The Value of Developing a Long-Term Database for Lakes and Their Management

New York State Federation of Lake Associations

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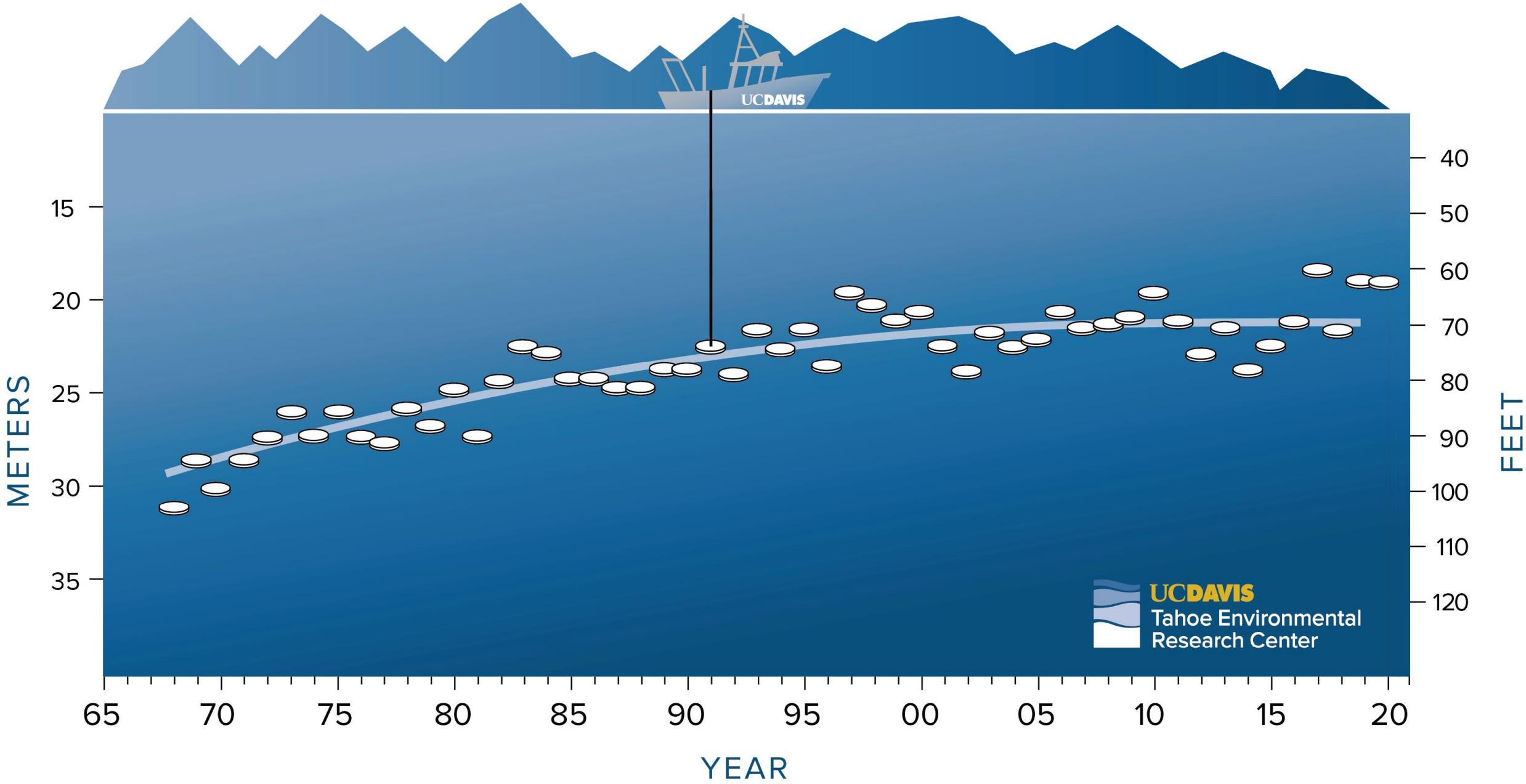
PRINCETON HYDRO

SCIENCE ENGINEERING DESIGN

What is the Value of a Long-Term Database?

- ✓ Tracking the overall "health" of an ecosystem.
- ✓ Identifying problems early on (invasive species, declines in water quality, sub-optimal fishery).
- ✓ Determining how the system responses to varying weather patterns and climate change.
- ✓ Providing objective data for all stakeholders and others.
- ✓ Increases chances of obtaining financial assistance for the implementation of projects to address problems.

ANNUAL AVERAGE SECCHI DEPTH



Lake Tahoe, CA

- Surface area of 122,624 acres
- Hydraulic Retention Time of 700 years

Castle Lake, CA

- Surface area of 47 acres
- Hydraulic retention time of about 1 year

A High-Quality Long-Term Database

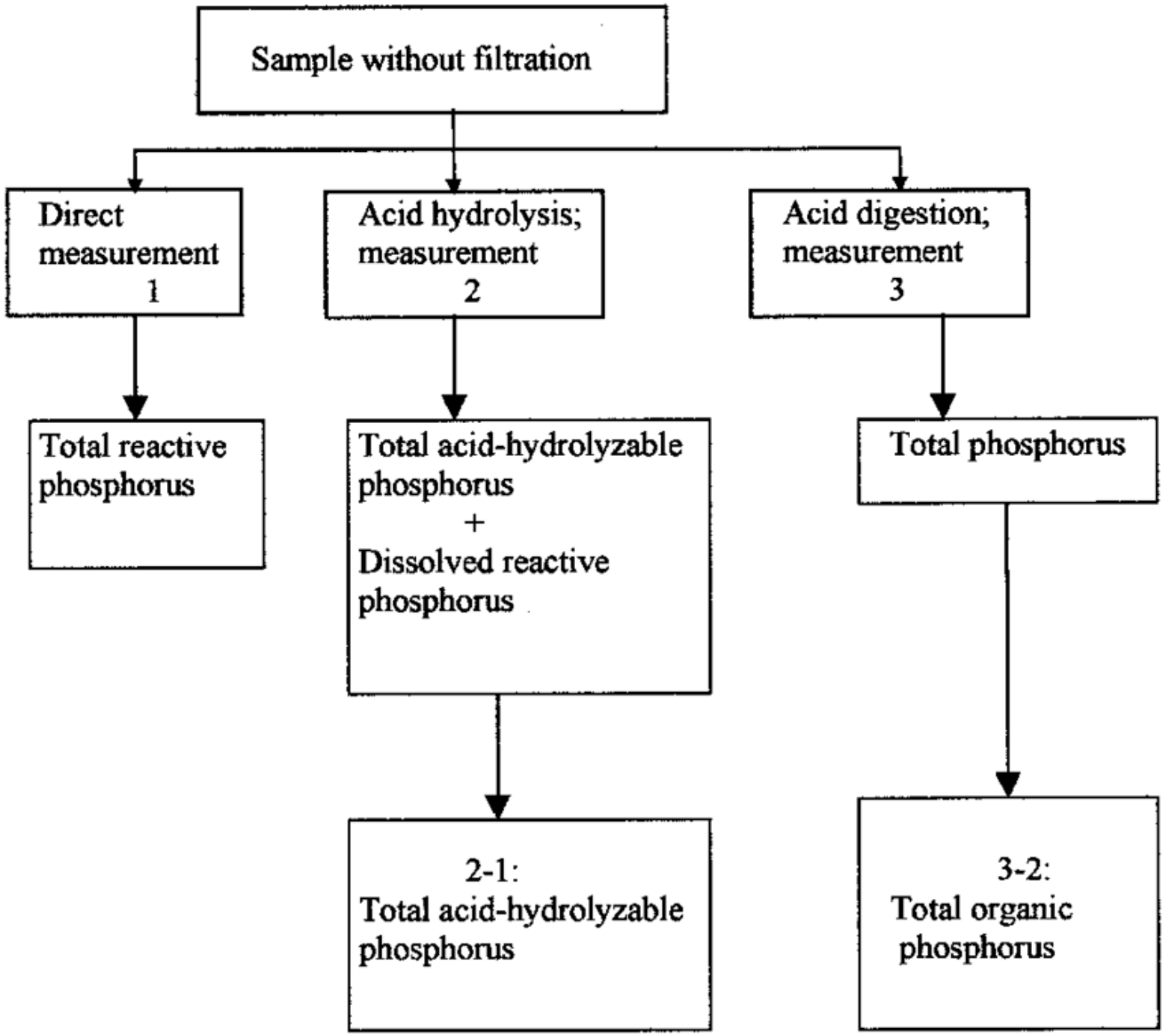
Consistency is the key.

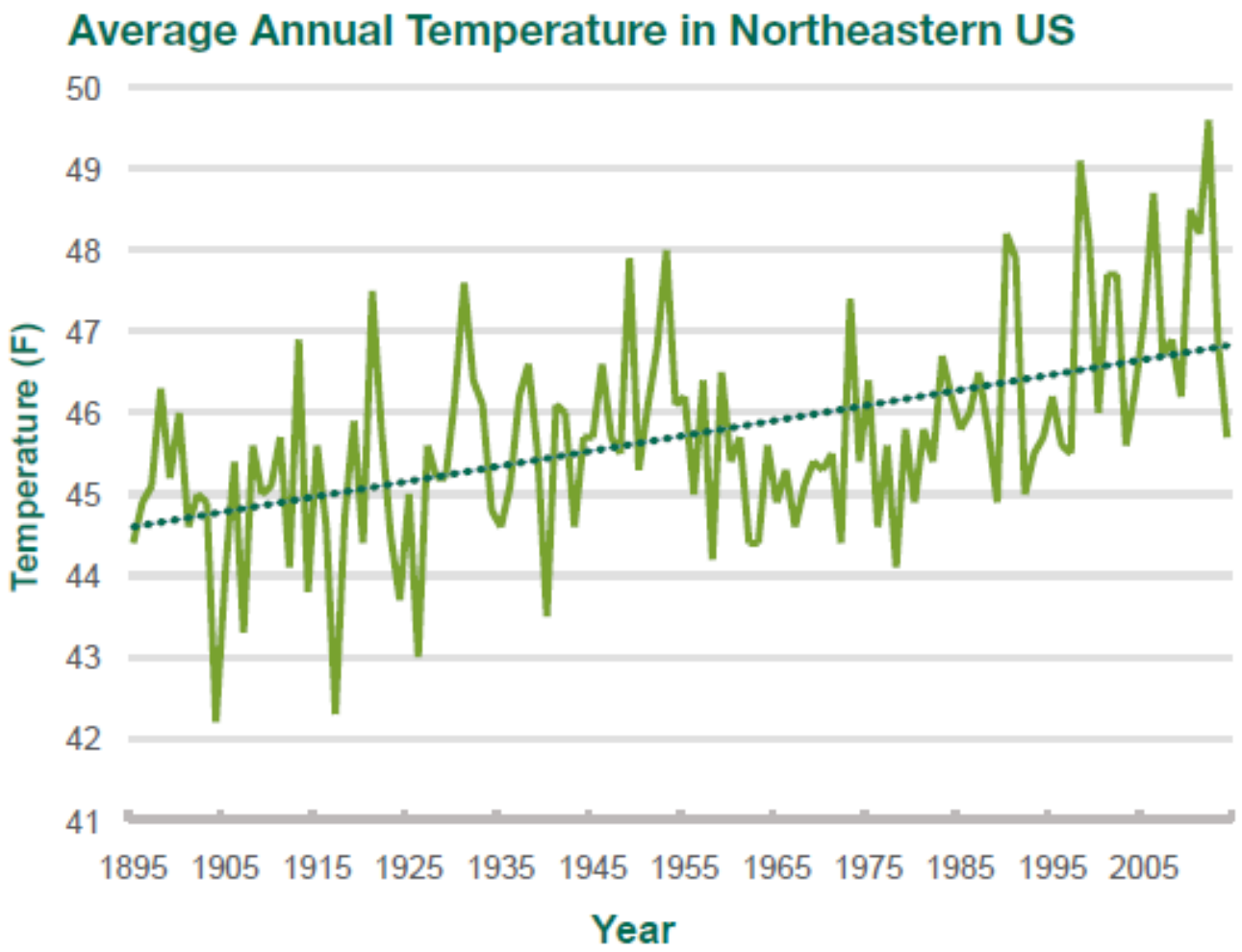
Have the same stations monitored (mid-lake, near the dam, at the beach or marina).

Sample around the same time of year; focus on the growing season.

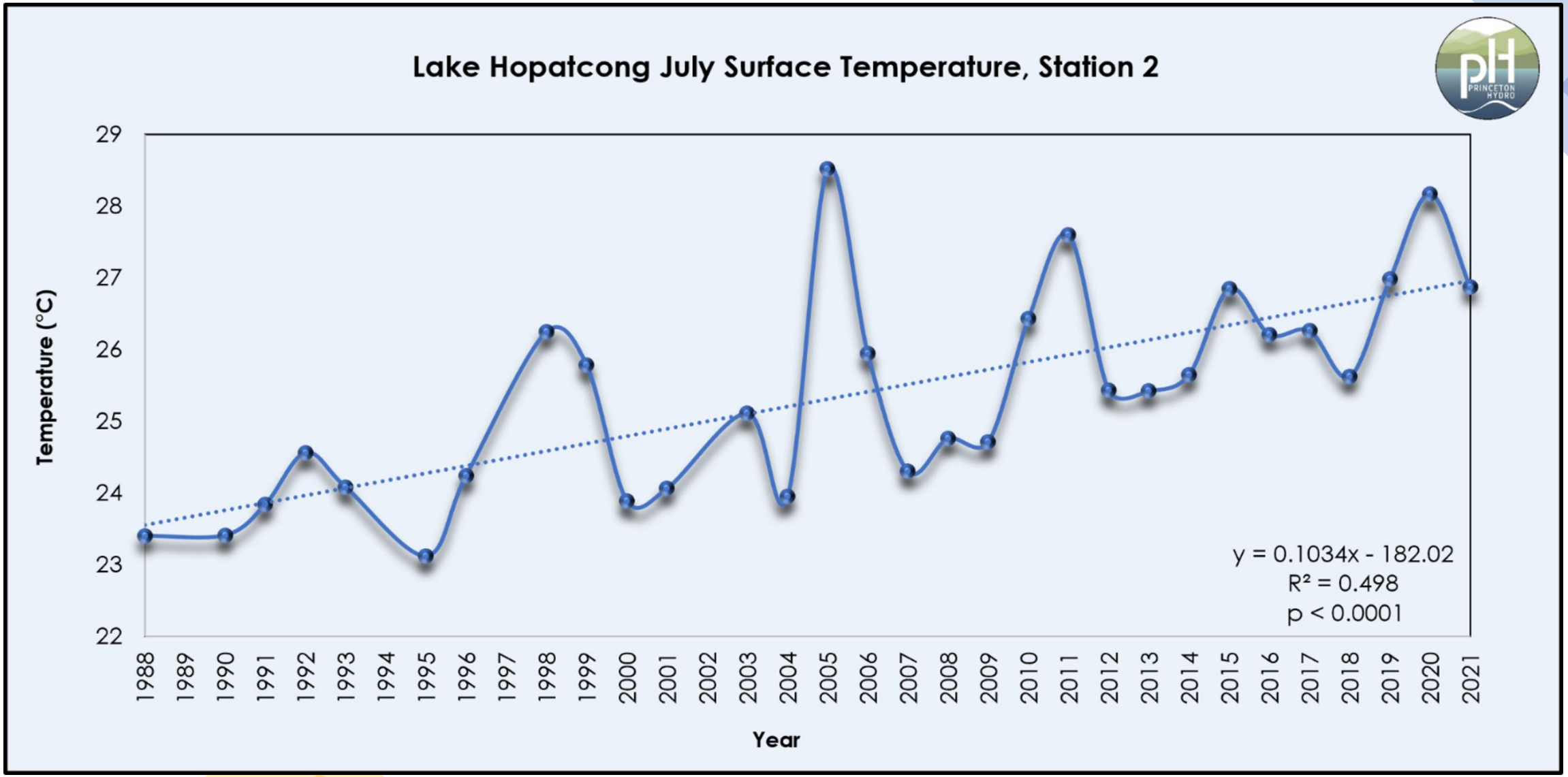
Use same parameters; can add new parameters but do not replace.

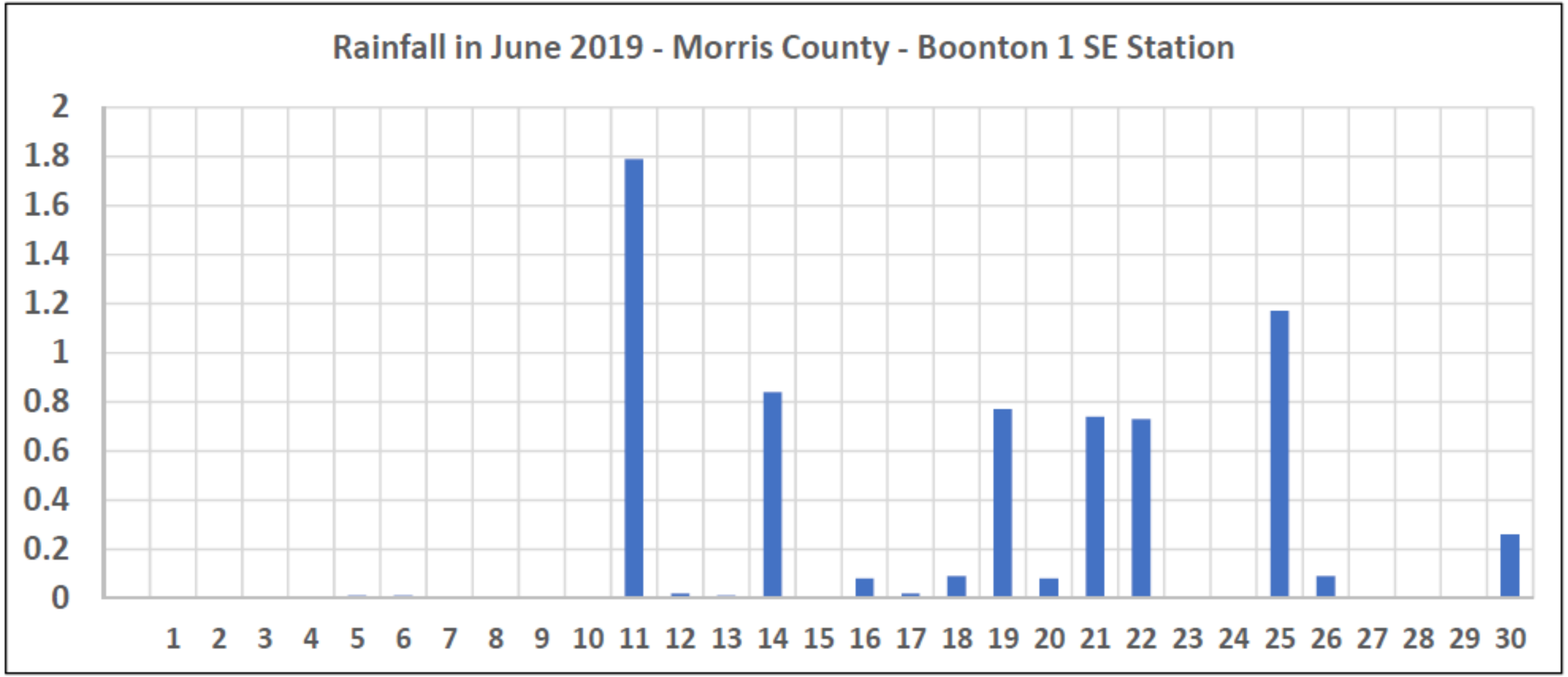
Use same methodology; example, phosphorus


Sample without filtration
Direct measurement 1
Acid hydrolysis; measurement 2
Acid digestion; measurement 3
Total reactive phosphorus
Total acid-hydrolyzable phosphorus
+
Dissolved reactive phosphorus
Total phosphorus
2-1:
Total acid-hydrolyzable phosphorus
3-2:
Total organic phosphorus



Data Source: NOAA National Climatic Data Center


Lake Hopatcong July Surface Temperature, Station 2
Temperature (°C)
29
28
27
26
25
24
23
22
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Year
y = 0.1034x - 182.02
R² = 0.498
p < 0.0001


Rainfall in June 2019 - Morris County - Boonton 1 SE Station
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

Blooms at Lake Hopatcong, New Jersey (June 2019)

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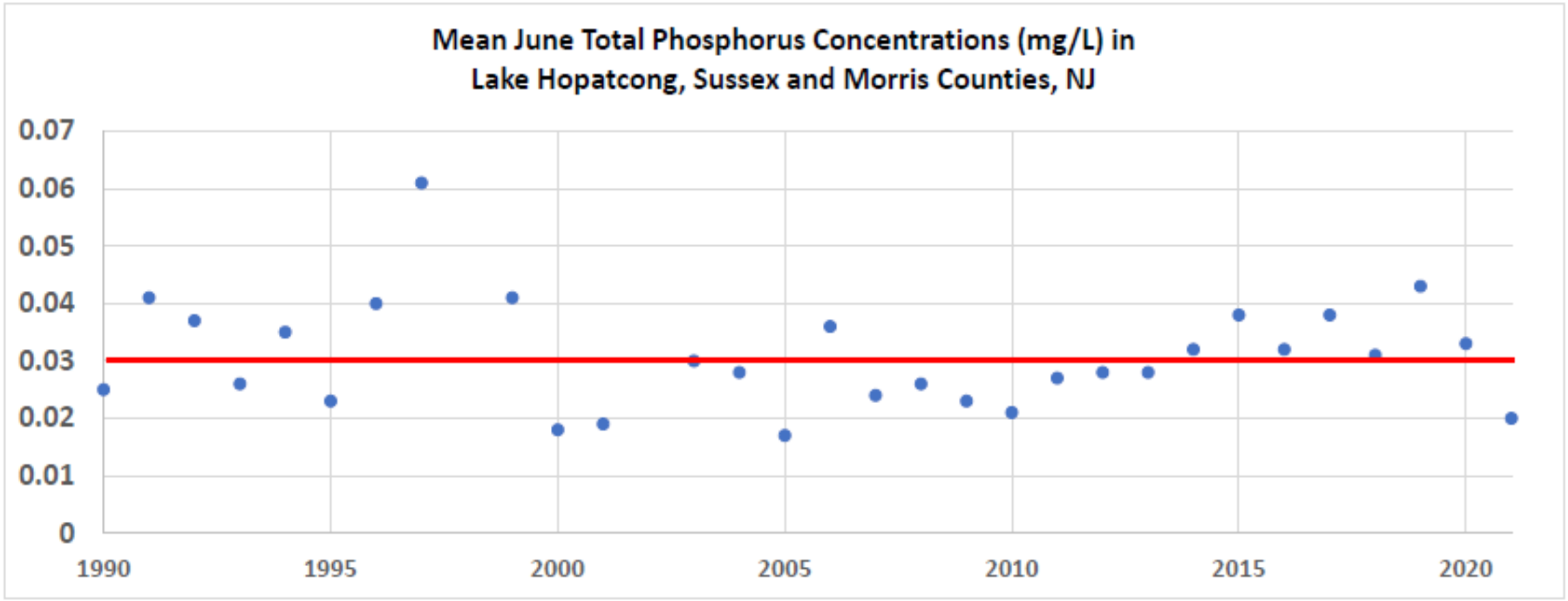
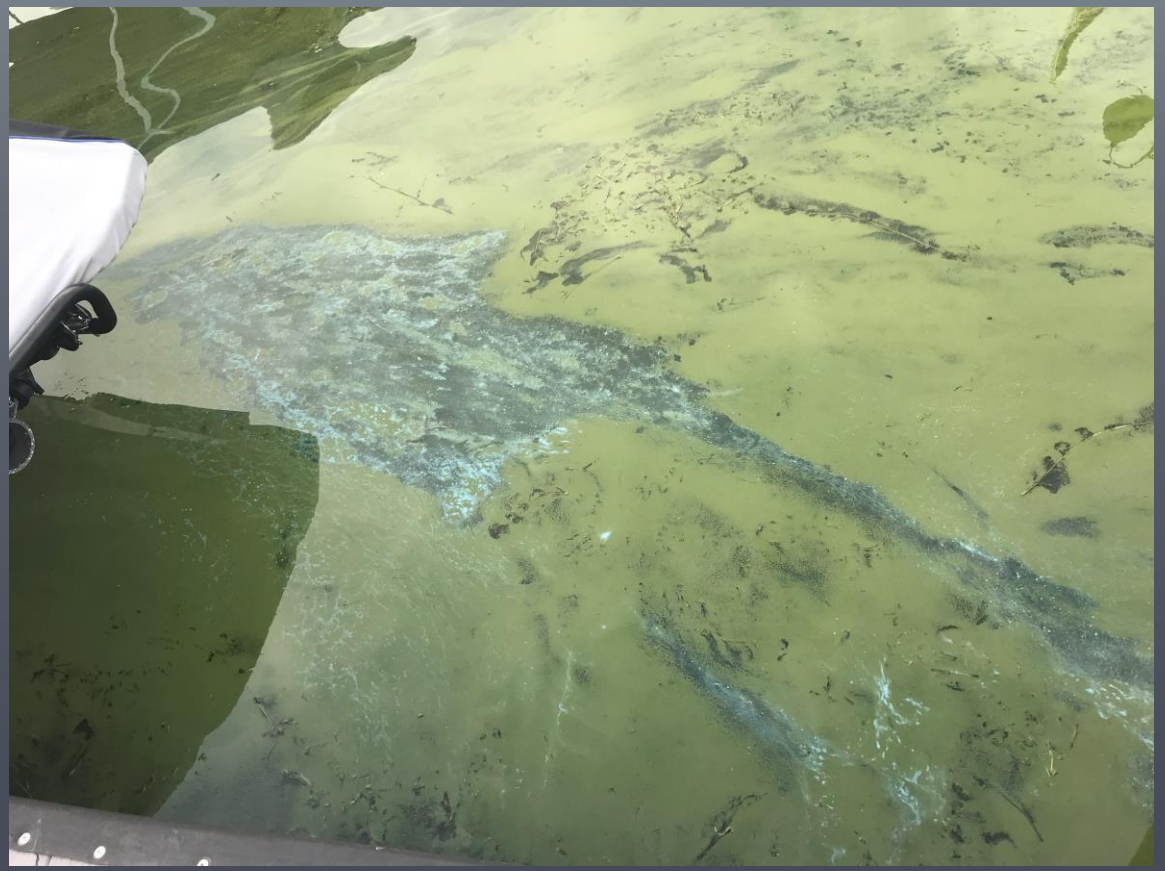

Mean June Total Phosphorus Concentrations (mg/L) in
Lake Hopatcong, Sussex and Morris Counties, NJ
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
1990
1995
2000
2005
2010
2015
2020



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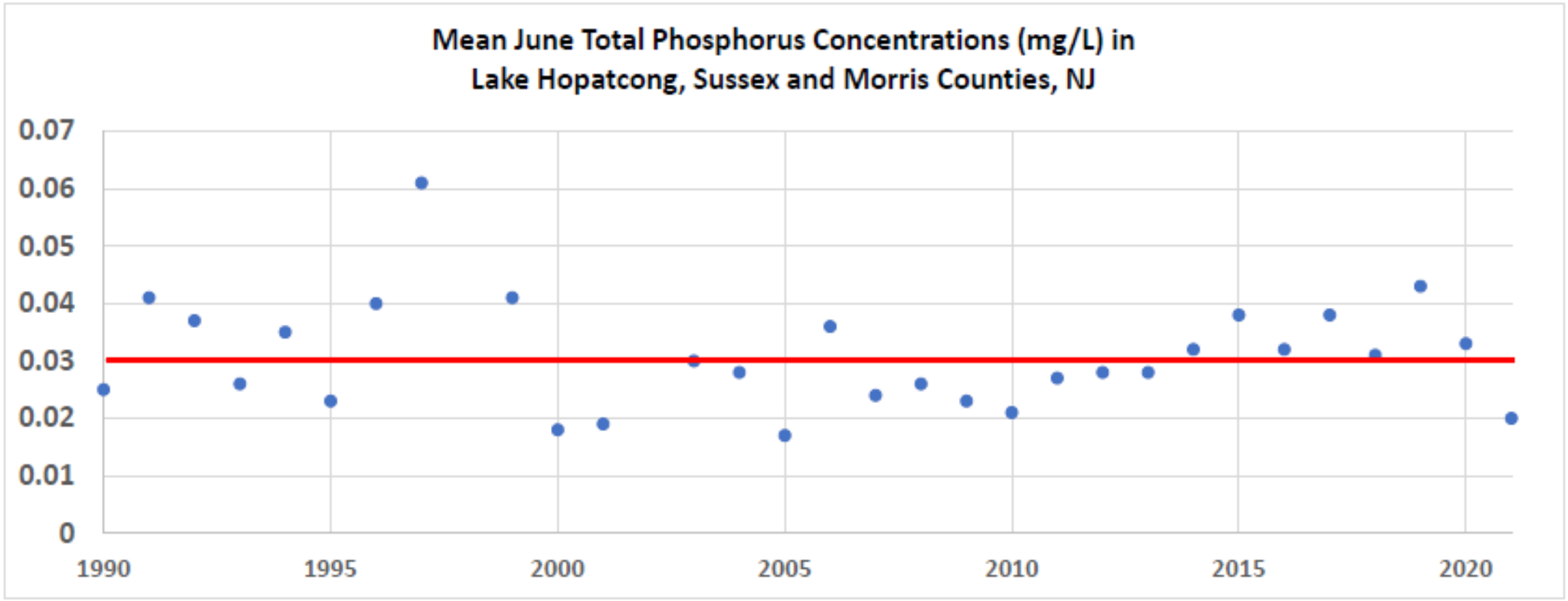
DESIGN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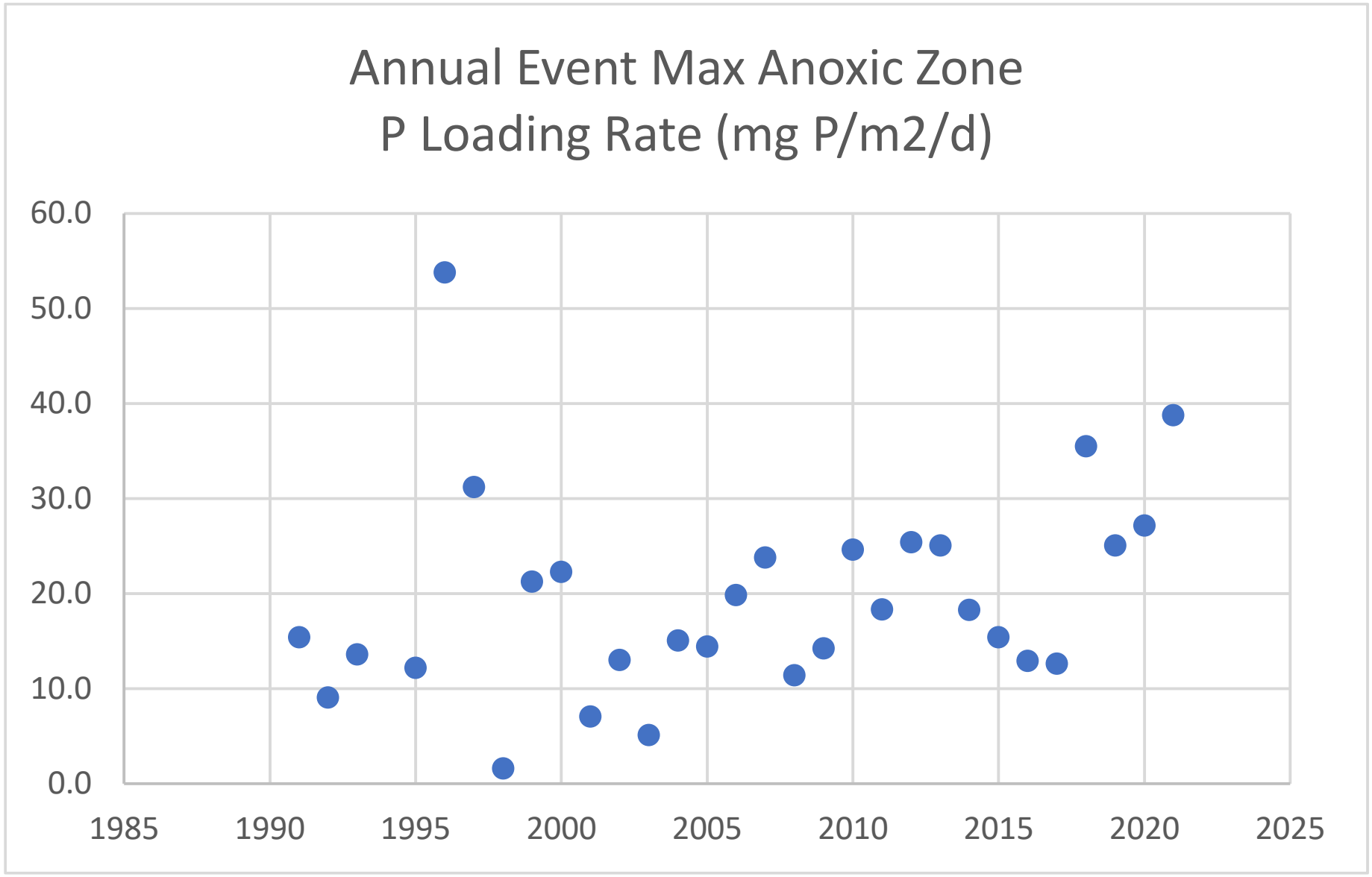
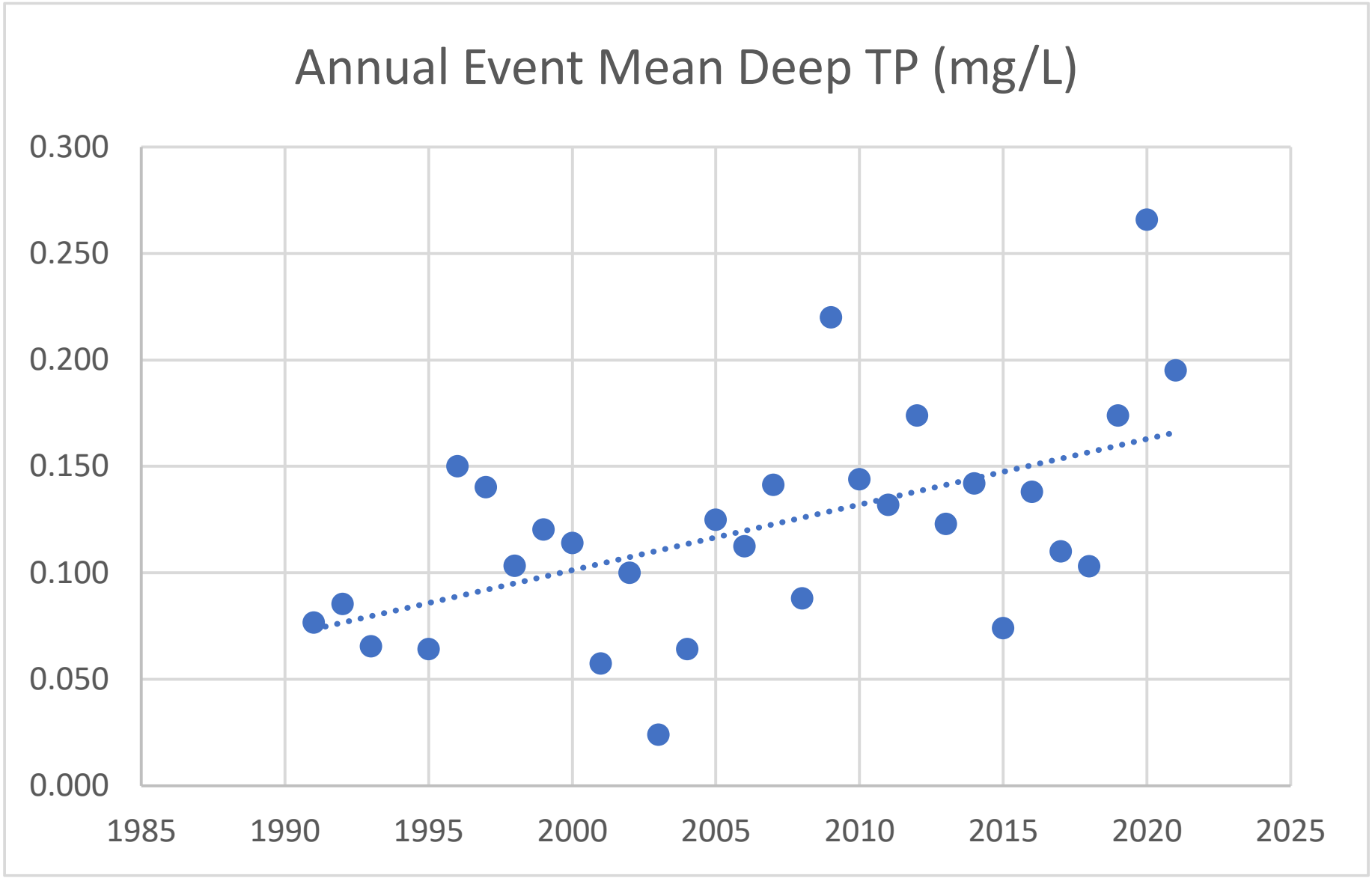
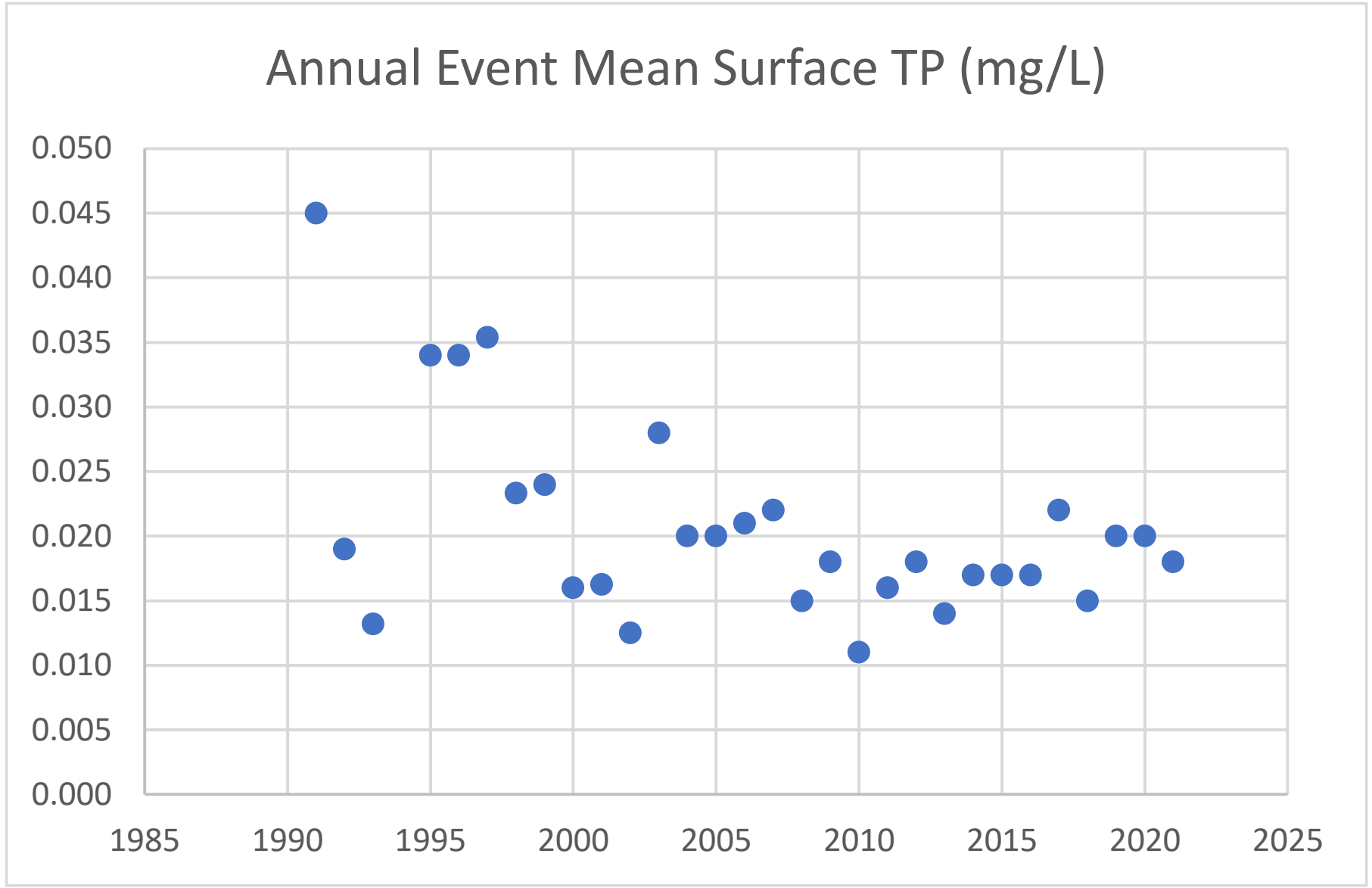
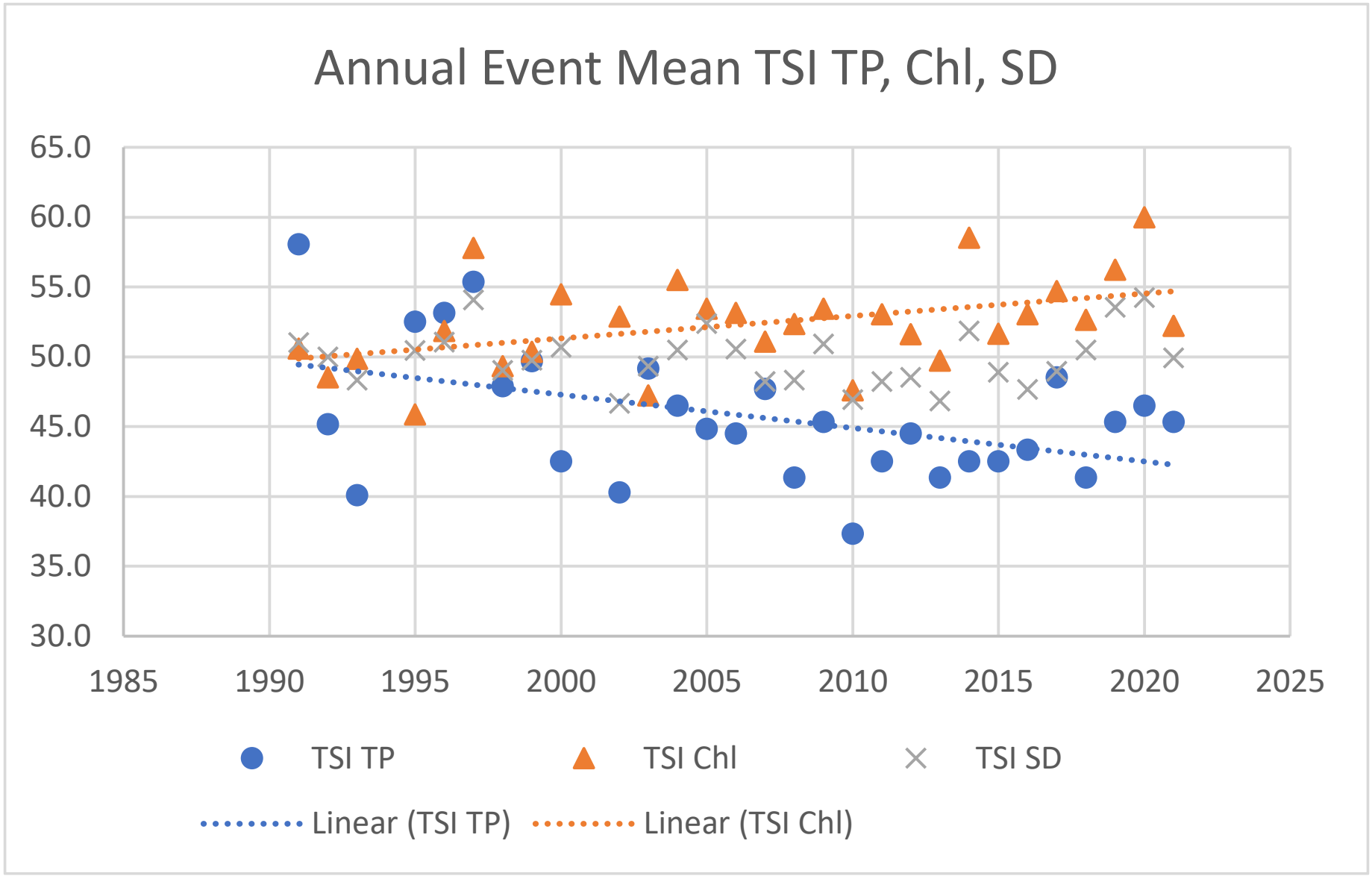

Annual Event Max Anoxic Zone
P Loading Rate (mg P/m2/d)
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1985
1990
1995
2000
2005
2010
2015
2020
2025


Annual Event Mean Deep TP (mg/L)
0.300
0.250
0.200
0.150
0.100
0.050
0.000
1985
1990
1995
2000
2005
2010
2015
2020
2025


Annual Event Mean Surface TP (mg/L)
0.050
0.045
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
1985
1990
1995
2000
2005
2010
2015
2020
2025

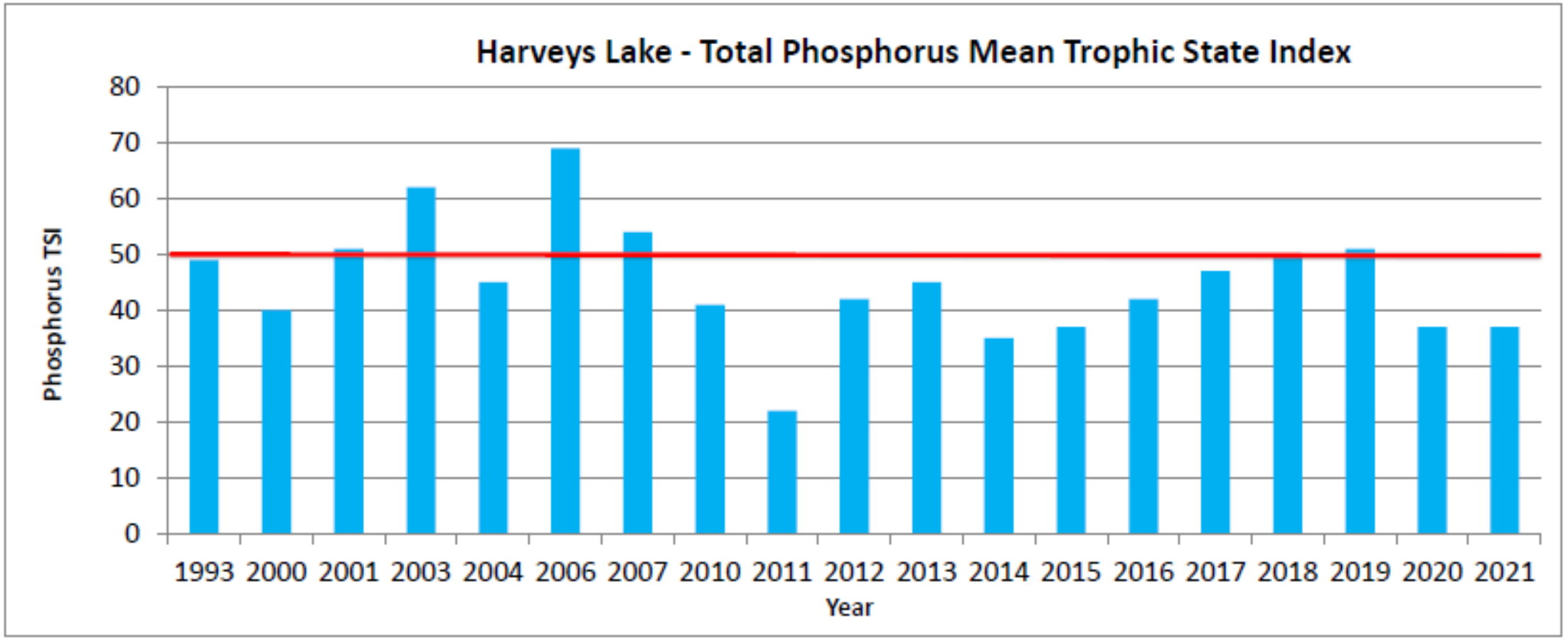

Annual Event Mean TSI TP, Chl, SD
65.0
60.0
55.0
50.0
45.0
40.0
35.0
30.0
1985
1990
1995
2000
2005
2010
2015
2020
2025
TSI TP
TSI Chl
TSI SD
Linear (TSI TP)
Linear (TSI Chl)

Correlation between TP concentrations and reported HABs

- ✓ In 2019 the mean June TP concentration was 0.043 mg/L; NJDEP conducted 40 site visits between 18th June and 29th October 2019.
- ✓ In 2020 the mean June TP concentration was 0.033 mg/L; NJDEP conducted 15 site visits between 27th May and 17th November 2020.
- ✓ In 2021 the mean June TP concentration was 0.020 mg/L; NJDEP conducted 11 site visits between 27th May and 12th October 2021.

Harveys Lake, Luzerne County, PA

- Largest natural lake, by volume, in Pennsylvania.
- Has a TMDL for total phosphorus (TP).
- Have been implementing a variety of watershed and in-lake measures to reduce the annual TP load.
- To date, the lake is approximately 75% in compliance with it's TMDL.

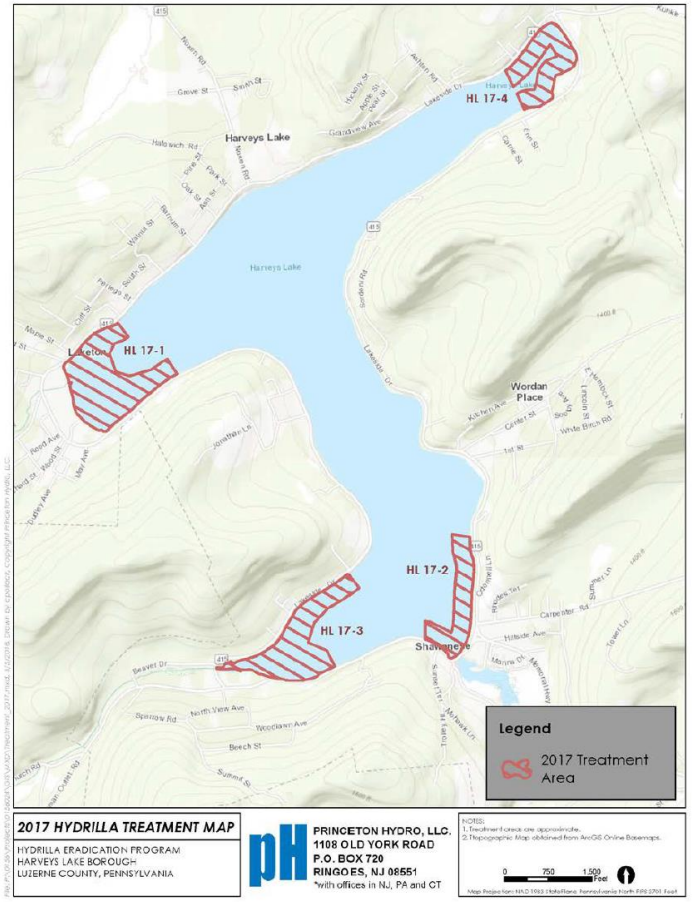

Harveys Lake - Total Phosphorus Mean Trophic State Index
Phosphorus TSI
80
70
60
50
40
30
20
10
0
1993
2000
2001
2003
2004
2006
2007
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Year

Hydrilla found!

July 16, 2014 – Hydrilla identified during standard water quality monitoring

Harveys Lake

- In 2012, no hydrilla was found in aquatic plant survey.
- In 2014, hydrilla found in 38% of the transects
- In 2016, hydrilla found in 58% of the transect
- By 2019 hydrilla was found in all 13 transects and monitoring was expanded to include more sampling points and tubers / turions.
- Using Sonar to combat the hydrilla



Lake Mohawk, Sussex County, NJ

Lake Mohawk is a 800-acre waterbody with over 2,000 families living around the lake.

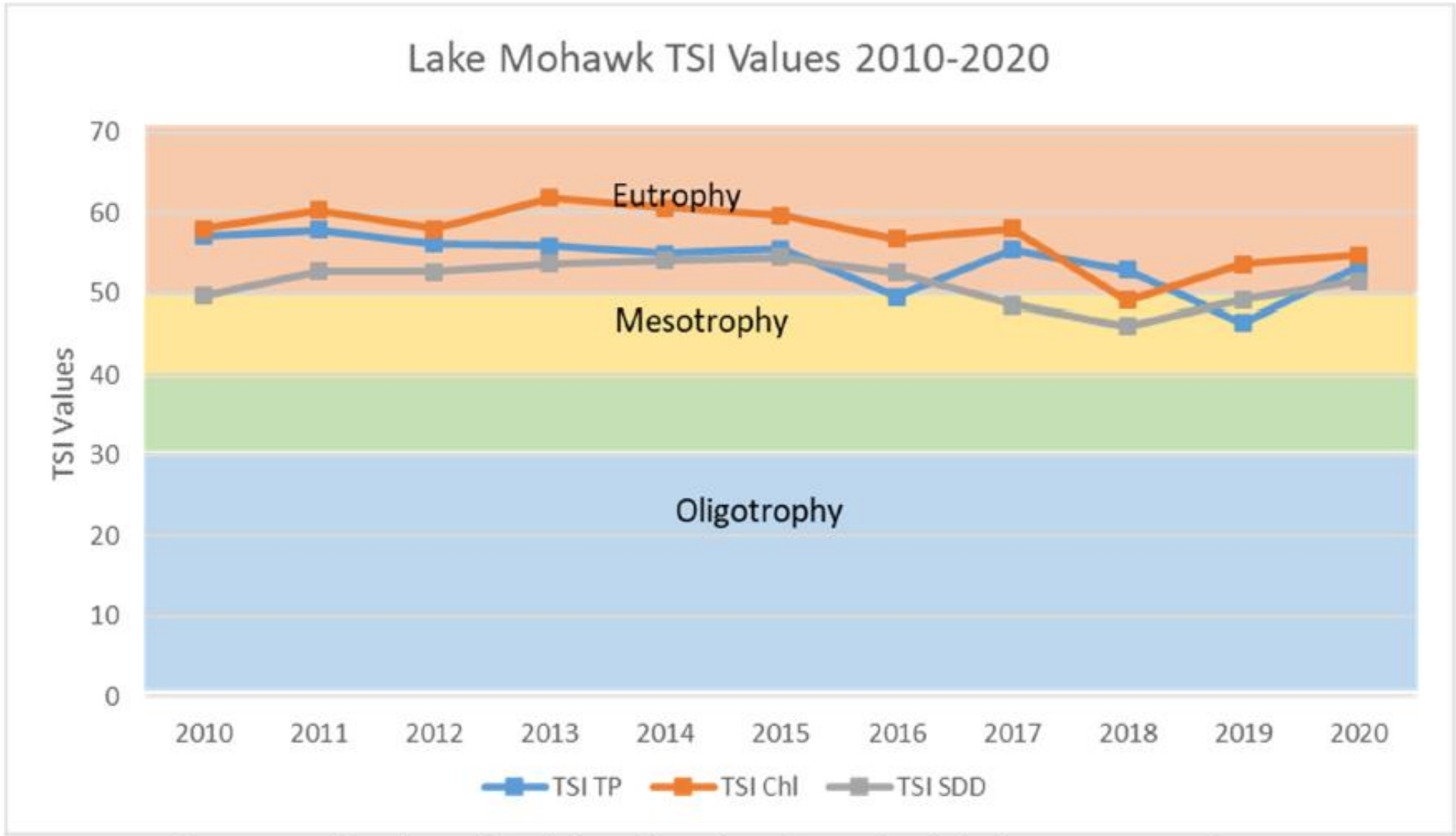
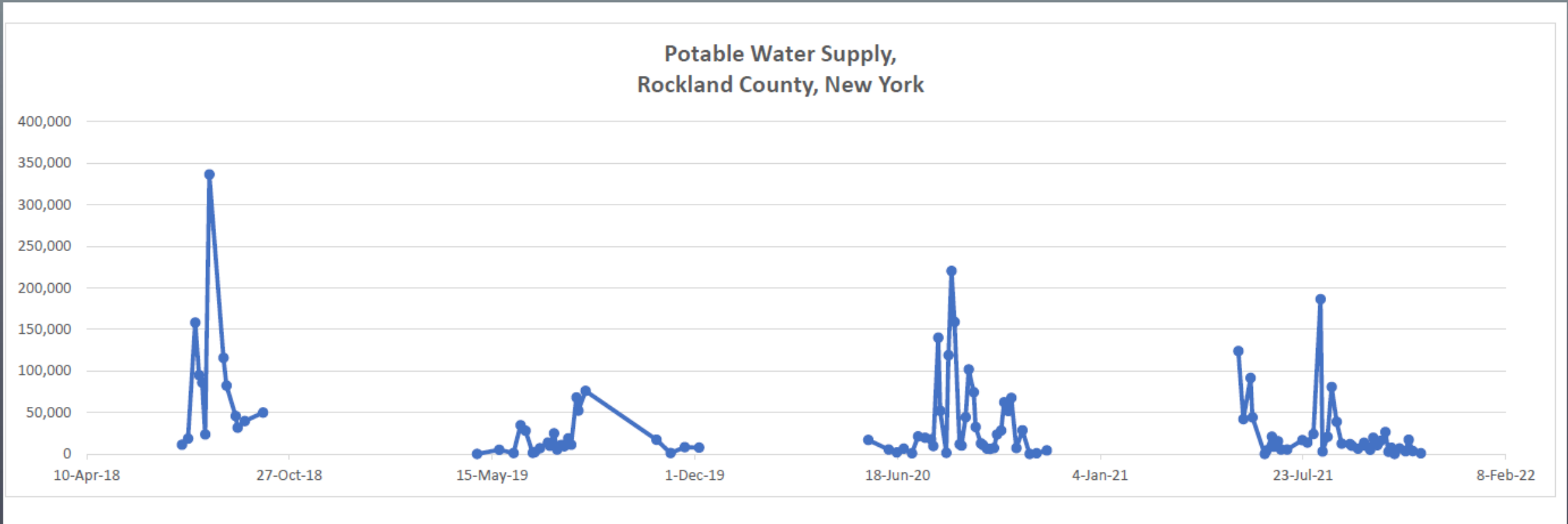
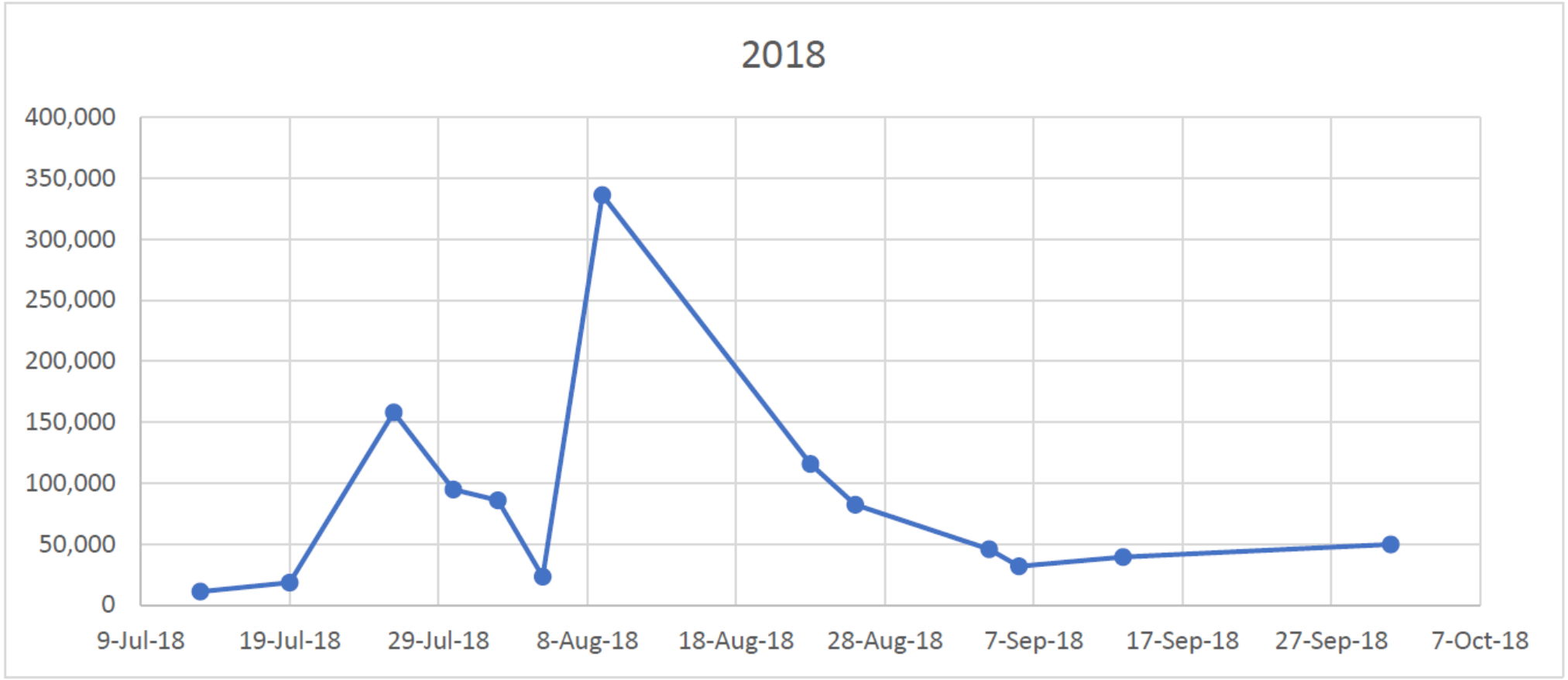


Figure 9. Carlson's Trophic State Indices for Lake Mohawk between 2010 and 2020.

Cyanobacteria cell counts (cells/mLs)



Cyanobacteria cell counts (cells/mLs)



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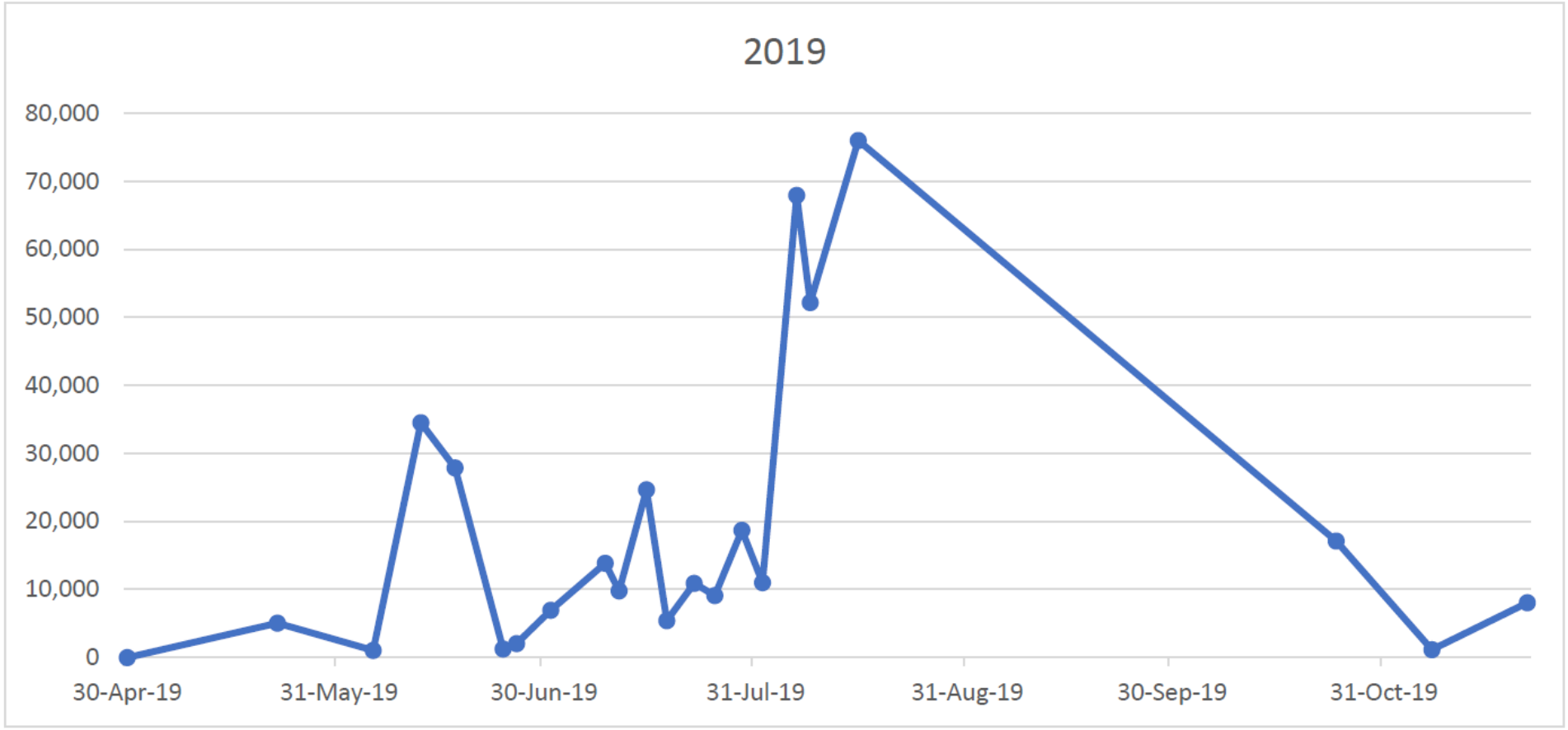

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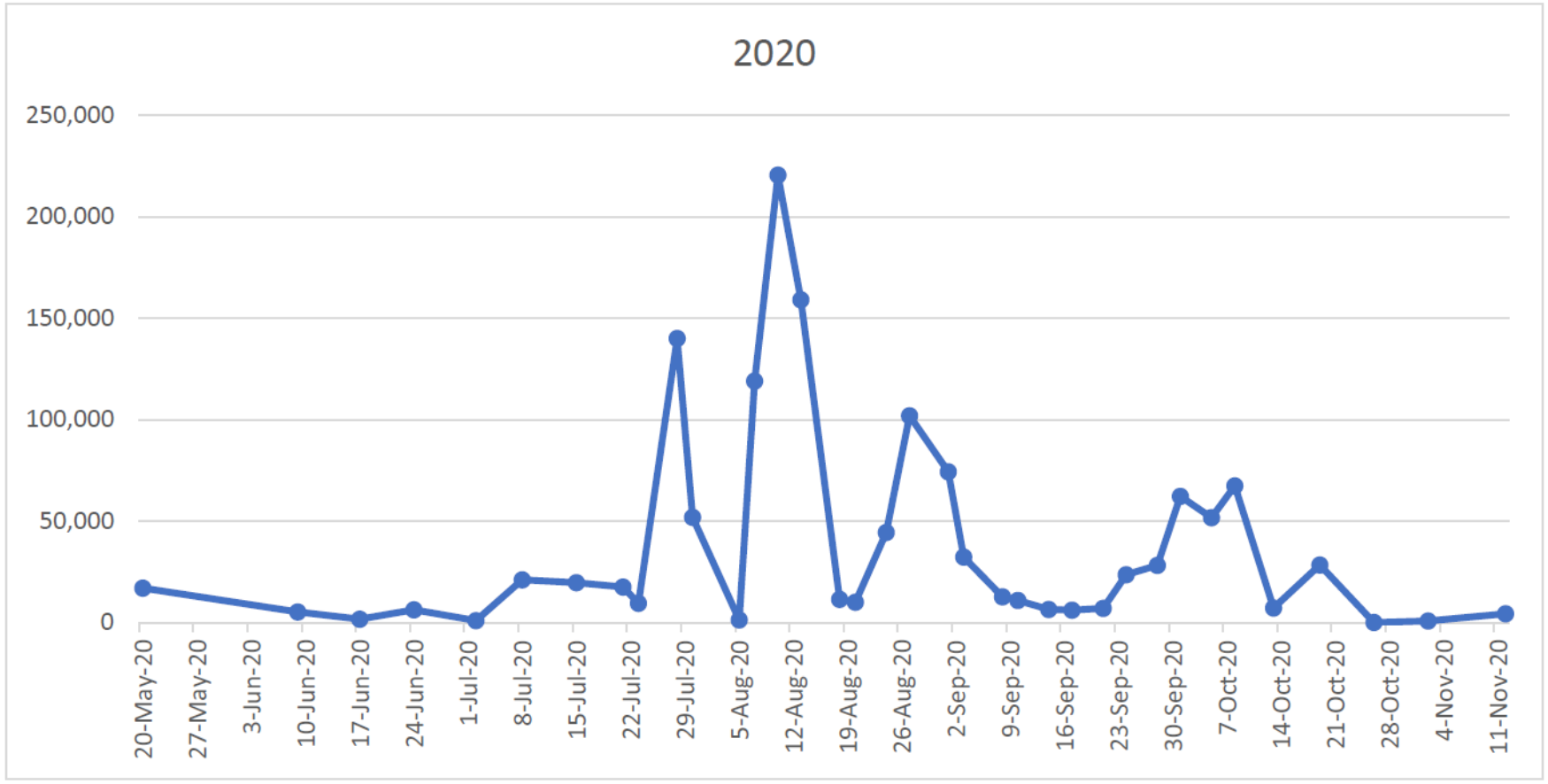

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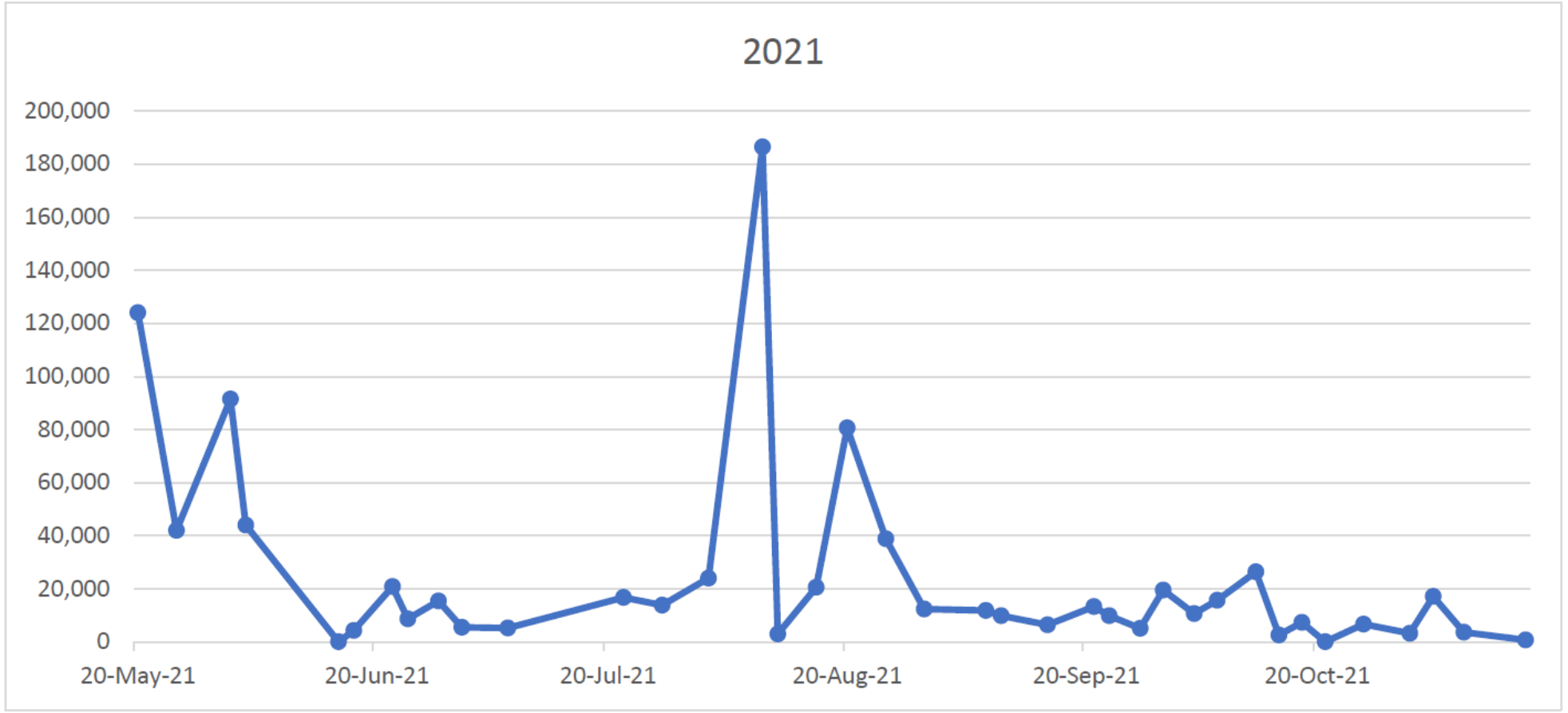
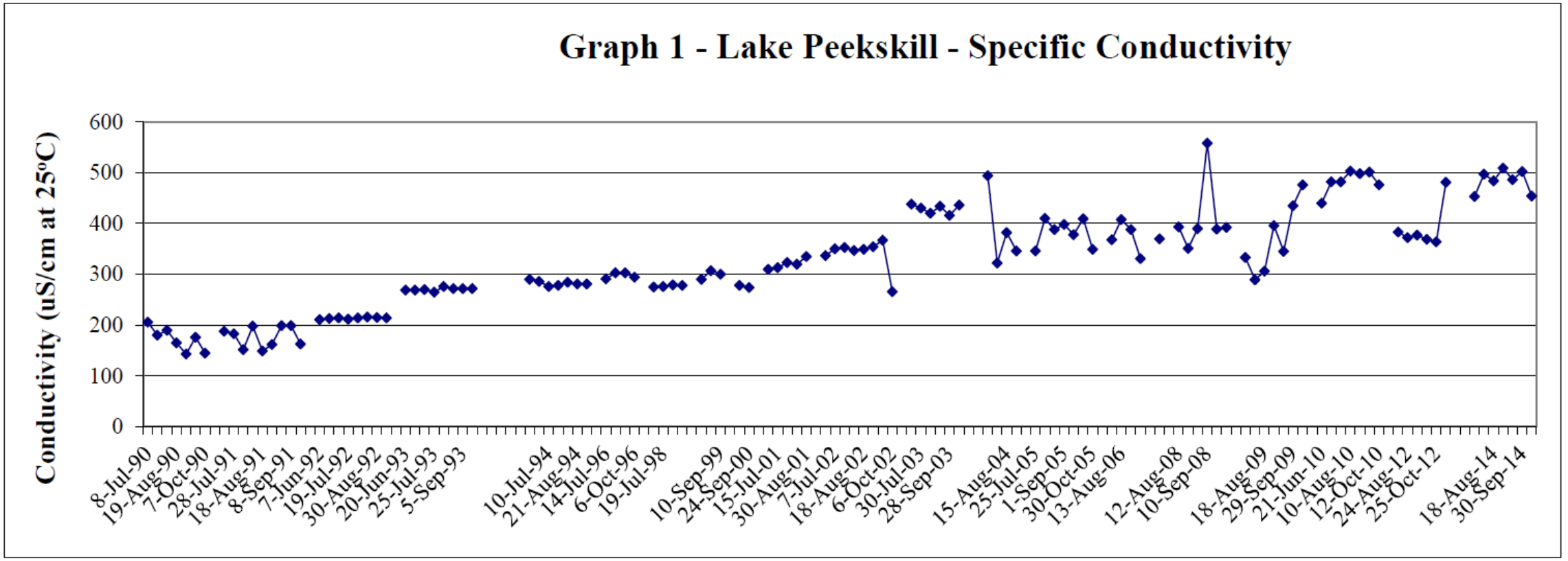
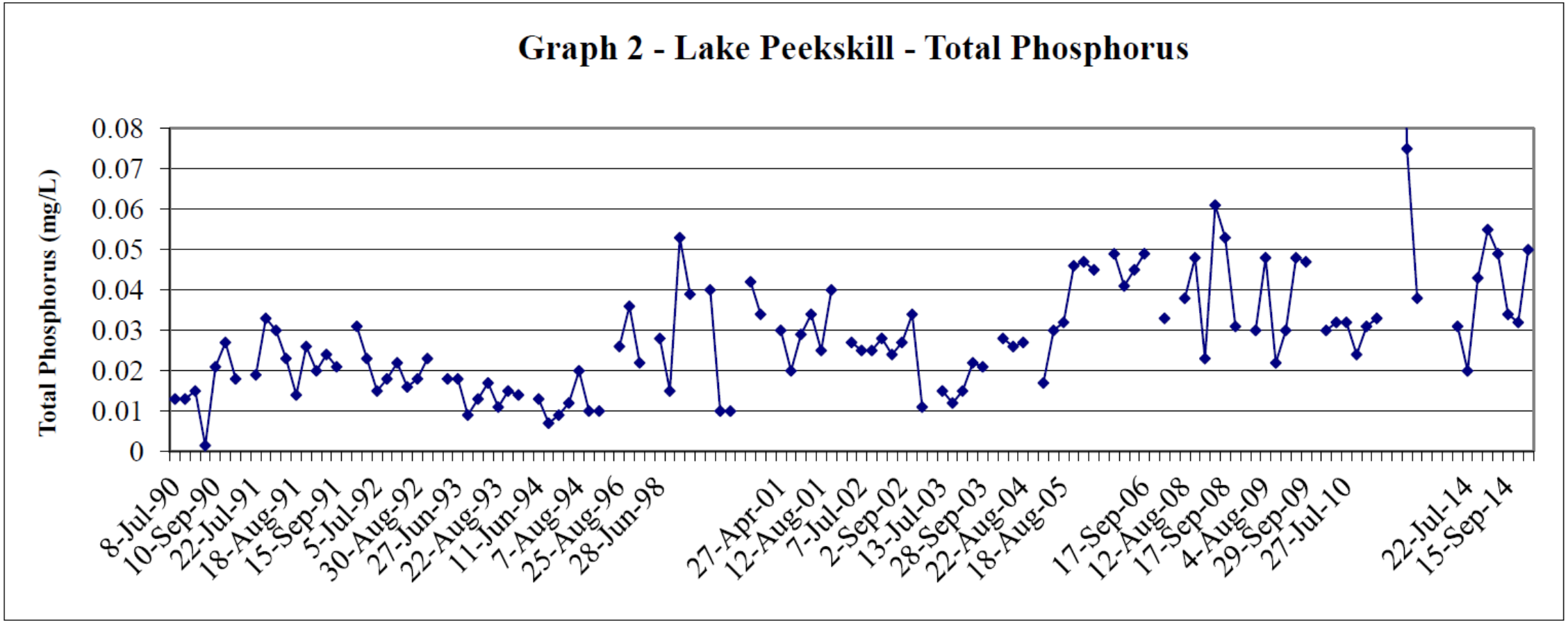
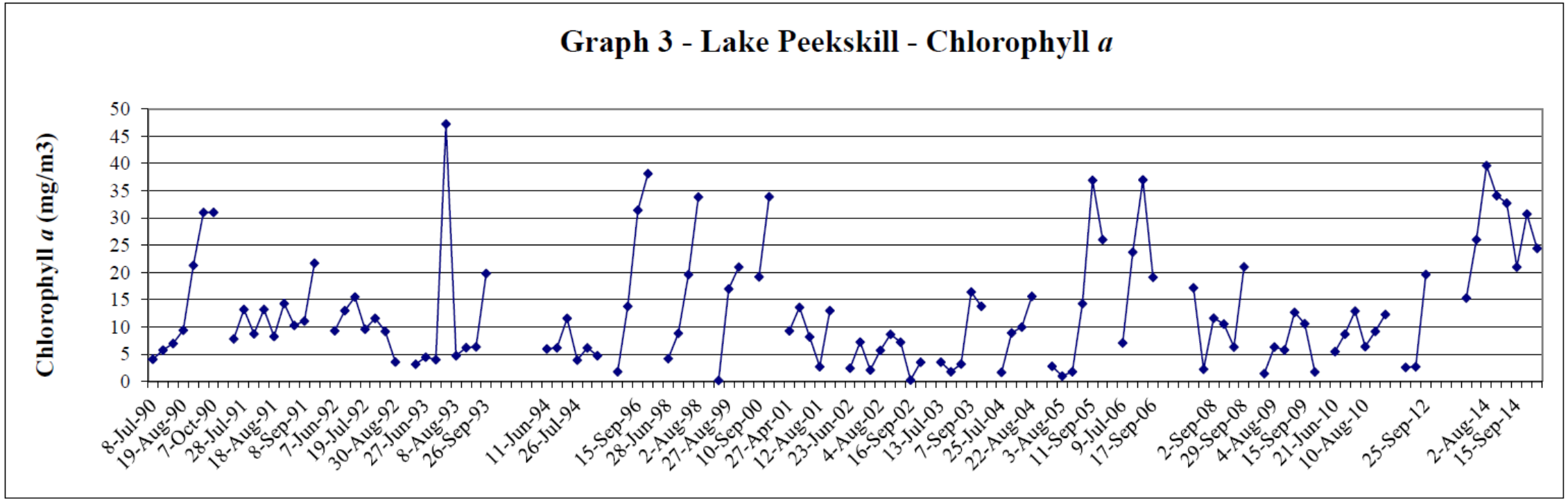


Lake Peekskill, Putnam County, NY

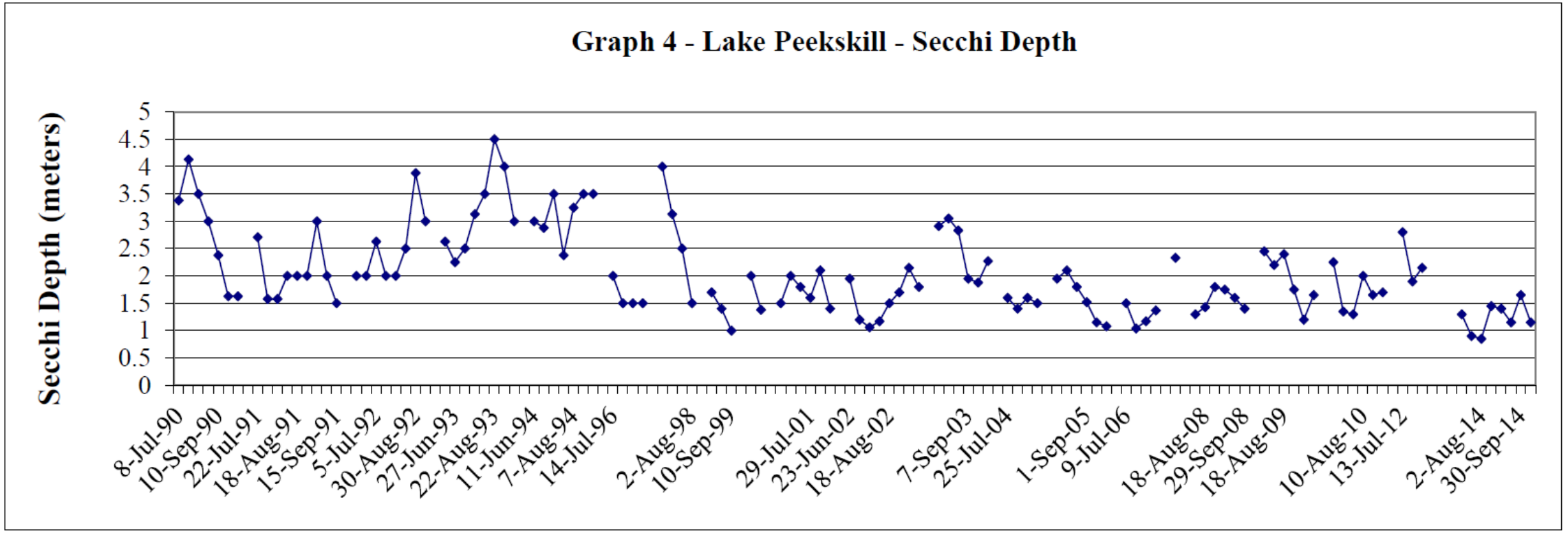

Graph 1 - Lake Peekskill - Specific Conductivity
Conductivity (uS/cm at 25°C)
600
500
400
300
200
100
0
8-Jul-90
19-Aug-90
7-Oct-90
28-Jul-91
18-Aug-91
8-Sep-91
7-Jun-92
19-Jul-92
30-Aug-92
20-Jun-93
25-Jul-93
5-Sep-93
10-Jul-94
21-Aug-94
14-Jul-96
6-Oct-96
19-Jul-98
10-Sep-99
24-Sep-00
15-Jul-01
30-Aug-01
7-Jul-02
18-Aug-02
6-Oct-02
30-Jul-03
28-Sep-03
15-Aug-04
25-Jul-05
1-Sep-05
30-Oct-05
13-Aug-06
12-Aug-08
10-Sep-08
18-Aug-09
29-Sep-09
21-Jun-10
10-Aug-10
12-Oct-10
24-Aug-12
25-Oct-12
18-Aug-14
30-Sep-14


Graph 2 - Lake Peekskill - Total Phosphorus
Total Phosphorus (mg/L)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
8-Jul-90
10-Sep-90
22-Jul-91
18-Aug-91
15-Sep-91
5-Jul-92
30-Aug-92
27-Jun-93
22-Aug-93
11-Jun-94
7-Aug-94
25-Aug-96
28-Jun-98
27-Apr-01
12-Aug-01
7-Jul-02
2-Sep-02
13-Jul-03
28-Sep-03
22-Aug-04
18-Aug-05
17-Sep-06
12-Aug-08
17-Sep-08
4-Aug-09
29-Sep-09
27-Jul-10
22-Jul-14
15-Sep-14

Graph 3 - Lake Peekskill - Chlorophyll *a*



Graph 4 - Lake Peekskill - Secchi Depth



Summary and Conclusions

- ✓ Long-term water quality datasets provide extremely valuable insight into how lakes function and, in turn, how to effectively manage them.
- ✓ Consistency is the key in implementing a long-term monitoring program.
- ✓ Can be used in the adaptive management of a lake.
- ✓ With climate change, HABs and invasive species, long-term water quality data is particularly important in managing lakes.

QUESTIONS?

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THANK YOU!

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