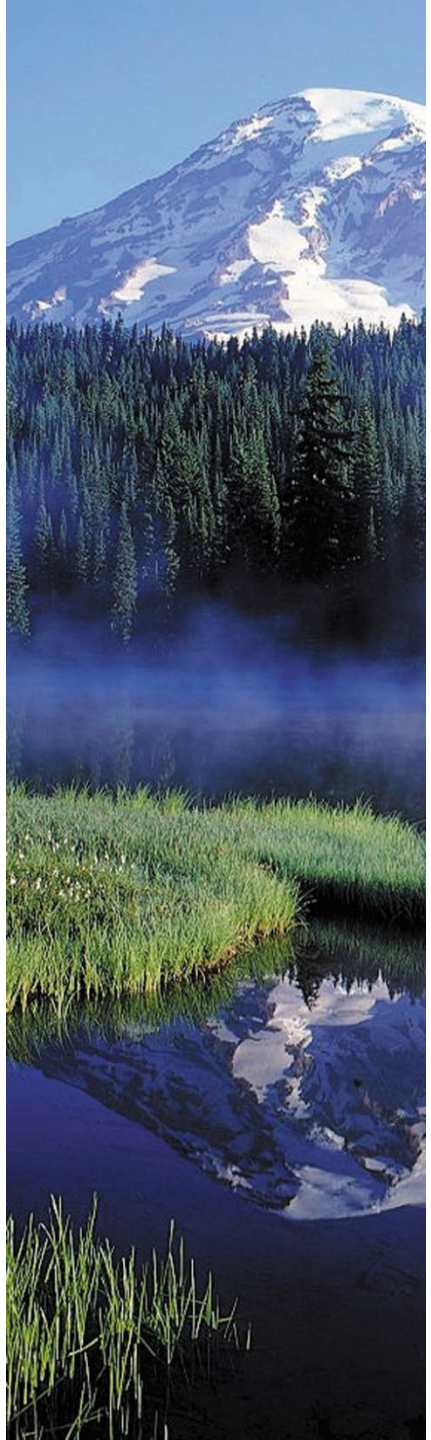


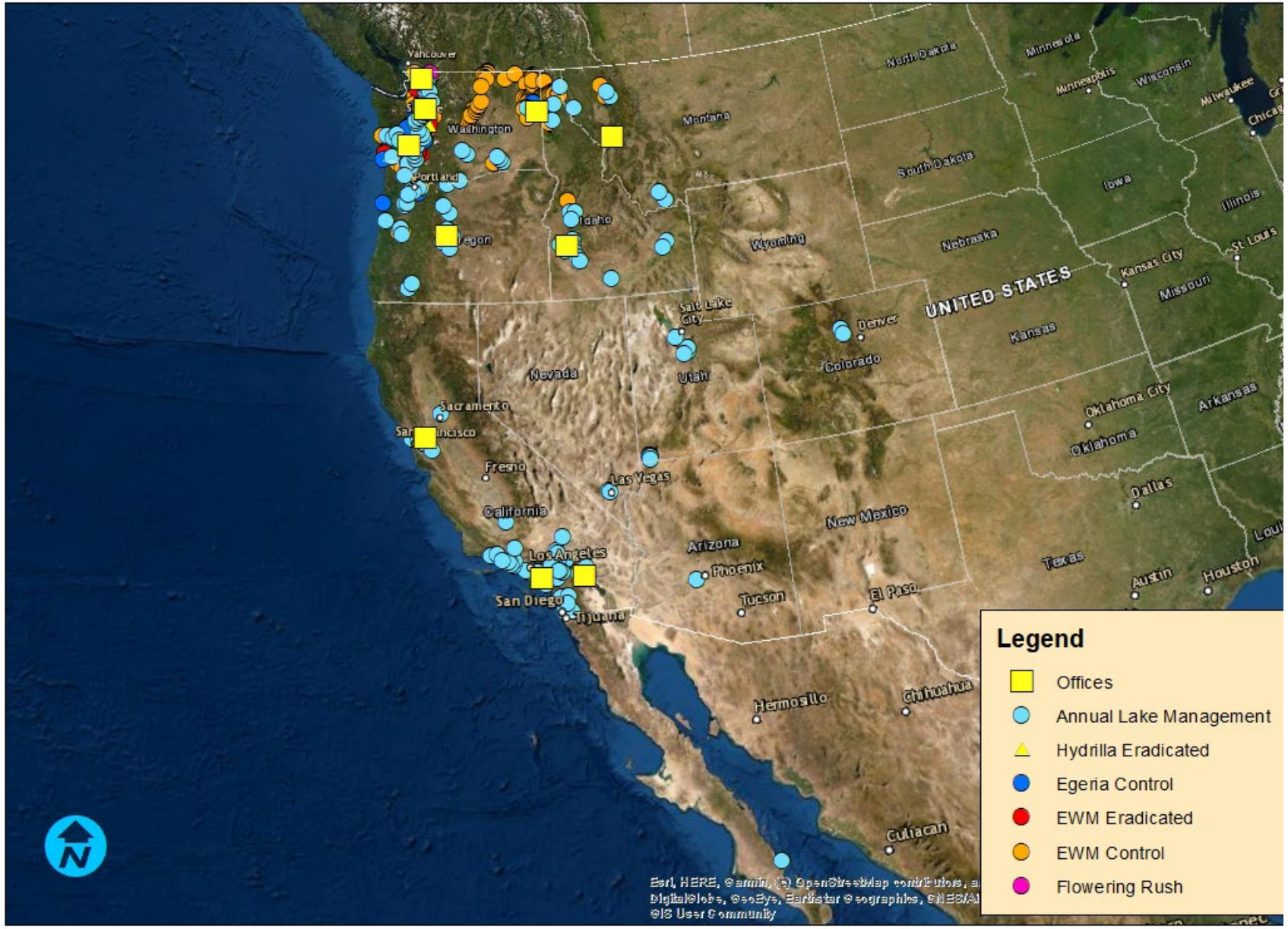
Cottage Lake HOA Meeting
May 14, 2022

Terry McNabb, CLM

Aquatechnex, LLC

Terry McNabb

- Graduate Michigan State University, BS Water Resource Management 1979
- Have worked in this field since 1970
- Past President, Aquatic Plant Management Society (www.apms.org) and North American Lake Management Society (www.nalms.org)
- Certified Lake Manager, CLM
- California Pest Control Advisor, PCA
- GCSAA Lake Management Instructor
- UC Davis Aquatic Weed School Faculty



Aquatechnex Major Lake Management and Invasive Aquatic Weed Projects

Company Overview Over Four Decades of Lake Management Experience

- Western Waters Experience
- Regulator Environment Experience
- 10 offices and 25 trained aquatic biologists to draw expertise and equipment from

Eurasian Milfoil Environmental Impacts

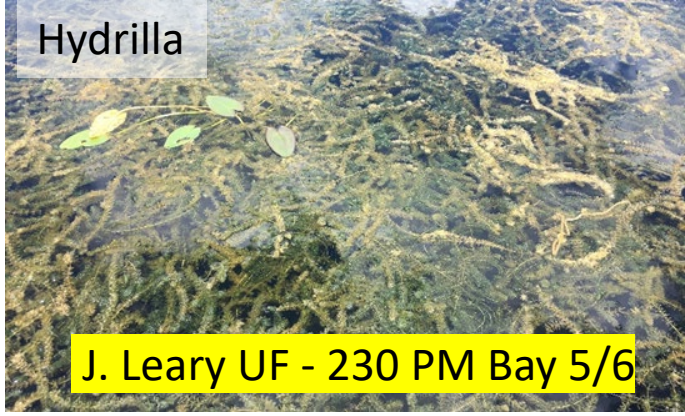
- Control Options, 2016
  - Contact Herbicides provide short term relief
  - Systemic herbicides such as 2.4-D and Triclopyr provide longer term control
  - Hybrid plants starting to show up in Pacific Northwest with 2,4-D starting to loose efficacy
  - Longer term control with Sonar (Fluridone) but requires whole lake treatment or at least large area treatment because of contact exposure time requirement

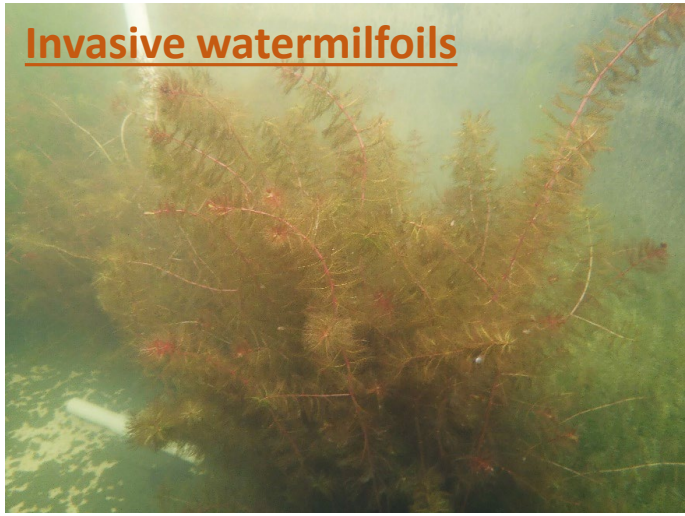
USAE APC Research Program/Aquatechnex Cooperation

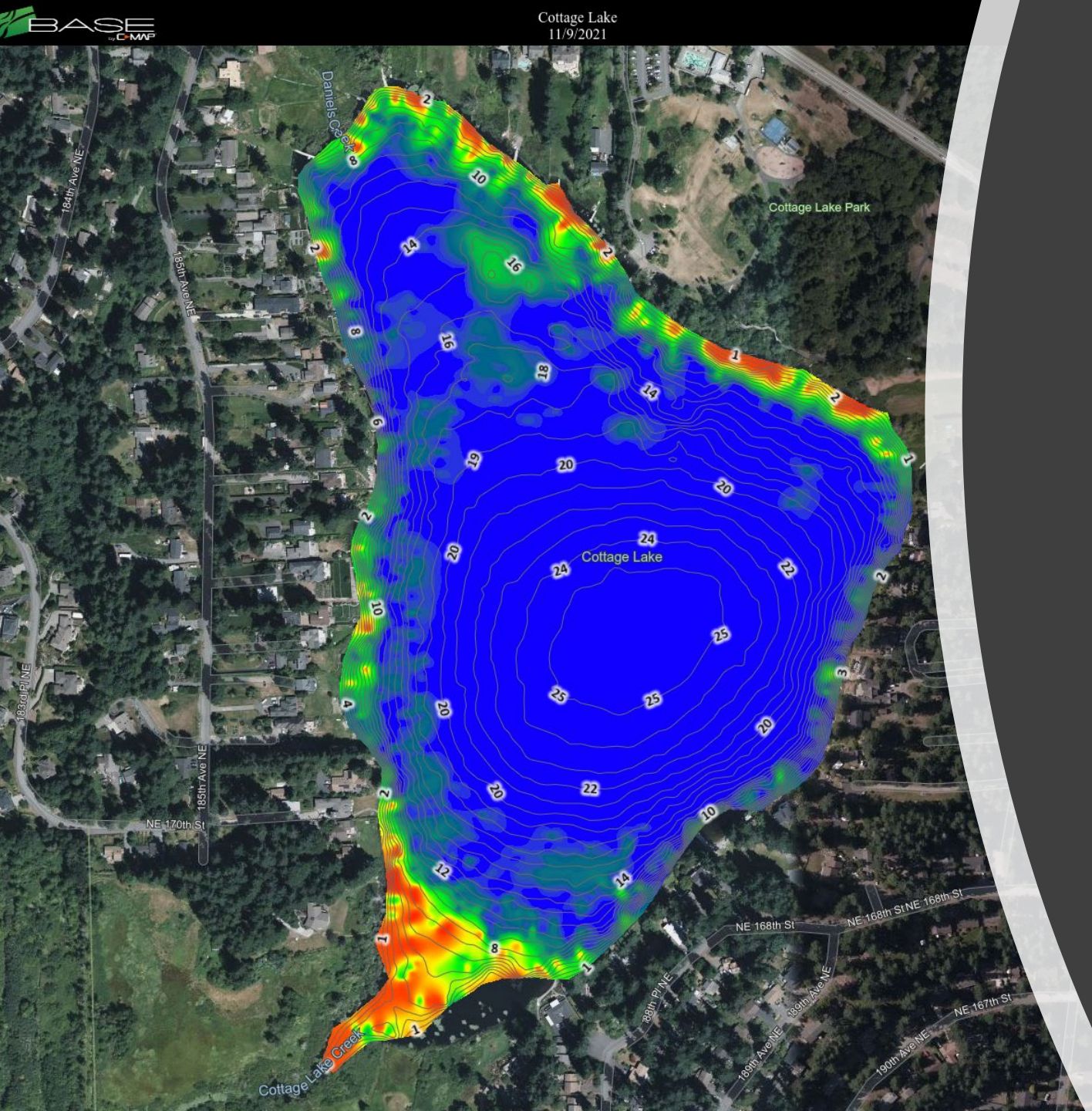
- 1981-82 Sacramento Delta Water Hyacinth Planning
- 1983-84 Potomac River Hydrilla Control Demo Program
- 1988-1990 Pend Oreille River Dye Studies
- 1991-93 Columbia and PO River Triclopyr Studies
- 1989-1991 Okeechobee/Seminole/Kentucky Lake hyperspectral aerial imaging demo project
- 1995-96 Lake Minnetonka, MN Triclopyr Milfoil Study
- 2000-2009 Various Washington Studies
- 2010-2012 PO River Acoustic Doppler vs. Dye water exchange study
- 2013-2017 Flowering Rush Herbicide Trials
- 2018-2021 Bubble Curtain Flowering Rush Study (video available, https://www.youtube.com/watch?v=fDWChNwJMIM)

ProcellaCOR® a.i., florpyrauxifen-benzyl

- **USEPA approval in late February 2018**
- **The first new herbicide active to have aquatic use with its initial registration in over 30 years.**
- **High selective, short-exposure (hrs to days) systemic activity** on multiple major US weeds
- **EPA Reduced Risk Classification**
  - **100X or greater reduction in use rates** versus older herbicides
  - **Excellent environmental profile**
- **USEPA exemption from tolerances in Sept 2019**







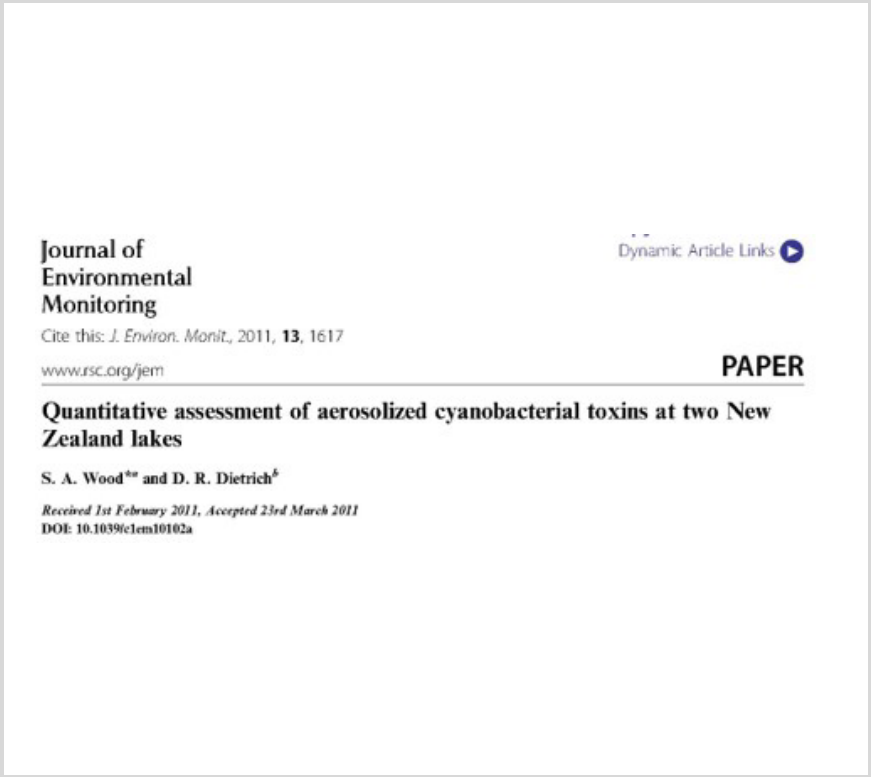
- Eurasian Milfoil is susceptable to Procellacor, will provide long term control
- No water use restrictions except 24 hour irrigation withdrawal (turf not impacted)
- Cost for public notice, $300 unless mailed by Community, Mob cost for treatment, $500.00 Cost per acre $650.00
- Estimated Acres, 8-10 spring survey would define better.

Harmful Algae Blooms

- Produce acute toxins
  - Liver toxins
  - Nervous system toxins
- Produce Chronic toxins to waterfowl
  - Avian vascular Myelinophathy
- Potentially have human health impact
  - Http://aquatechnex.com/2012/01/does-tap-water-cause-lou-gehrigs-als-disease/
  - This image is Lake Erie near Toledo Ohio Potable Water Intake

HAB and Long-Term Exposure

- Direct link to compounds produced and ALS
- Exposure can be from airborne toxins
- Exposure can be from potable water supply from impacted reservoir
- UF news 2020, “can travel 10 miles in light wind”



Journal of Environmental Monitoring

Cite this: *J. Environ. Monit.*, 2011, **13**, 1617

www.rsc.org/jem

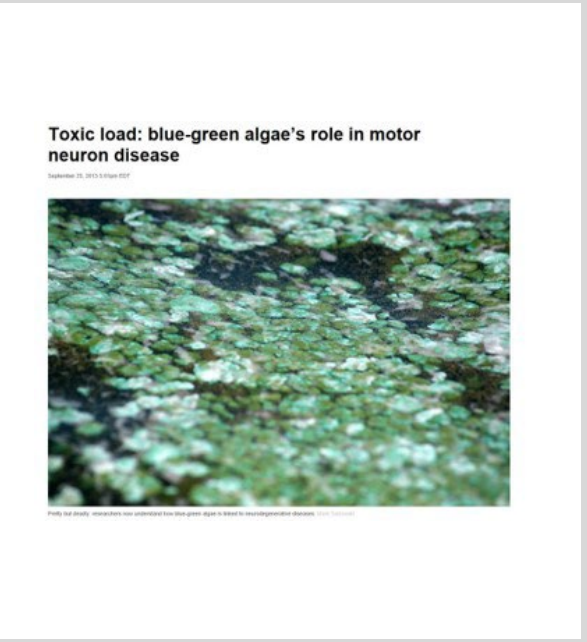
Dynamic Article Links

PAPER

Quantitative assessment of aerosolized cyanobacterial toxins at two New Zealand lakes

S. A. Wood[a*] and D. R. Dietrich[b]

Received 1st February 2011, Accepted 23rd March 2011
DOI: 10.1039/c1em10102a



Toxic load: blue-green algae's role in motor neuron disease

Environmental Health NEWS

FRONT PAGE TOXIFICATION CHILDREN WATER POPULATION OCEANS FOOD & AG ENERGY CLIMATE BIODIVERSITY AIR

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Closing in on ALS? Link between lethal disease and algae explored

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By Lindsey Konkel
Staff Writer
Environmental Health News

Toxins **2015**, *7*, 322-336; doi:10.3390/toxins7020322

OPEN ACCESS

toxins

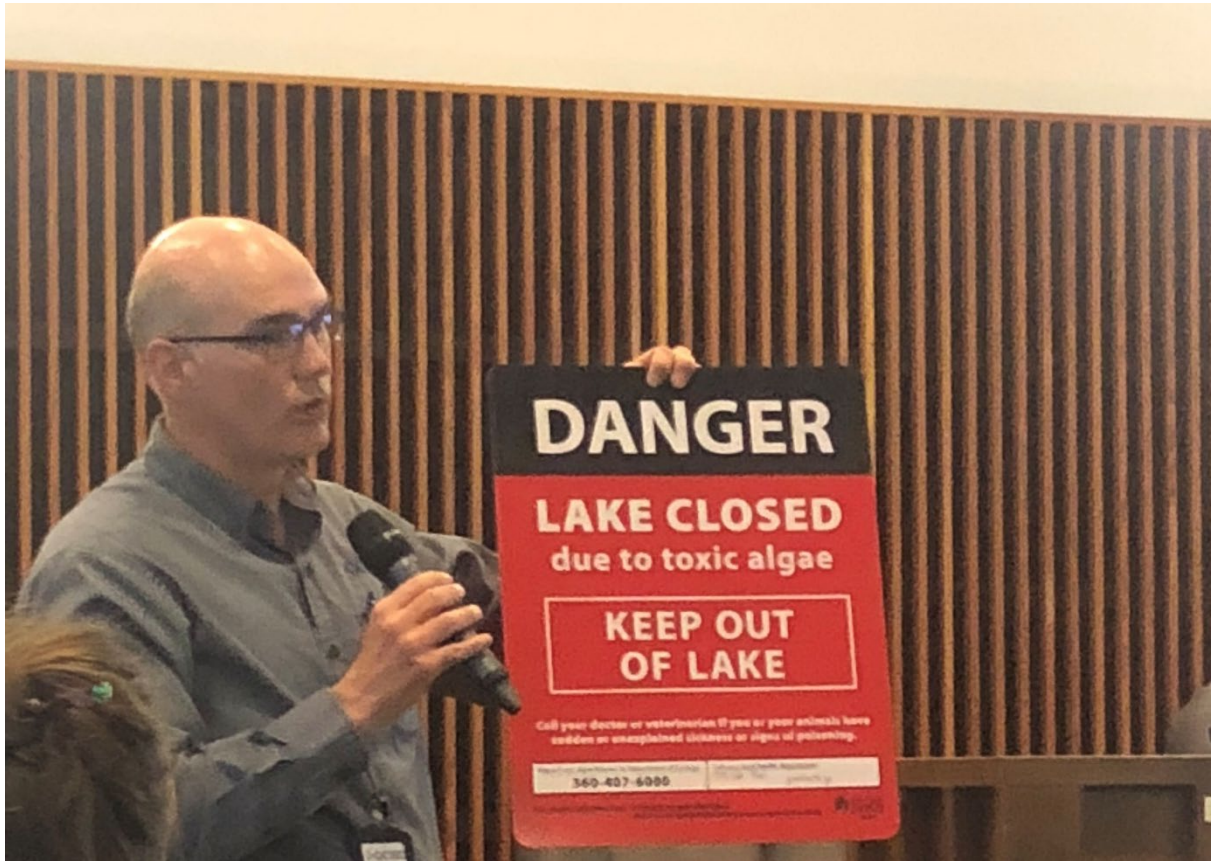
ISSN 2072-6651

www.mdpi.com/journal/toxins

Article

Detection of Cyanotoxins, β-*N*-methylamino-L-alanine and Microcystins, from a Lake Surrounded by Cases of Amyotrophic Lateral Sclerosis

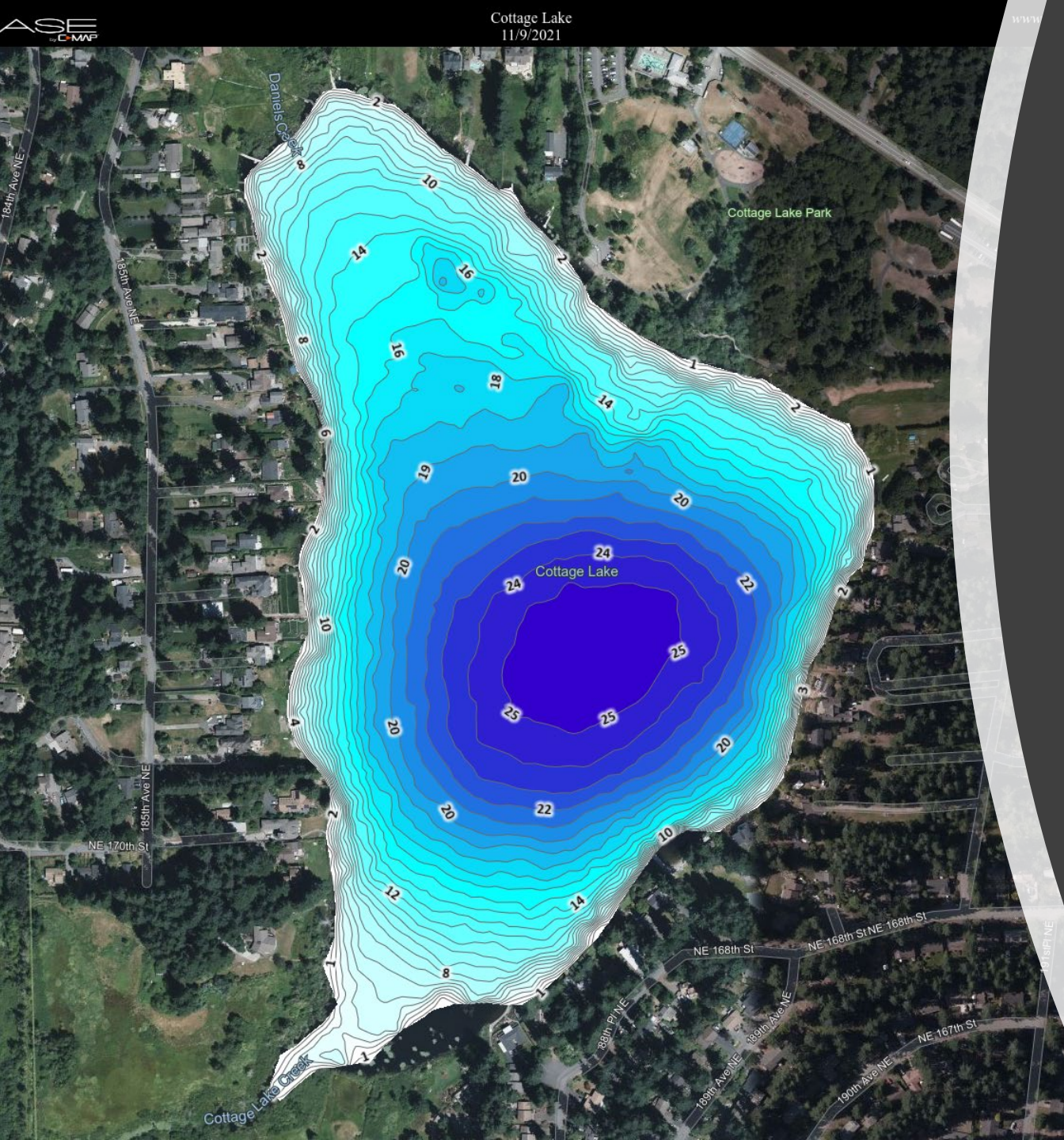
Sandra Anne Banack [1], Tracie Caller [2,*], Patricia Henegan [3,*], James Haney [4,*], Amanda Murby [4], James S. Metcalf [1], James Powell [1], Paul Alan Cox [1] and Elijah Stommel [3,*]



Harmful Algae Blooms (HAB)

Reactive HAB Treatments

- US EPA registered algaecides can be used to provide relief
- First Picture is City of Maple Valley Ironman Event, Toxic algae bloom threatened to cancel swim, Peroxygen Algaecide treatment provided safety
- Lake Silverwood, terminal reservoir for California Aquaduct Delivers water to 4.5 million, HAB halted Delivery, PAK 27 treatment allowed



Algae treatment costs

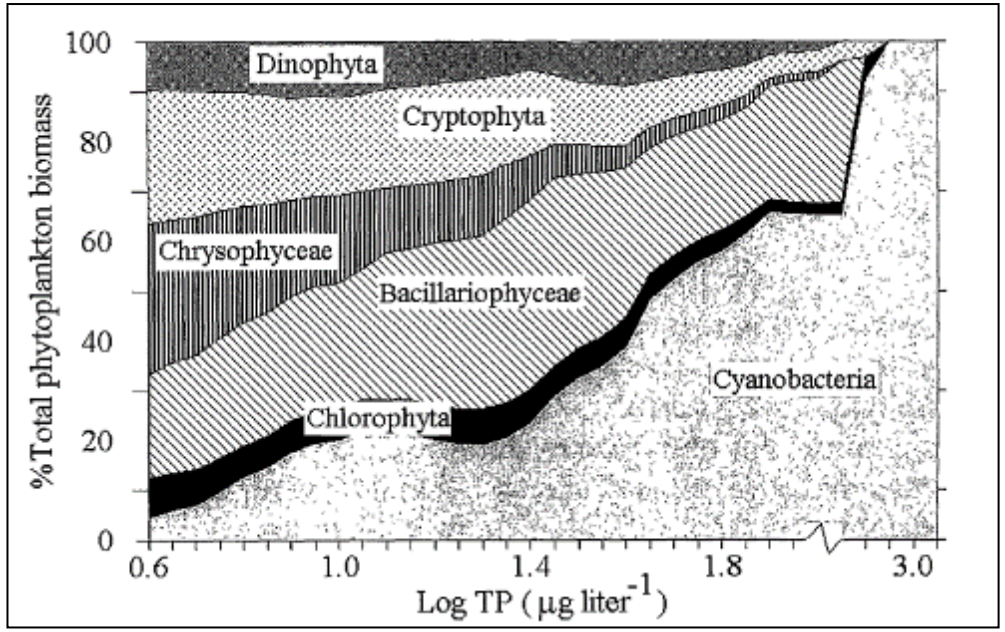
- Peroxygen algaecide will control algae and knock down toxins if present
- Cost for lake this size about $8,000.00 per treatment
- Treatment effective in short term, may have additional blooms, should assume 2-3 treatments

Nutrient Inactivation

Why Phosphorus?

- Phosphorus control is critical to mitigating eutrophication.
  (Carpenter, S.R. 2008)

- Eutrophication of lakes cannot be controlled by reducing nitrogen input: results of a 37 year whole ecosystem experiment.
  (Schindler, D.W., et. al. 2008)



Watson SB, McCauley E, Downing JA 1997. Patterns in phytoplankton taxonomic composition across temperate lakes of different nutrient status.
Limnology and Oceanography 42: 487–495.

Our Experience with Phosphorus Sequestration

- 1970's Lake Lansing (MI) and Skinner Lake (IN) US EPA Clean Lakes Studies, alum treatments
- Ongoing since then as necessary in our work, Big Bear Lake CA 750,000 Gallons applied 2015
- Orange County Parks RFP, primary issue was algae management in reclaimed water lakes
- Discovered Lanthanum in 2010

Our Model

- Compete for Study, we have scientists with real world experience
- Often studies cost more than necessary, get enough data to develop program and use funding to fix the problem
- Many lakes that have issues can not afford extensive study
- Adaptive Management is ongoing process that can be more cost effective

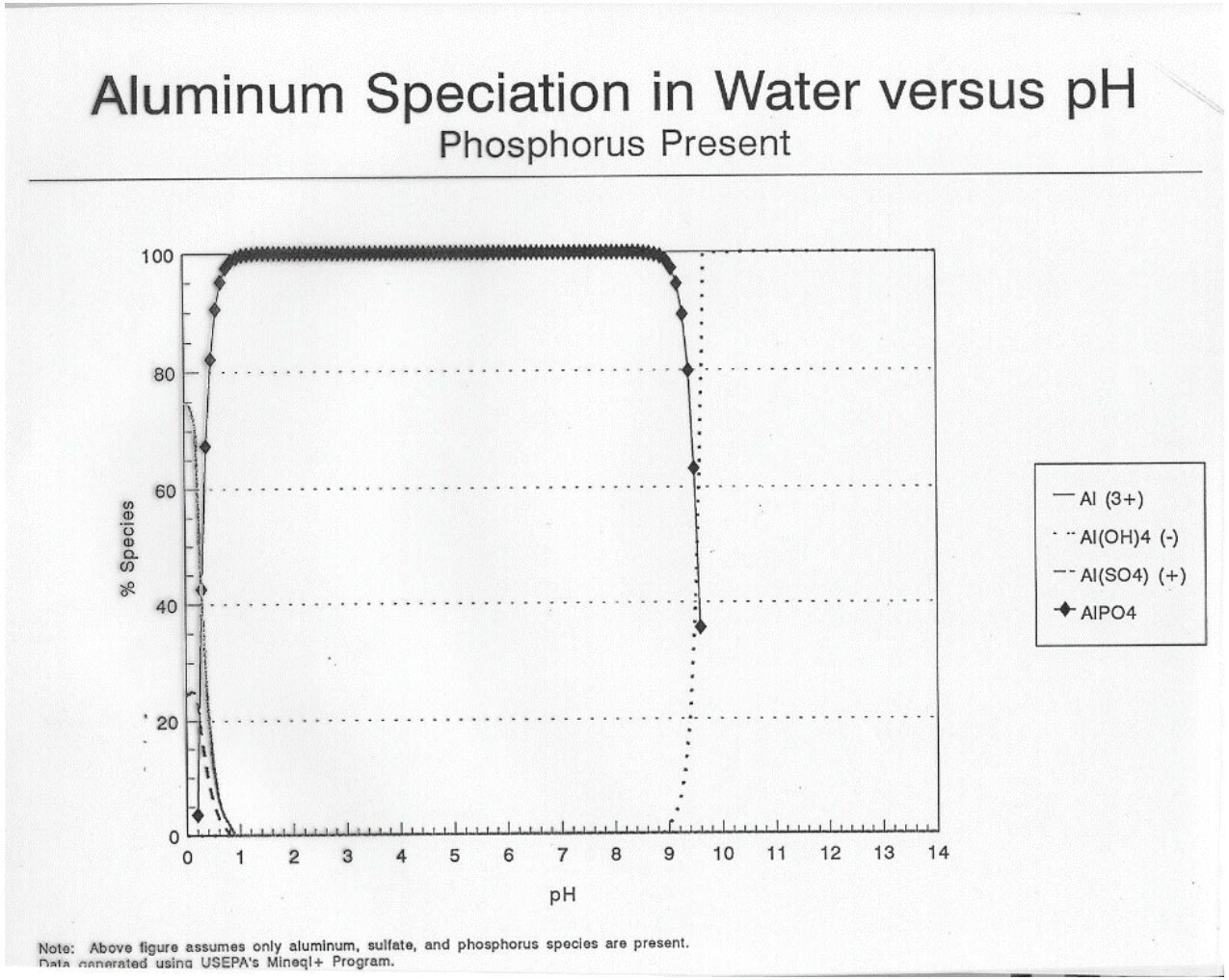
Aluminum Sulfate

Canyon Lake

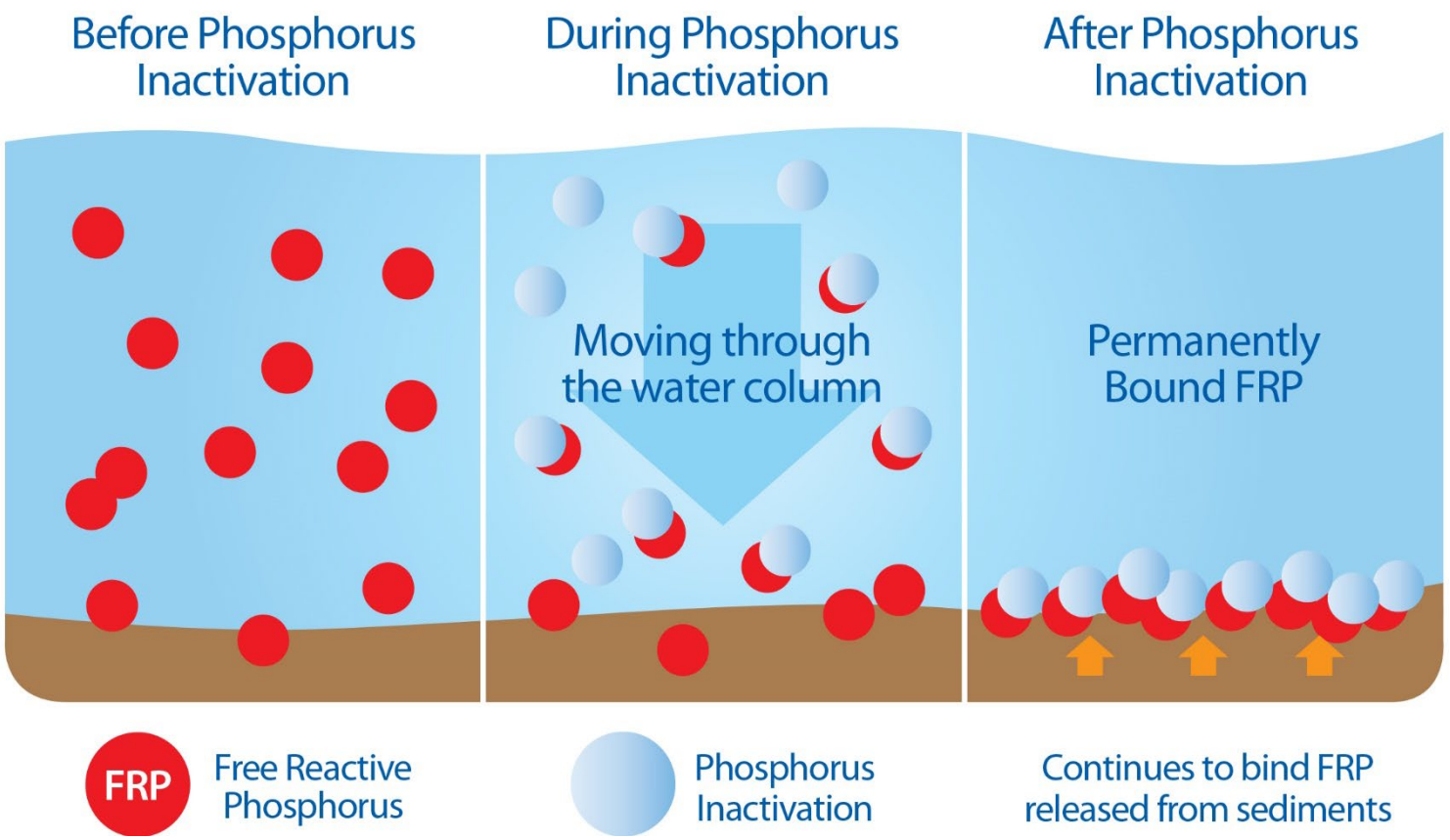
- 400 Acre potable water reservoir in Southern California
- TMDL set for Phosphorus about 2010 with numeric targets
- We have treated twice per year, spring to target inflows from 73 square mile watershed, just before turnover to target internal loading
- One of the few lakes in the Country that has met TMDL Target for Phosphorus, achieved in 2015

Alum and Phosphorus Capture

- Not effective in high pH waters
- Southern California lakes with cyanobacteria blooms can have pH in the range that is problematic
- Needed newer technology to overcome this limitation



Lanthanum vs. Alum

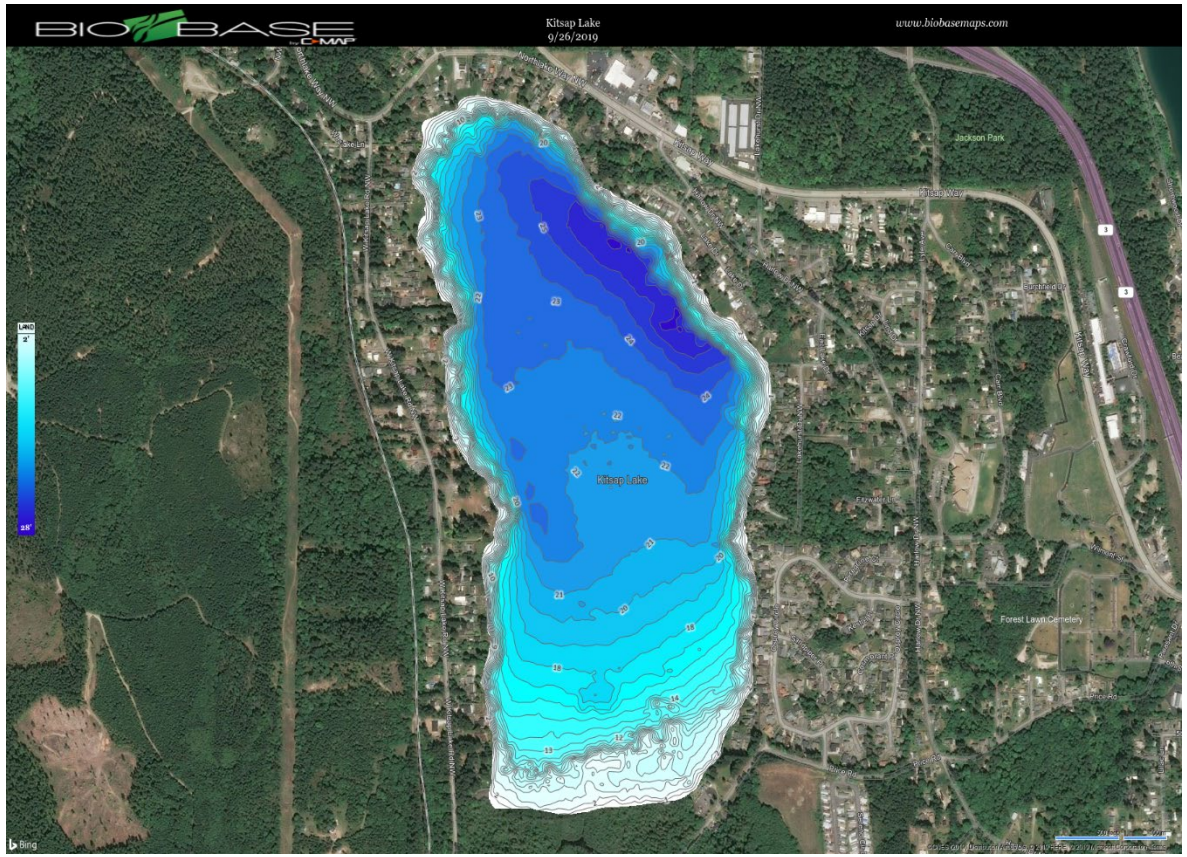


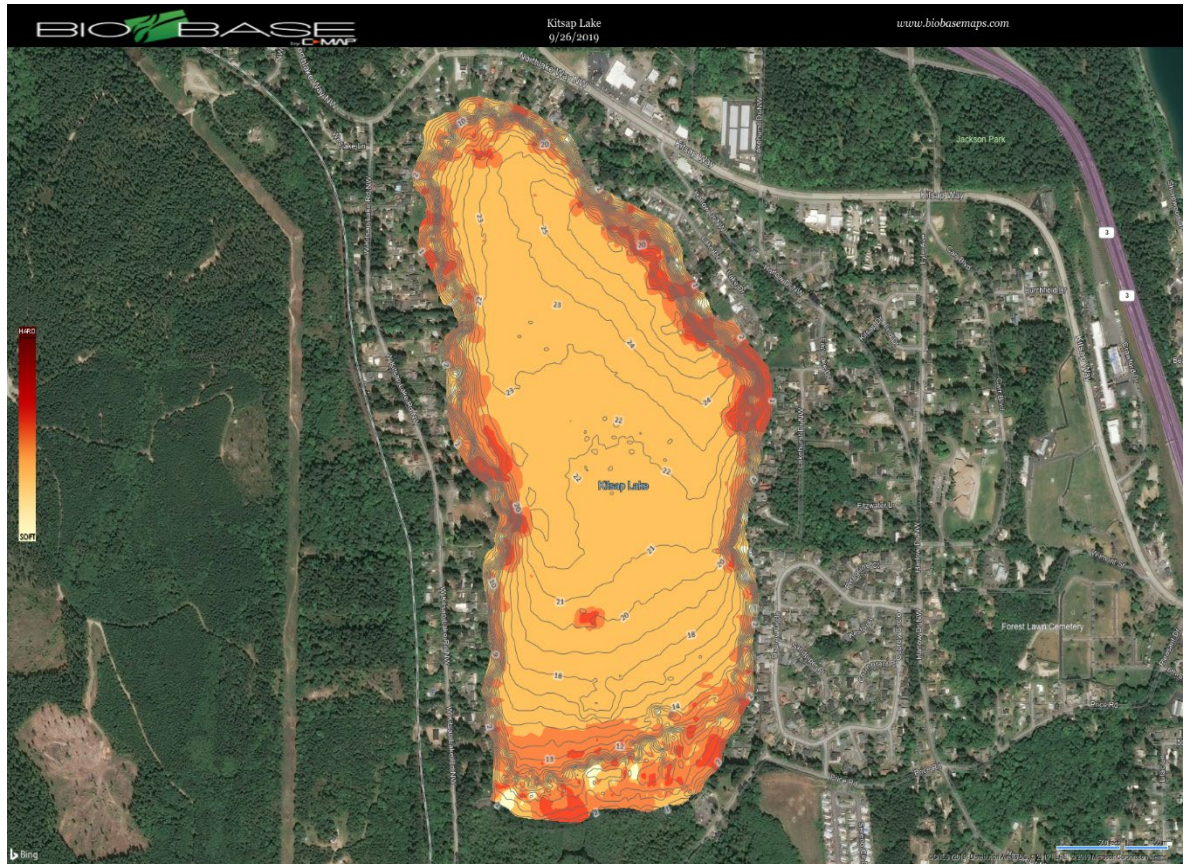
- Primary Difference between Lanthanum and Alum, Lanthanum captures FRP, forms new compound not biologically available
- Water quality does not impact performance of P sequestration
- Application does not change water quality
  - Alum treatments have been associated with fish kills recently
- Does not require buffer
- Can calculate P removal, 100:1 ratio
- New Washington DOE permit Monitoring Requirements impact Alum application costs, do not impact Phoslock costs

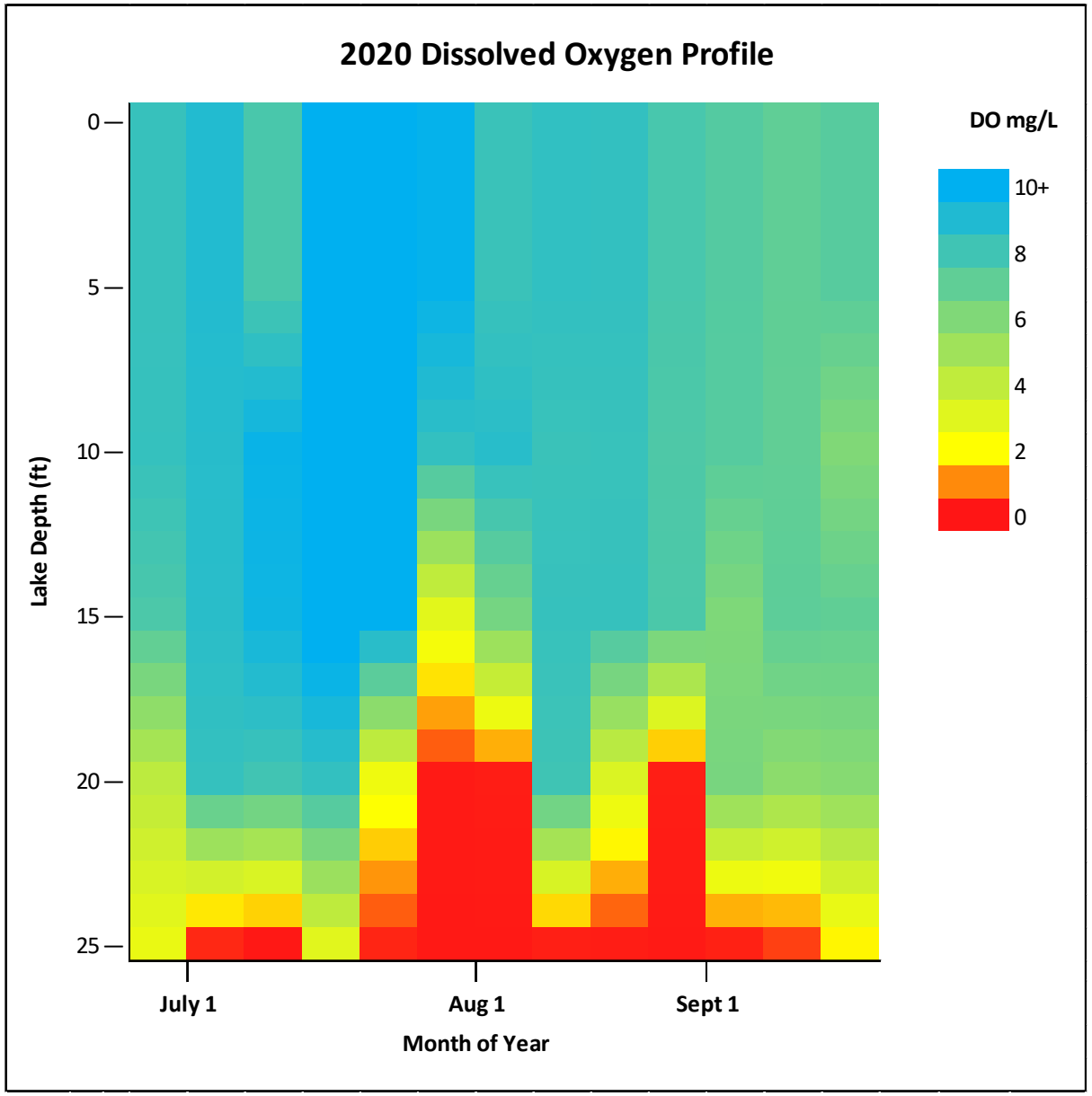
Kitsap Lake, WA

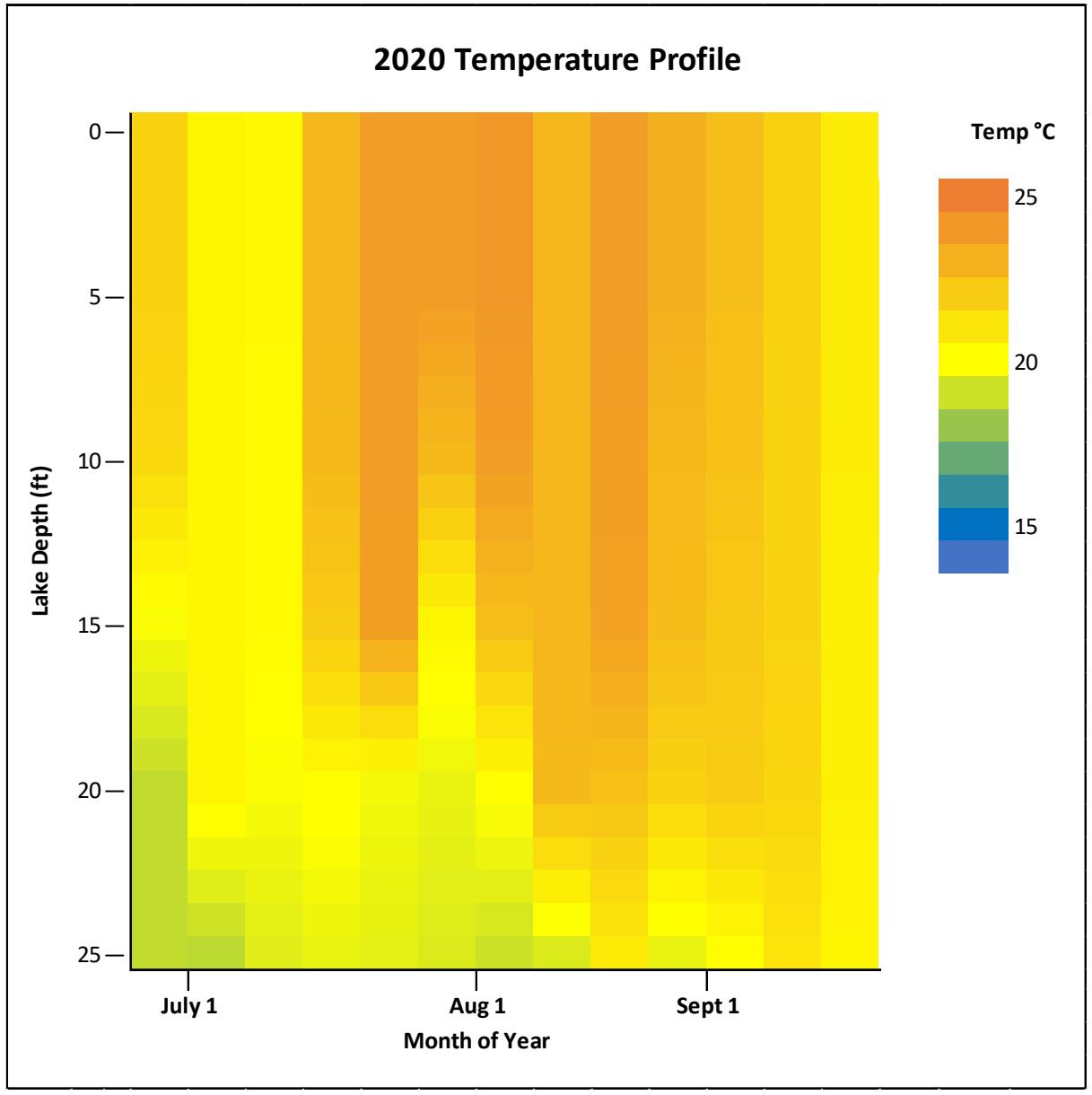
- 245-acre lake, West of Seattle, WA
- Has had toxic algae closures for several years
- Issued RFP for Phosphorus management plan, 2019, we competed and were selected
- Completed fall 2019
- After community input, program was implemented summer 2020
- Lanthanum technology was selected by community as primary tool

Kitsap Lake Bathymetry and Sediment Composition Maps

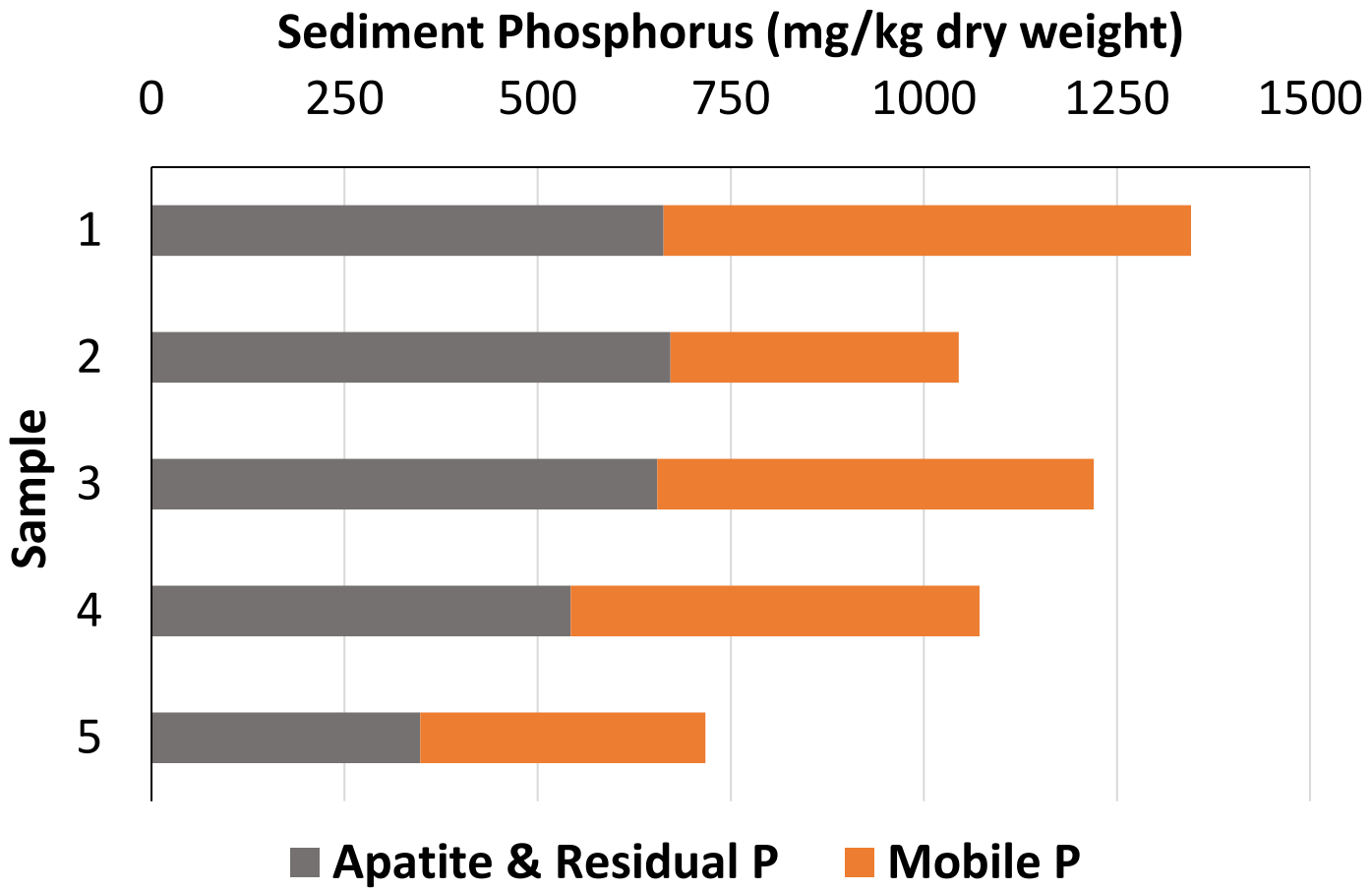





2020 Dissolved Oxygen Profile
DO mg/L
10+
8
6
4
2
0
Lake Depth (ft)
0
5
10
15
20
25
July 1
Aug 1
Sept 1
Month of Year


2020 Temperature Profile
Temp °C
25
20
15
Lake Depth (ft)
0
5
10
15
20
25
July 1
Aug 1
Sept 1
Month of Year

2019 Sediment Analysis



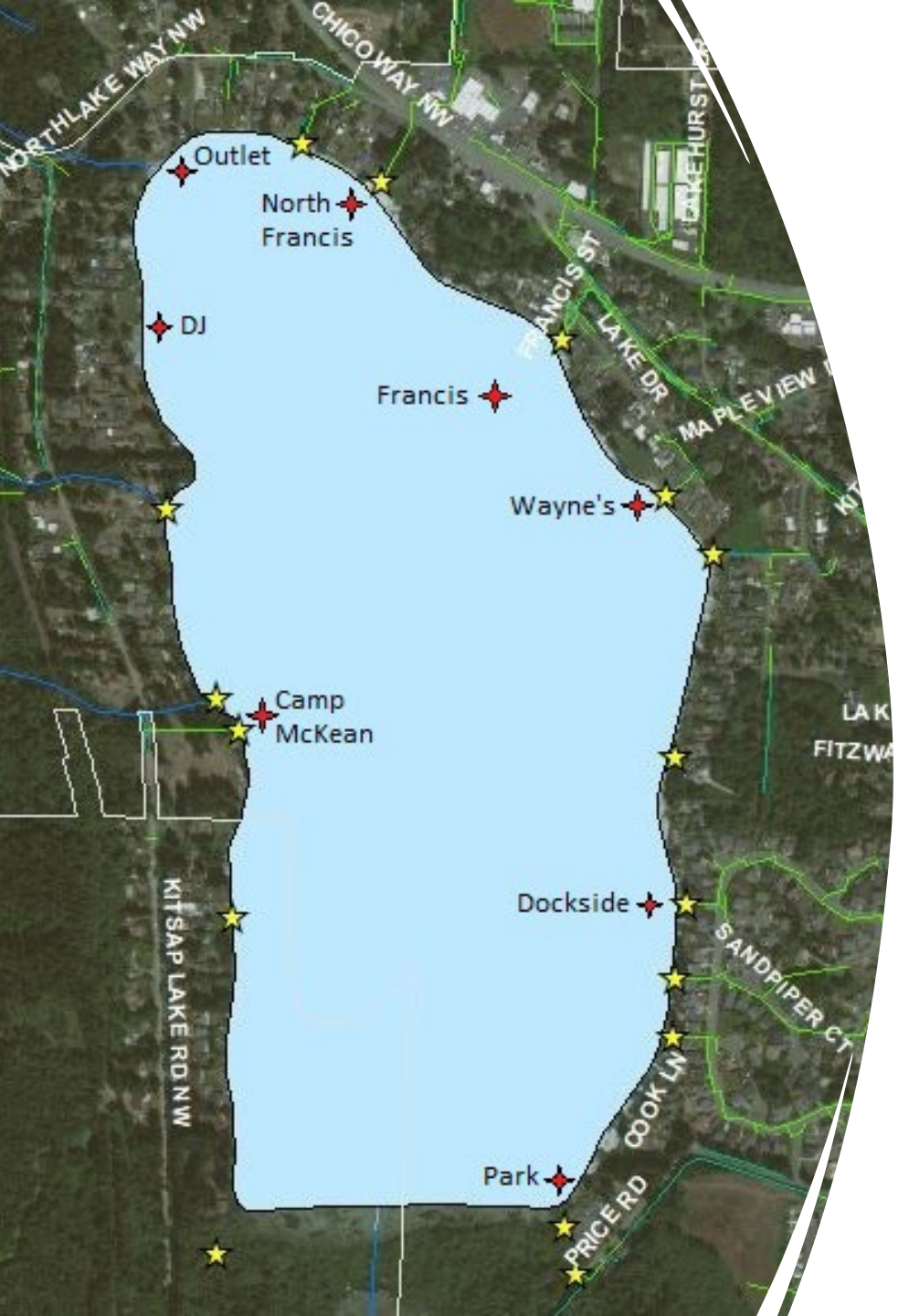
Estimated Phosphorus in the Anoxic Zone Sediment	
Sediment Depth	**Mobile P (lbs)**
Top 4cm	1,636
Top 10cm	4,091

First Treatment Week of June 10th, 2020

Application to Kitsap Lake

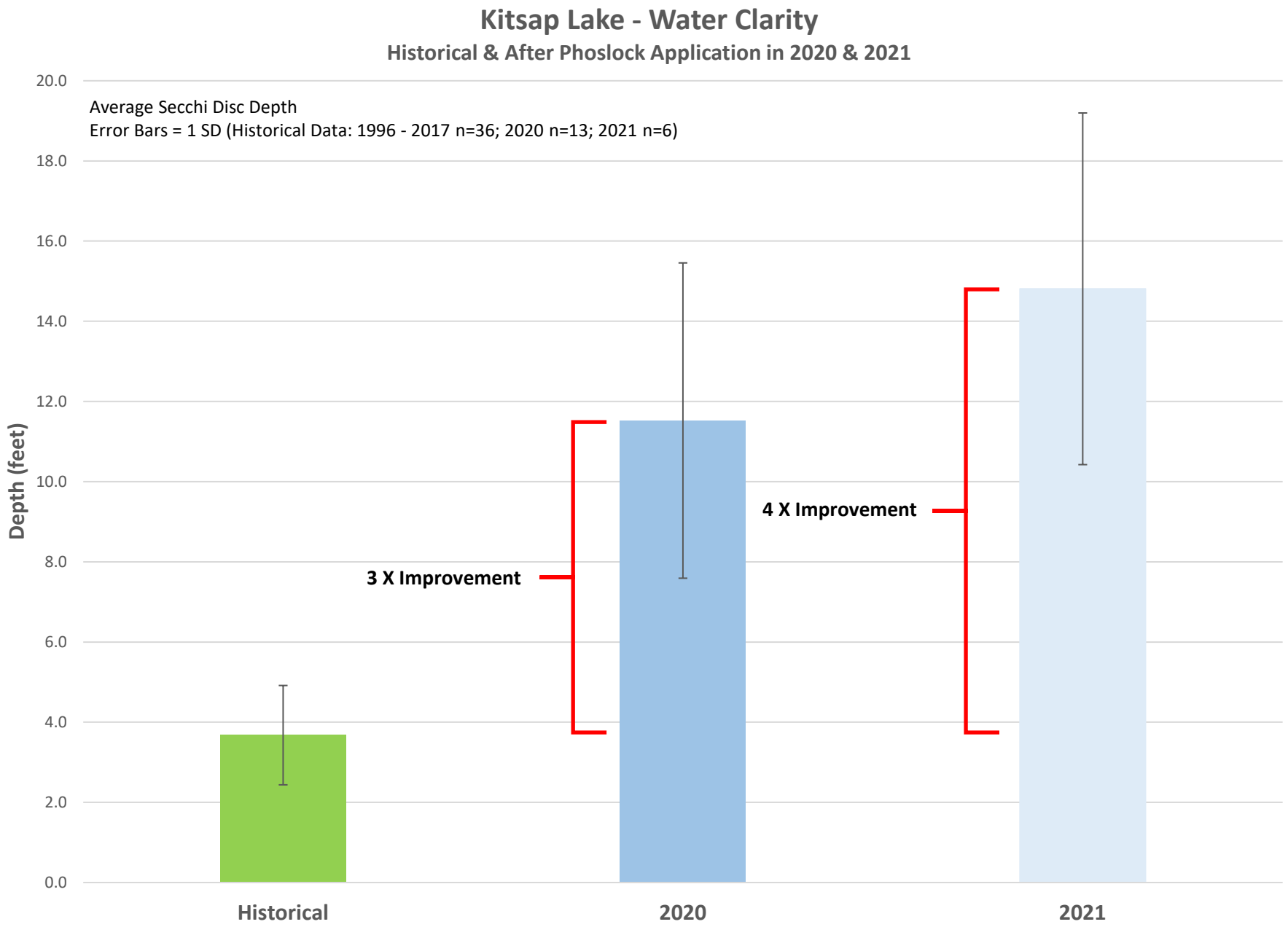
Project Operations

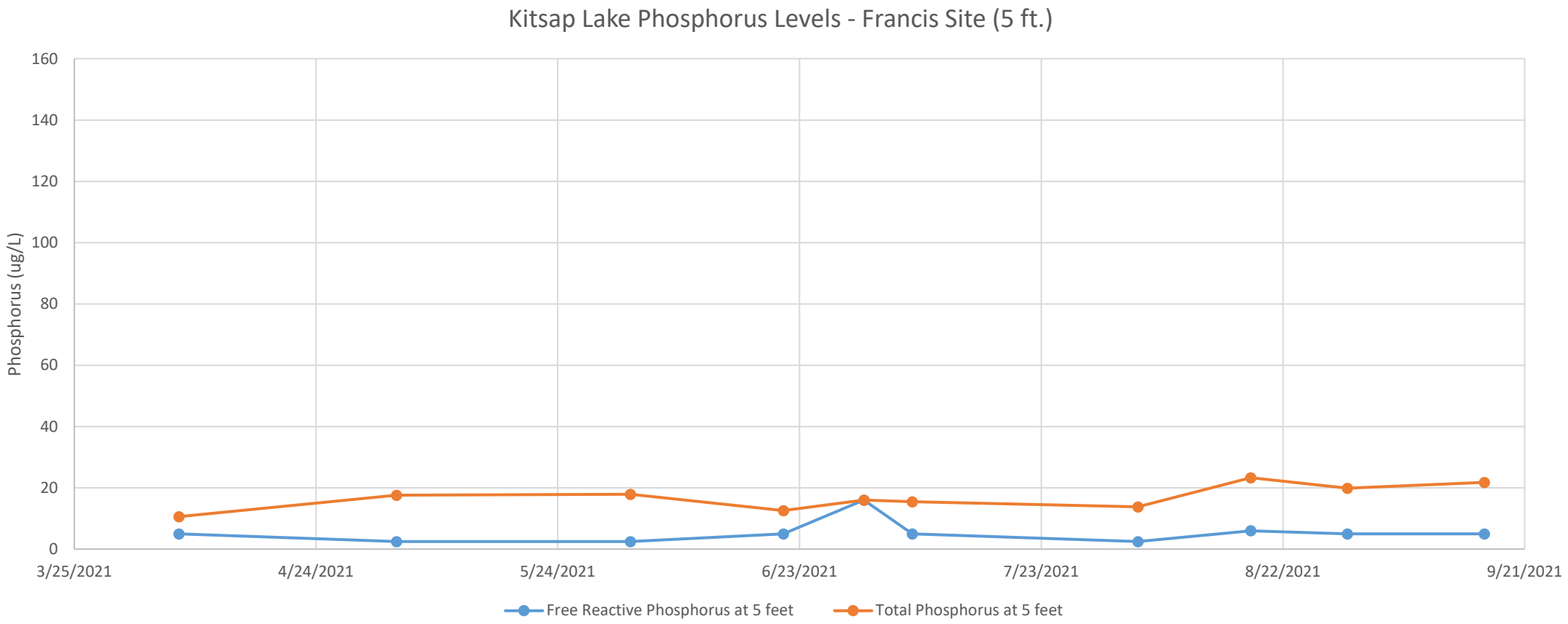
- 2020 First Year of treatment, June treatment targeted water column P, August treatment targeted Hypolimnion P before turnover
- Water volume and pounds phosphorus calculations
- 2020-Approx. 57,400 pounds applied June, 20,000 pounds July 2020
- 2021 June application 25,140 pounds applied; September 15,400 applied



Sample Sites

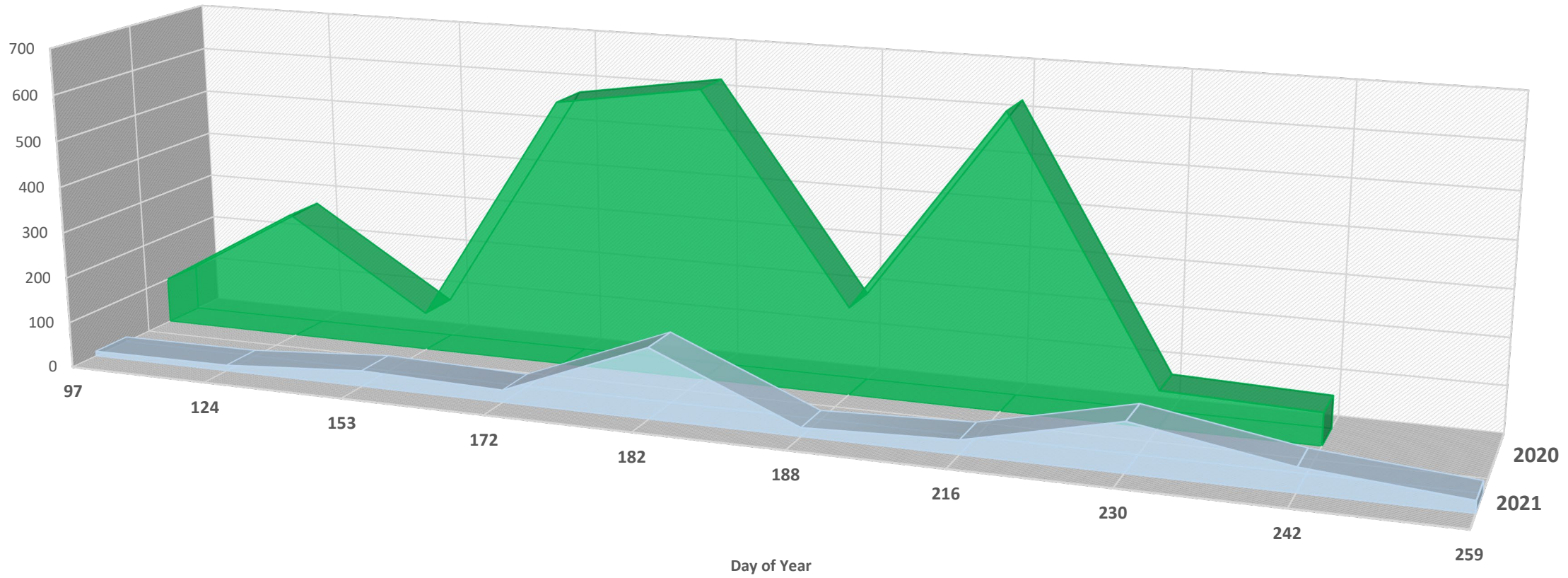
- City of Bremerton Sampling Sites
- Collected TP and FRP, algae species and enumeration
- Used Turner unit to monitor for pigment unique to cyanobacteria

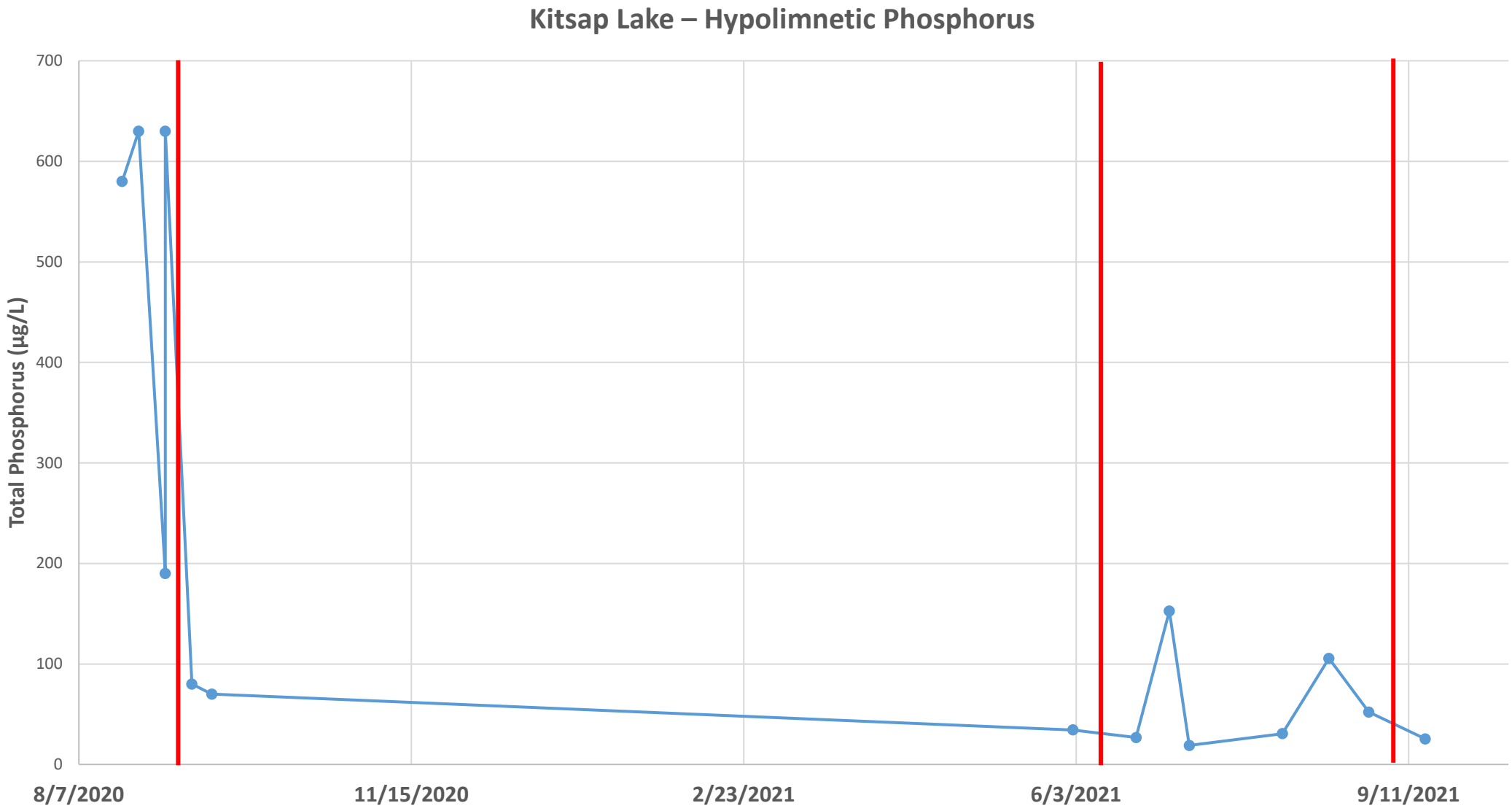

Kitsap Lake - Water Clarity
Historical & After Phoslock Application in 2020 & 2021
Average Secchi Disc Depth
Error Bars = 1 SD (Historical Data: 1996 - 2017 n=36; 2020 n=13; 2021 n=6)
Depth (feet)
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
3 X Improvement
4 X Improvement
Historical
2020
2021



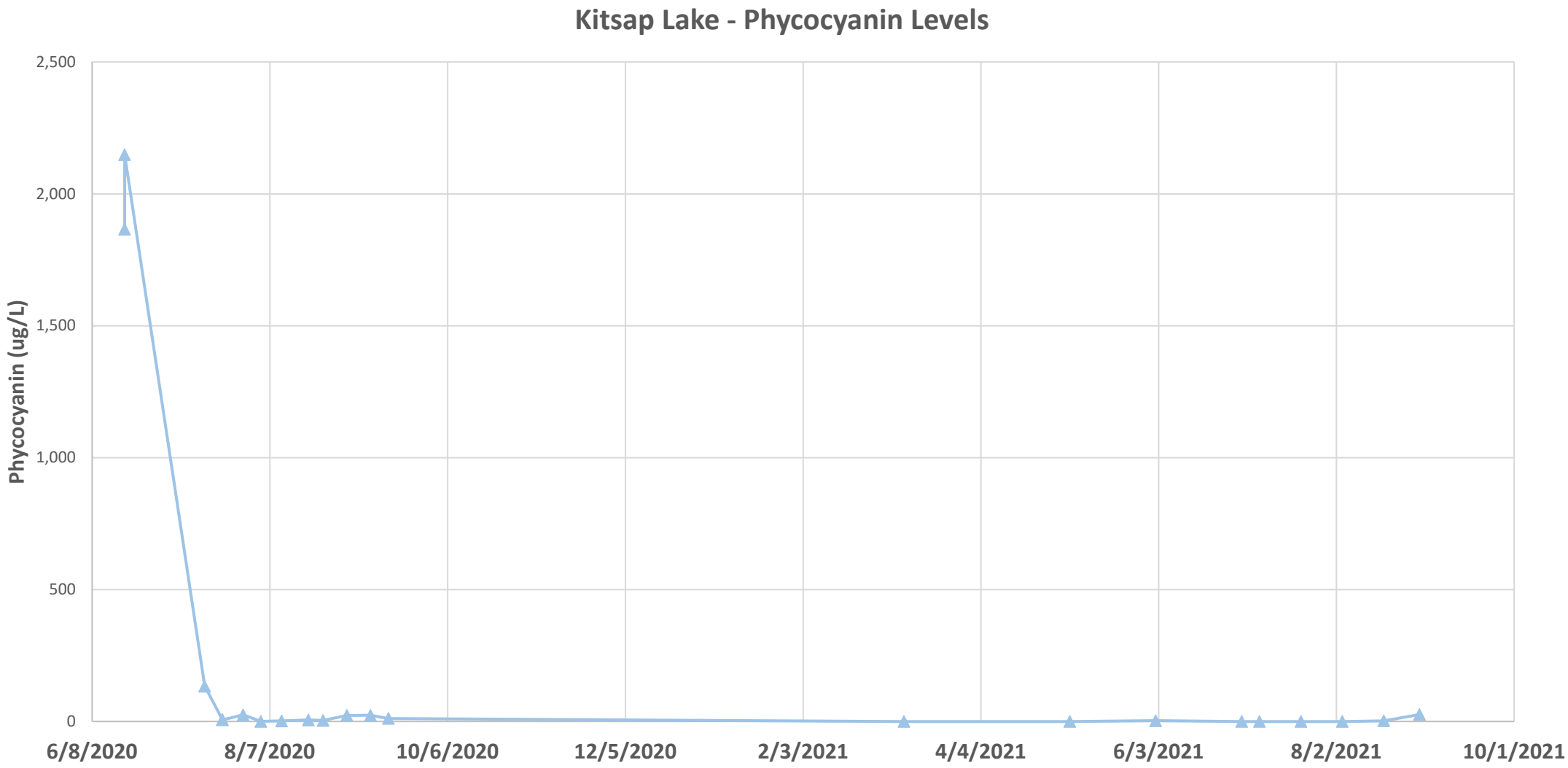
Average TP: 16.9 ug/L
Average FRP: 5.4 ug/L

Kitsap Lake - Hypolimnetic Phosphorus
Total P (µg/L) 2020 & 2021





*red line indicate Phoslock treatment dates


Kitsap Lake - Phycocyanin Levels
Phycocyanin (ug/L)
2,500
2,000
1,500
1,000
500
0
6/8/2020
8/7/2020
10/6/2020
12/5/2020
2/3/2021
4/4/2021
6/3/2021
8/2/2021
10/1/2021

August 2021

- Water Clarity Excellent
- Aquatic plant communities thriving
- Aquatic plant harvesting operations help maintain beneficial uses

Before and after

August 2019 Pre Treatment

August 2021

Summary

- Technologies exist to fix the problem in the short term
- We have predictive technologies that can help us do a better job limiting the impacts of HAB by monitoring and treating early
- Technologies to capture phosphorus and limit HAB problems are also available
- EutroSORB technologies coming this year
  - EutroSORB Filters for inflows
  - Lanthanum technologies for water column stripping and sediment inactivation of legacy phosphorus

BIOBASE

VEGETATION ANALYSIS

Cottage Lake, King Washington

Report Time Stamp: 2021 November 09 - 17:56 (UTC)

Survey Metadata

Data Collector:	Kyle Langan
Survey Time Stamp (UTC):	2021 November 09 - 17:41
Starting Location:	47.754537, -122.087129
Ending Location:	47.755903, -122.090336

Survey Statistics

Average Water Temperature:	51.4 °F
Survey Area:	53.211 acres
Survey Volume:	918.216 acre ft
Percent of Waterbody Surveyed:	82.8%
Waterbody Area:	64.266 acres
Estimated Waterbody Volume	1108.986 acre ft

Survey Settings

Includes Edited Data:	No
Track Buffer:	25 m
BV Grid Cell Size:	5 m
BV Minimum Detection - Percent:	5.0%
BV Minimum Detection - Depth:	2.4
BV Maximum Detection - Depth:	20
BV Sonar Channel:	Pri

Quality Control

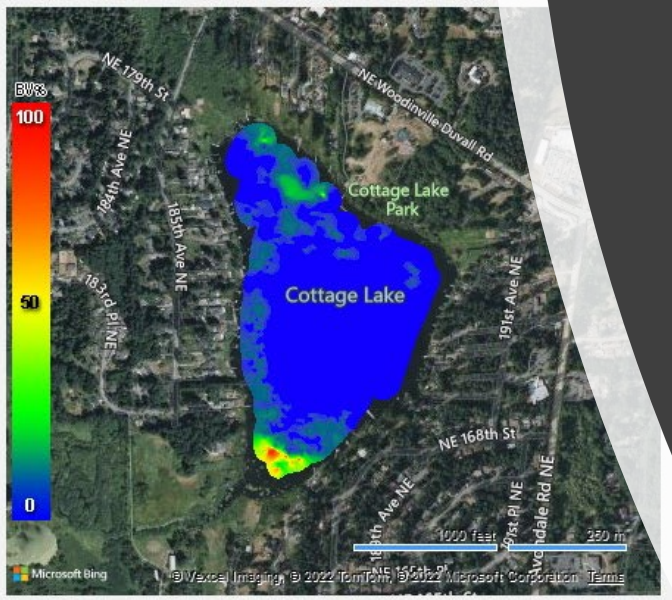
Reviewer:	McCormack, Ian
Comments:	We have reviewed this trip. Pleas e use THE EXPERTS" button for this trip if you questions.

Survey Summary

Type ?	PAC ?	Avg BVp ?	SD BVp ?	Avg BVw ?	SD BVw ?	Depth Range	Depth Avg	Distance	No. Dep
Point	19.6%	13.1%	± 14.0%	2.6%	± 9.3%	5.42 - 25.99 ft	18.278 ft	3.974 miles	16 34
Grid	11.5%	17.8%	± 17.4%	2.1%	± 8.2%	0.55 - 25.94 ft	17.256 ft	NA	18 316

Bathymetric Contour Map

Vegetation Biovolume Heat Map



Phosphorus mitigation

- Water column stripping based on lake volume and recent phosphorus data $30,000.00
- Sediment contributions during the summer
- Cost for Second late season $10,000.00 if necessary
- Shouldn’t assume one year will fix problem but will get smaller and smaller each year.
- Will need to amend permit and that will take 30-45 days