2018 Water Quality Program

Outline

- Lake Water Quality
- Alum Plant Updates
- PFAS in Battle Creek
- Frost Kennard Spentlime
- Iron Enhanced Sand Filter
- Kohlman Test Basin Chambers
- Future Monitoring

Lake Water Quality Monitoring

Overall Objective: to assess the condition of our lakes over time

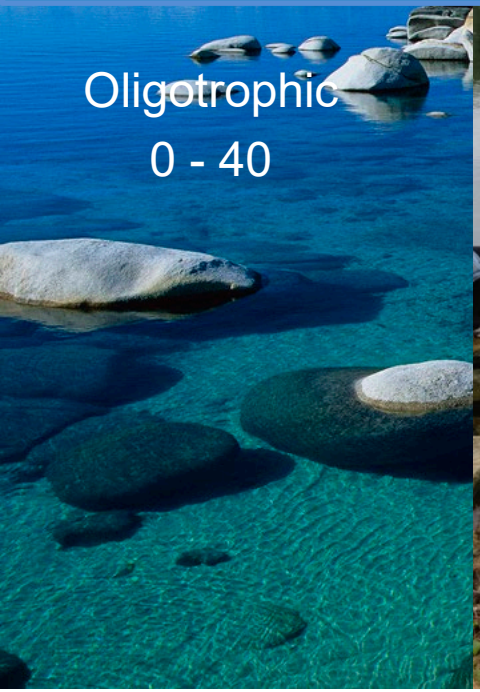
Lake and Pond Water Quality Monitoring

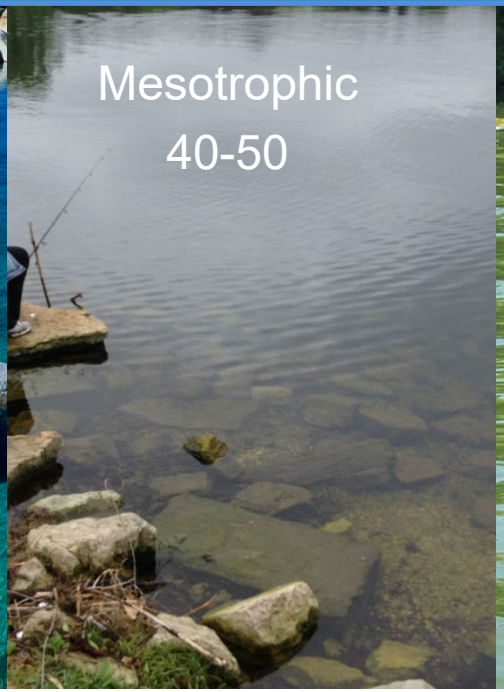
- Sample at deepest point
- Sample every two – three weeks
- Monitor- Ice out and June – September
- Readings at 1 meter intervals (Dissolved Oxygen, Temperature, pH, Turbidity and Conductivity)
- Water Samples (Top two meters & bottom)
  - Phosphorus
  - Chloride
  - Chlorophyll A
  - Nitrogen

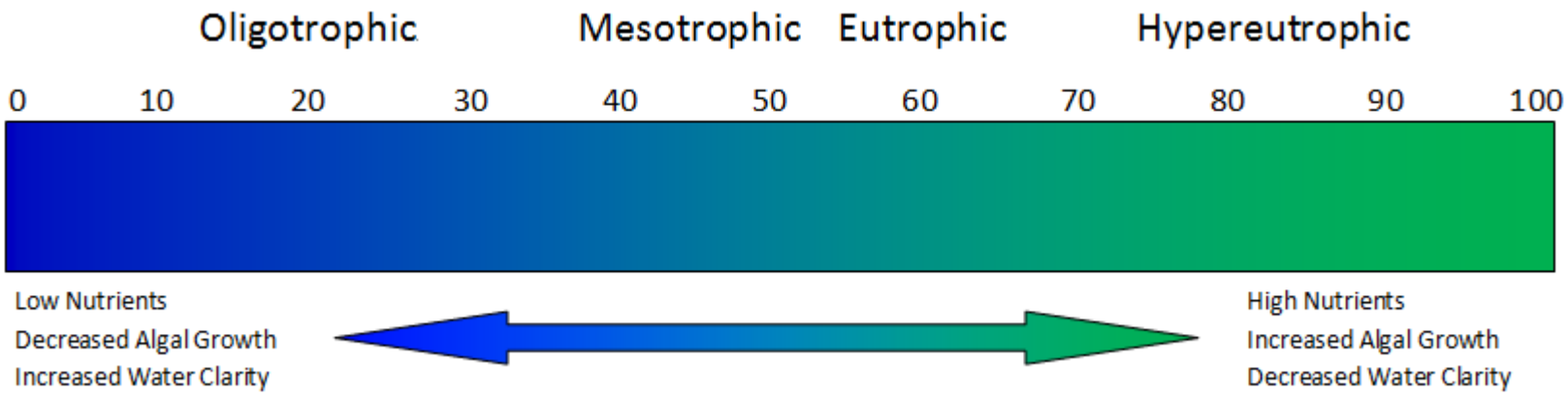
Trophic State Index

- Determine the condition
- Chlorophyll is a main component in the index
- A measure of algal production in a lake
- Scale: 0 to 100
- Simplified and normalized way of looking at data
- Standard measure in lake water quality monitoring

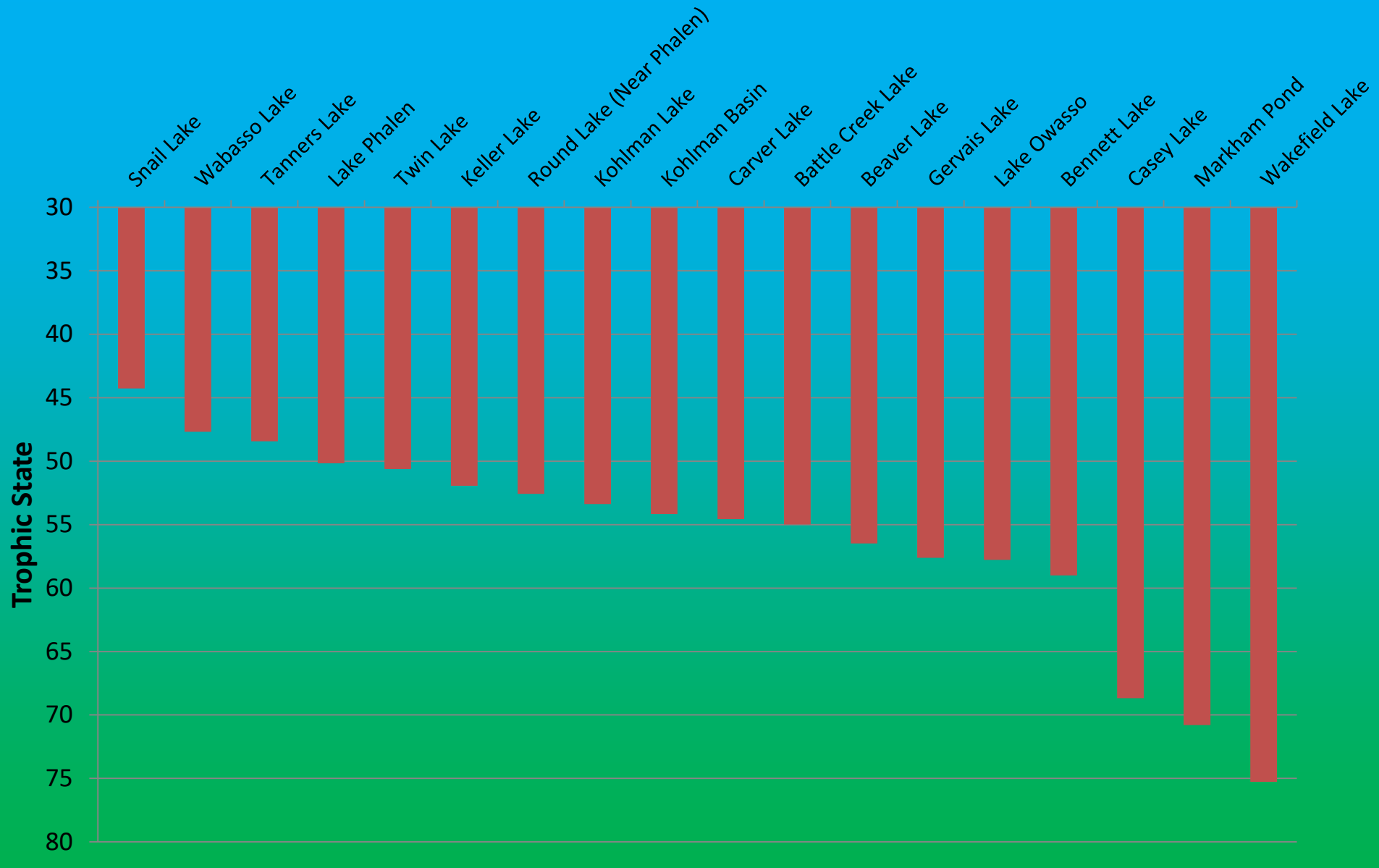
Different Trophic States





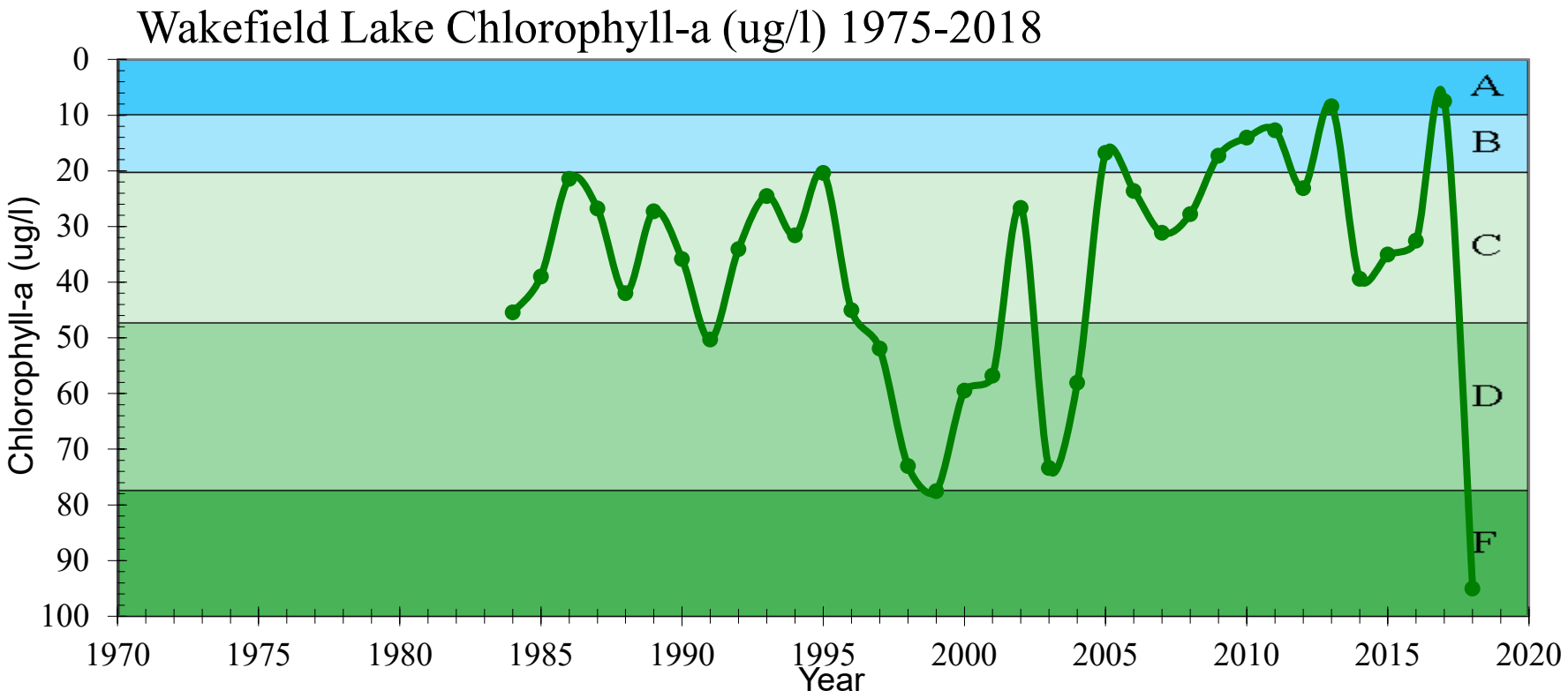


2018 Comparing Trophic States



2018 Trophic State Drop

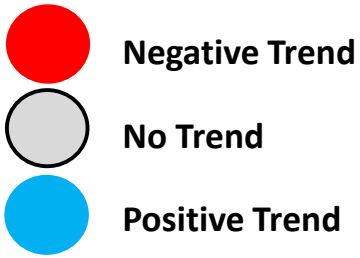
- Average 10 % increase in TSI from 2017
- Deep snow cover late, let in little light
- Ice out late, ave. ice out 4/5 and in 2018 it was 4/28
- Plants died off, build up of phosphorus
- Higher temps in May, ave. temp in 69, in 2018 it was 78.3.



Lake and Pond Condition Over Time

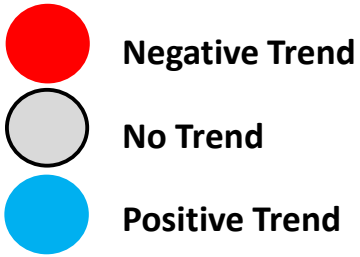
- Computed summer TSI averages for each lake
- Looked at trends for two time scales – 10 and 30 years
- Use a test called the “Mann-Kendall” to determine significance
- Standard procedure used in water quality data analysis

2018 - 30 Trend Analysis for TSI

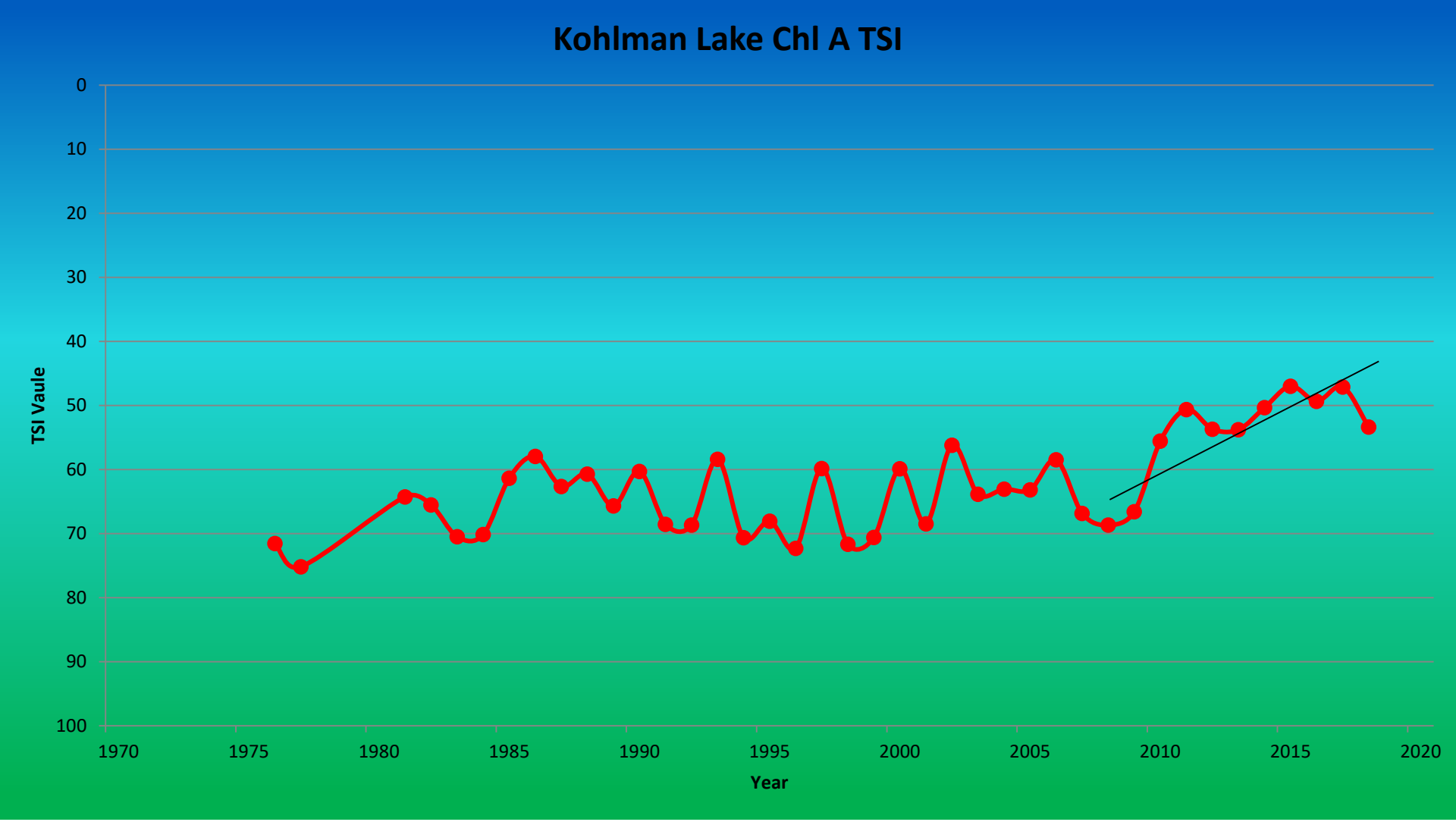


Lake	Trend?
Battle Creek Lake	Positive
Beaver Lake	Positive
Bennett Lake	Positive
Carver Lake	Positive
Gervais Lake	Positive
Keller Lake	Positive
Kohlman Lake	Positive
Lake Owasso	No
Lake Phalen	No
Round Lake	Positive
Snail Lake	No
Tanners Lake	Positive
Twin Lake	No
Wabasso Lake	Positive
Wakefield Lake	No

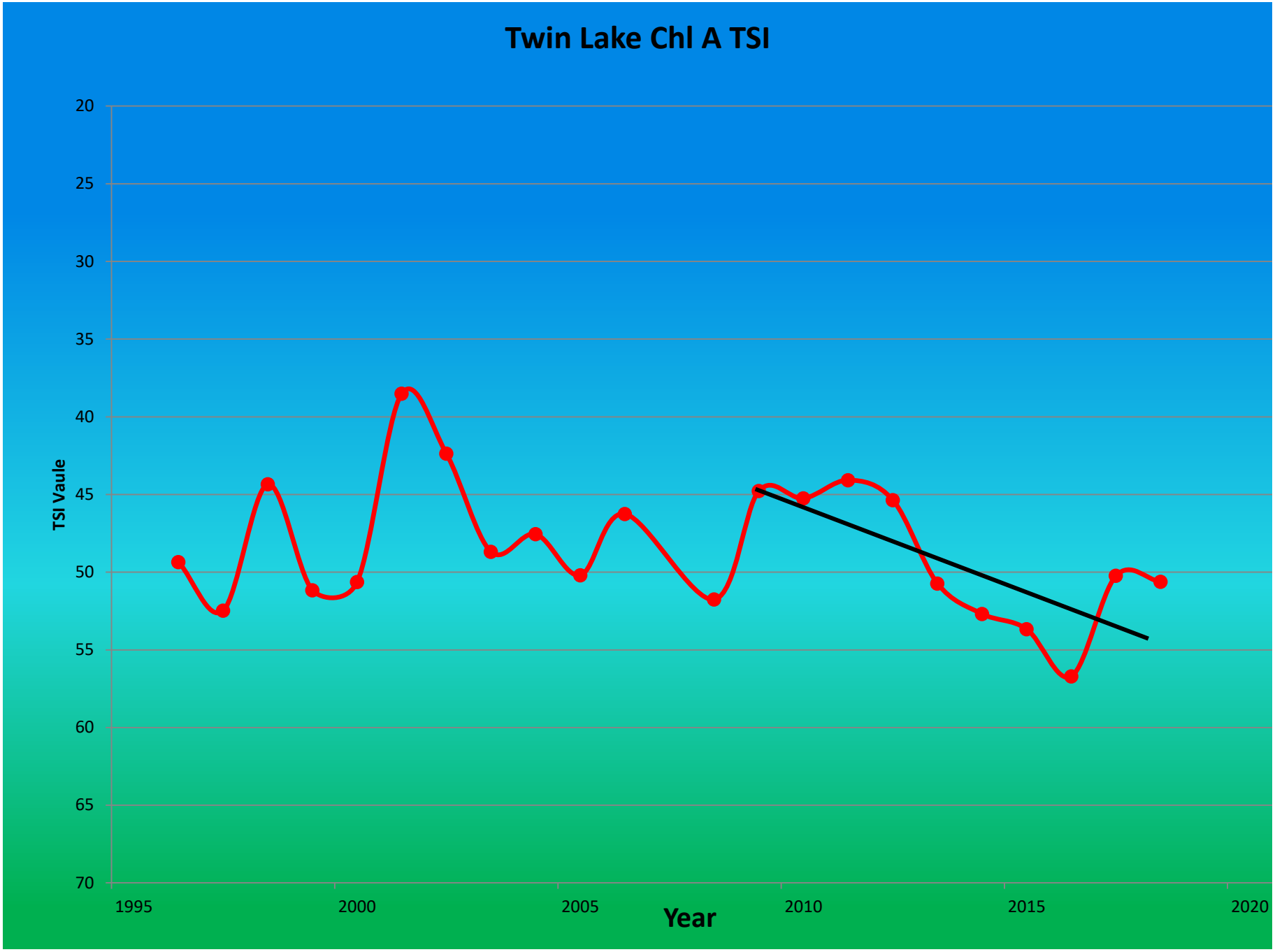
2018 - 10 Year Trend Analysis for TSI



Lake	Trend?	Years
Battle Creek Lake	No	10
Beaver Lake	No	10
Bennett Lake	No	10
Carver Lake	No	10
Casey Lake	No	10
Gervais Lake	No	10
Keller Lake	No	10
Kohlman Basin	No	8*
Kohlman Lake	Positive	10
Lake Owasso	No	10
Lake Phalen	No	10
Markham Pond	No	8*
Round Lake	No	10
Snail Lake	No	10
Tanners Lake	No	10
Twin Lake	Negative	10
Wabasso Lake	No	10
Wakefield Lake	No	10



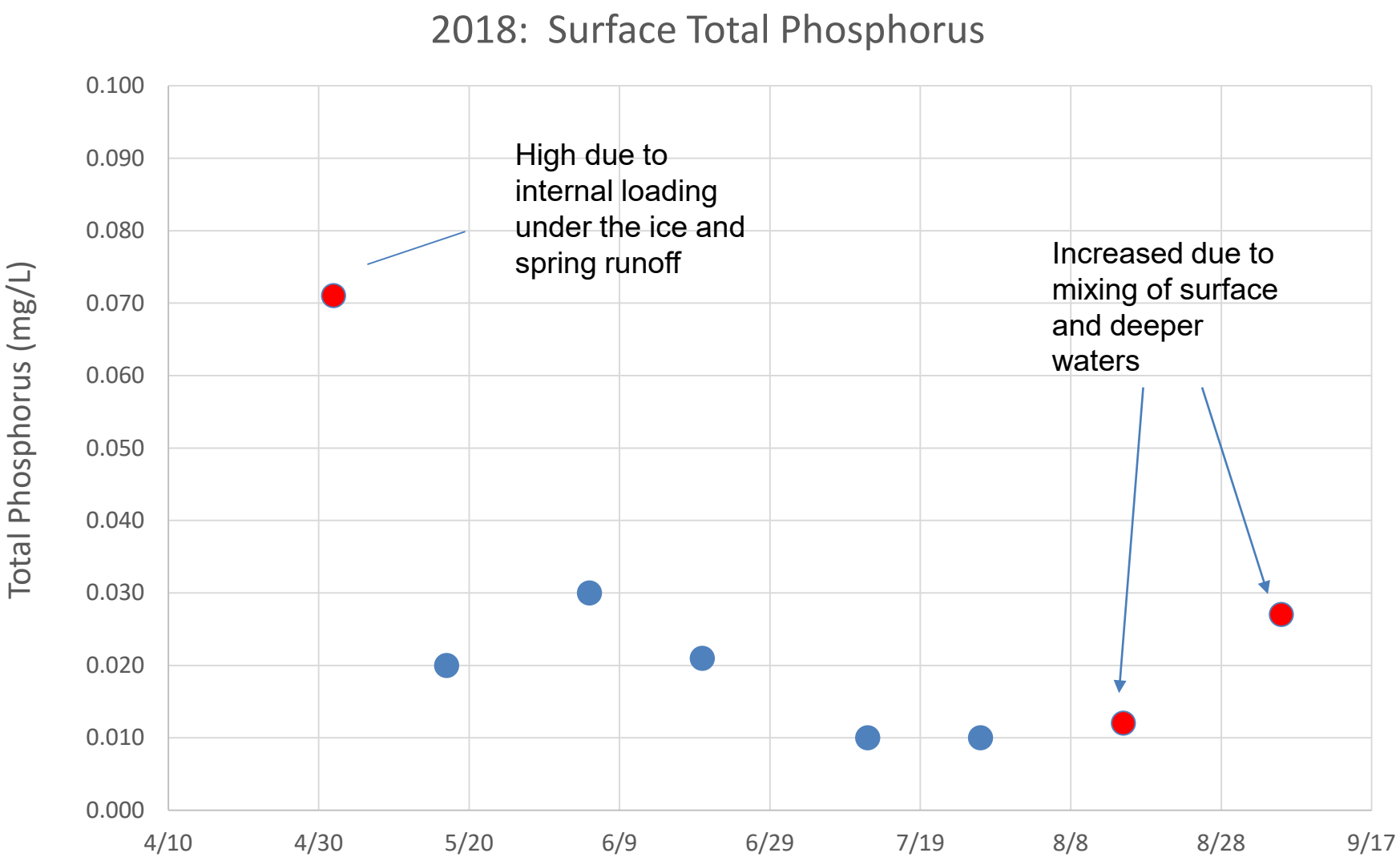
- Whole lake alum treatment
- Herbicide treatments for curly leaf pond weed
- Carp removal in the chain
- Plus other BMPs upstream


Twin Lake Chl A TSI
20
25
30
35
40
45
50
55
60
65
70
TSI Vaule
1995
2000
2005
2010
2015
2020
Year

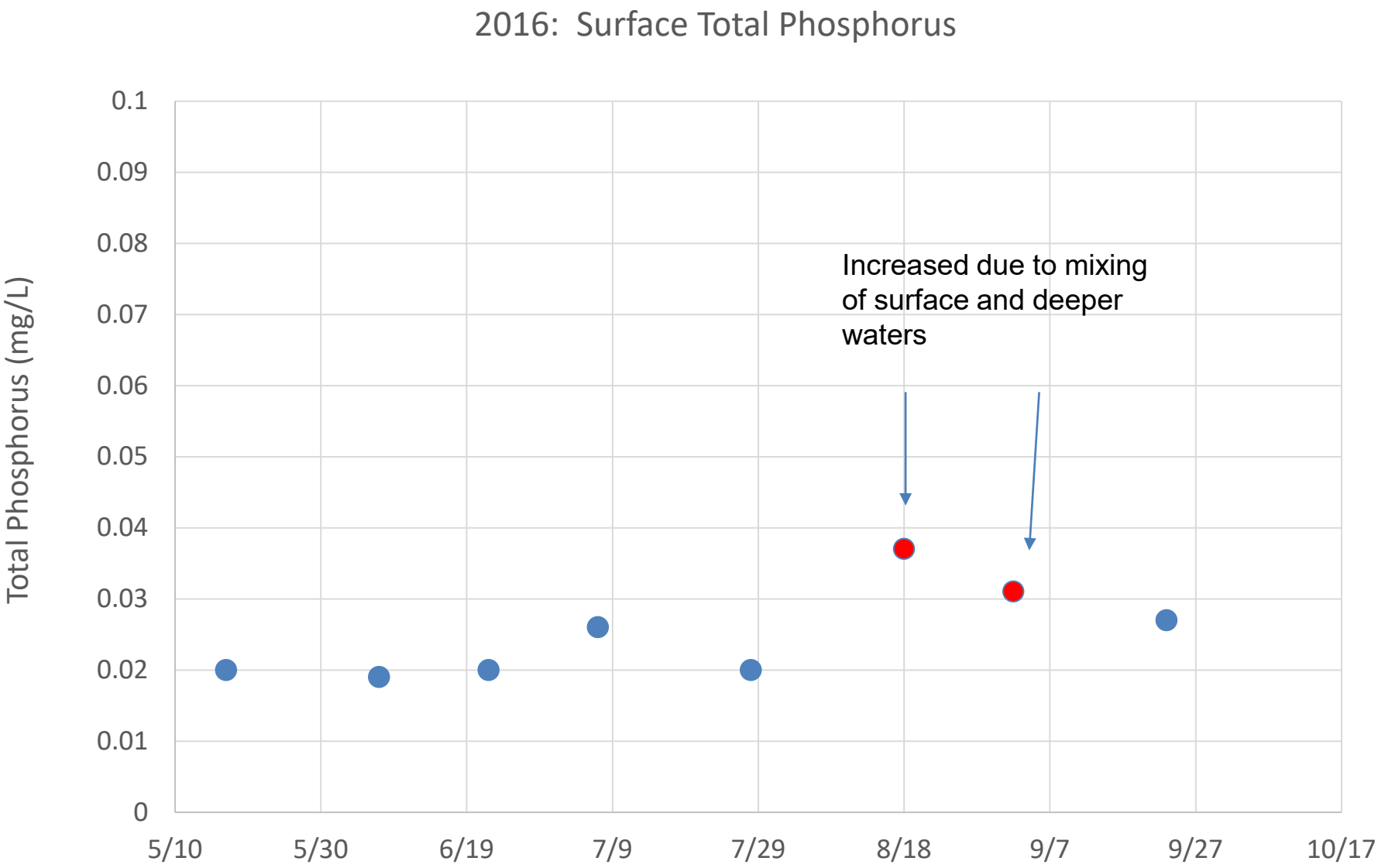
Twin Lake – Decreasing WQ Trend

- Hypothesis – declining trend caused by climatic variability
  - Internal loading under ice in the winter
  - Increase in runoff volume affecting mid-summer TP
  - Warmer temps in fall causing mixing of surface and deep water

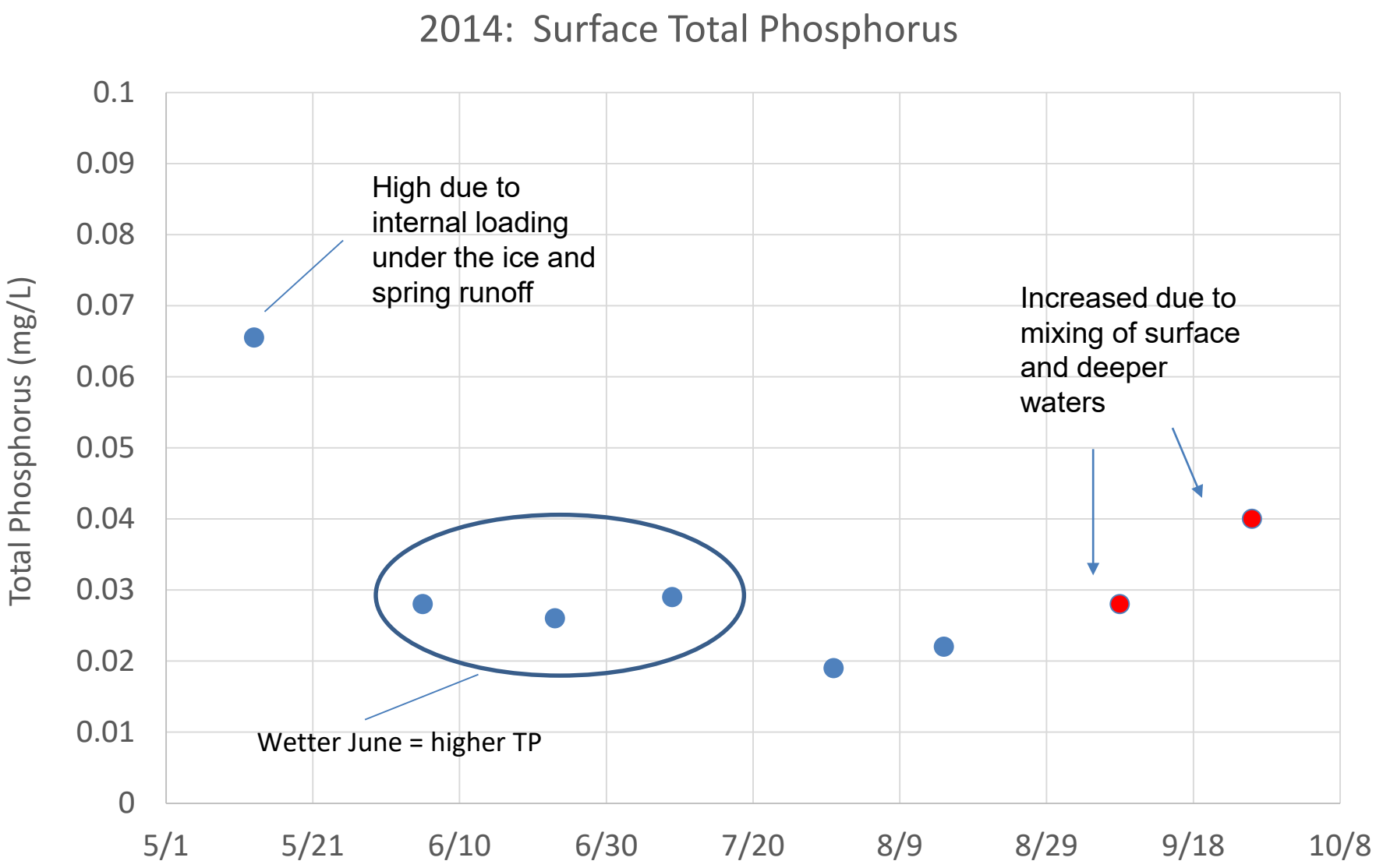
Twin Lake


2018: Surface Total Phosphorus
Total Phosphorus (mg/L)
0.100
0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
4/10
4/30
5/20
6/9
6/29
7/19
8/8
8/28
9/17
High due to internal loading under the ice and spring runoff
Increased due to mixing of surface and deeper waters

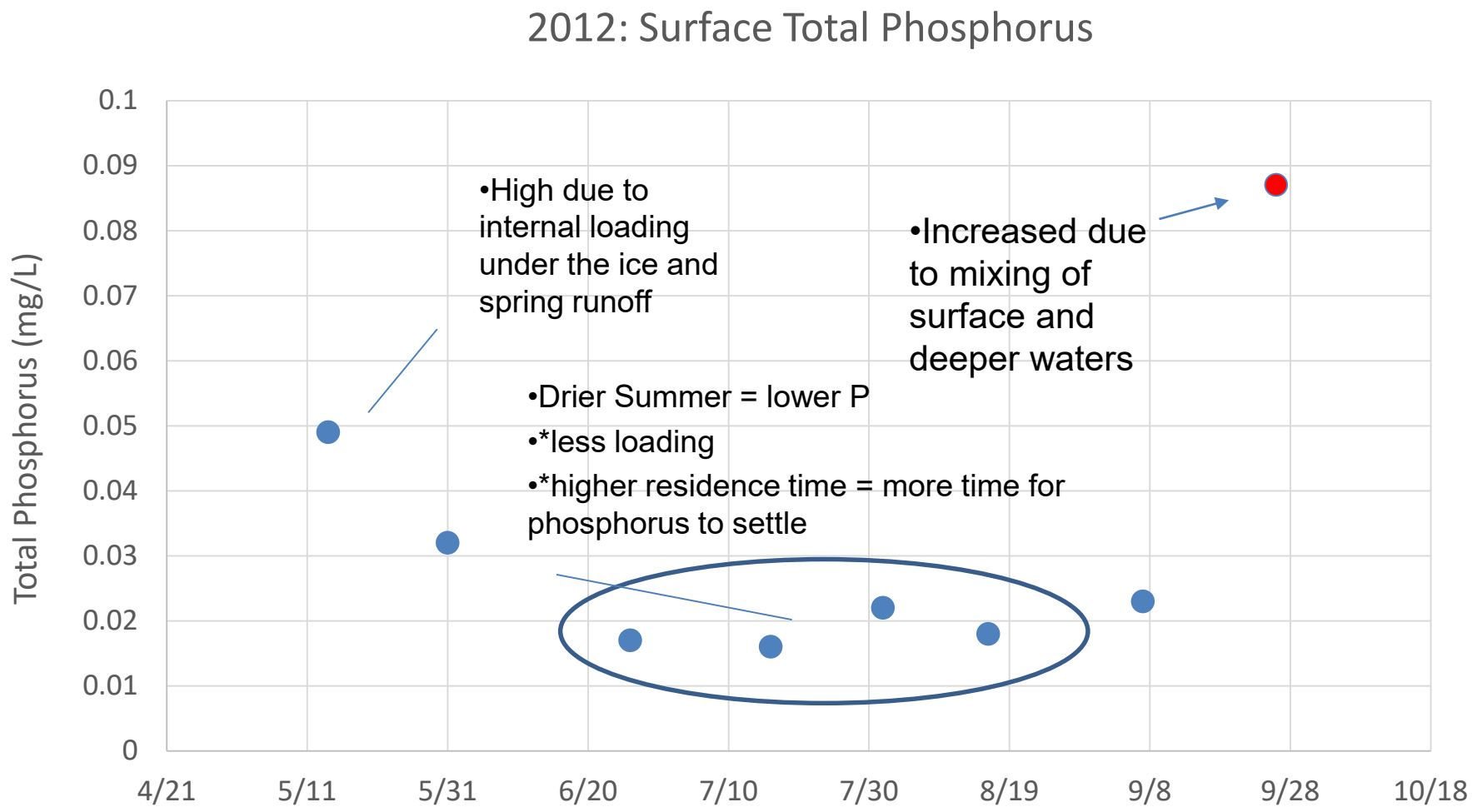
Twin Lake


2016: Surface Total Phosphorus
Total Phosphorus (mg/L)
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
5/10
5/30
6/19
7/9
7/29
8/18
9/7
9/27
10/17
Increased due to mixing of surface and deeper waters

Twin Lake


2014: Surface Total Phosphorus
Total Phosphorus (mg/L)
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
5/1
5/21
6/10
6/30
7/20
8/9
8/29
9/18
10/8
High due to internal loading under the ice and spring runoff
Increased due to mixing of surface and deeper waters
Wetter June = higher TP

Twin Lake


2012: Surface Total Phosphorus
Total Phosphorus (mg/L)
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
4/21
5/11
5/31
6/20
7/10
7/30
8/19
9/8
9/28
10/18
•High due to internal loading under the ice and spring runoff
•Increased due to mixing of surface and deeper waters
•Drier Summer = lower P
•*less loading
•*higher residence time = more time for phosphorus to settle

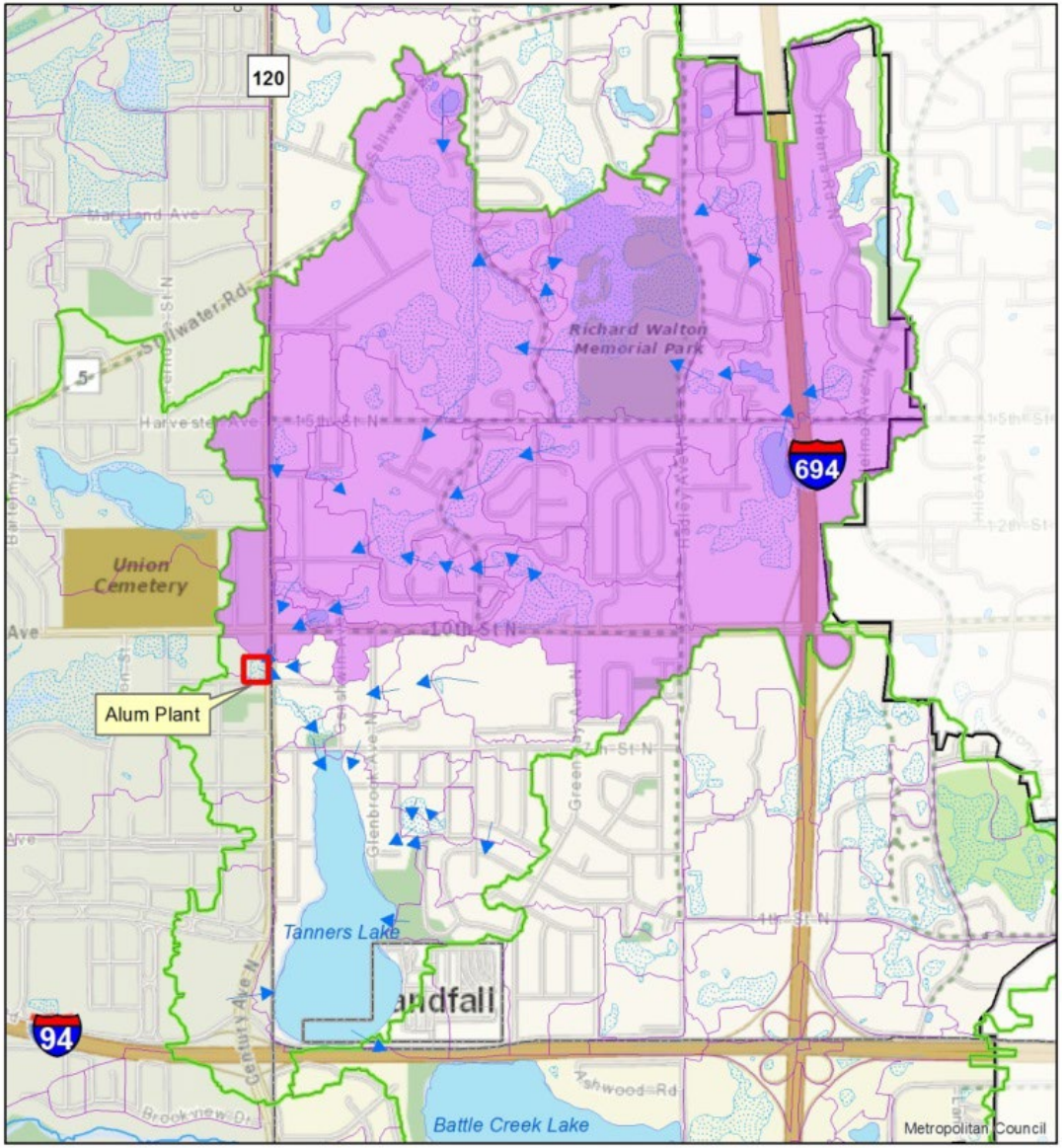
Twin Lake

- Lake responding to climatic variability rather than a sustained decrease in water quality
- Twin Lake is meeting WQ goals

Water Quality Parameter	MPCA Deep Lake Eutrophication Standard (NCHF Ecoregion)	Twin Lake (2009-2018) Growing Season Average
Total Phosphorus (µg/L)	≤ 40	24.0
Chlorophyll-a (µg/L)	≤ 14	7.5
Secchi disk transparency (m)	≥ 1.4	2.68

Tanners Lake - Alum Plant

- North of Tanners Lake
- Treats 60% surface water that enters Tanners
- Reduces phosphorus loading to Tanners Lake



Alum Plant

- Alum added to stormwater
- Binds with phosphorus
- Creates a floc, snow flake like
- Settles out in the pond
- Water continues over to ditch, series of wetlands and then Tanners Lake

Alum Plant : MS4 Permit Requirement

Table B-1:
Monitoring Parameters During Operation

Station	Alum Parameters	Ferric Parameters	Units	Frequency
Upstream-Background	Total Phosphorus	Total Phosphorus	mg/L	1 x week
	Dissolved Phosphorus	Dissolved Phosphorus	mg/L	1 x week
	Total Aluminum	Total Iron	mg/L	1 x month
	Dissolved Aluminum	Dissolved Iron	mg/L	1 x week
	pH	pH	SU	1 x week
	Flow	Flow	Mgd	Daily
Alum or Ferric Chloride Feed	Alum	Ferric	Gallons	Daily Total Dosed In Gallons
Discharge From Treatment	Total Phosphorus	Total Phosphorus	mg/L	1 x week
	Dissolved Phosphorus	Dissolved Phosphorus	mg/L	1 x week
	Total Aluminum	Total Iron	mg/L	1 x month
	Dissolved Aluminum	Dissolved Iron	mg/L	1 x week
	pH	pH	SU	1 x week
	Flow	Flow	Mgd	Daily

e. In the following situations, the **permittee** shall perform corrective action(s) and immediately notify the Minnesota Department of Public Safety Duty Officer at 1-800-422-0798 (toll free) or 651-649-5451 (Metro area):

(1) The pH of the discharged water is not within the range of 6.0 and 9.0
(2) Any indications of toxicity or measurements exceeding **water quality standards**
(3) A spill, as defined in Minn. Stat. § 115.01, subd. 13, of alum or ferric chloride

3. Reporting and Recordkeeping

a. Annual Reporting

The **permittee** shall submit the following information with the Annual Report in Part IV.B. The Annual Report must include a month-by-month summary of:

(1) Date(s) of operation
(2) Chemical(s) used for treatment
(3) Gallons of water treated
(4) Gallons of alum or ferric chloride treatment used
(5) Calculated pounds of phosphorus removed
(6) Any performance issues and the corrective action(s), including the date(s) when corrective action(s) were taken

b. On-Site Recordkeeping

A record of the following design parameters shall be kept on-site:

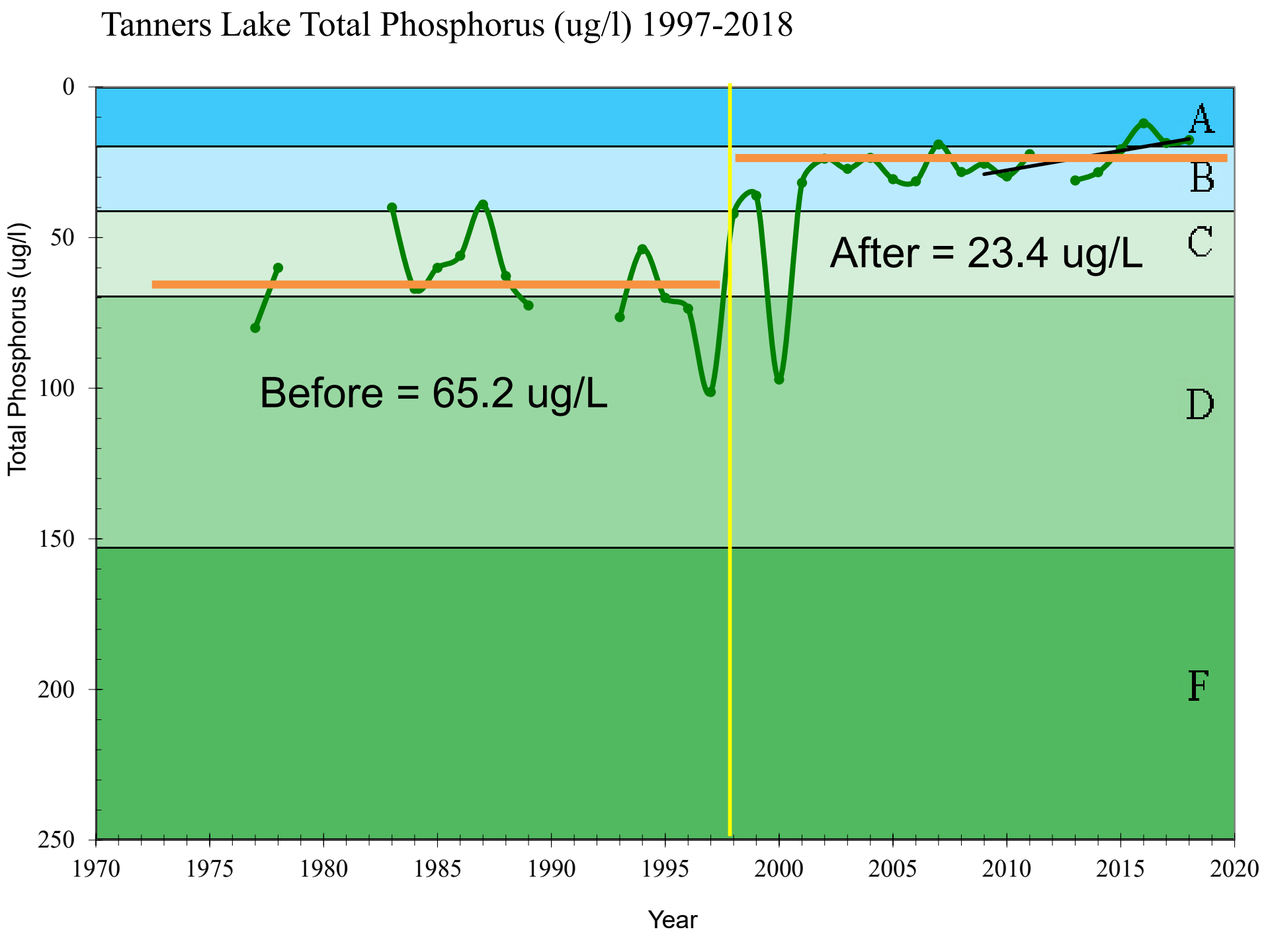
(1) Site-specific jar testing conducted using typical and representative water samples in accordance with ASTM D2035-08 (2003)
(2) Baseline concentrations of the following parameters in the influent and **receiving waters:**

- Weekly sampling of inlet and outlet (grabs or storms)
  - •Total Phosphorus
  - •Dissolved Phosphorus
  - •Total Aluminum (monthly)
  - •Dissolved Aluminum
- •Continuous Monitoring
  - •pH with alarm (required to be 6 – 9 pH)
  - •Flow
- Annual Record Keeping
  - •Dates of operation
  - •Chemicals used
  - •Gallons of water treated
  - •Gallons of alum used
  - •Calculated lbs of TP removed
  - •Any performance issues

Alum Plant Results

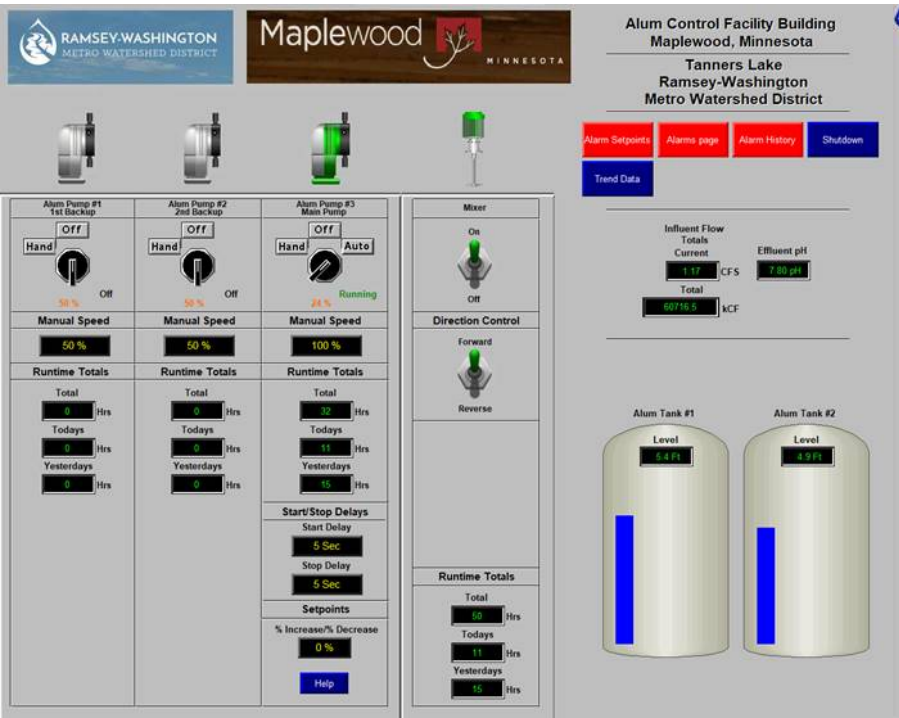
- In 2018
  - Ran for 3.5 months
  - pH probe problems, shutdown
  - Average phosphorus removal was 76%
  - 120 lbs phosphorus removed
- 1998 to present - TP removal 72%

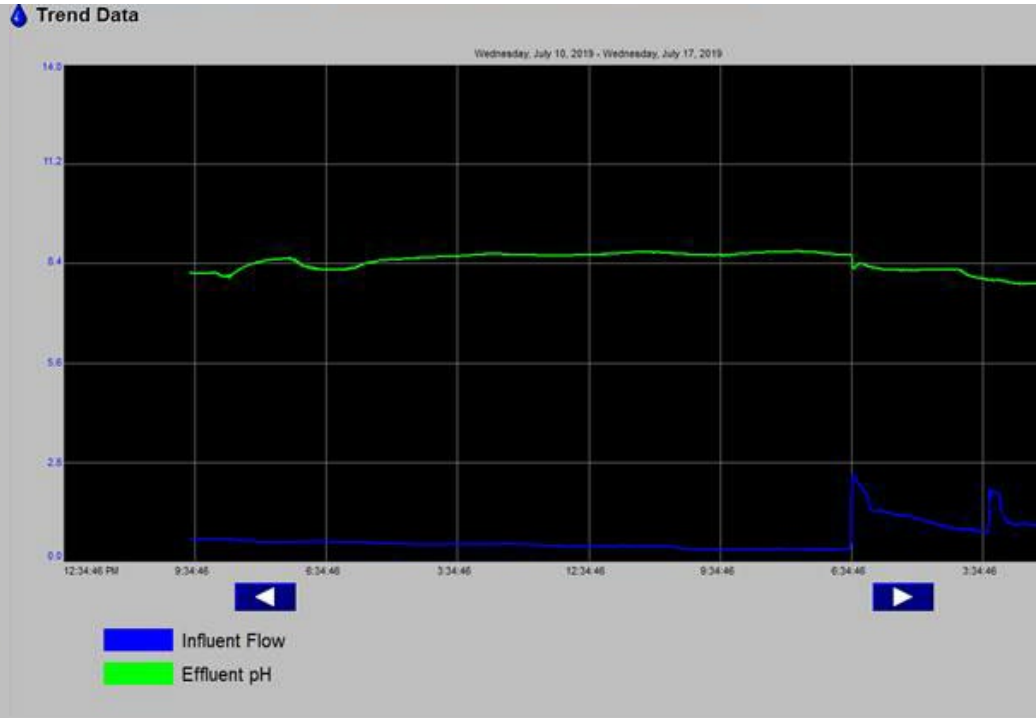
Total Phosphorus				
Year	**Inflow Mass (lbs)**	**Outflow Mass (lbs)**	**Removed (lbs)**	**Removal (%)**
2012	151	21	130	86
2013	158	43	115	73
2014	350	106	244	70
2015	514	77	437	85
2016	509	57	452	89
2017	405	51	354	87
2018	182	52	129	71


Tanners Lake Total Phosphorus (ug/l) 1997-2018
Total Phosphorus (ug/l)
0
50
100
150
200
250
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Year
A
B
C
D
F
Before = 65.2 ug/L
After = 23.4 ug/L

Alum Plant Upgrades

- Planned to upgrade over winter of 2018-19
- Alum plant shut down in July 2018, outlet pH probe unreliable
- Delays - Equipment wasn't purchased, reinstall 200ft of pH cable, programming, calibration of pumps and meters
- Upgraded pH probe, new flow meter, added mobile accessibility, digital tank levels, digital pH reading, plus new tanks and plumbing coming soon
- Up in running in early July





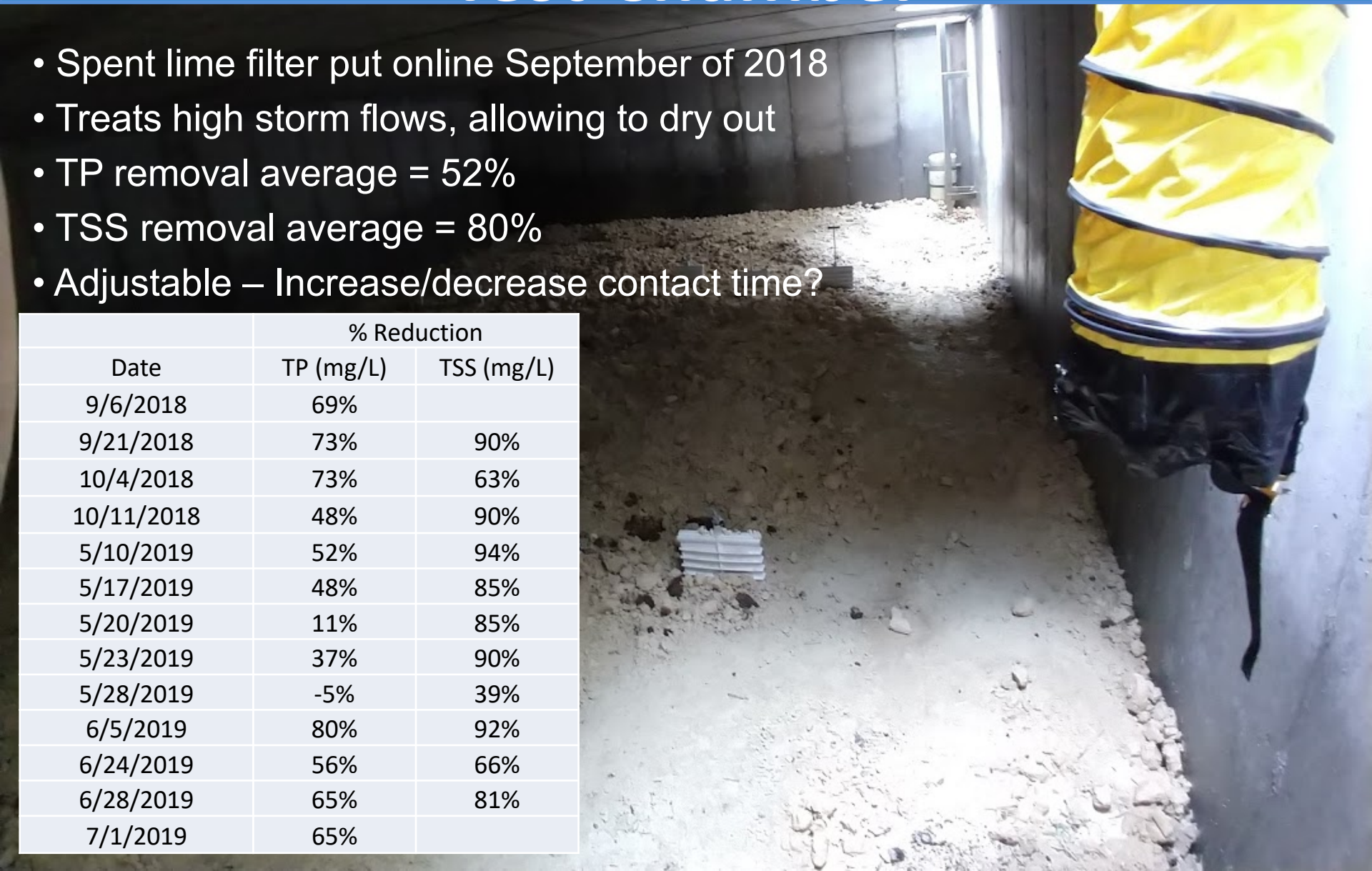
PFAS in Battle Creek

- In May, Dept. Health tested for PFAS (Perfluoroalkyl Substances) in Battle Creek, Battle Creek Lake and Tanners Lake
- PFAS – human made chemicals – can be found in water-repellent fabrics, non-stick products, paints, fire fighting foams and other products
- Background levels in Tanners Lake, Battle Creek Lake and the creek
- High levels of PFAS in Battle Creek's foam
- Compounds possibly from a fire suppressant
- Possible sources- Fire on I94? Fire training? 3M Disposal site in Oakdale?
- Low risk - Not absorbed well through skin, not a source of drinking water
- Next step – Barr, MPCA and MDH on identifying source
- Possible money from 3M settlement for source ID and needed mitigation

Frost Kennard Spentlime Test Chamber

- Spent lime filter put online September of 2018
- Treats high storm flows, allowing to dry out
- TP removal average = 52%
- TSS removal average = 80%
- Adjustable – Increase/decrease contact time?

	% Reduction	
Date	TP (mg/L)	TSS (mg/L)
9/6/2018	69%	
9/21/2018	73%	90%
10/4/2018	73%	63%
10/11/2018	48%	90%
5/10/2019	52%	94%
5/17/2019	48%	85%
5/20/2019	11%	85%
5/23/2019	37%	90%
5/28/2019	-5%	39%
6/5/2019	80%	92%
6/24/2019	56%	66%
6/28/2019	65%	81%
7/1/2019	65%	



Iron Enhanced Sand Filter

- Upstream of Kohlman Lake (Beam & County View Lane)
- Sand with 5% iron filings with an underdrain
- Iron binds with phosphorus
- Constructed in 2008
- Lab tests have show that this could last for 30 years
- Problem? First 15 feet solidified but still working

	TP	TSS	Iron
2009	77%	97%	
2010	76%	92%	90%
2011	46%	84%	84%
2012	N/A	64%	89%
2013	72%	86%	86%
2014	91%	91%	97%
2015	87%	54%	89%
2016	72%	88%	91%
2017	90%	96%	96%
2018	84%	97%	91%
Average	**77%**	**87%**	**91%**

Kohlman Basin Test Chambers

- Test facility
- Upstream of Kohlman lake
- Four chambers
- Test multiple materials (steel slag two different conc., hemitite and crush limestone)
- Test for phosphorus before and after
- Adjust flow to change contact time
- What works best?

Future and Current Monitoring

- Shoreview Commons Pond – U of M treating pond with Iron filings
- Willow Pond Continuous Monitoring and Adaptive Control Filtration (CMAC) BMP – drawing water off pond into spentlime filter, ability to dry out, not effected by rain

Questions?