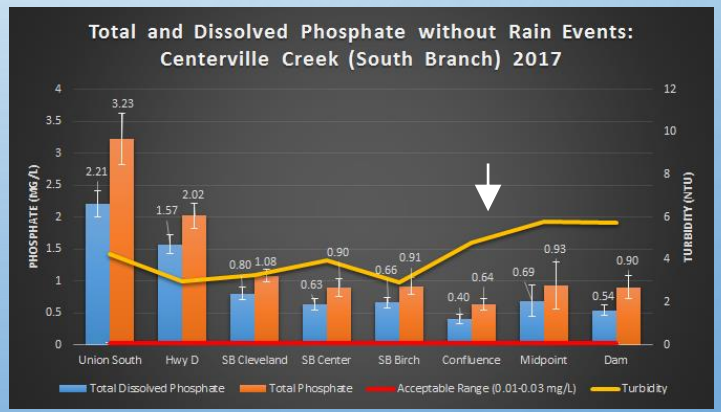
North Branch:




South Branch:



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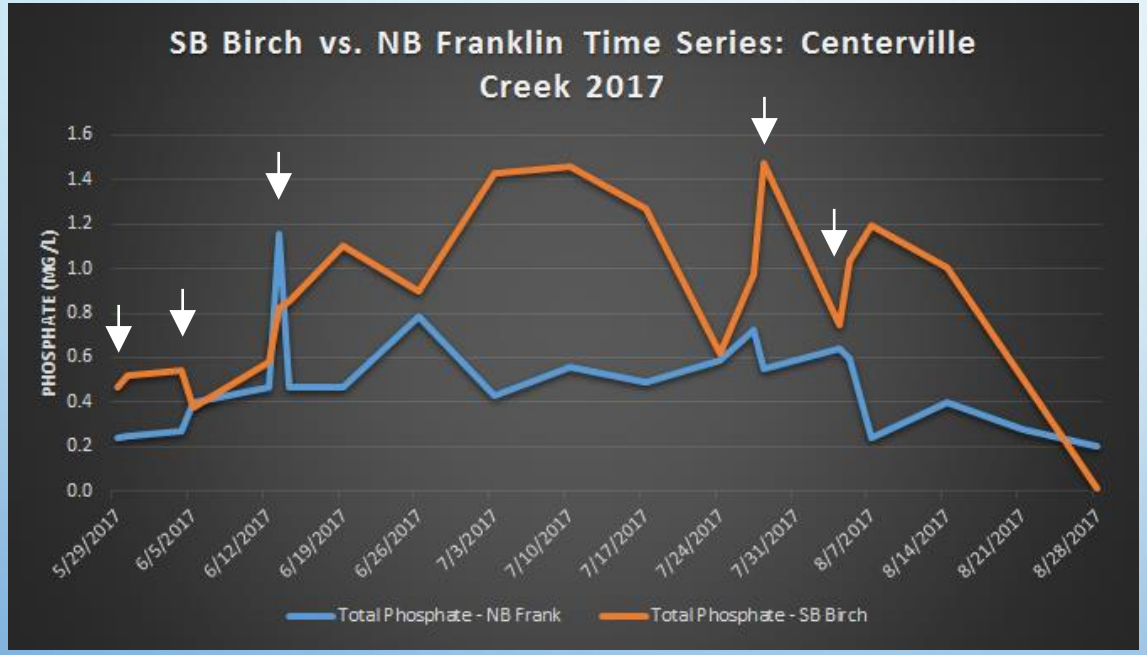
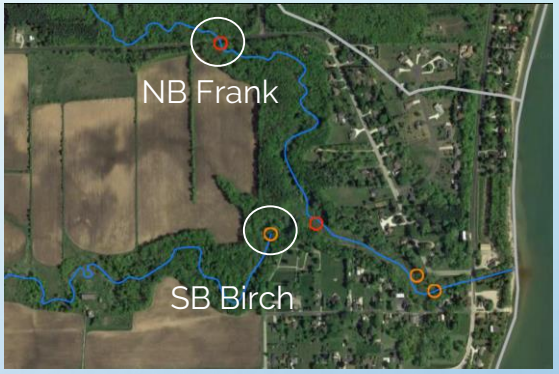
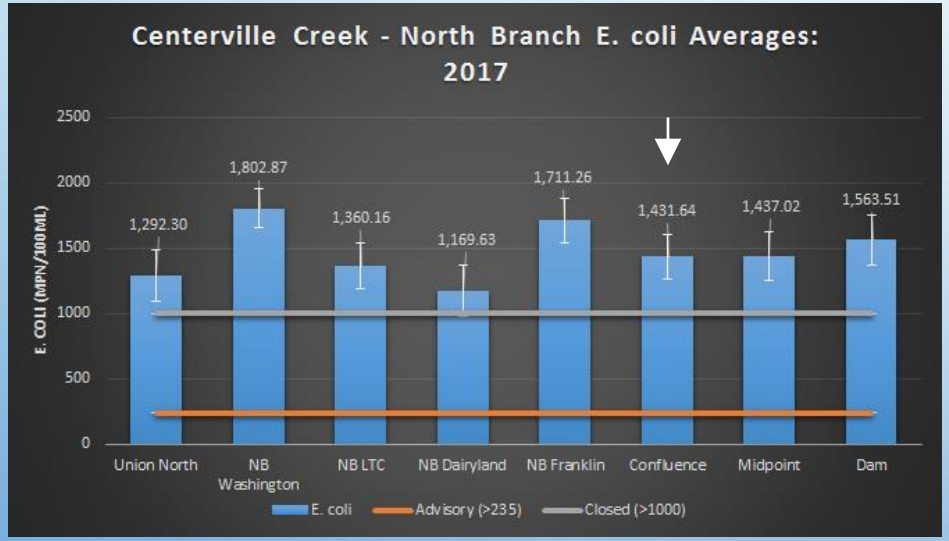


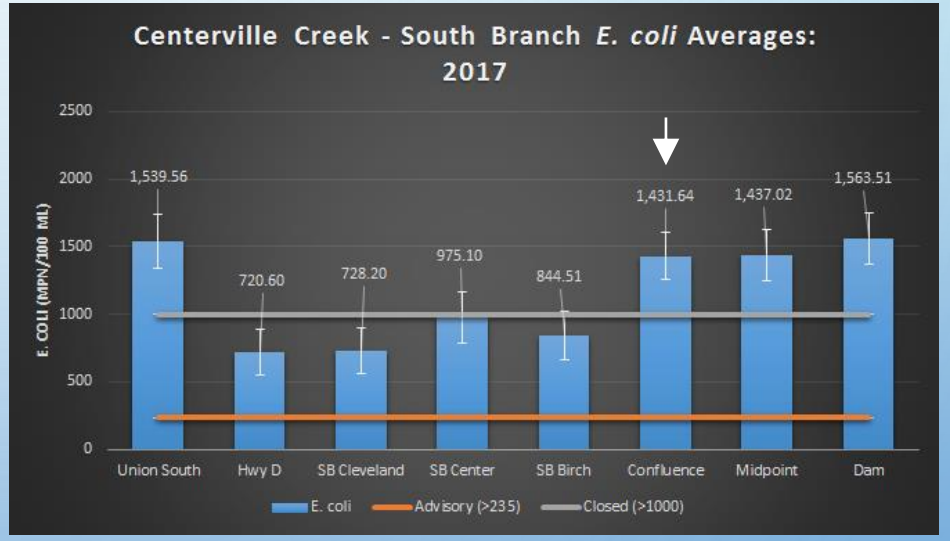

Total Phosphate over time plotting North Branch against South Branch




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

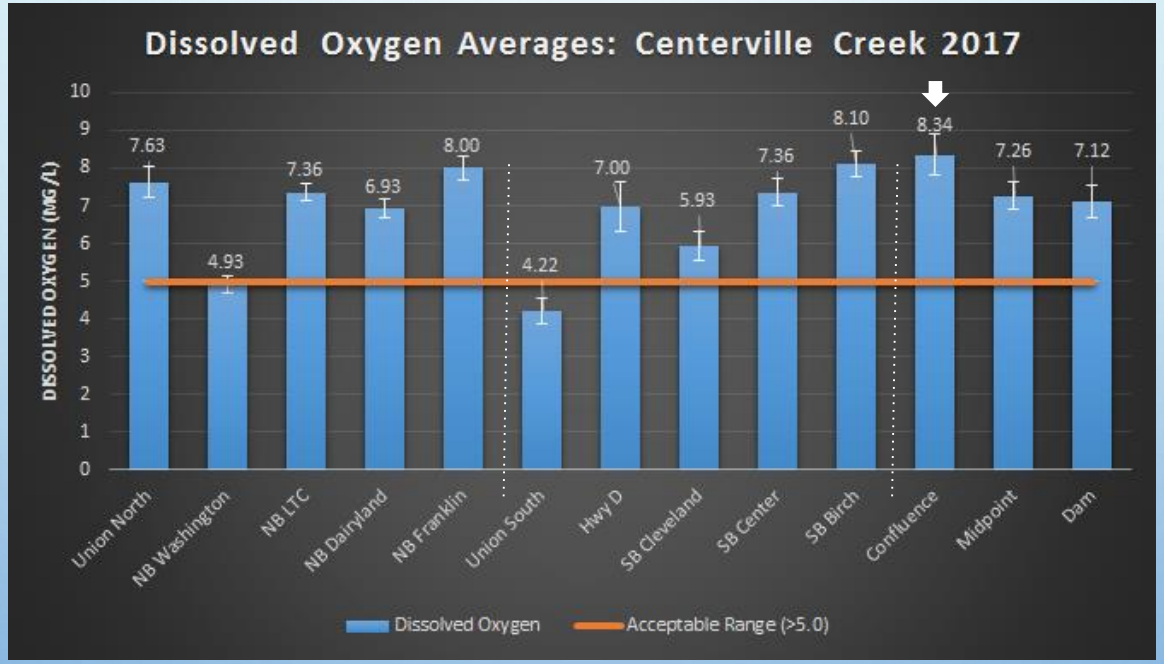
# Centerville Creek 2017 Site Analysis



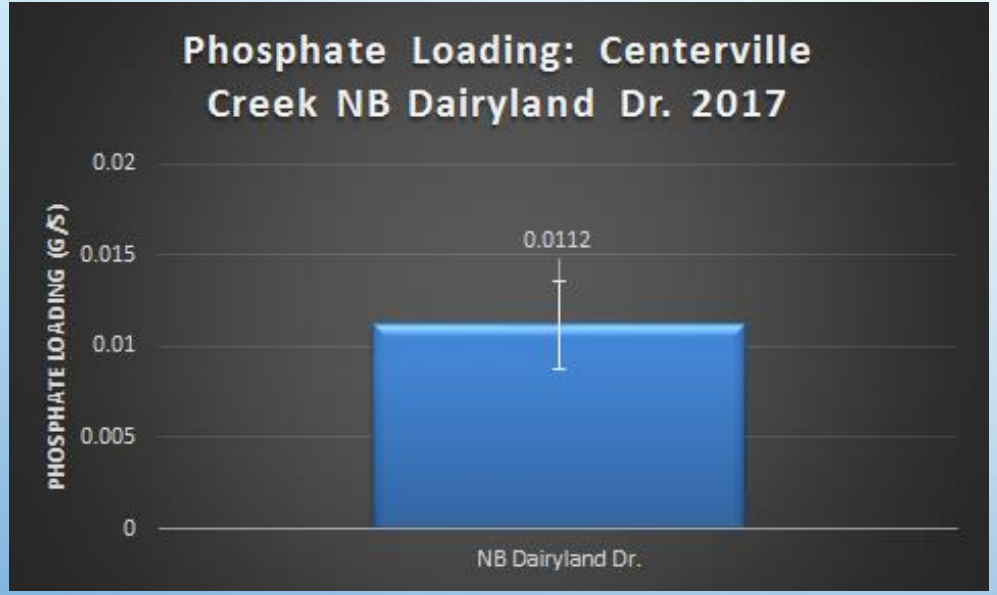

*E. coli* Averages

# Centerville Creek 2017 Site Analysis

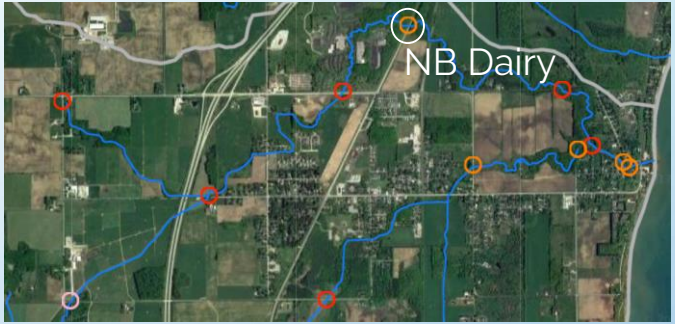


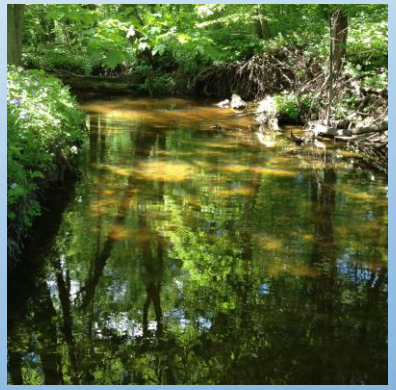

Dissolved Oxygen Averages

# Centerville Creek 2017 Site Analysis




Phosphate Loading Averages

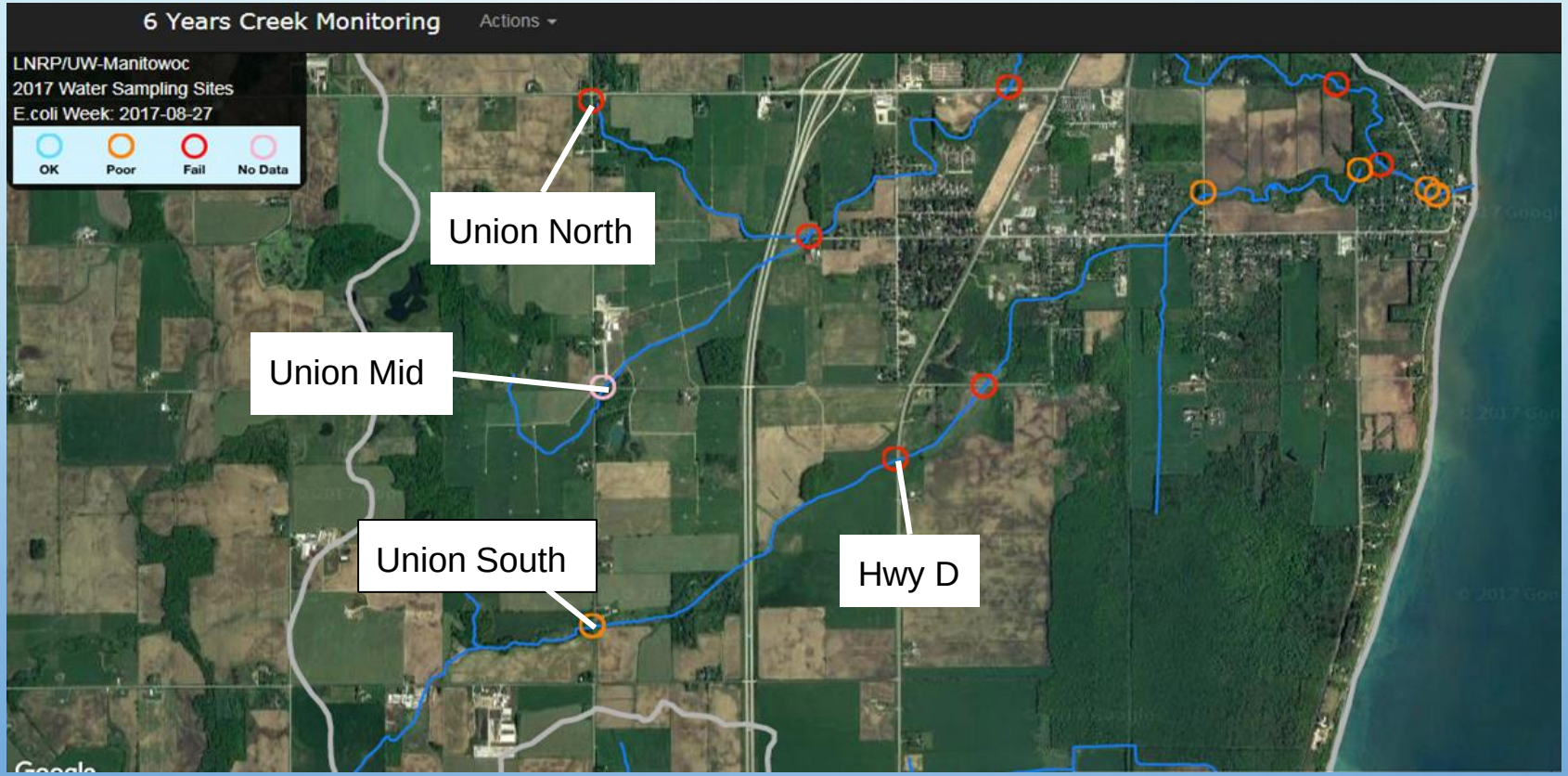


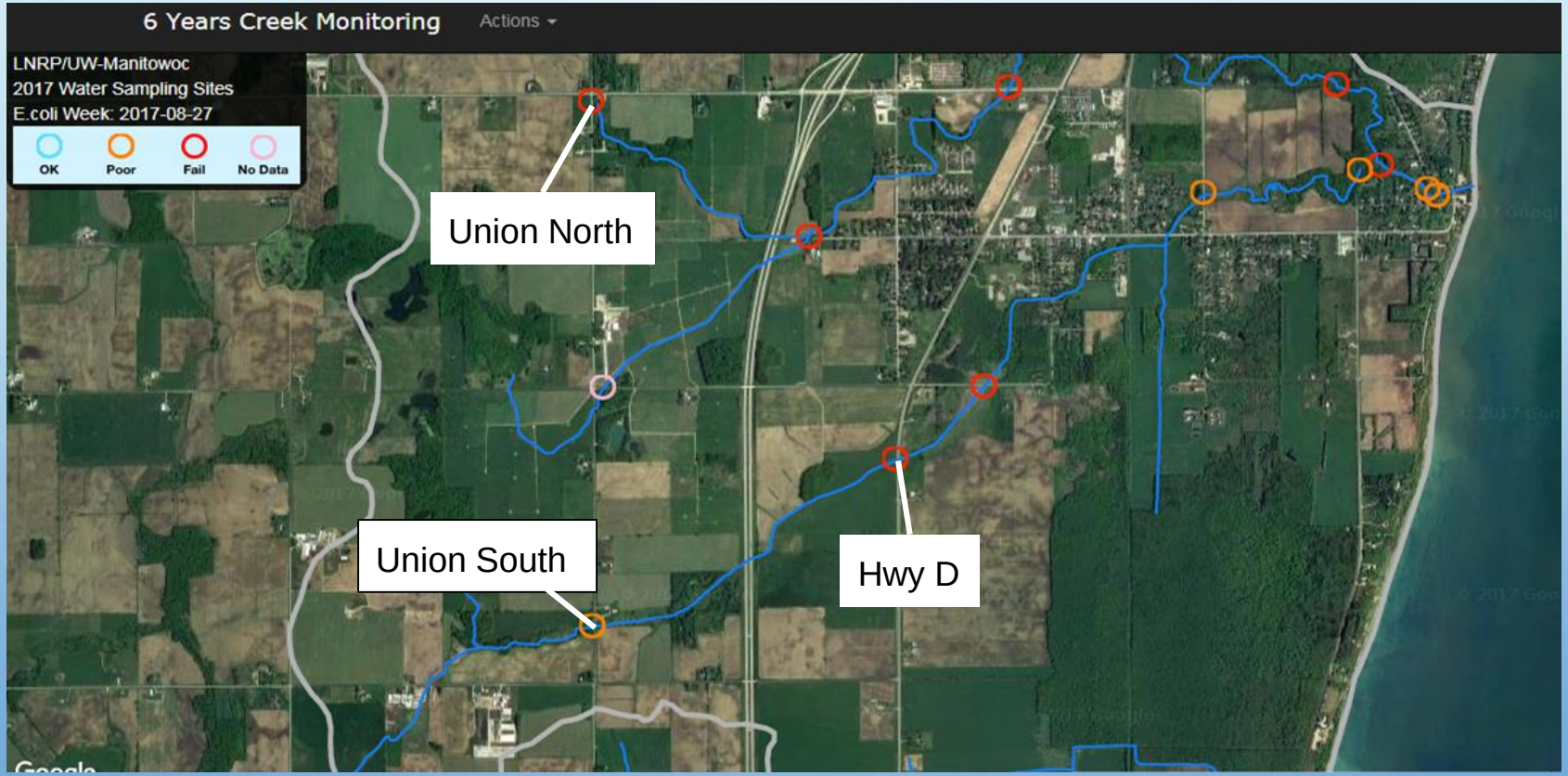
# Centerville Creek Analysis

- 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 $PO_4$ values downstream
  - SB = low turbidity, high phosphate, low E. coli, $PO_4$ 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

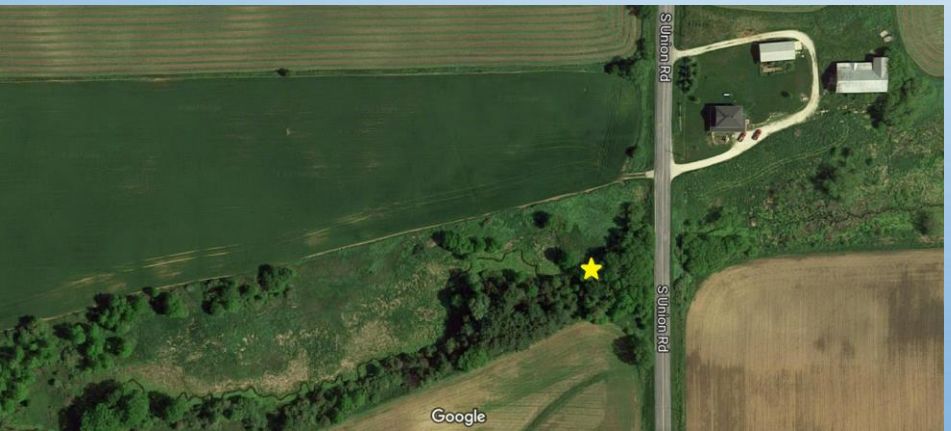


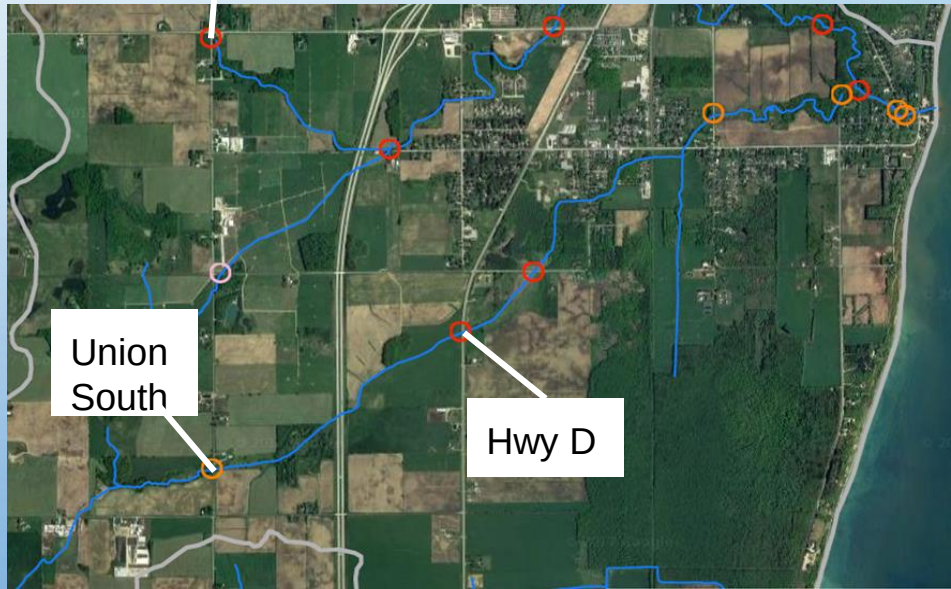
# Centerville Creek - Union Sites Focus



# 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



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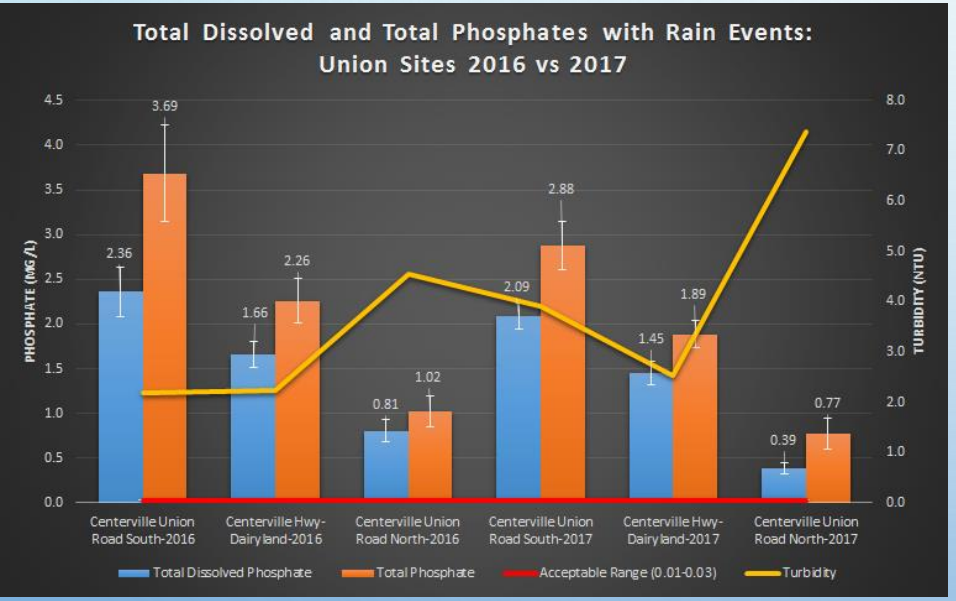


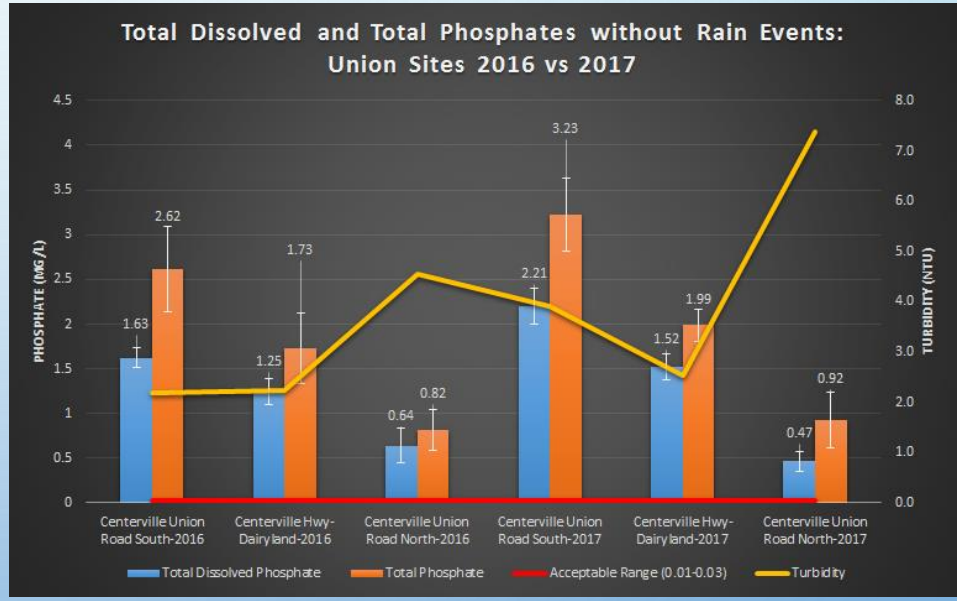

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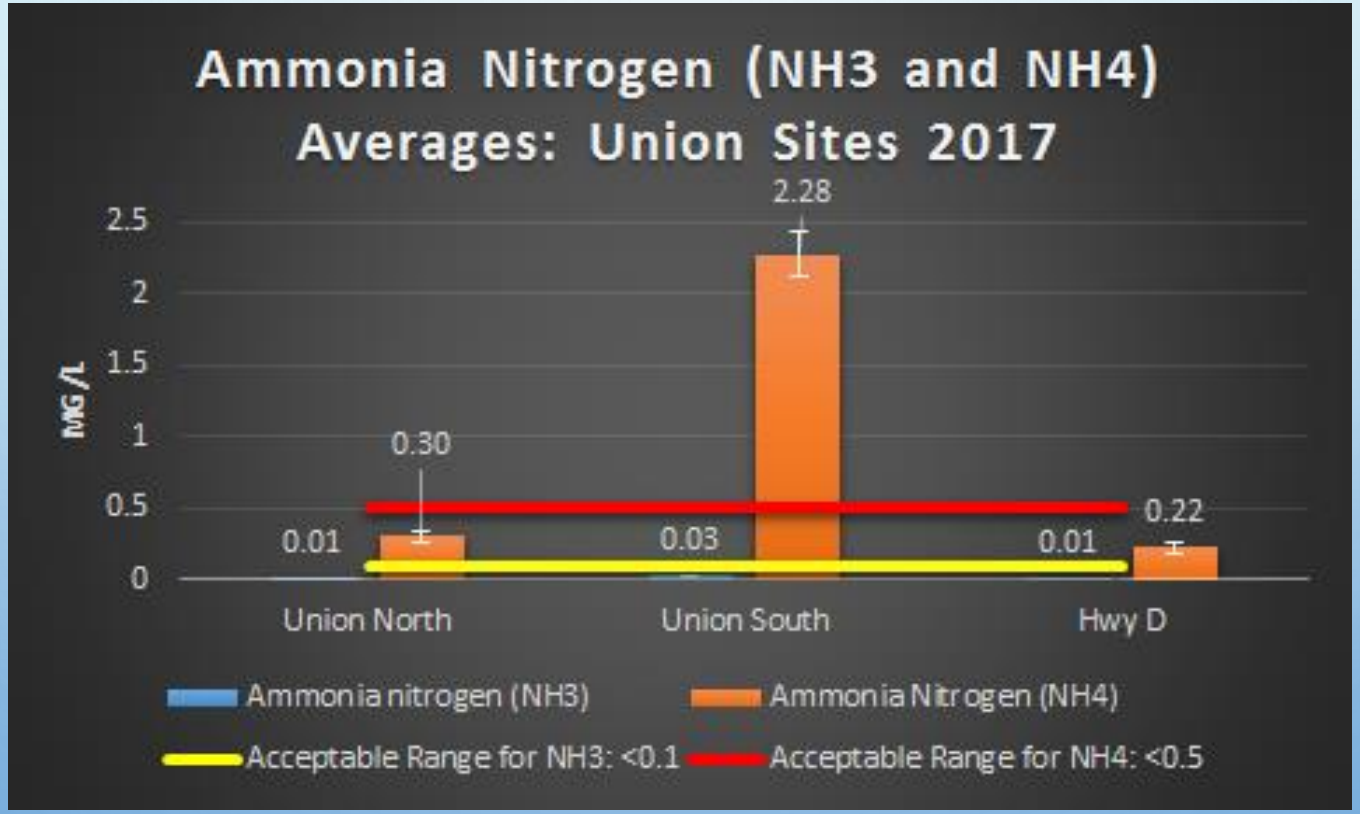

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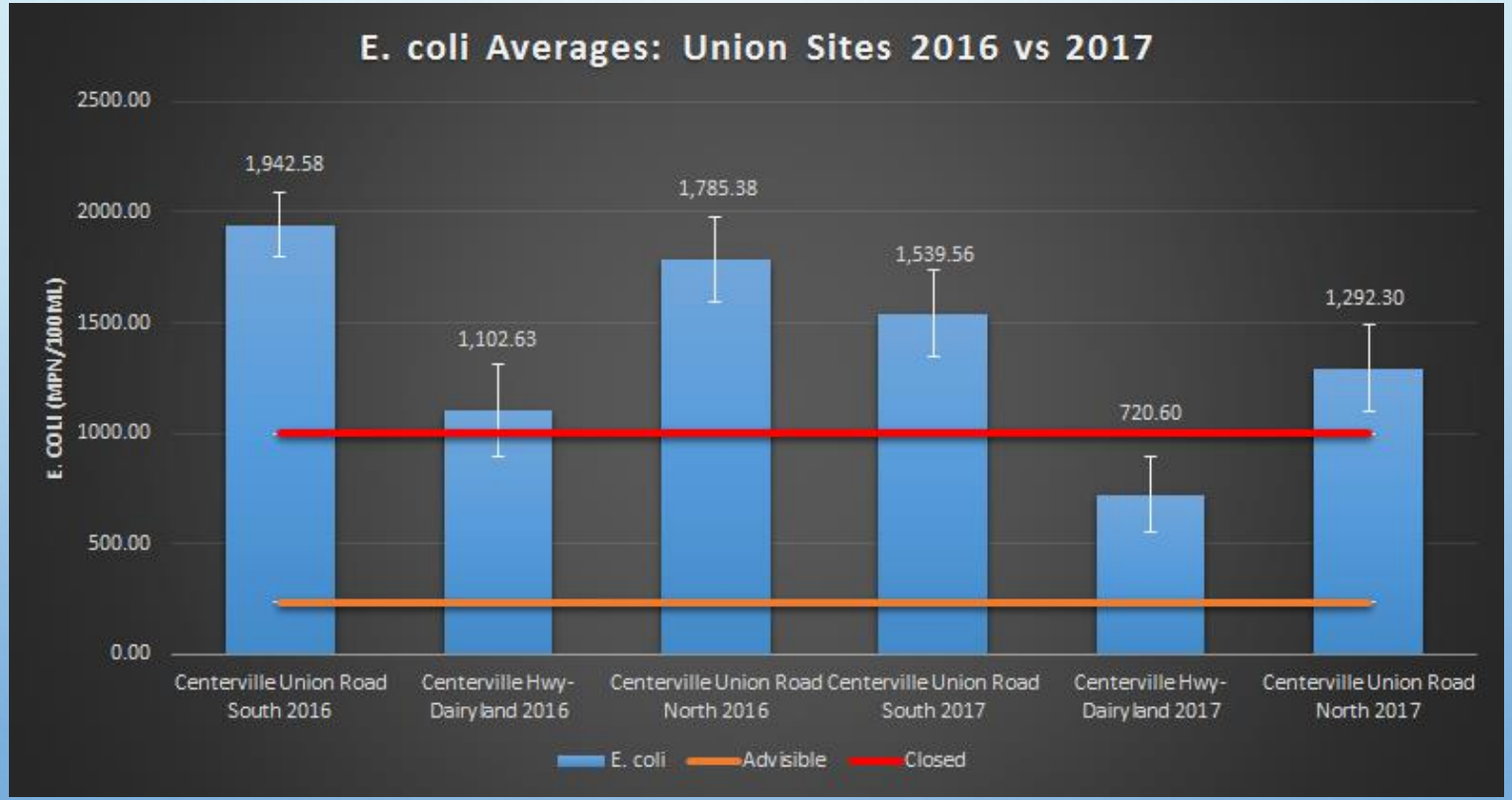

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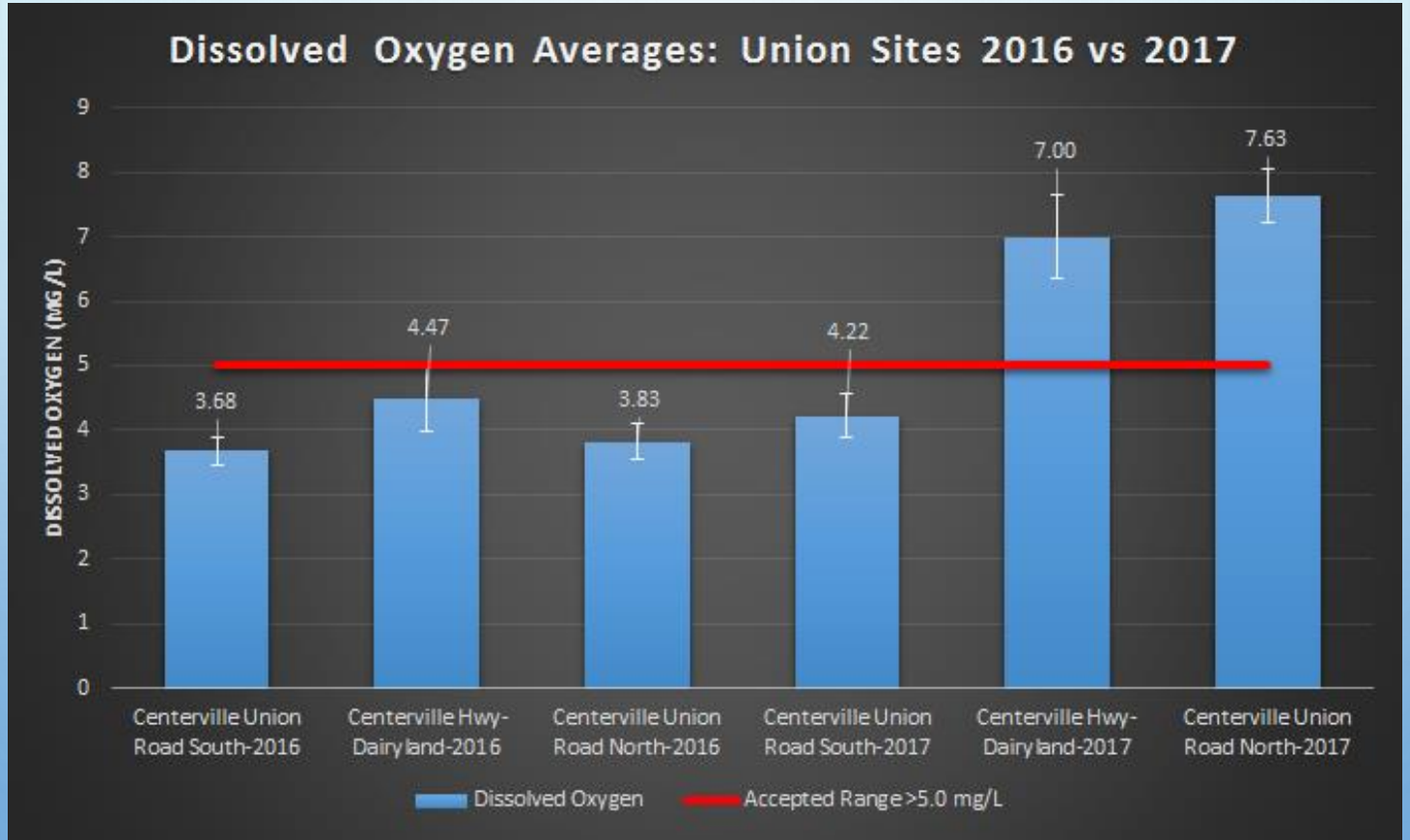

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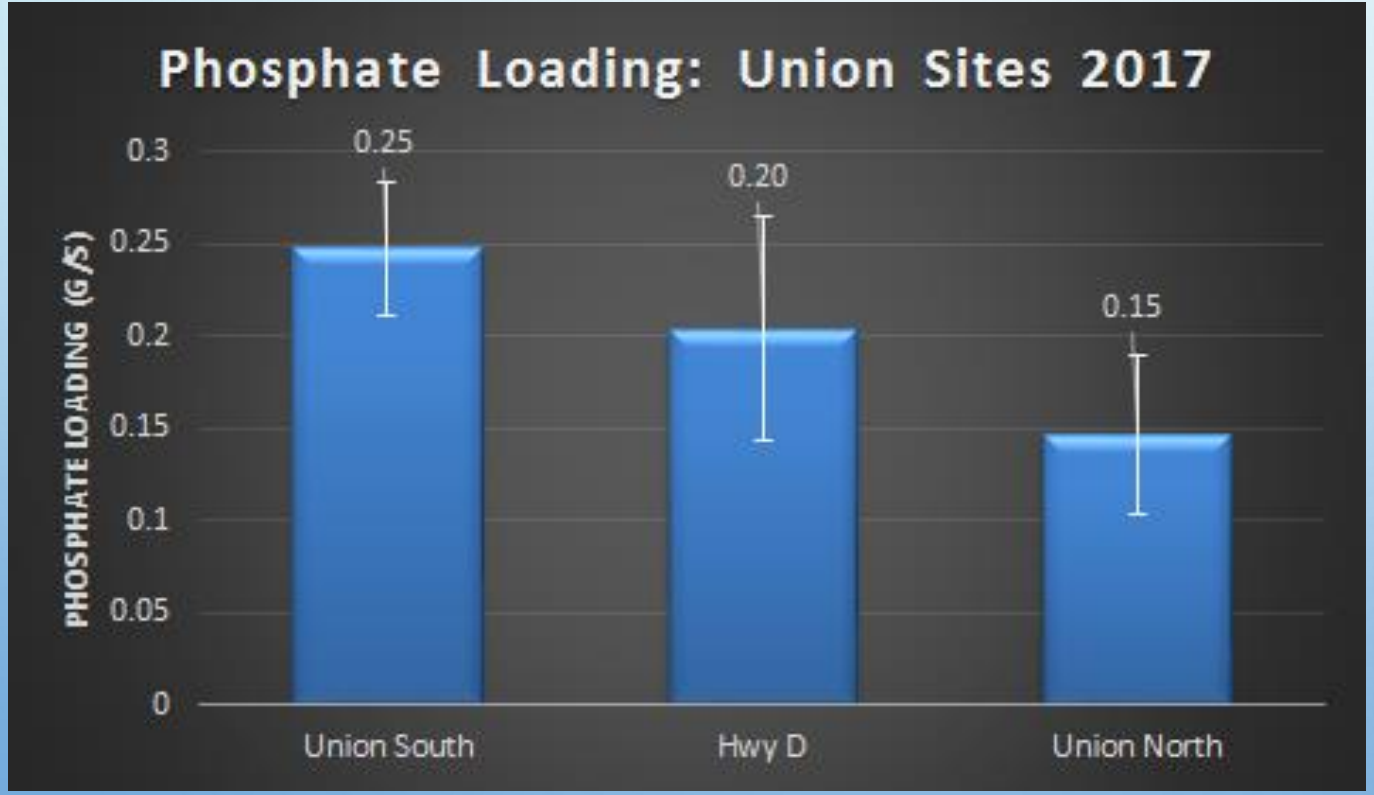
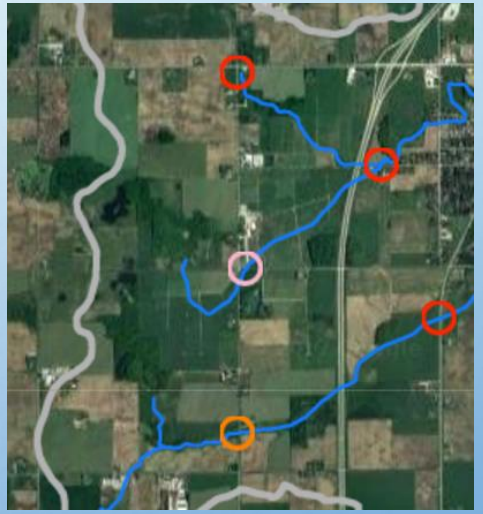


# Centerville Creek - Union Sites Analysis

- 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.

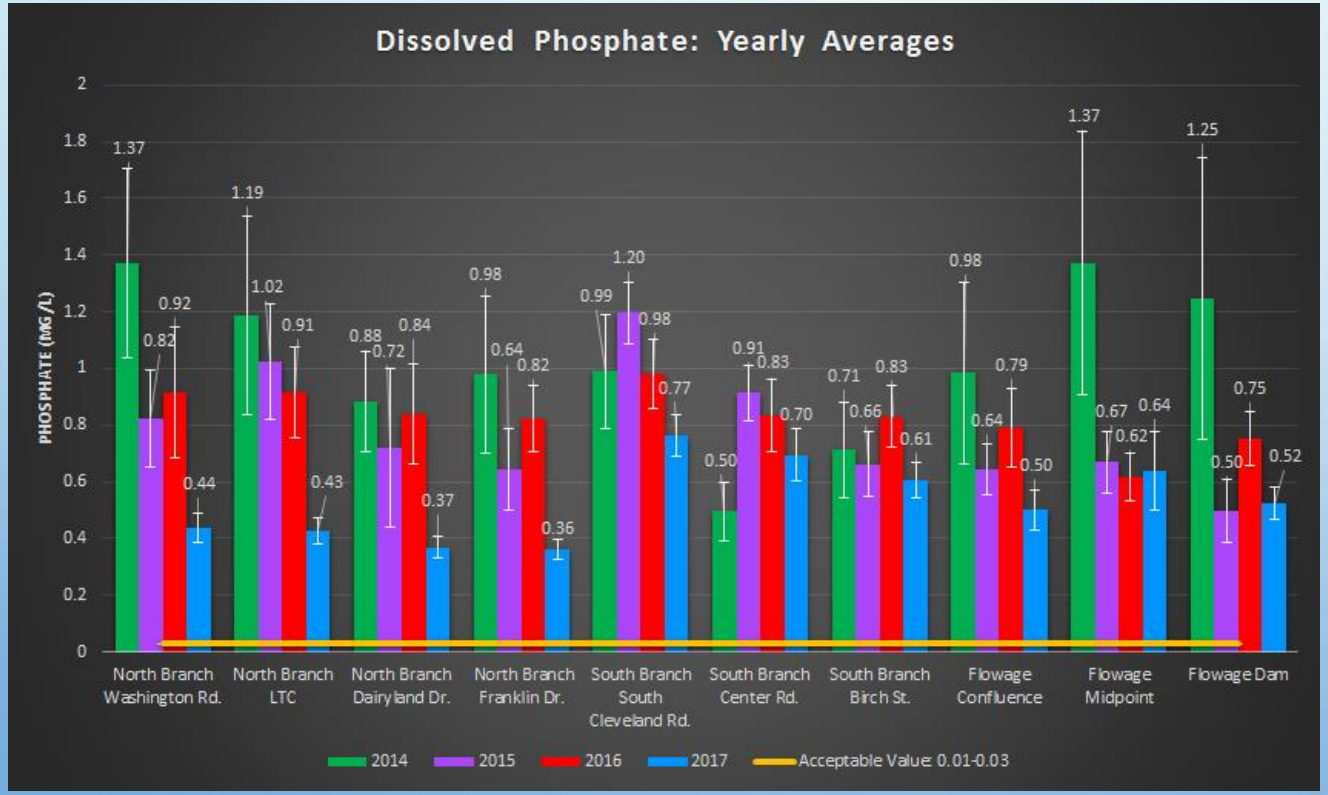
-Create dead zones depriving water of oxygen and life.

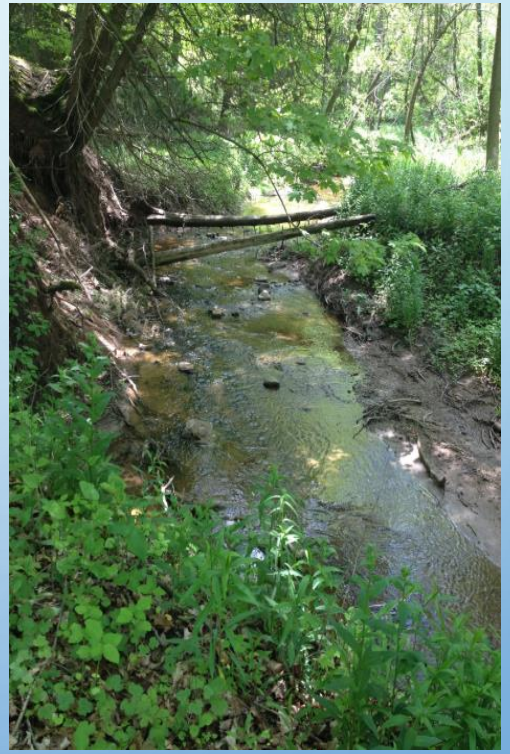
# Importance of Restoration

*Economical Importance

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

# Restoration Data



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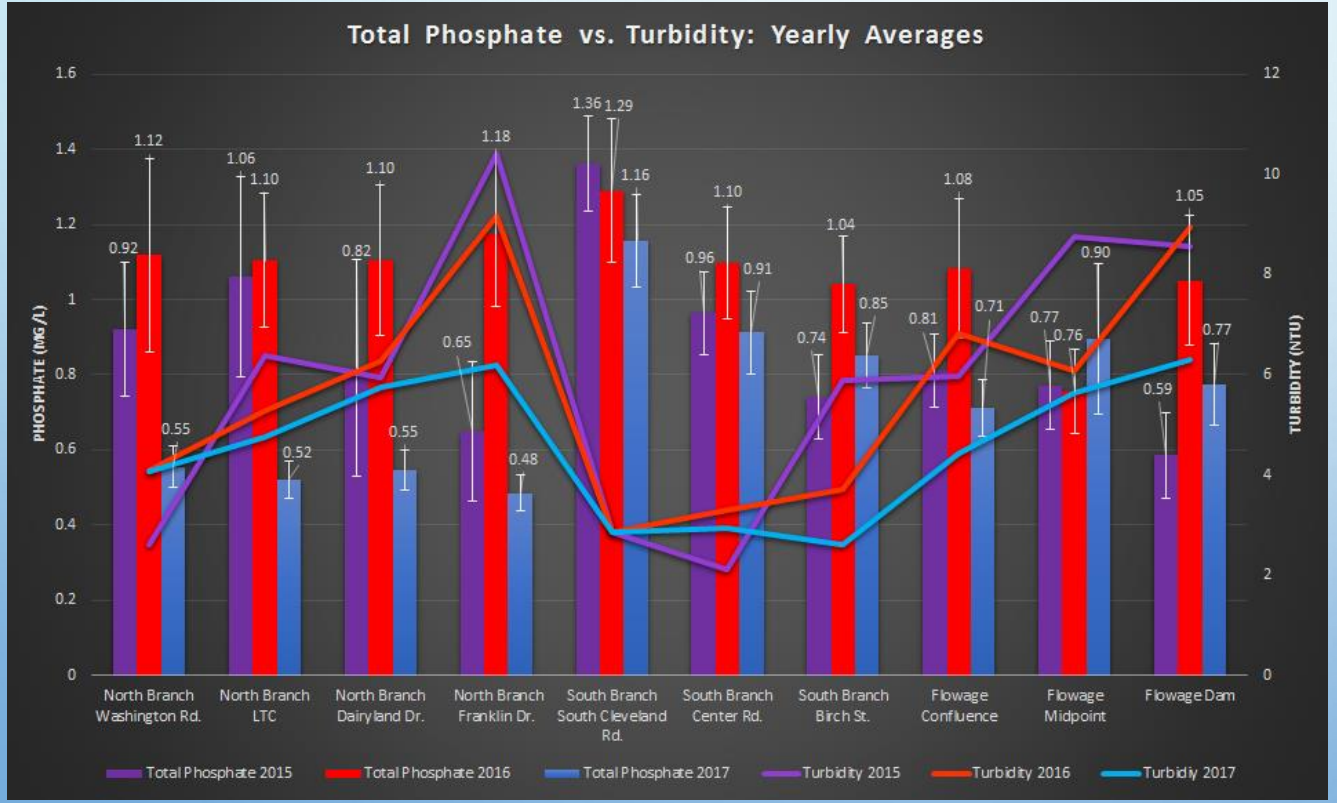
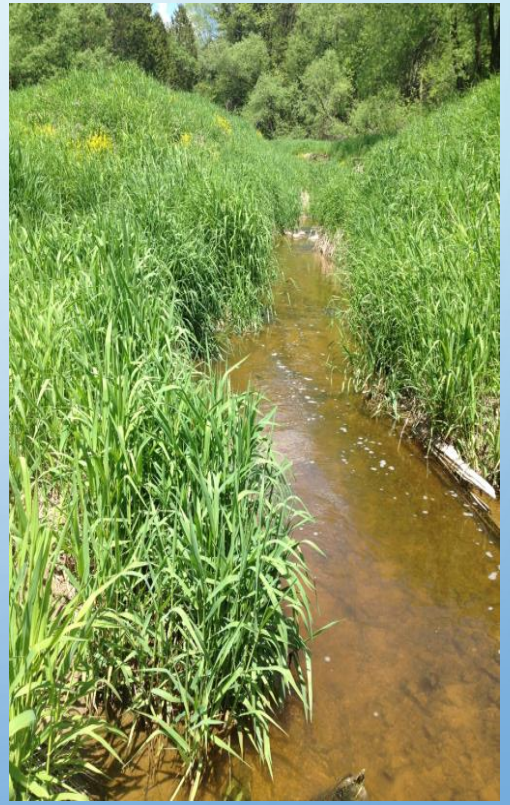


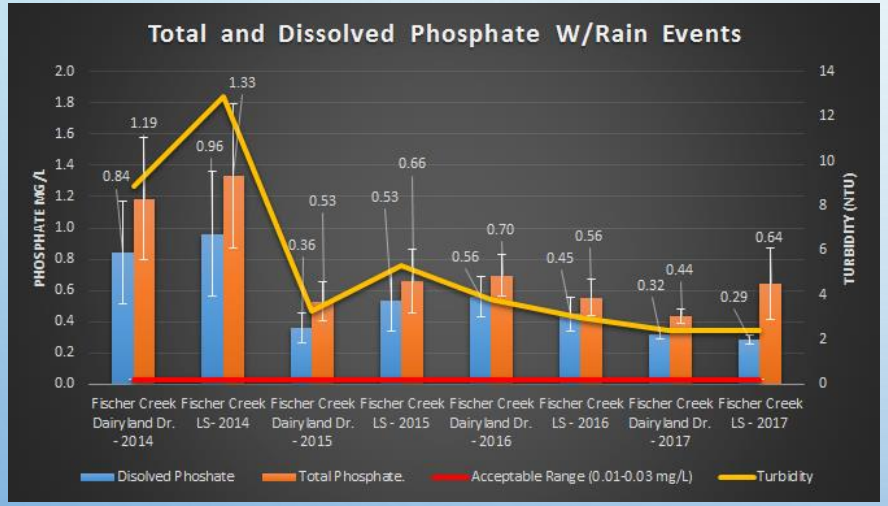
# Restoration Data Analysis Summary

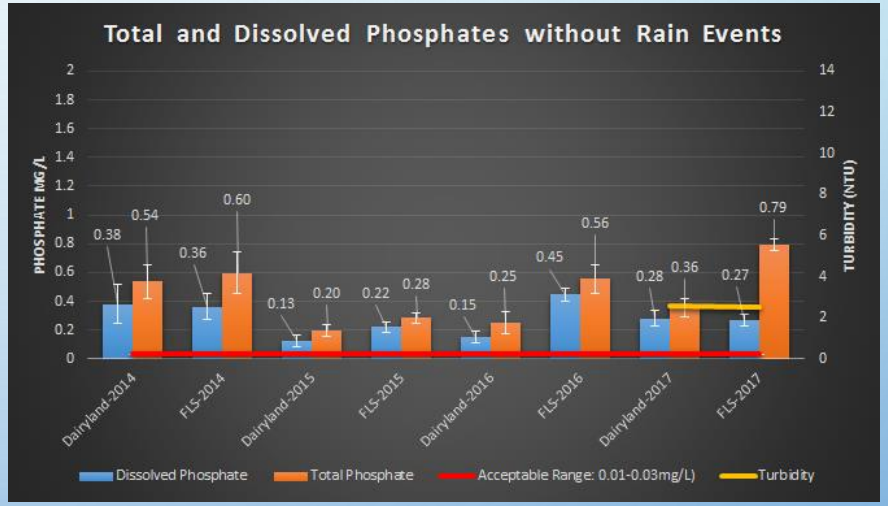
*Phosphate is  marginally trending down overall.
*All North Branch sites are down significantly.
*Phosphate levels at all sites are still beyond acceptable range.
*Turbidity not following  phosphate levels.

# Fischer Creek

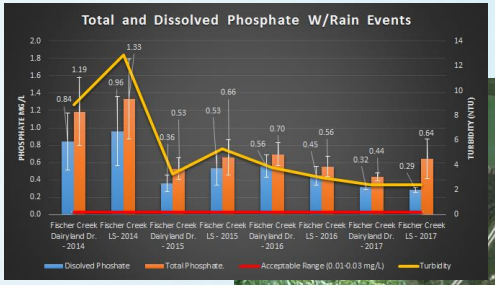
| | |
|---|---|
| FI02 | Fischer Creek LS |
| FI03 | Fischer Creek Dairyland Dr. |


# Fischer Creek Analysis



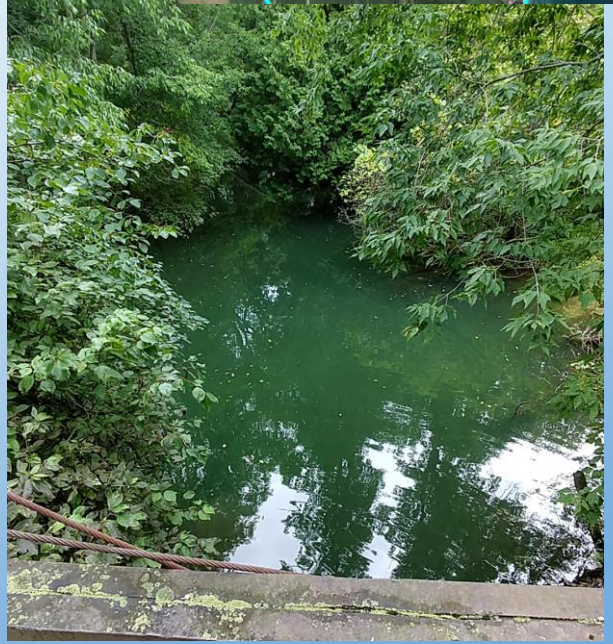



# Fischer Creek LS Analysis





- 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).



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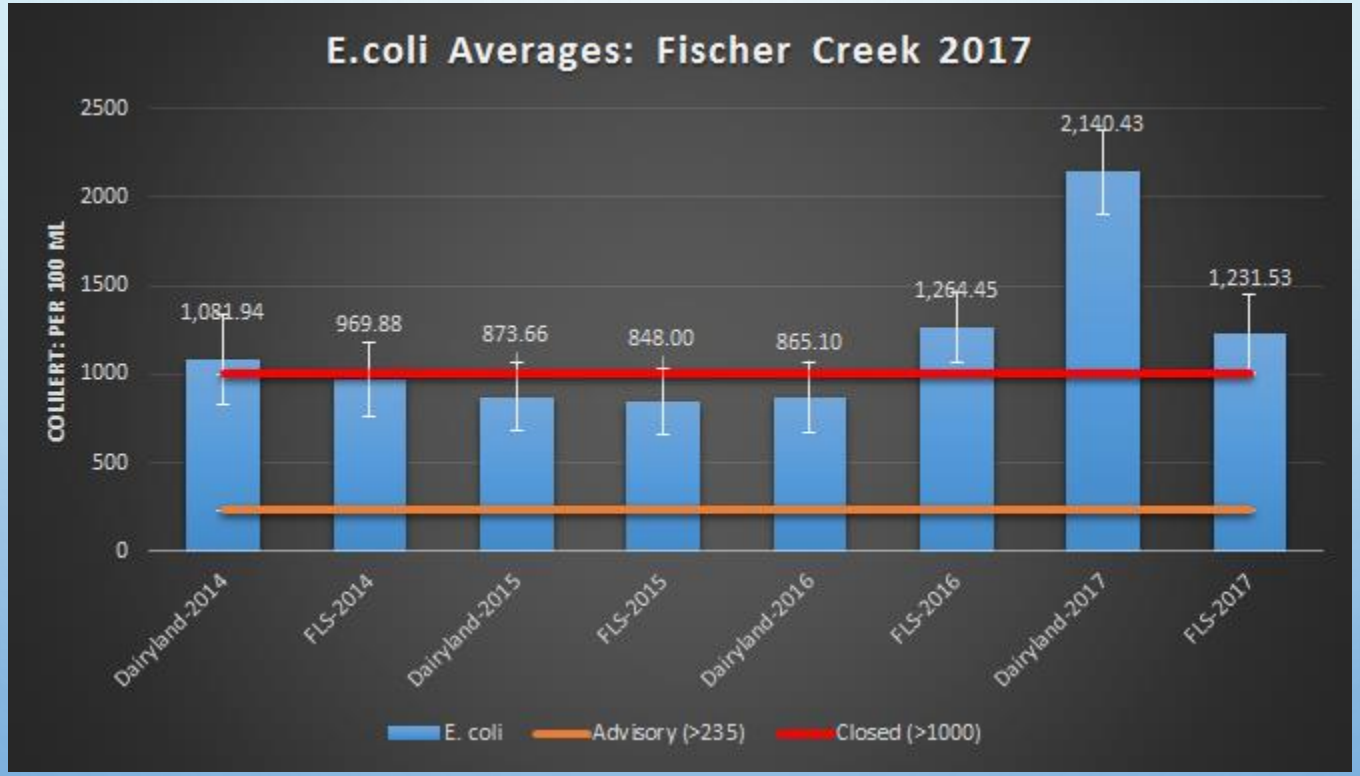


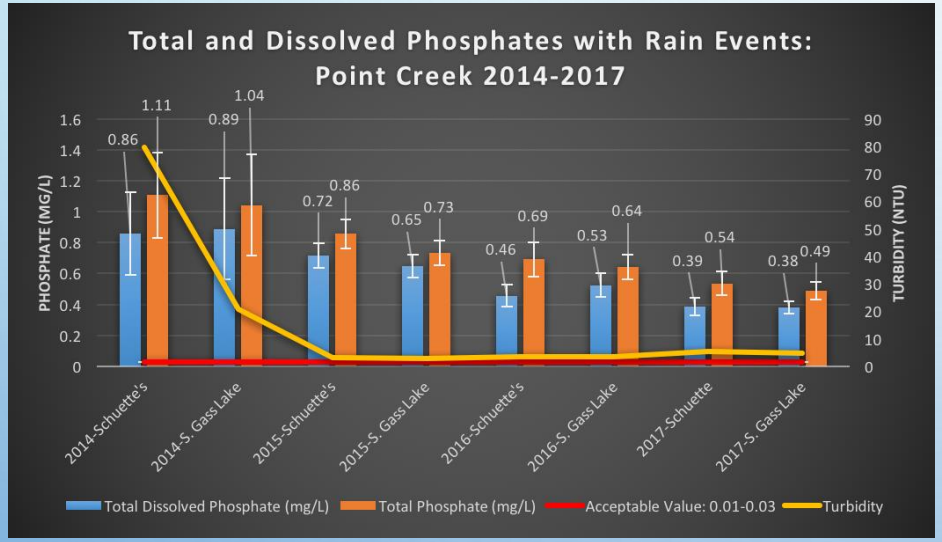
# Fischer Creek Analysis

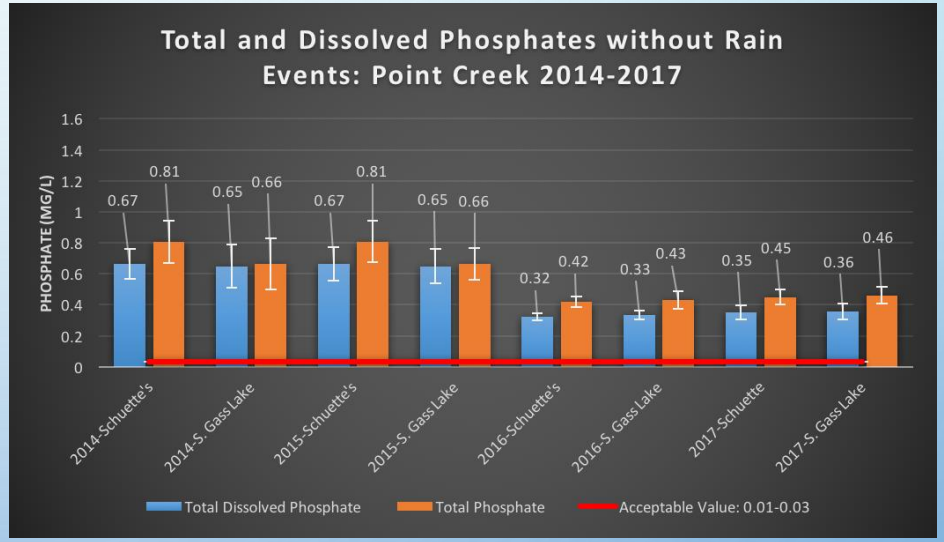
- Turbidity and phosphates correlated with one another.
- The FLS total phosphate was more more than double the dissolved phosphate level. This means there may have been a point source of phosphate contamination either at the site site of FLS or between F-Dairy (the upstream site) and FLS.
- *E. coli* 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.

# Point Creek

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


# Point Creek Analysis



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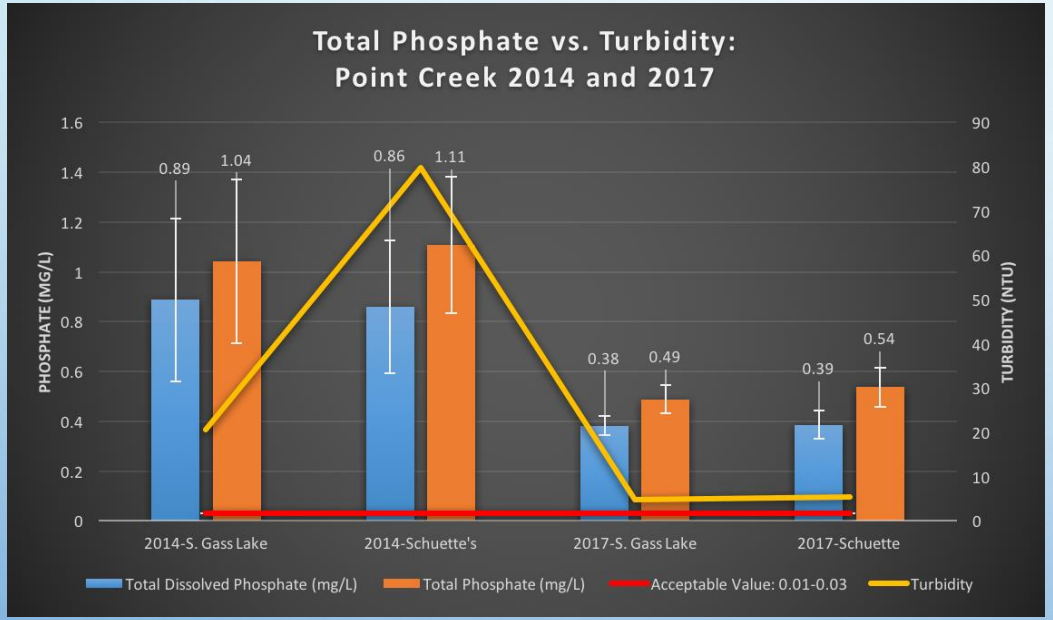


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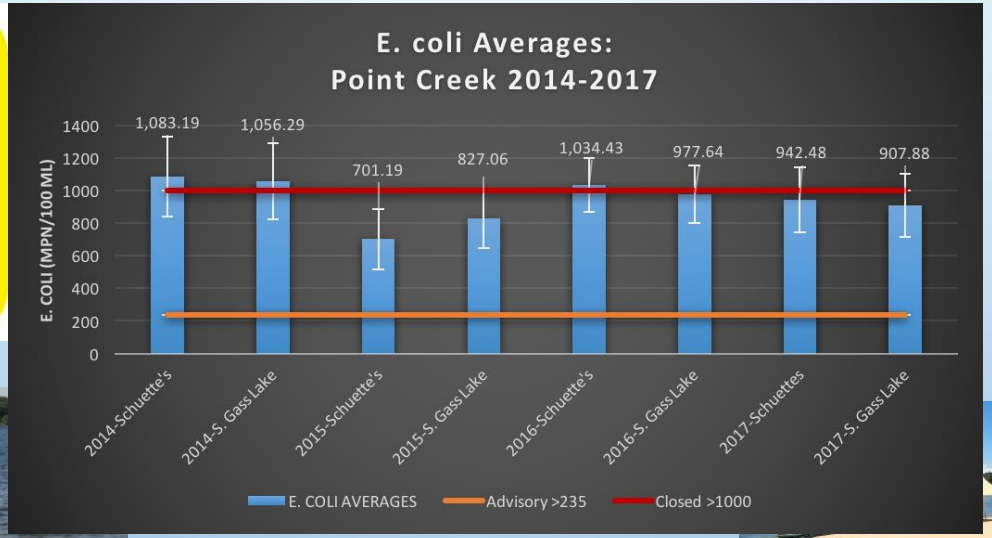



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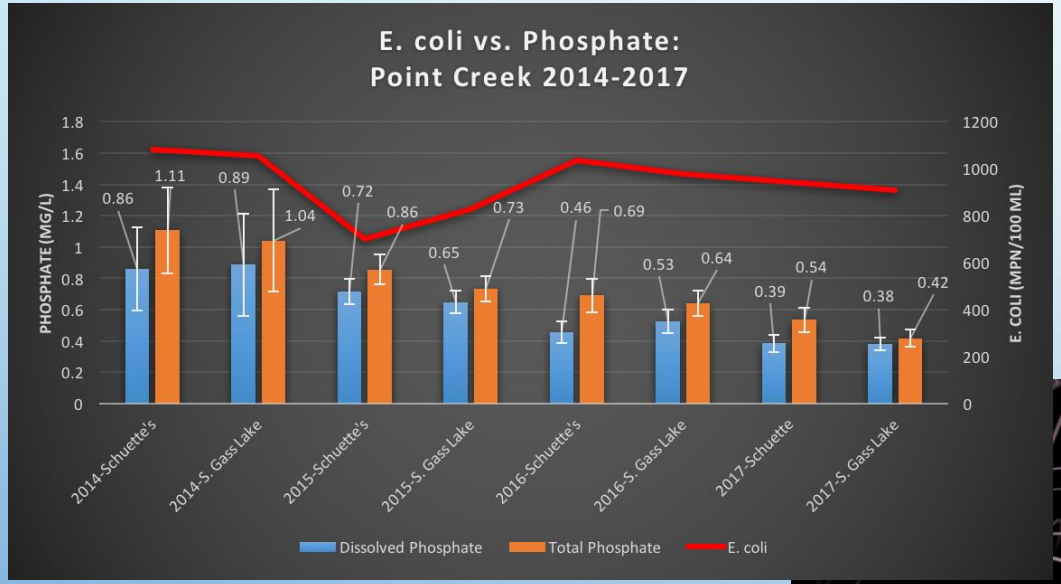
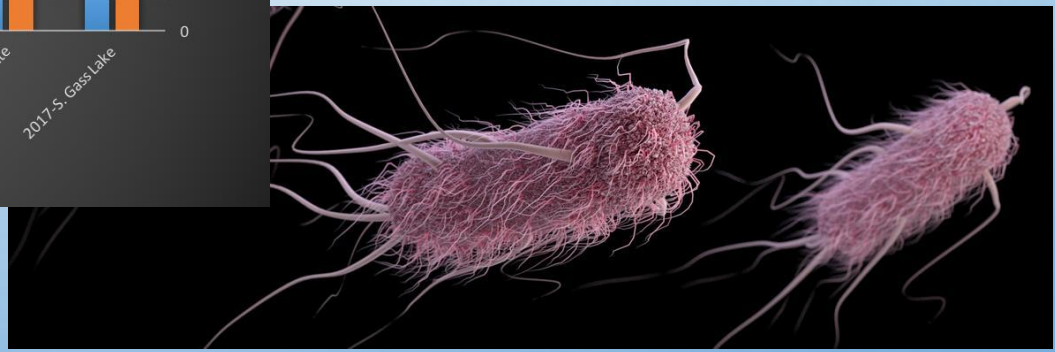


# Point Creek Analysis Summary

*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..

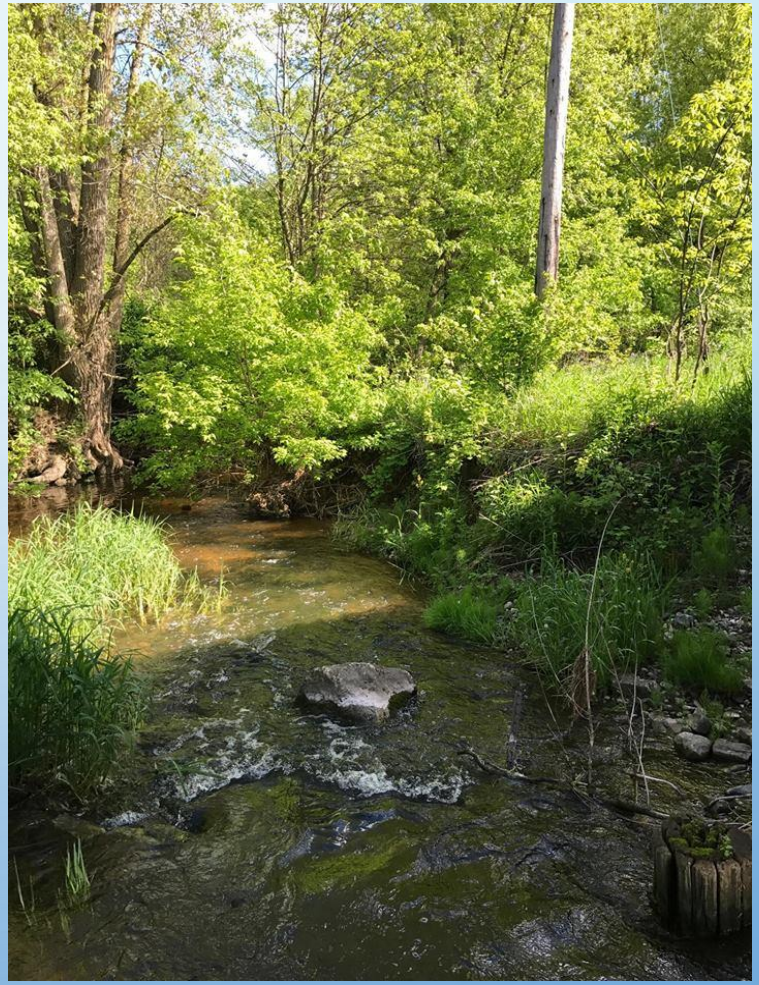
*Low turbidity and yet high phosphate levels.

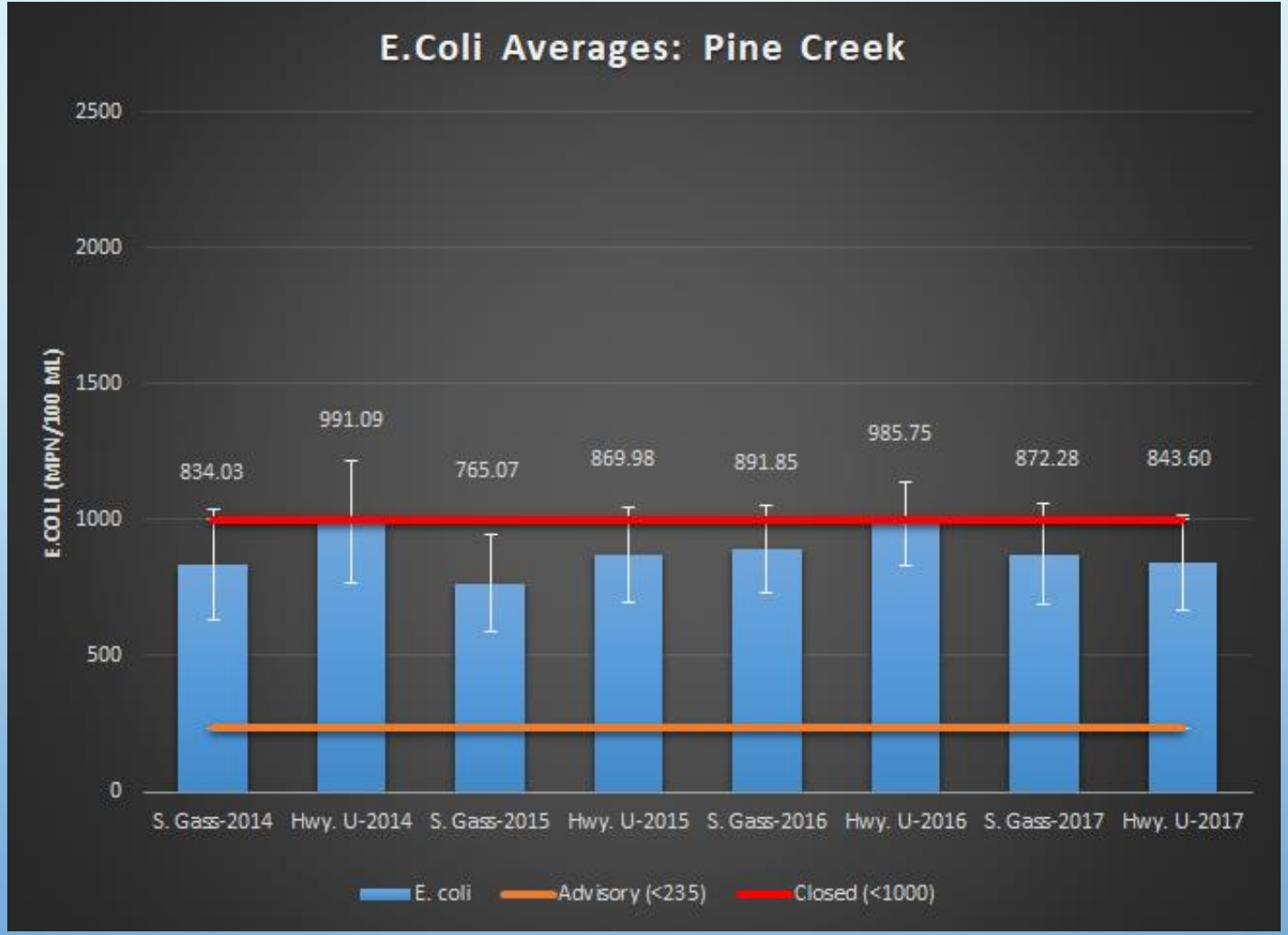
*Possibly another source of contamination other than surface runoff.

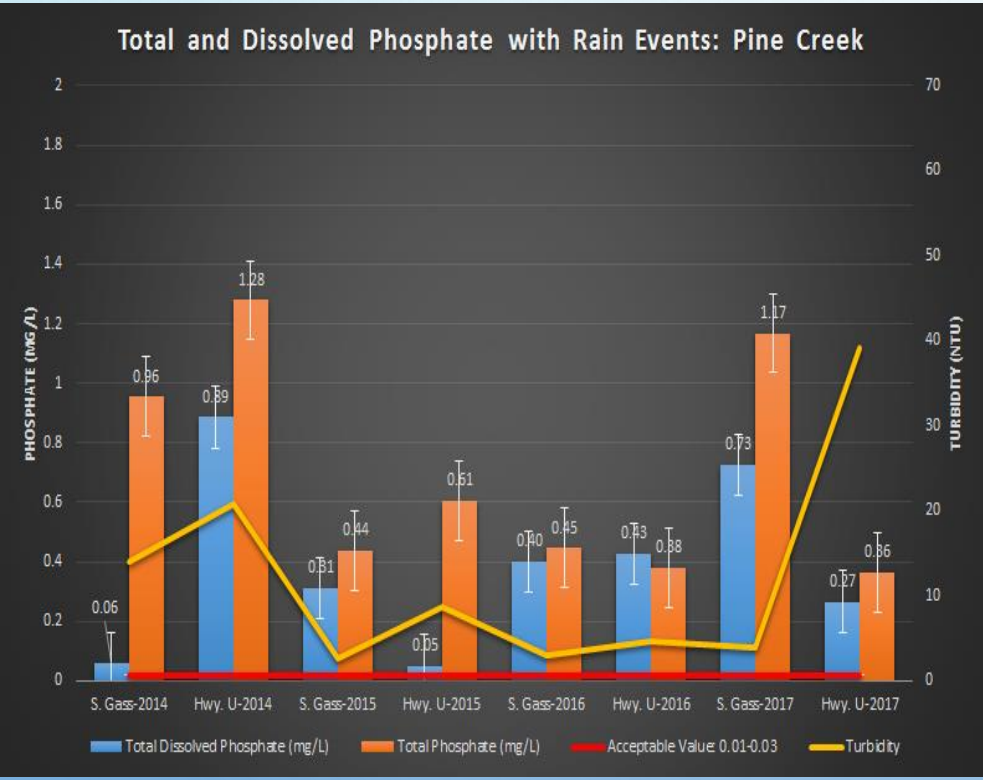
*No Phosphate loading data.

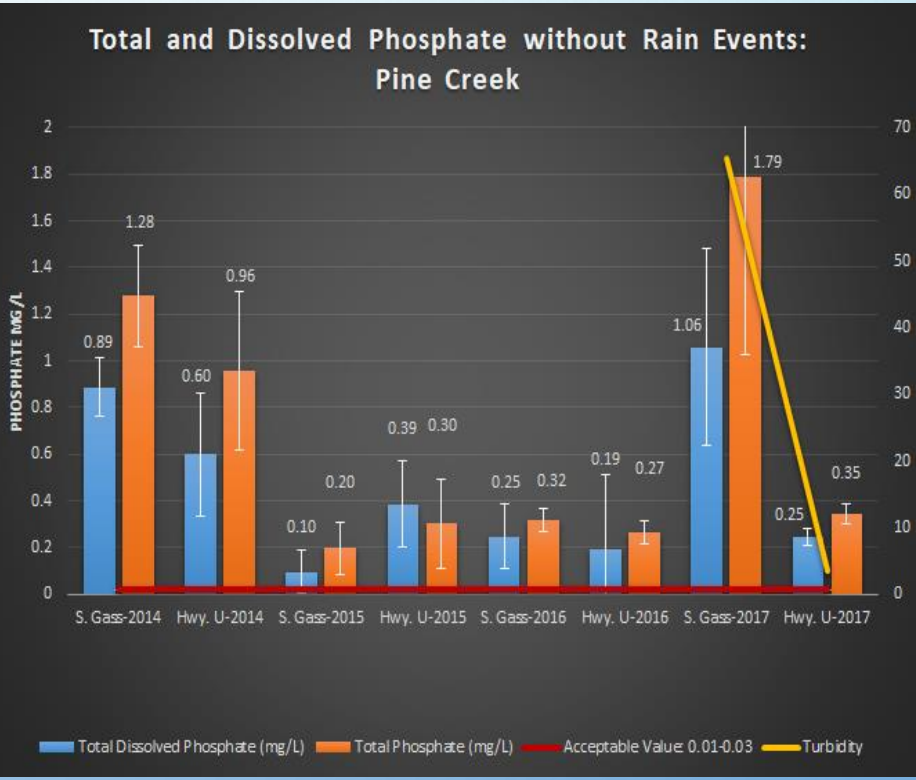
# Pine Creek

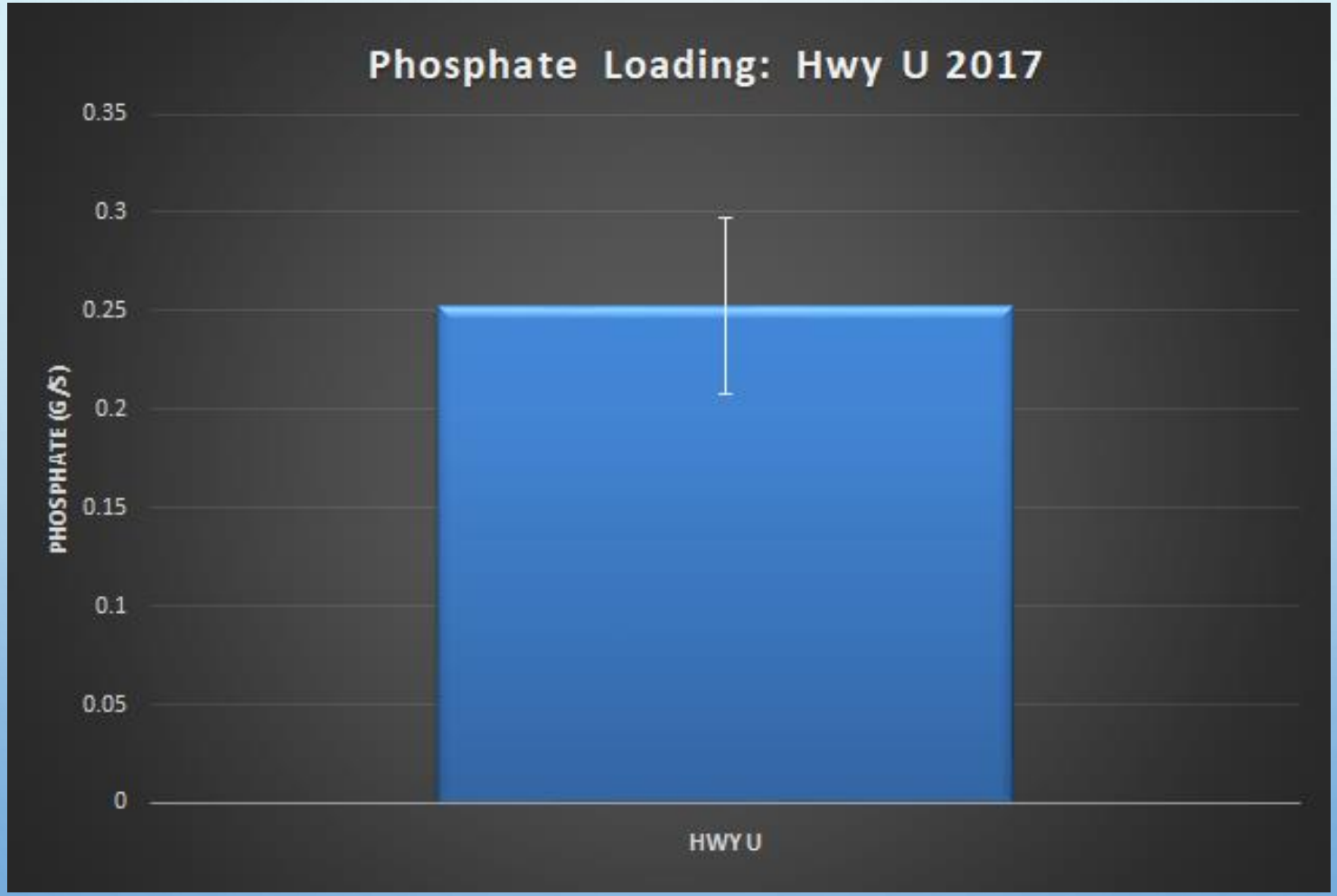
| | |
|---|---|
| PI02 | Pine Creek Hwy. U |
| PI03 | Pine Creek South Gass Lake Rd. |


E.Coli Averages: Pine Creek
E.COLI (MPN/100 ML)
2500
2000
1500
1000
500
0
834.03
991.09
765.07
869.98
891.85
985.75
872.28
843.60
S. Gass-2014
Hwy. U-2014
S. Gass-2015
Hwy. U-2015
S. Gass-2016
Hwy. U-2016
S. Gass-2017
Hwy. U-2017
E. coli
Advisory (<235)
Closed (<1000)

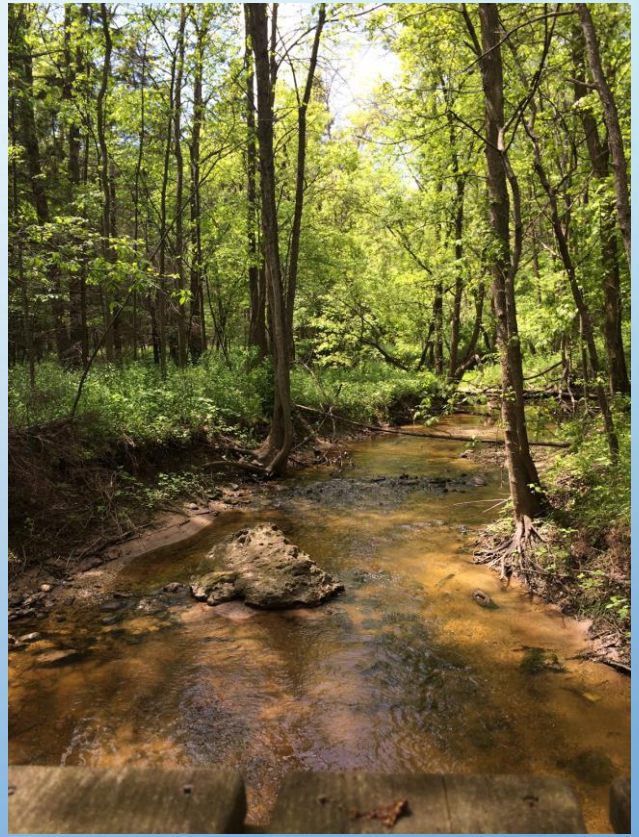

Total and Dissolved Phosphate with Rain Events: Pine Creek
PHOSPHATE (MG/L)
TURBIDITY (NTU)
0.06
0.96
0.89
1.28
0.31
0.44
0.05
0.61
0.40
0.45
0.43
0.38
0.73
1.17
0.27
0.36
S. Gass-2014
Hwy. U-2014
S. Gass-2015
Hwy. U-2015
S. Gass-2016
Hwy. U-2016
S. Gass-2017
Hwy. U-2017
Total Dissolved Phosphate (mg/L)
Total Phosphate (mg/L)
Acceptable Value: 0.01-0.03
Turbidity


Total and Dissolved Phosphate without Rain Events: Pine Creek
PHOSPHATE MG/L
0.89
1.28
0.60
0.96
0.10
0.20
0.39
0.30
0.25
0.32
0.19
0.27
1.06
1.79
0.25
0.35
S. Gass-2014
Hwy. U-2014
S. Gass-2015
Hwy. U-2015
S. Gass-2016
Hwy. U-2016
S. Gass-2017
Hwy. U-2017
Total Dissolved Phosphate (mg/L)
Total Phosphate (mg/L)
Acceptable Value: 0.01-0.03
Turbidity

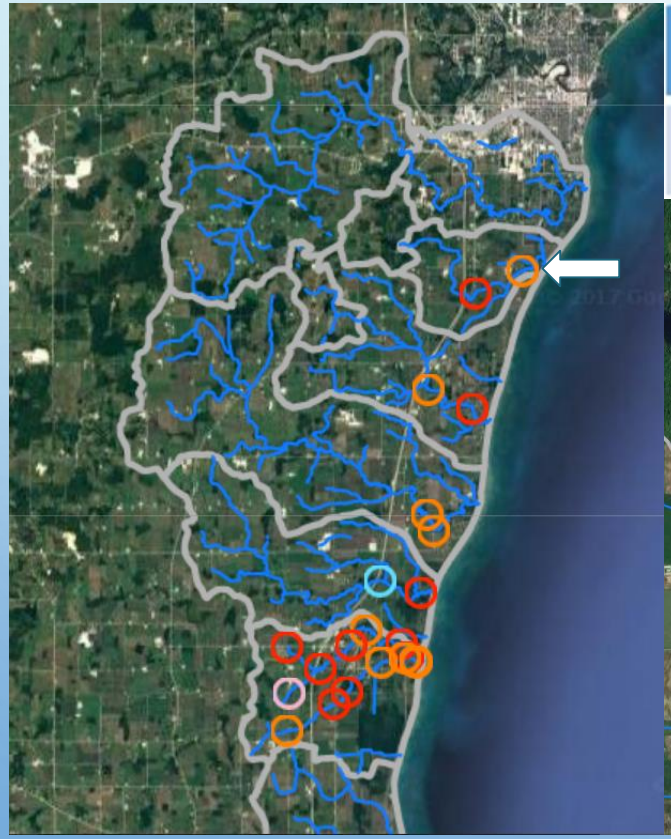

Phosphate Loading: Hwy U 2017
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
PHOSPHATE (G/S)
HWY U

# Pine Creek Analysis

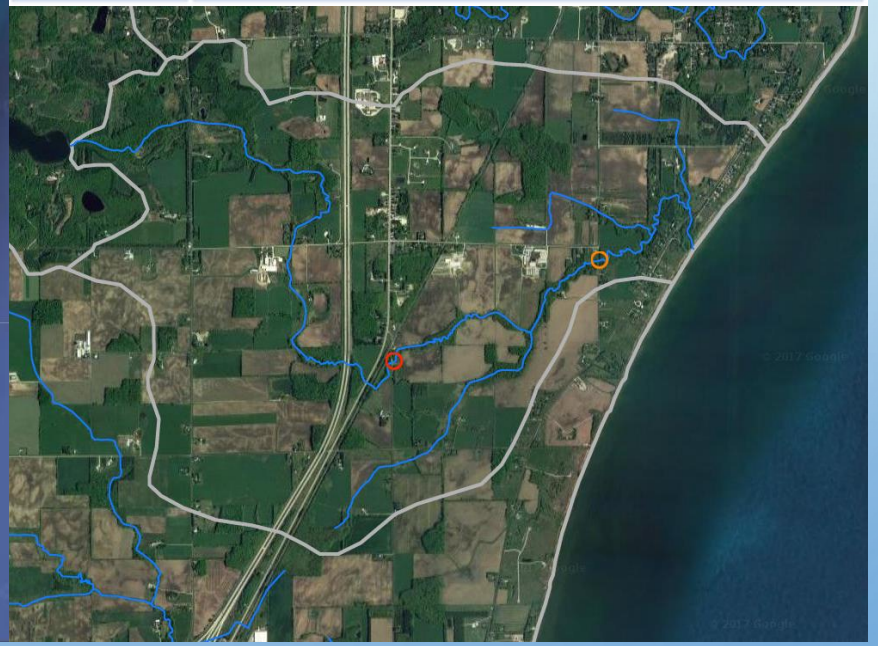
- Decrease in *E.coli* but still above advisory
- Drastic increase in total and dissolved phosphate, and ammonia nitrogen
- All other parameters similar to past years
- More to come...



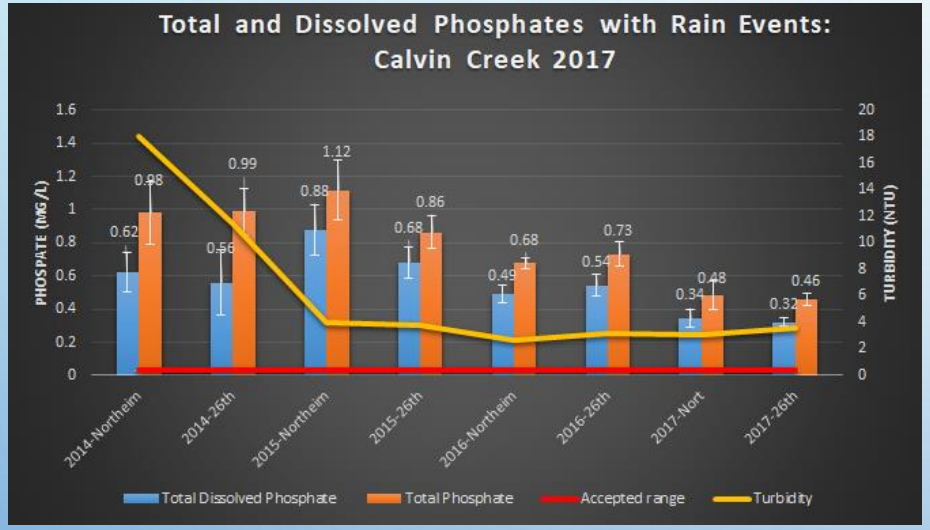
# Calvin Creek

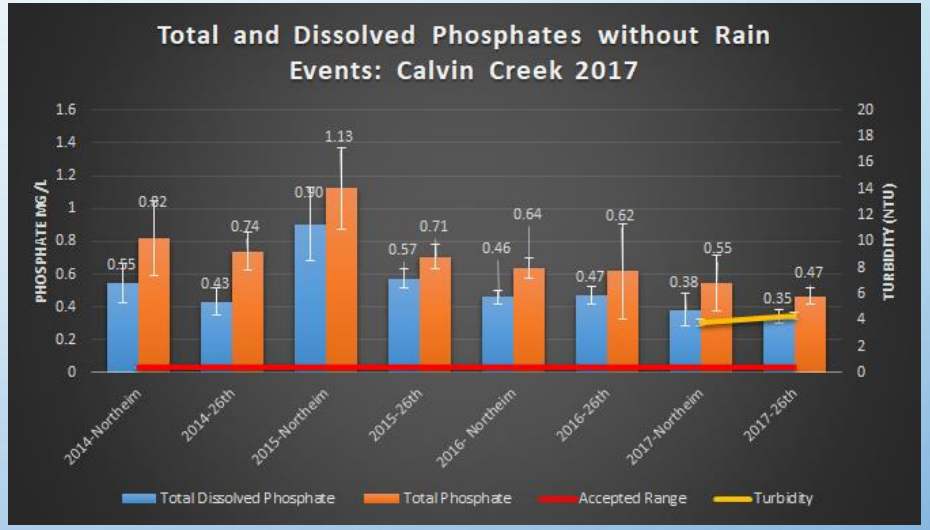


| | |
|---|---|
| CA02 | Calvin Creek South 26th St. |
| CA03 | Calvin Creek Northeim Rd. |

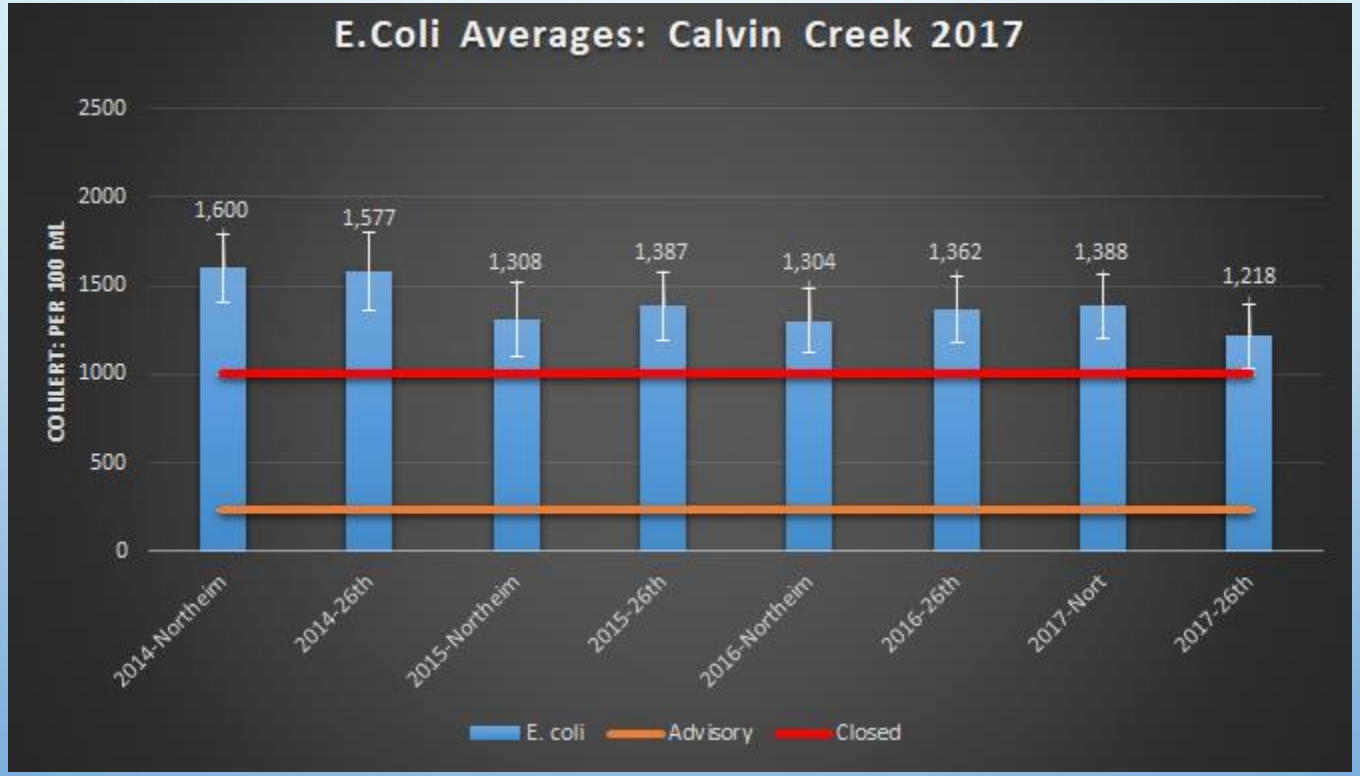


# Calvin Creek Analysis

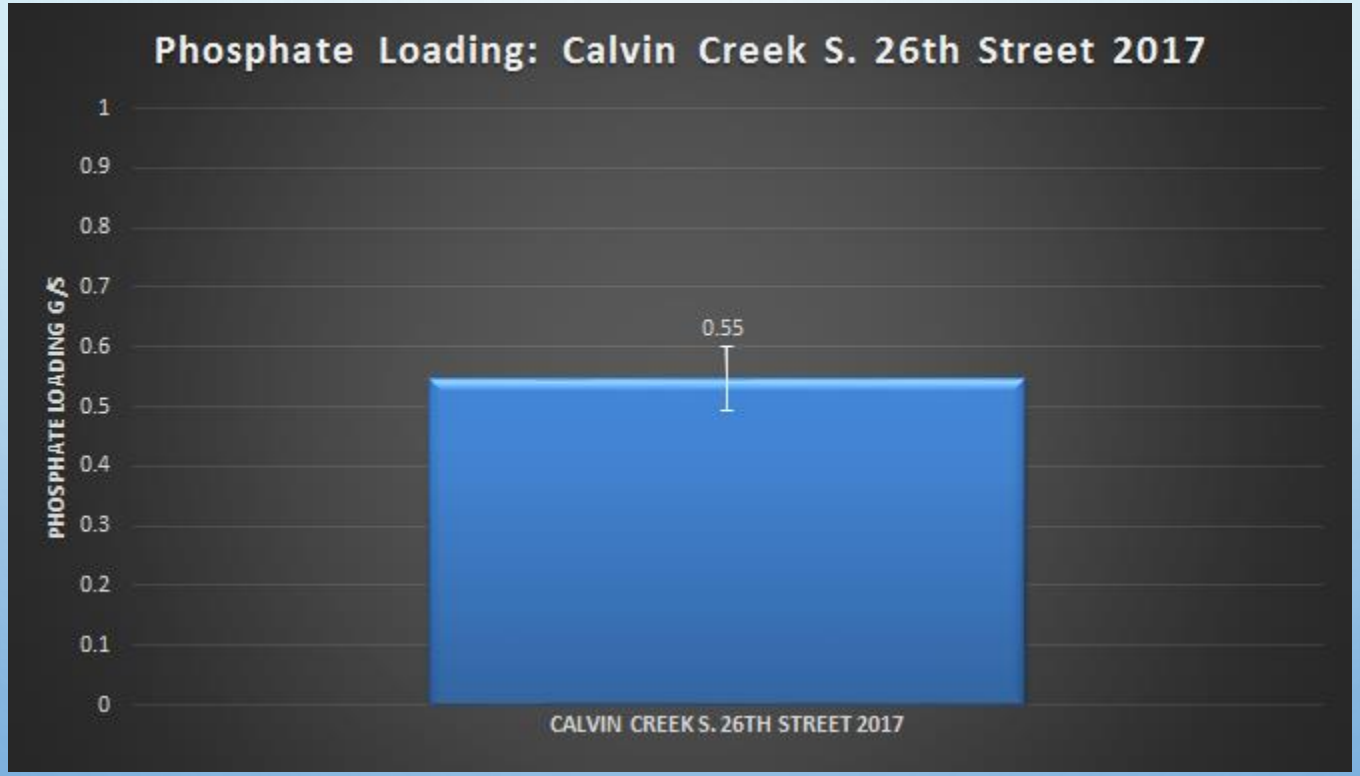


# Calvin Creek Analysis



# Calvin Creek Analysis



# Calvin Creek Analysis

Phosphate Loading Data:

- 0.547 g/s
- 729 pounds/week
- 9,520 pounds/summer

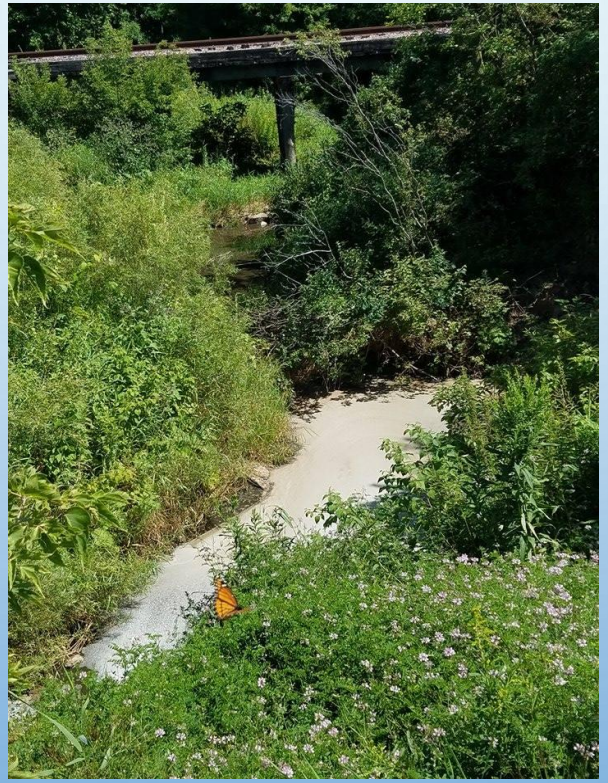
E.Coli levels remained high and are past the closed range

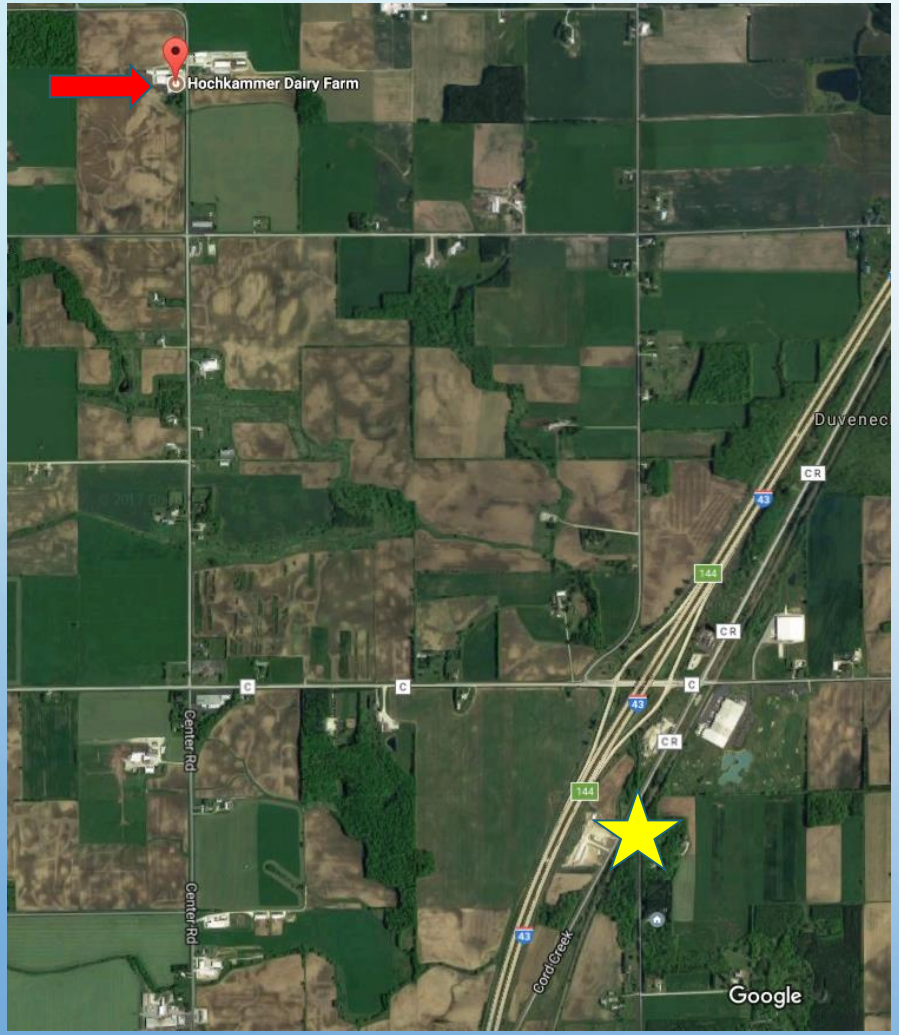
Lower values for Total Phosphate and Dissolved Phosphate in a contin

Phosphate levels did not show much correlation to turbidity

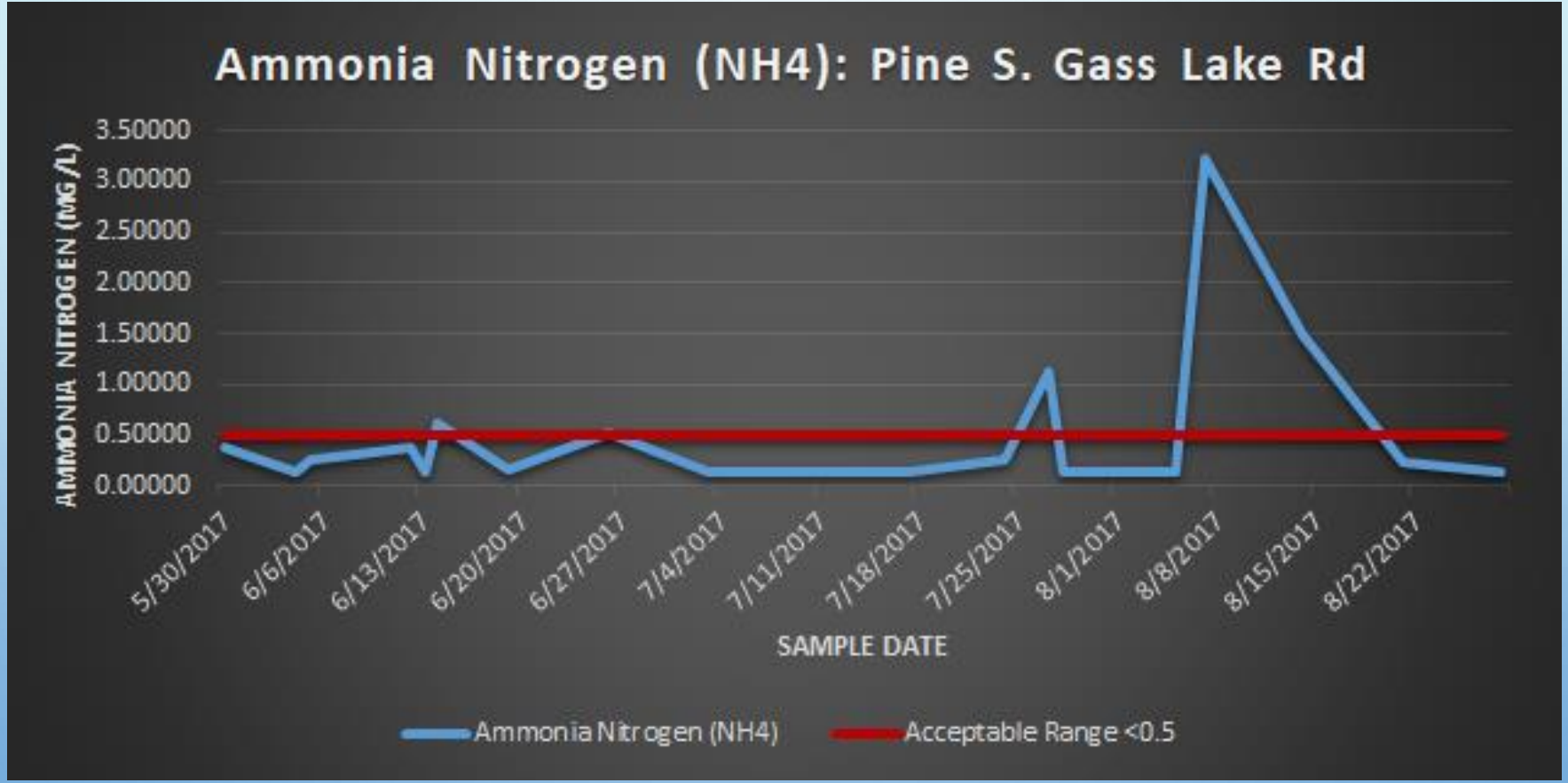
Low rain event impact on Phosphate for 2017

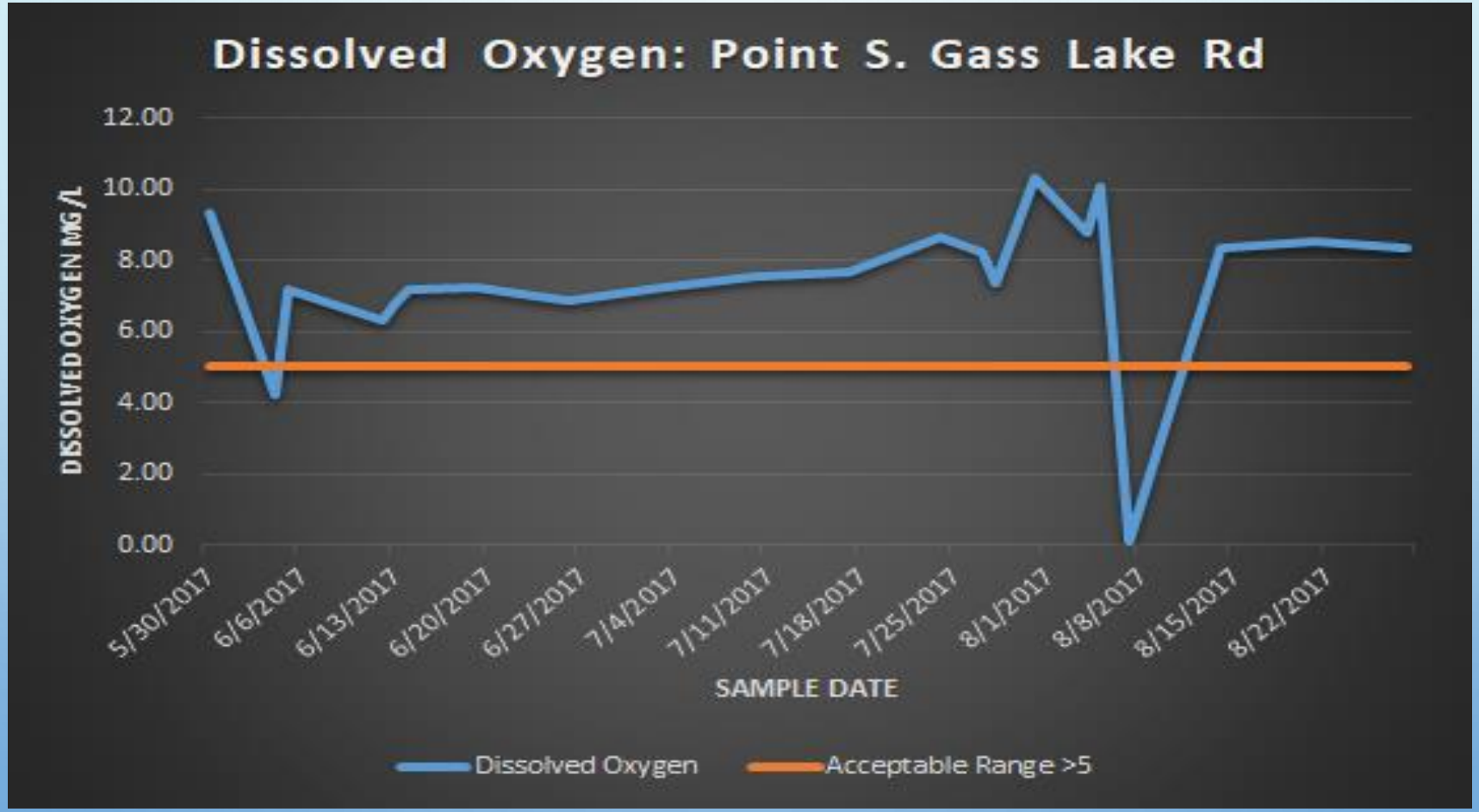
# Pine Creek Manure Spill
# August 7th 2017



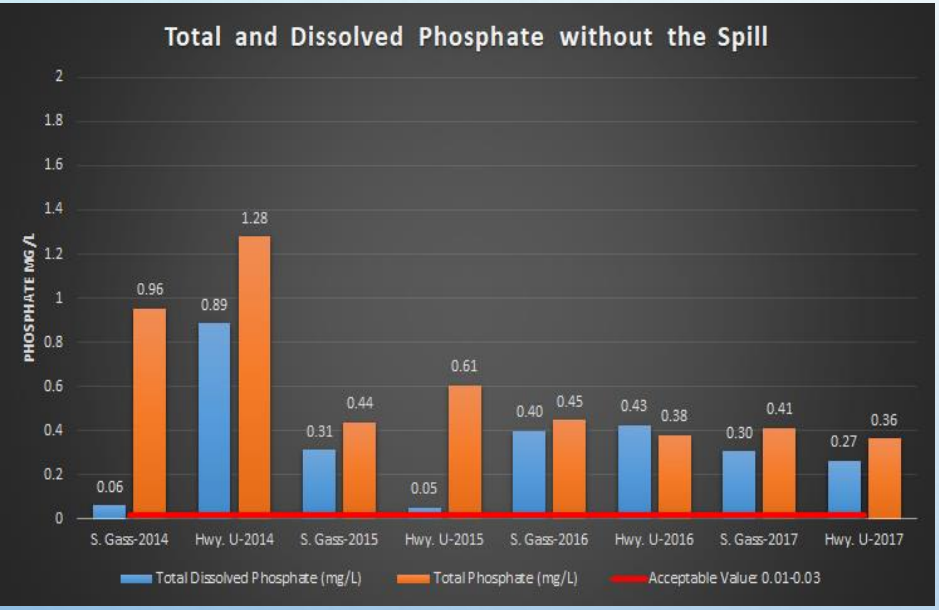


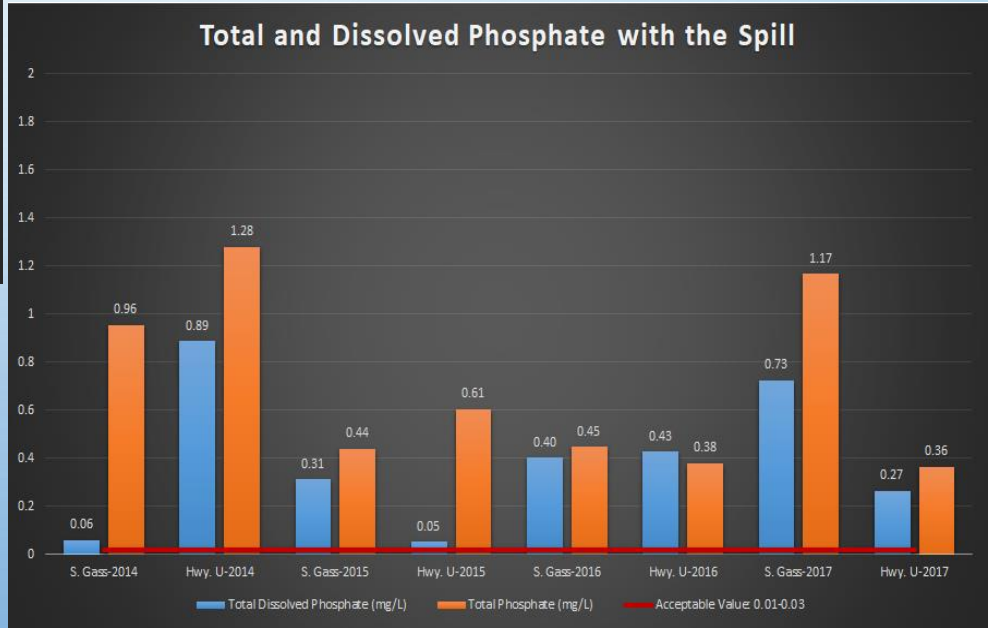

- Source: Hochkammer Dairy Farm
- Pine South Gass: 2.8 miles South East
- Concrete plug fail in manure pit
- Discovered early afternoon August 7th
- Manitowoc County lake testing


Ammonia Nitrogen (NH4): Pine S. Gass Lake Rd
AMMONIA NITROGEN (MG/L)
3.50000
3.00000
2.50000
2.00000
1.50000
1.00000
0.50000
0.00000
5/30/2017
6/6/2017
6/13/2017
6/20/2017
6/27/2017
7/4/2017
7/11/2017
7/18/2017
7/25/2017
8/1/2017
8/8/2017
8/15/2017
8/22/2017
SAMPLE DATE
Ammonia Nitrogen (NH4)
Acceptable Range <0.5


Dissolved Oxygen: Point S. Gass Lake Rd
DISSOLVED OXYGEN MG/L
12.00
10.00
8.00
6.00
4.00
2.00
0.00
5/30/2017
6/6/2017
6/13/2017
6/20/2017
6/27/2017
7/4/2017
7/11/2017
7/18/2017
7/25/2017
8/1/2017
8/8/2017
8/15/2017
8/22/2017
SAMPLE DATE
Dissolved Oxygen
Acceptable Range >5

# An interesting comparison…

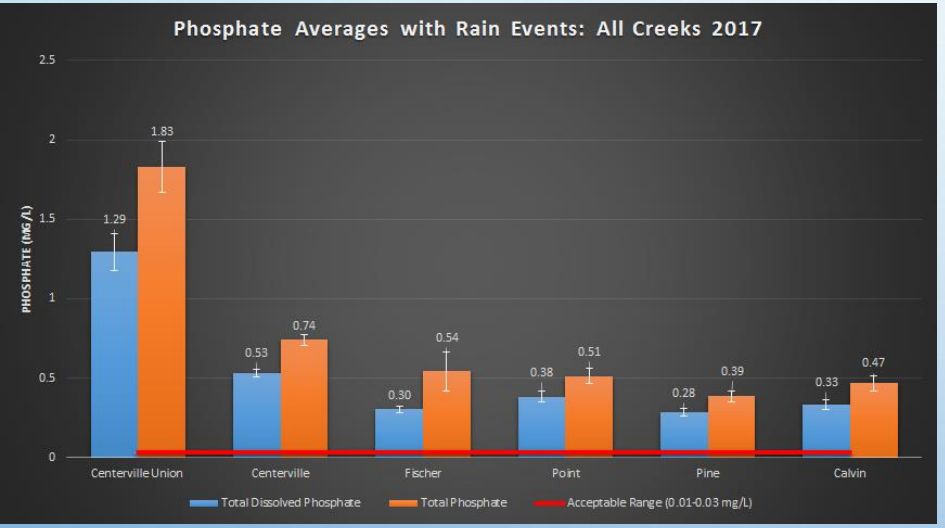


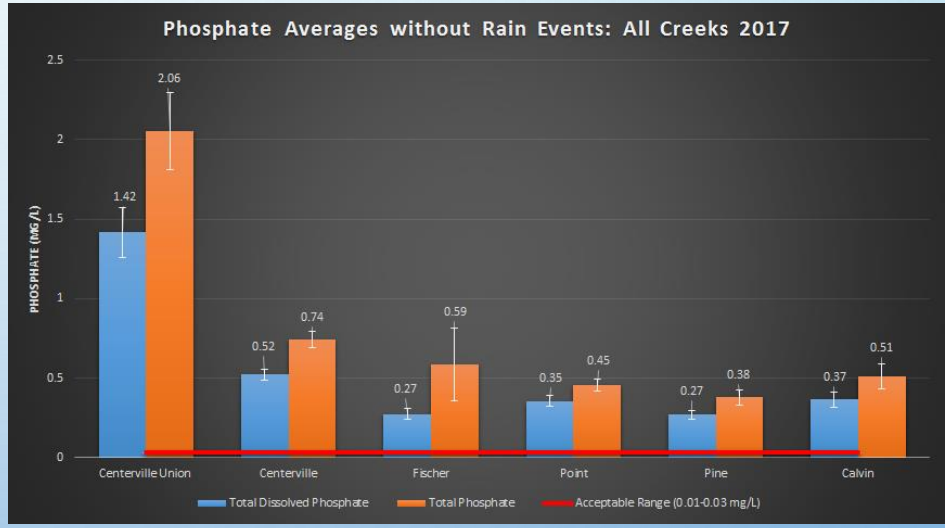



# Overall Analysis

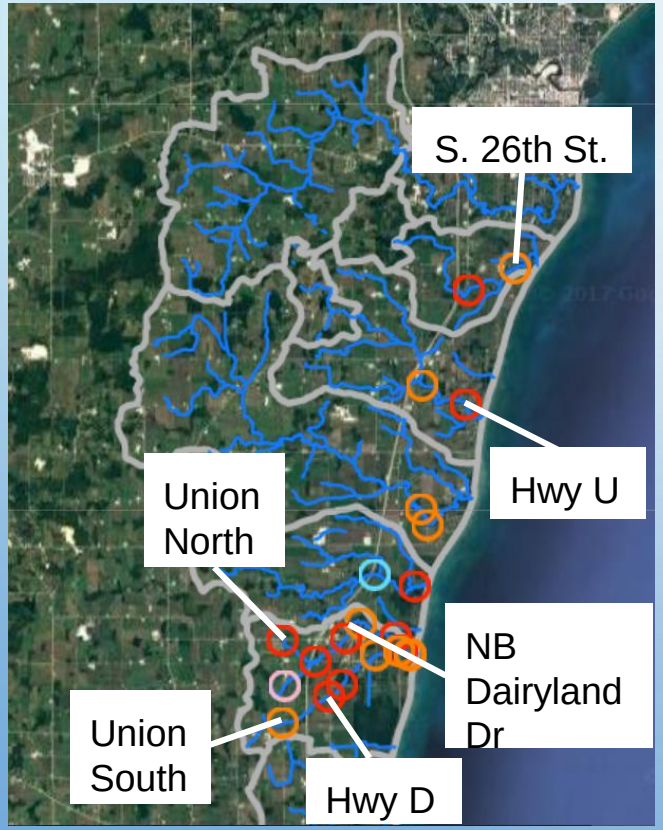
- Pine Creek spill and helping the community
- Union South has some of the highest nutrient input out of all our sites
- E. coli hasn't really changed much over time and remains above safe levels
- No phosphate correlation with rainfall like previous years
    - Phosphates entering stream without rain
        - 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

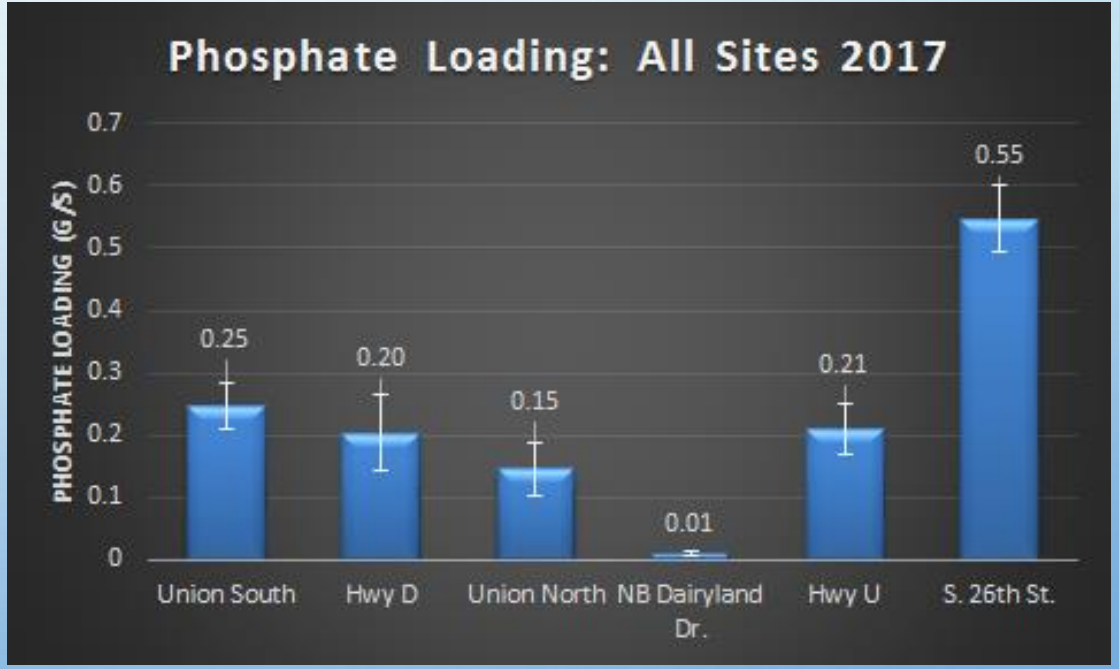
# Overall Analysis



# 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