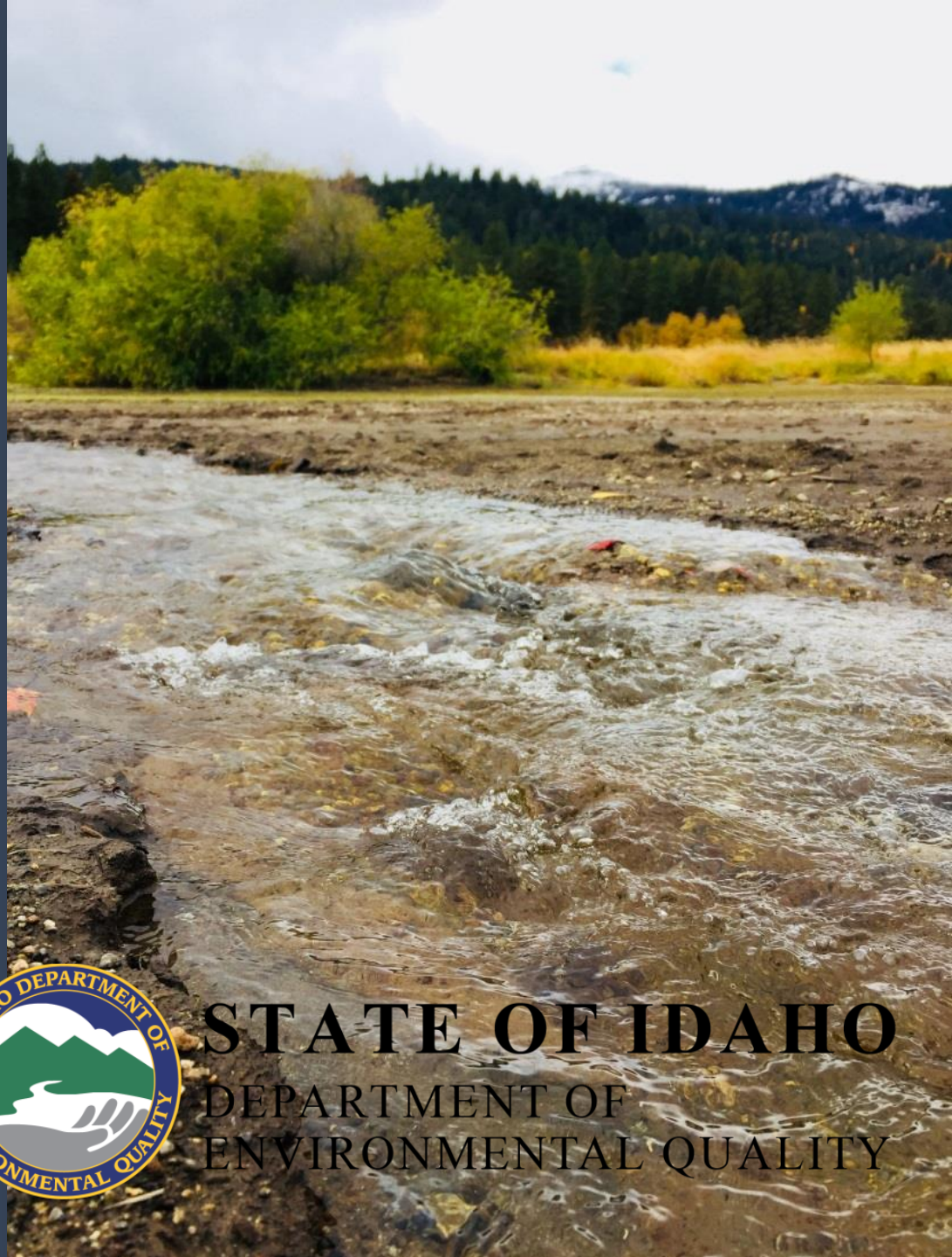
North Fork Payette Update

NF Payette Monitoring

Cascade Reservoir Monitoring Cyanobacteria

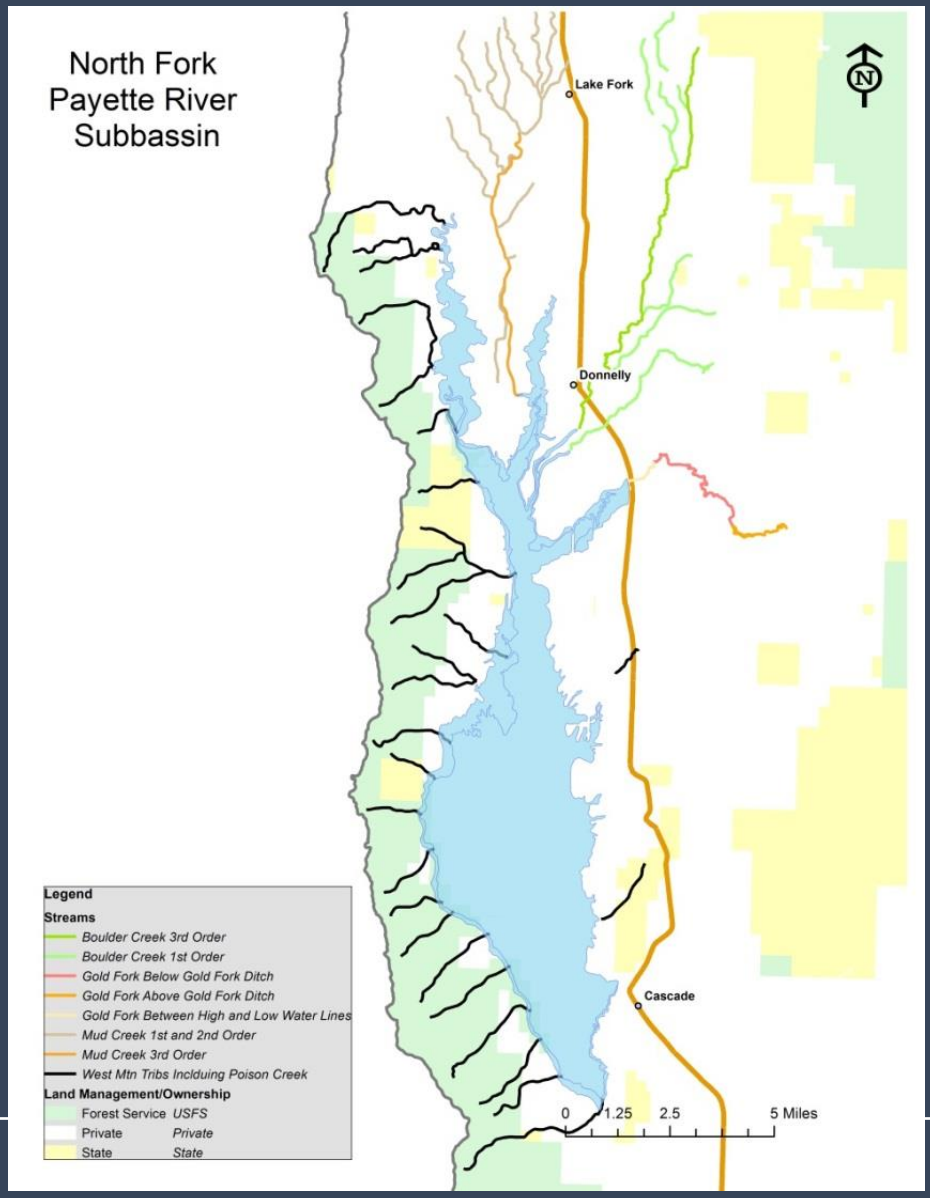
Big Payette Lake Monitoring

Chase Cusack
Water Quality Analyst
Boise Regional Office



Impaired Waterbodies

Stream Name	Pollutant
Boulder Creek 3rd Order	TP, Sediment
Boulder/Willow Creek 2nd Order	TP
Cascade Reservoir	TP, pH
Gold Fork Above Gold Fork Ditch	TP
Gold Fork Between High and Low Water Lines	TP, pH
Gold Fork Lower 5th order Below Gold Fork Ditch	TP, Sediment
Mud Creek	TP, Sediment
Mud Creek	TP, Sediment
West Mtn. Tribs to Cascade (Poison Creek)	TP



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Current Watershed Documents

- **1996 & 1999** TMDLs (Phase I & II) – Highlights Nutrients and pH in Cascade Reservoir and Tributaries
- **2009** Water Quality Management Plan and TMDL 5-Year Review (Phase III)
- **2011** Tributary TMDL Addendum – Highlights Sediment in Gold Fork, Boulder Creek, and Mud Creek
- **2018** TMDL 5-Year Review

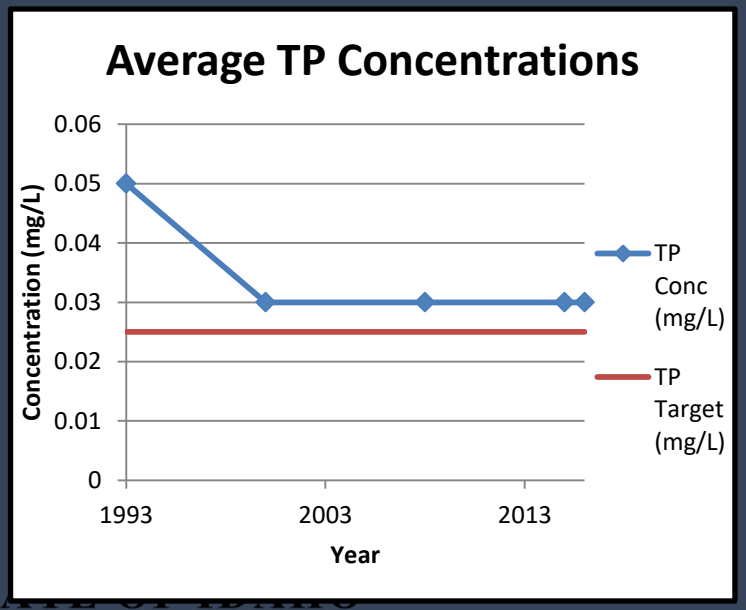
Water Quality Targets

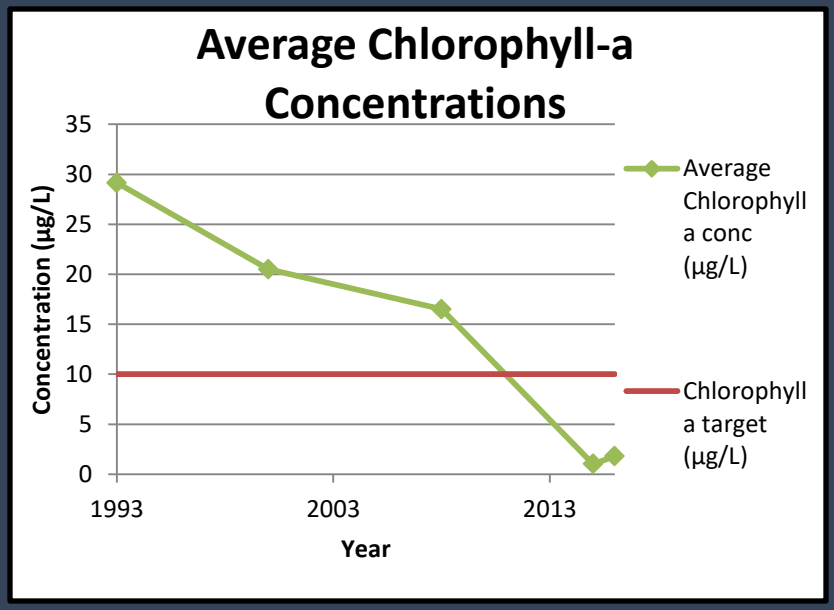
- Cascade Reservoir
  - Total Phosphorus (TP) – **0.025 mg/L**
  - Chlorophyll A – **10 µg/L or less**
  - Dissolved Oxygen (DO) > **6.0 mg/L**
- Tributaries to Cascade Reservoir– TP
  - **37% Reduction**
  - **0.025 mg/L**
- Tributaries to Cascade Reservoir– Sediment
  - **47-83 % reduction**
  - **80% bank stability**

Cascade Reservoir 5-Year Review Summary

Measurement	Year				
	1993	2000	2008	2015	2016
Average total phosphorus concentrations (mg/L)	0.05	0.03	0.03	0.03	0.03
Mean chlorophyll a concentrations (µg/L)	29.15	20.50	16.50	1.02	1.80

Note: Average total phosphorus concentrations in 2015 and 2016 are an average of all total phosphorus samples collected from the e. Phosphorus concentrations from the hypolimnion were excluded from these averages.





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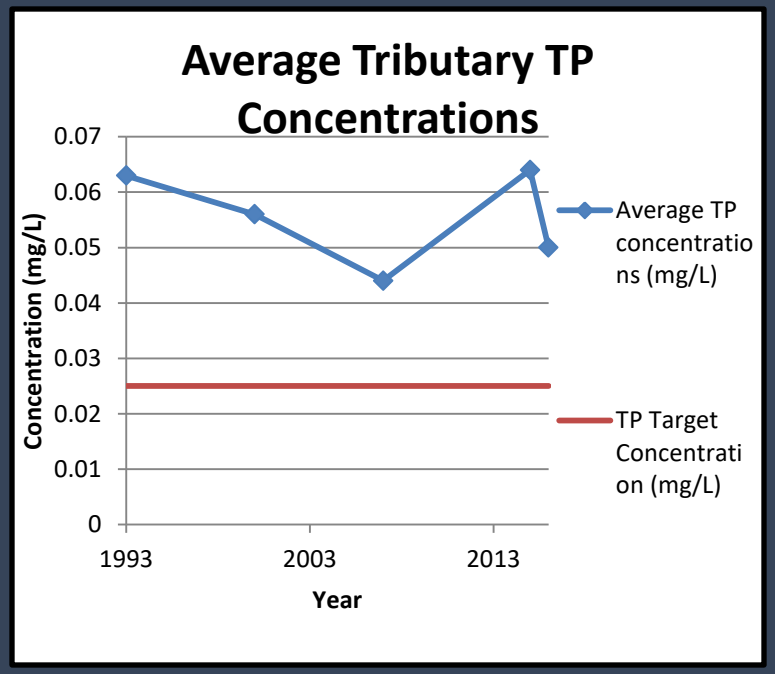
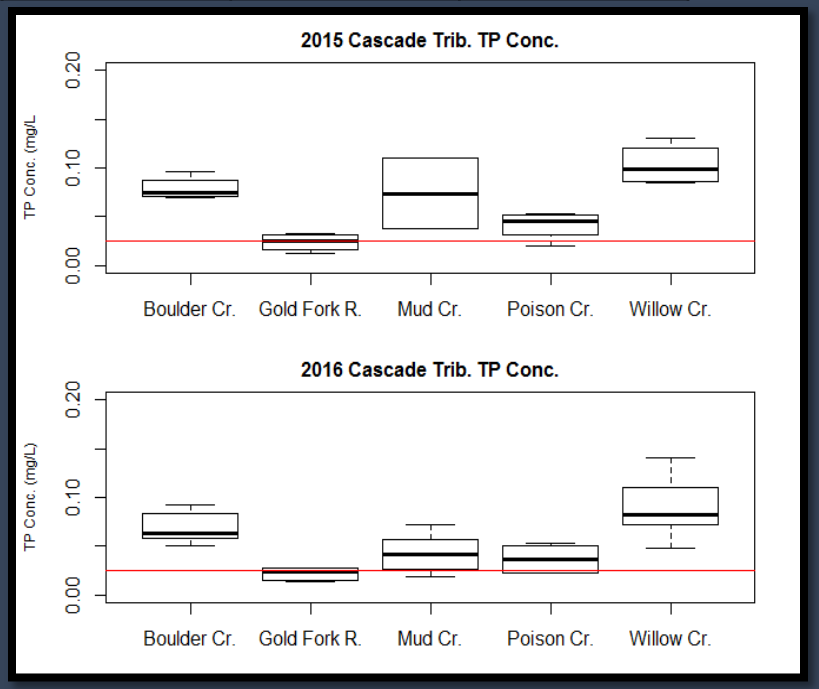
Tributary 5-Year Review - TP

Measurement	Year				
	1993	2000	2007	2015	2016
Average total phosphorus concentrations (mg/L)	0.063	0.056	0.044	0.064	0.05
Total phosphorus concentration range (mg/L)	0.033–0.270	0.016–0.21	0.007–0.155	0.012–0.13	0.014–0.22





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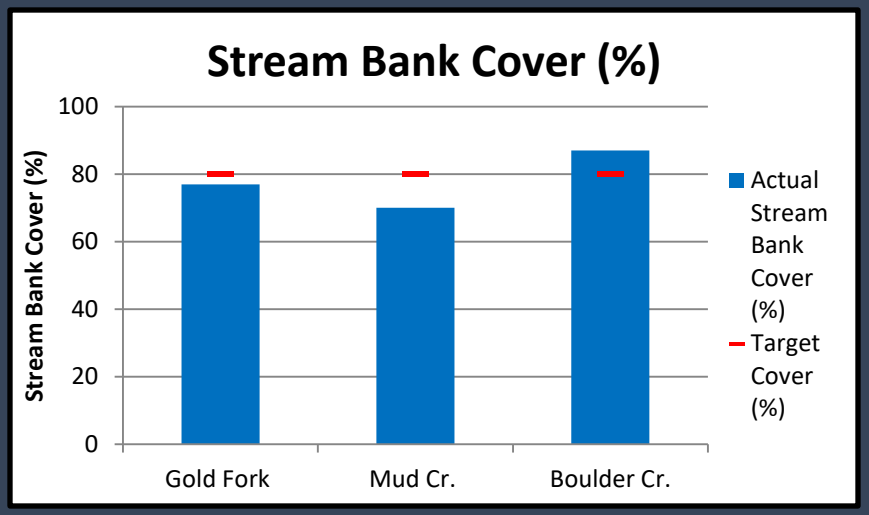
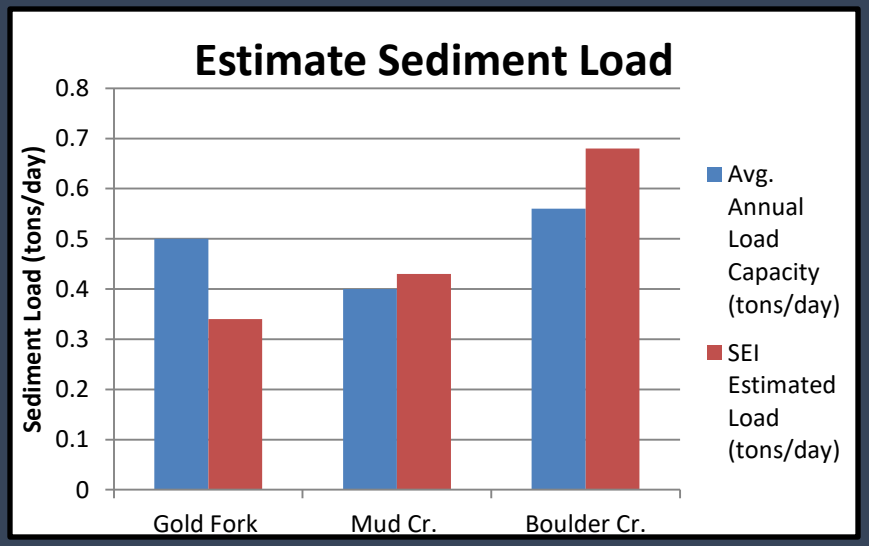
Tributary 5-Year Review - Sediment

Assessment Unit	Target Cover (%)	Actual Stream Bank Cover (%)	Average Annual Load Capacity (tons/day)	SEI Estimated Load (tons/day)
Gold Fork—lower 5th order, below Gold Fork Ditch (ID17050123SW008_05a)	80	77	0.50	0.34
Mud Creek—3rd order (Norwood to Reservoir) (ID17050123SW015_03)	80	70	0.40	0.43
Boulder Creek—3rd order (Louie Creek to mouth) (ID17050123SW011_03)	80	87	0.56	0.68





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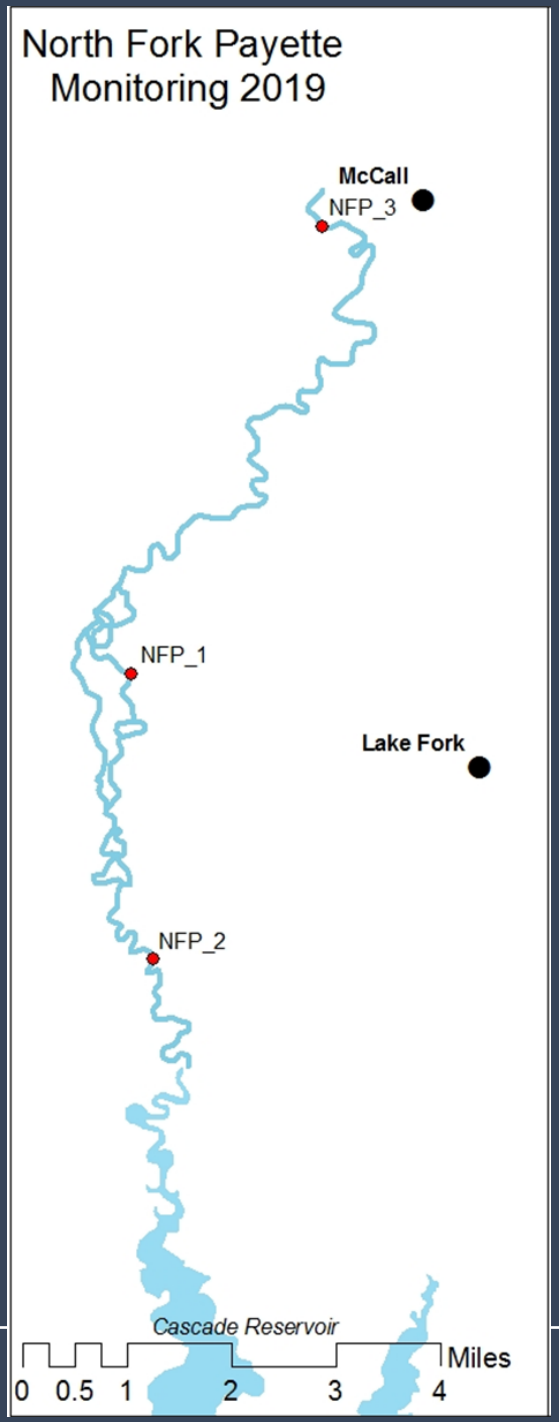
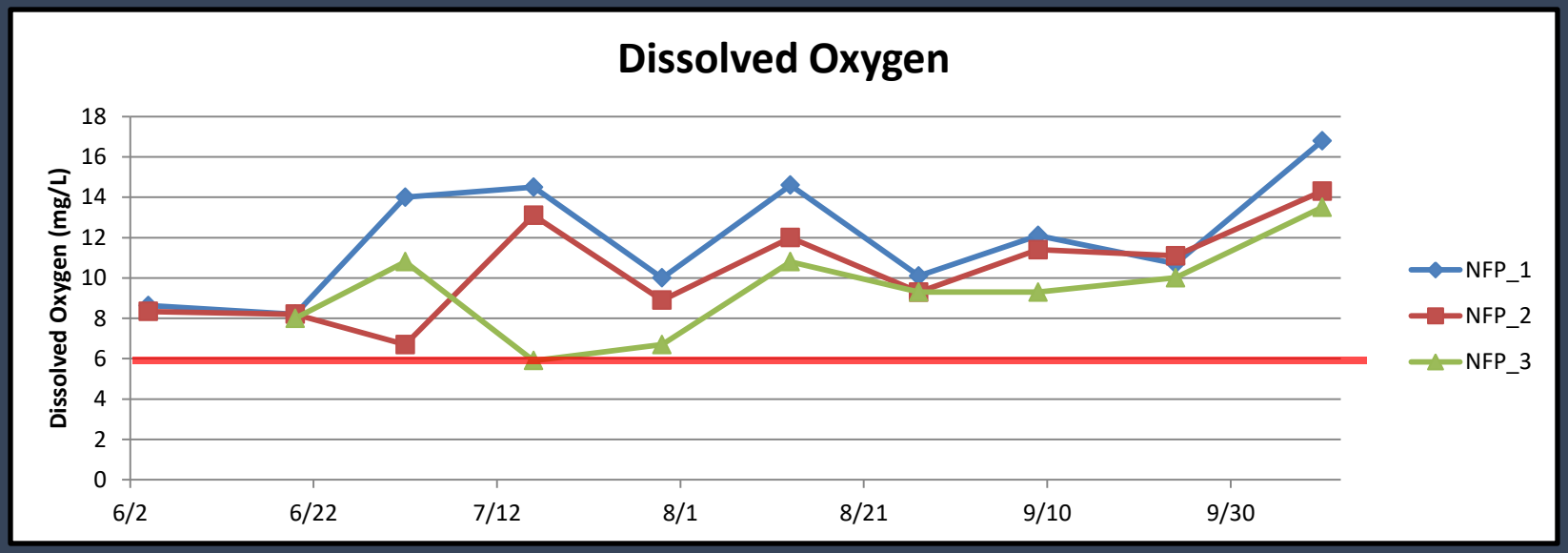
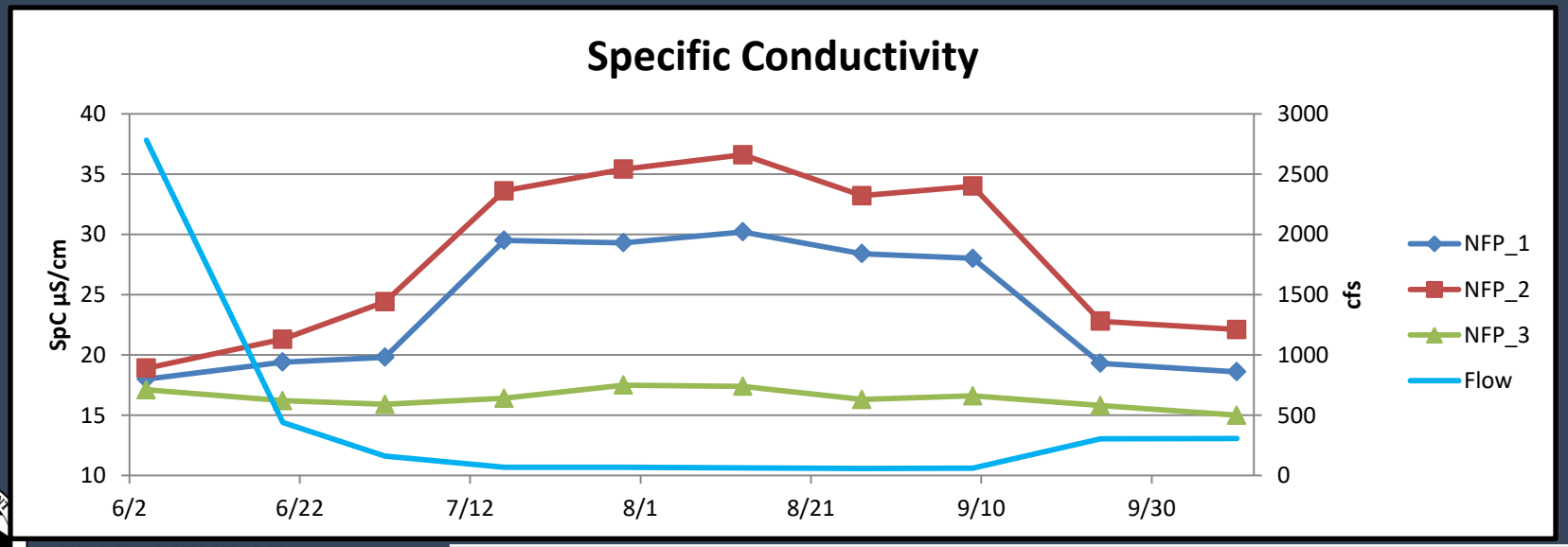
2019 NF Payette Monitoring

- 303(d) listed for Combined Biota/Habitat Bioassessments
- Looking at:
  - Nutrients
  - Temperature
  - *E. coli*
  - Sediment

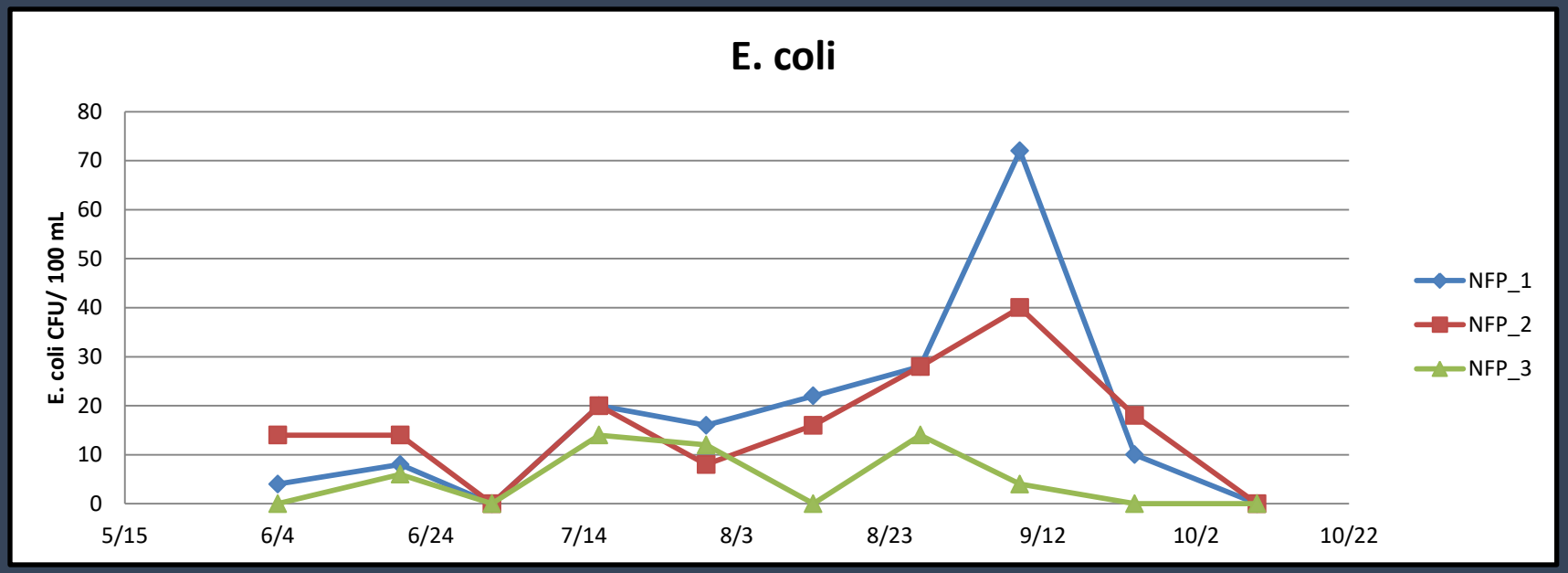


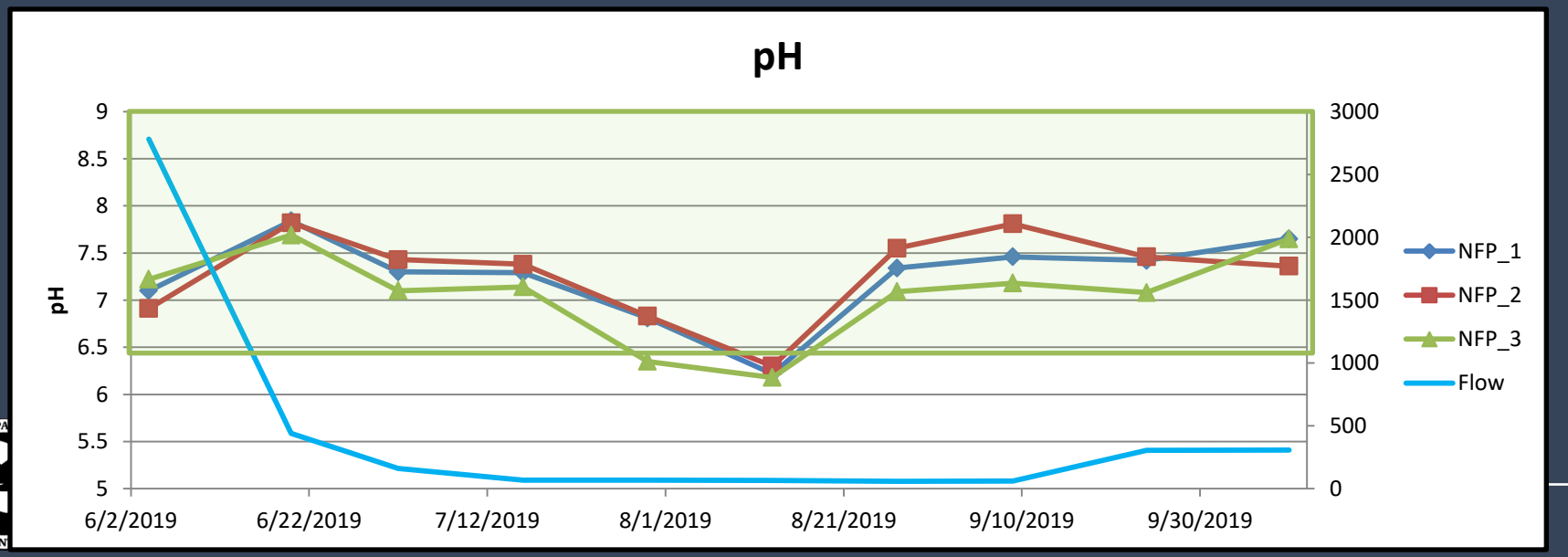
Results


Dissolved Oxygen
Dissolved Oxygen (mg/L)
18
16
14
12
10
8
6
4
2
0
6/2
6/22
7/12
8/1
8/21
9/10
9/30
NFP_1
NFP_2
NFP_3

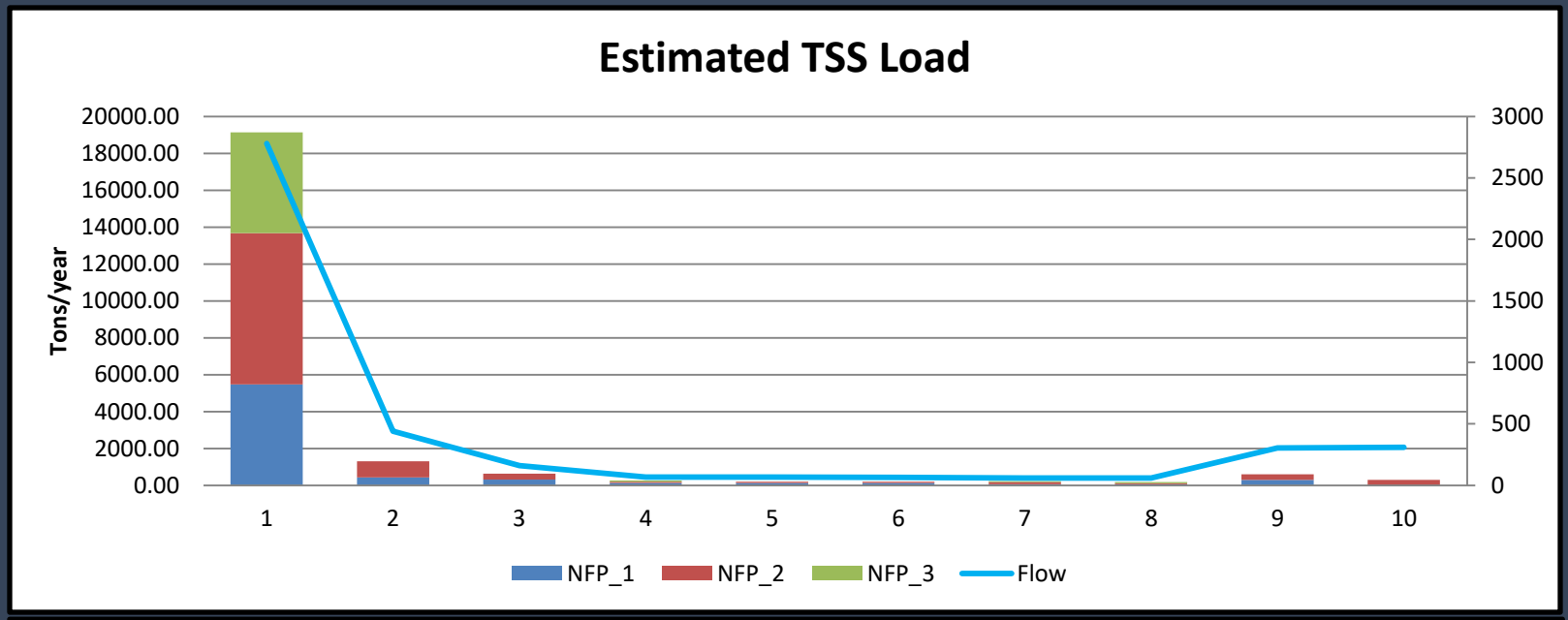

Specific Conductivity
SpC µS/cm
40
35
30
25
20
15
10
cfs
3000
2500
2000
1500
1000
500
0
6/2
6/22
7/12
8/1
8/21
9/10
9/30
NFP_1
NFP_2
NFP_3
Flow

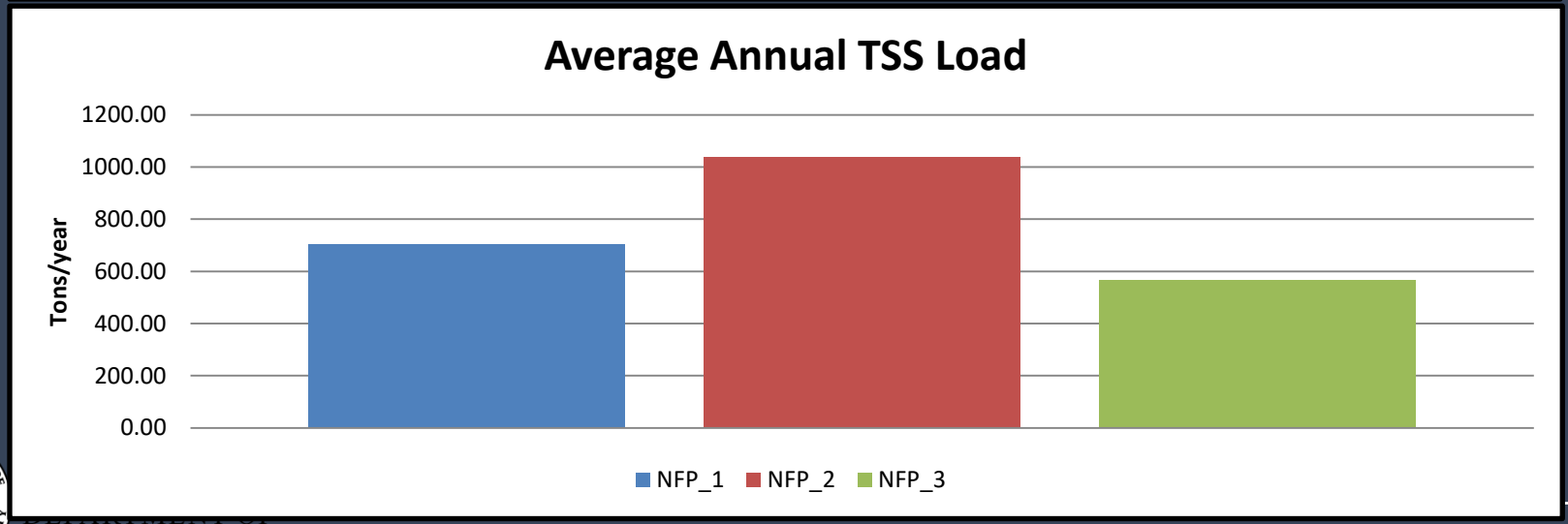
Results


E. coli
E. coli CFU/ 100 mL
80
70
60
50
40
30
20
10
0
5/15
6/4
6/24
7/14
8/3
8/23
9/12
10/2
10/22
NFP_1
NFP_2
NFP_3

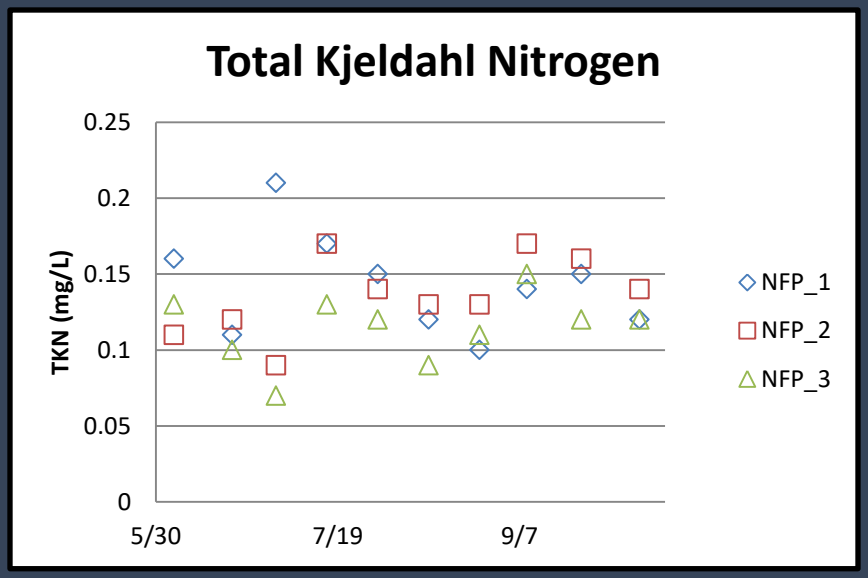

pH
pH
9
8.5
8
7.5
7
6.5
6
5.5
5
3000
2500
2000
1500
1000
500
0
6/2/2019
6/22/2019
7/12/2019
8/1/2019
8/21/2019
9/10/2019
9/30/2019
NFP_1
NFP_2
NFP_3
Flow

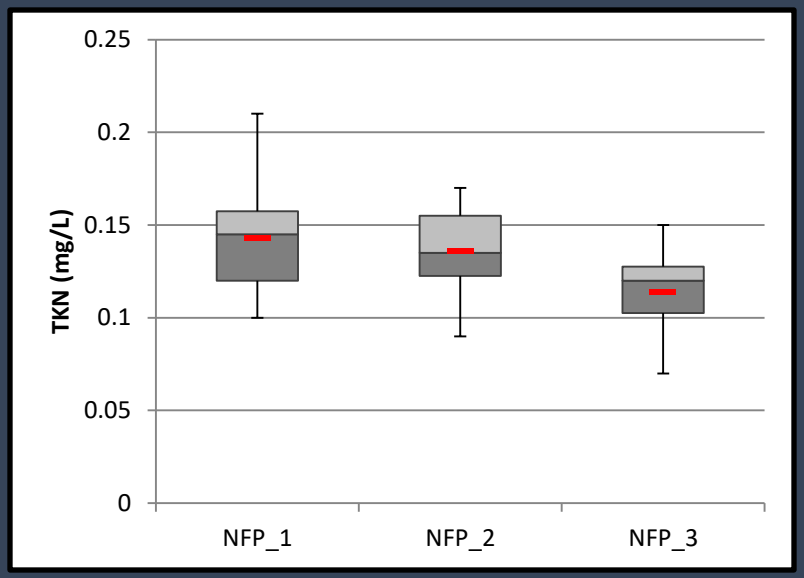
Results: Sediment

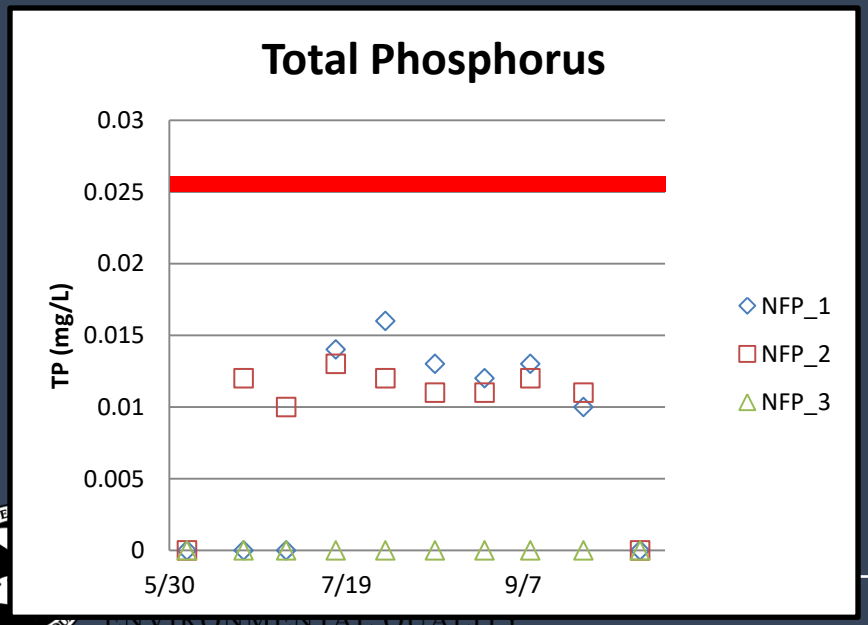


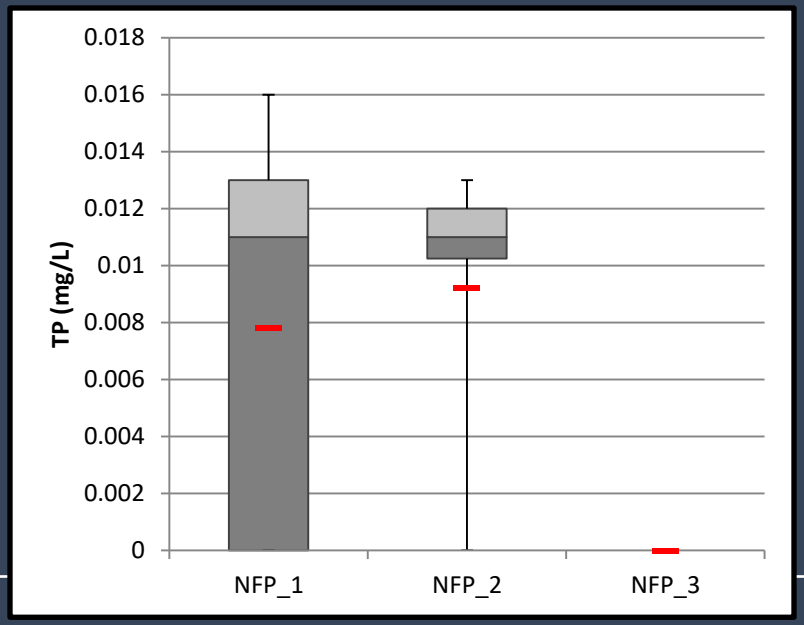


Results: Nutrients

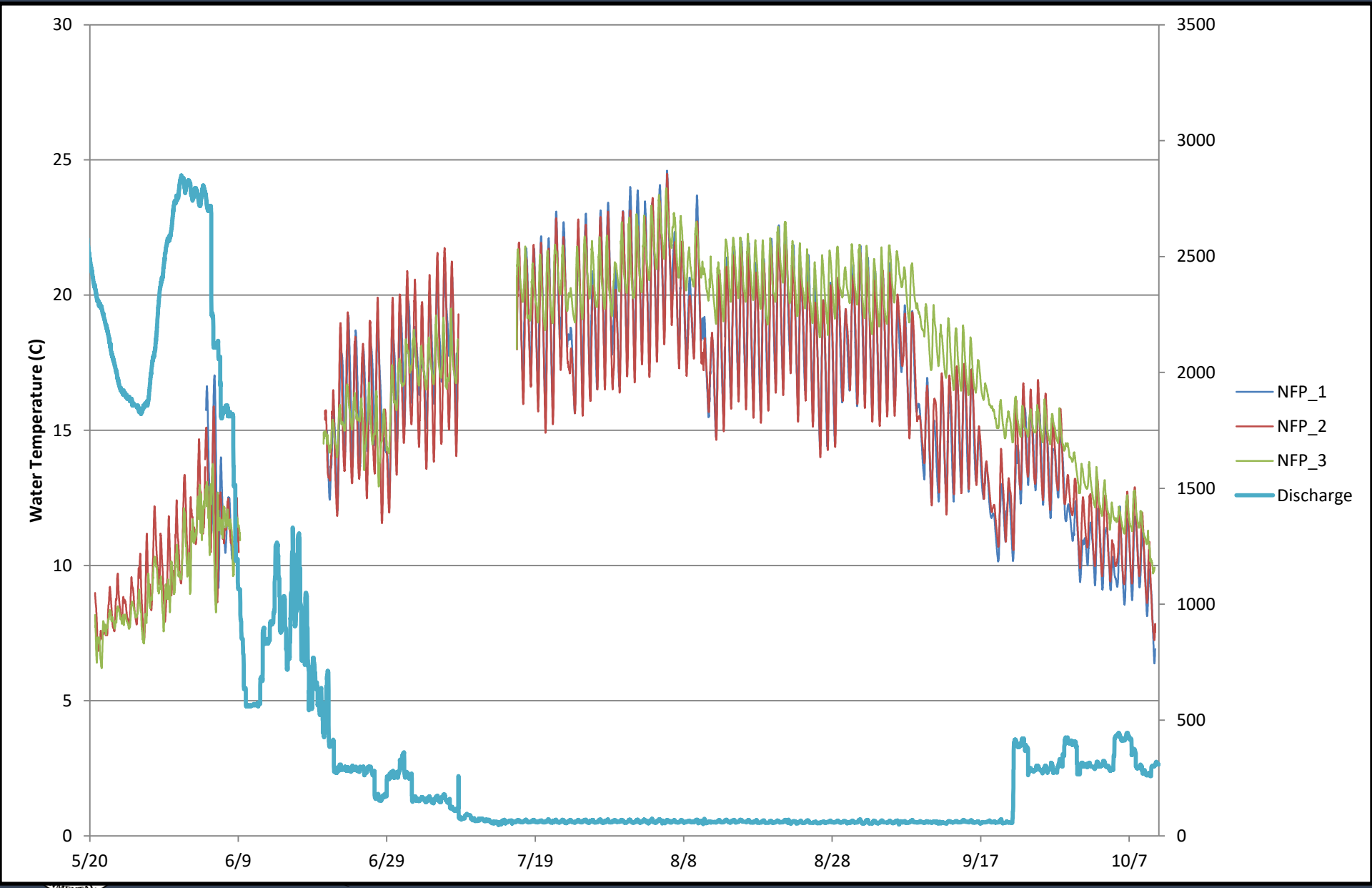


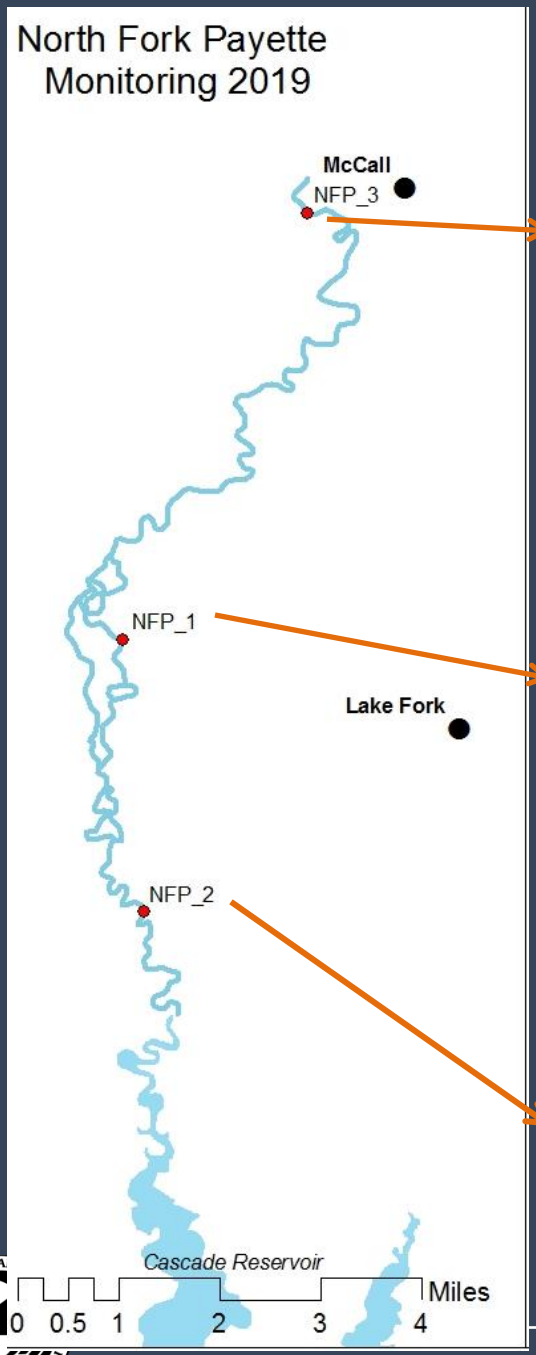


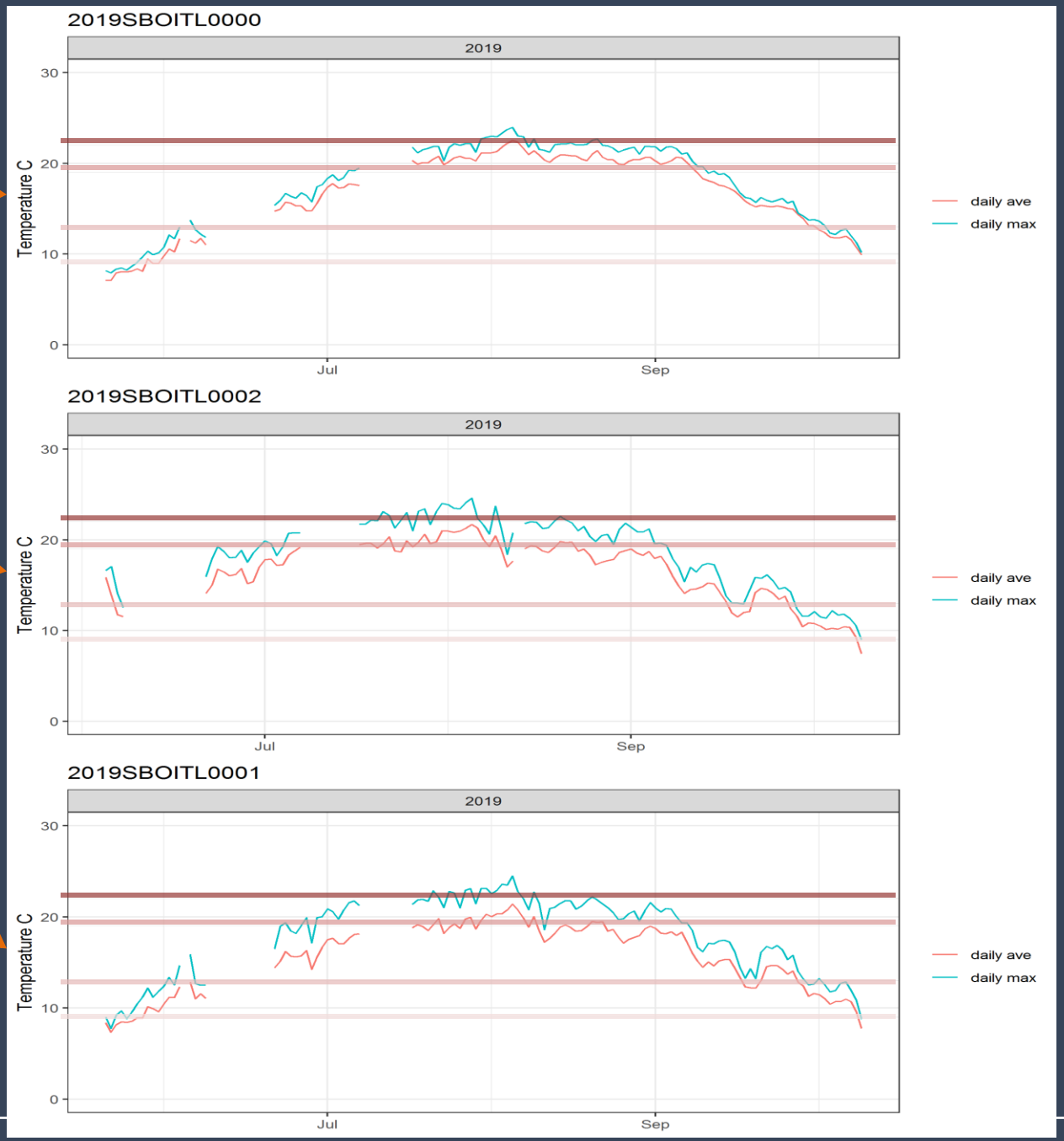




Results: Temperature







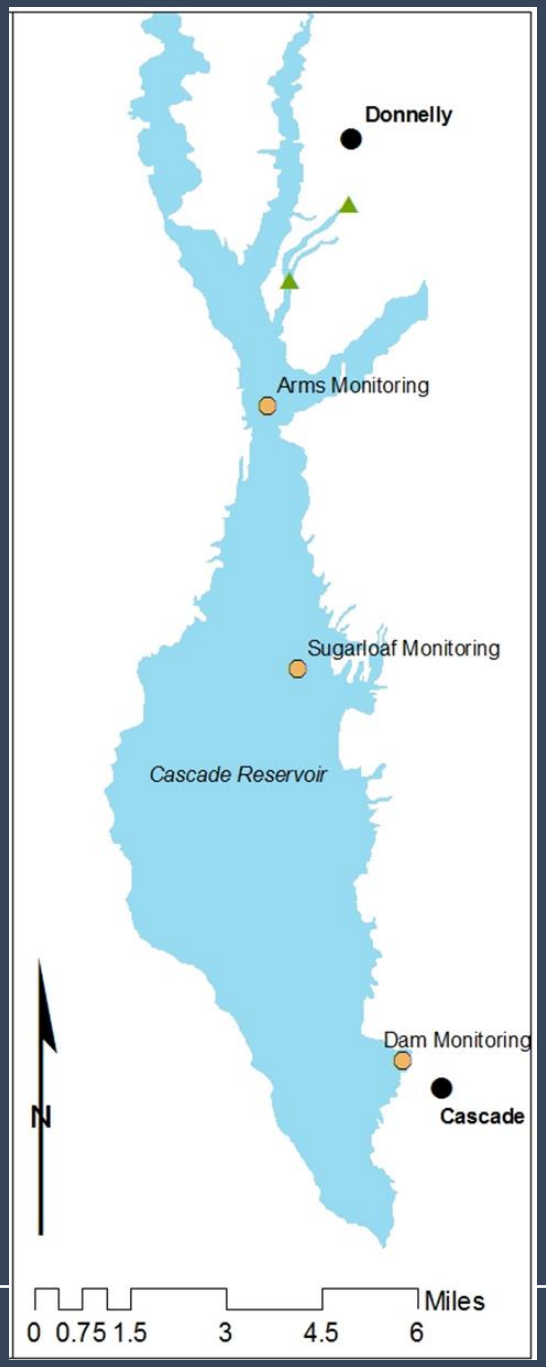
ENVIRONMENTAL QUALITY

	NFP_1	NFP_2	NFP_3
Highest Daily Maximum	24.61	24.48	23.95
Maximum 7-Day Maximum	23.80	23.32	23.27
Mean Daily Maximum	18.63	17.82	17.82
Highest Daily Average	21.68	21.41	22.52
Mean Daily Average	16.53	15.54	16.73
Lowest Daily Minimum	6.38	6.84	6.20
Mean Daily Minimum	14.43	13.31	15.79
Highest Daily Diurnal	6.96	7.96	5.49
Mean Daily Diurnal	4.20	4.51	2.02
COLD Exceedance (22 C)	24%	19%	29%
COLD Exceedance (19 C)	36%	24%	64%
SS Exceedance (13 C)	95%	56%	50%
SS Exceedance (9 C)	100%	78%	72%

AU switched to Temperature Listing – Temperature TMDL needed

2019 Cascade Reservoir Monitoring

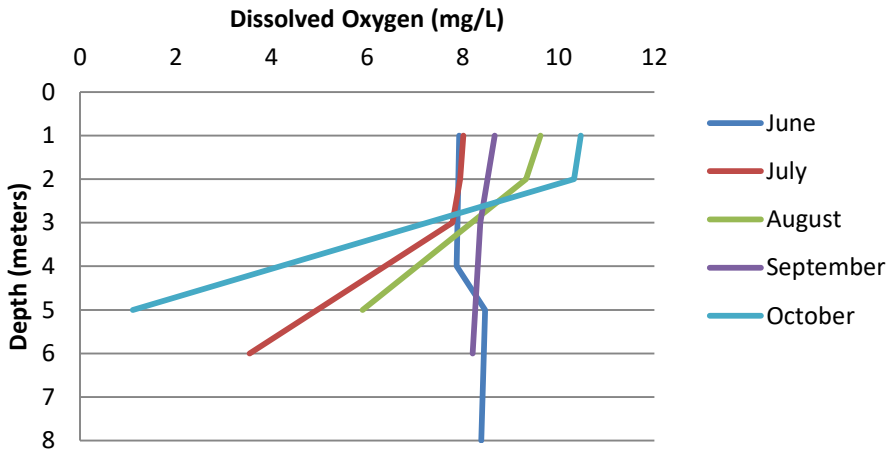
- TMDLs (1999)
  - pH
  - Phosphorus (Total)
- Looking at:
  - Total Phosphorus
  - Temperature
  - pH
  - Conductivity
  - Phycocyanin (cyanobacteria)
  - Chlorophyll a
  - Dissolved Oxygen



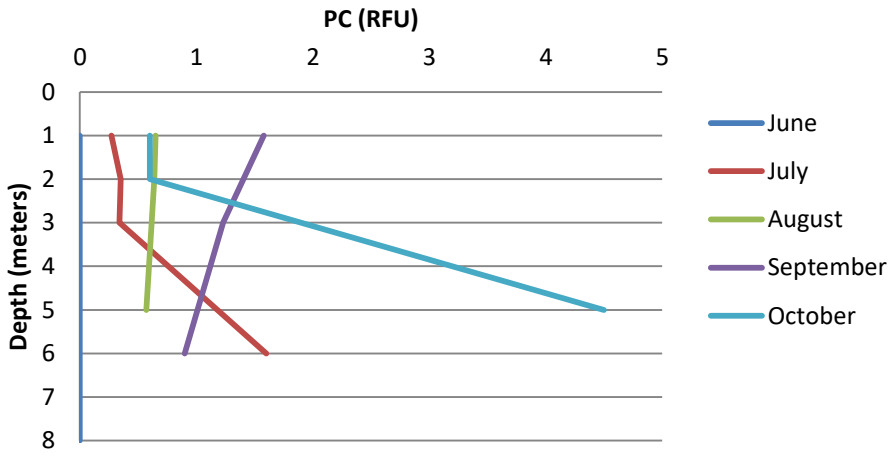
Results

Arms (GAR049)
44.669300°, -116.101200°

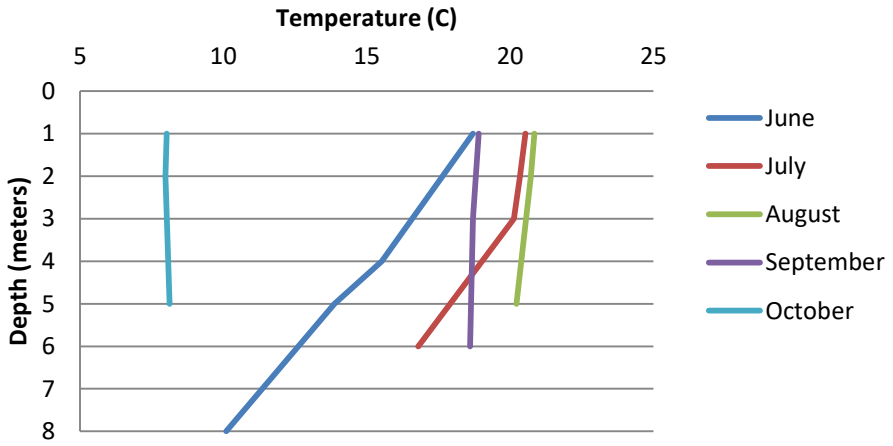
Arms Dissolved Oxygen



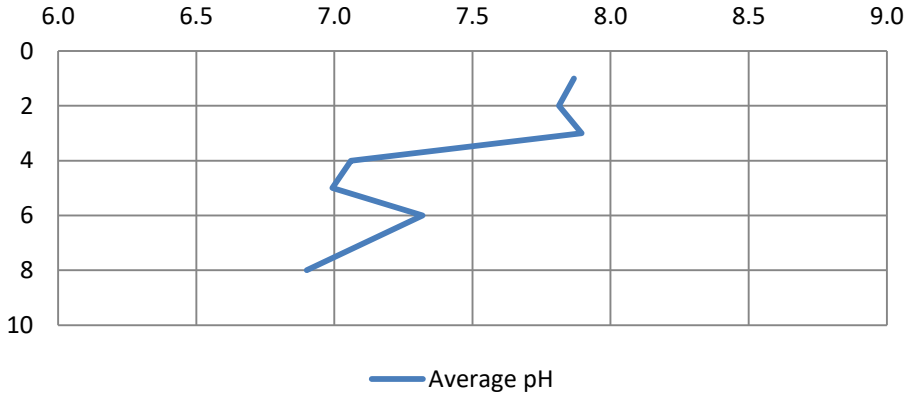
Arms Phycocyanin



Arms Temperature



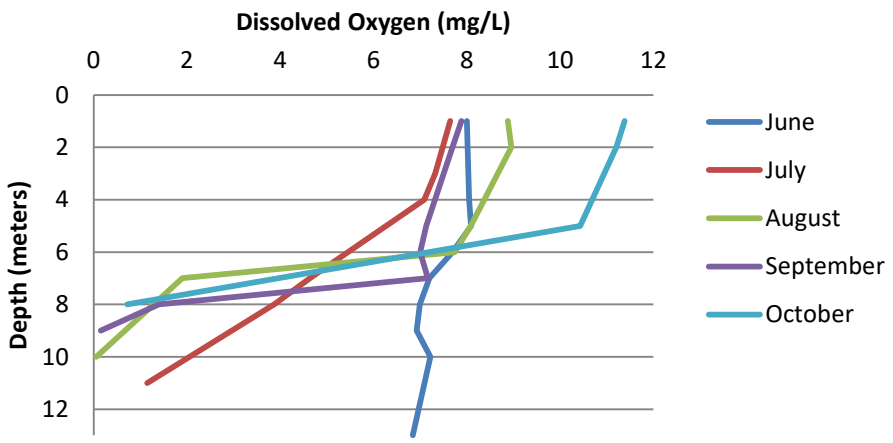
Average pH Depth Profile at Arms Confluence



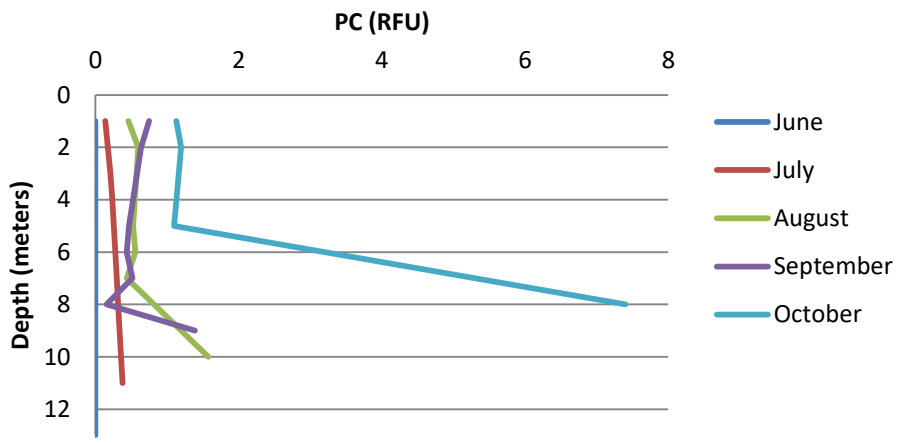
Results

Sugarloaf (GAR052)
44.610500°, -116.091100°

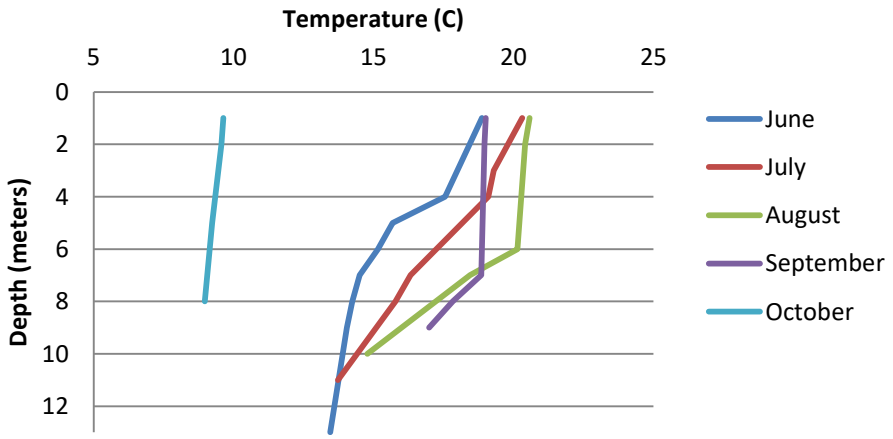
Sugarloaf Dissolved Oxygen



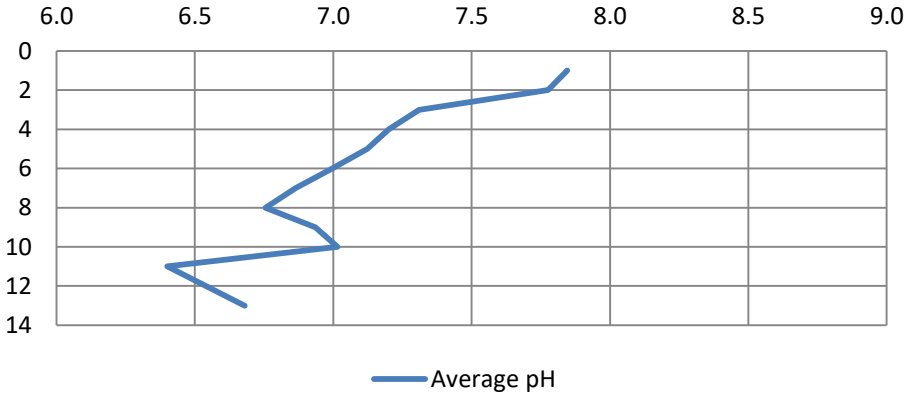
Sugarloaf Phycocyanin



Sugarloaf Temperature



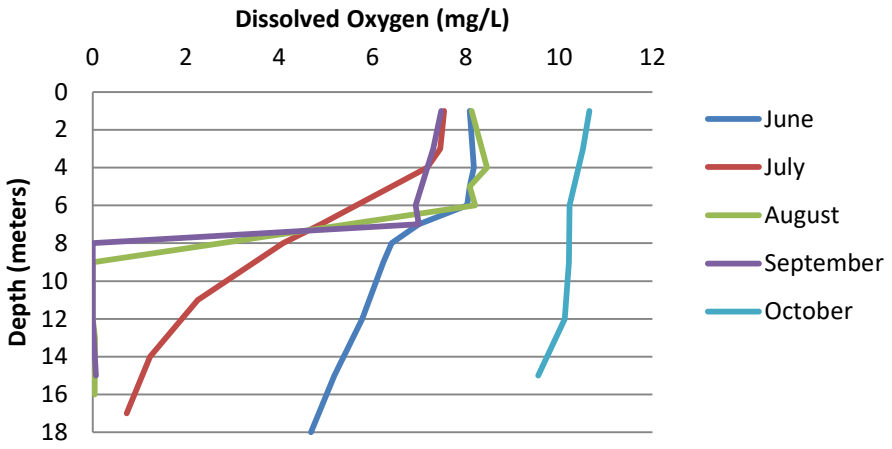
Average pH Depth Profile at Sugarloaf Island



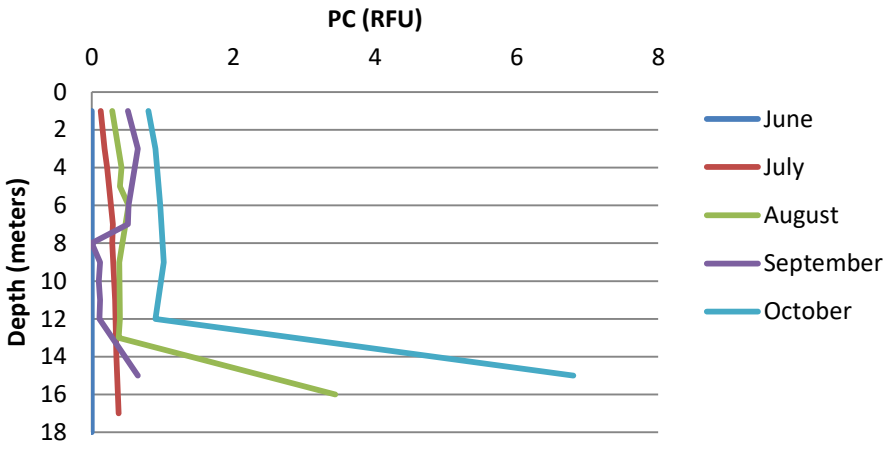
Results

Dam (GAR053)
44.522100°, -116.054700°

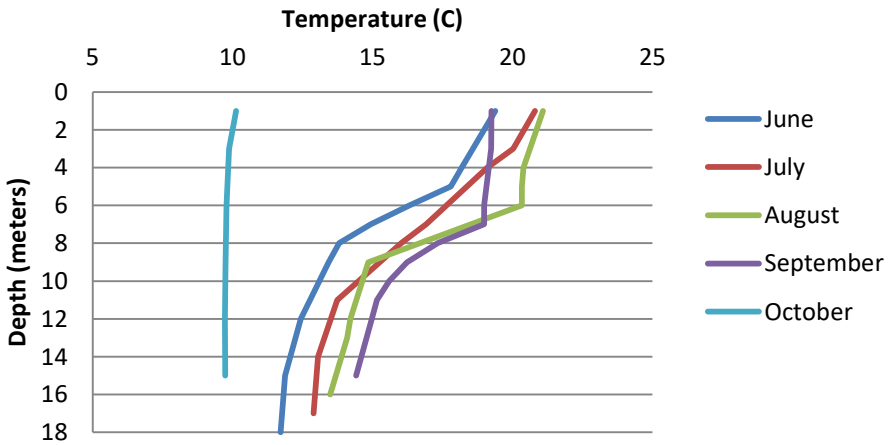
Dam Dissolved Oxygen



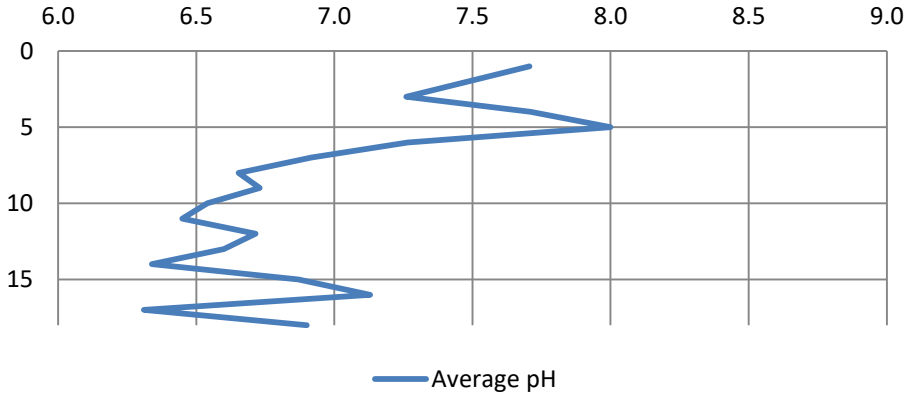
Dam Phycocyanin



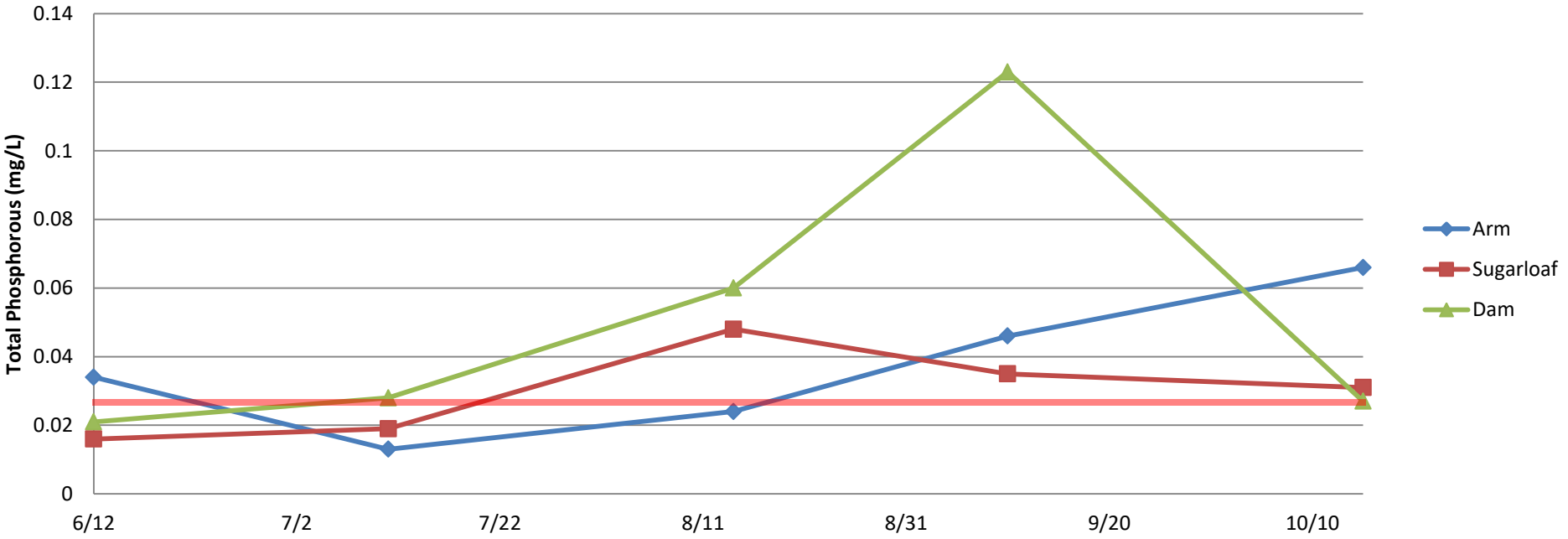
Dam Temperature



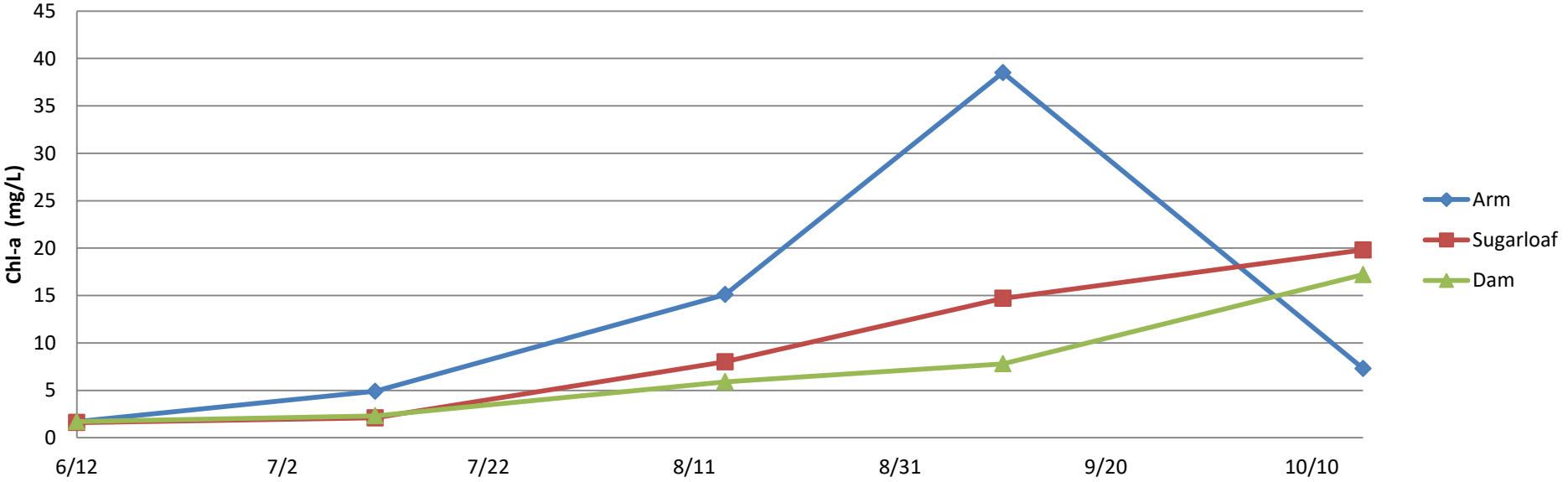
Average pH Depth Profile at Cascade Dam

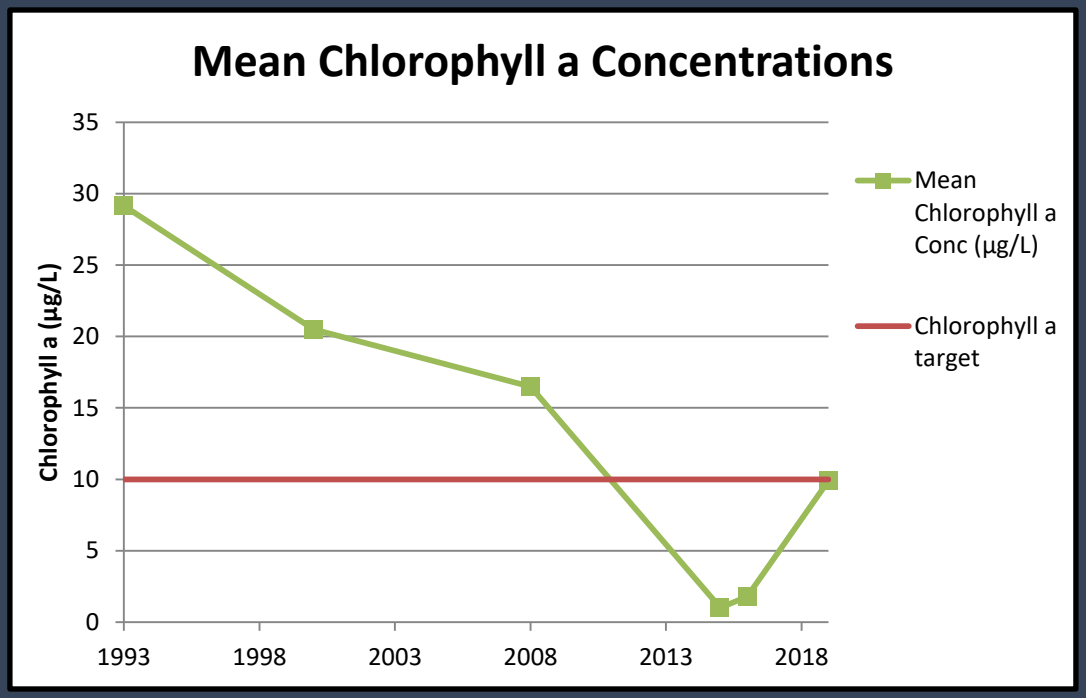


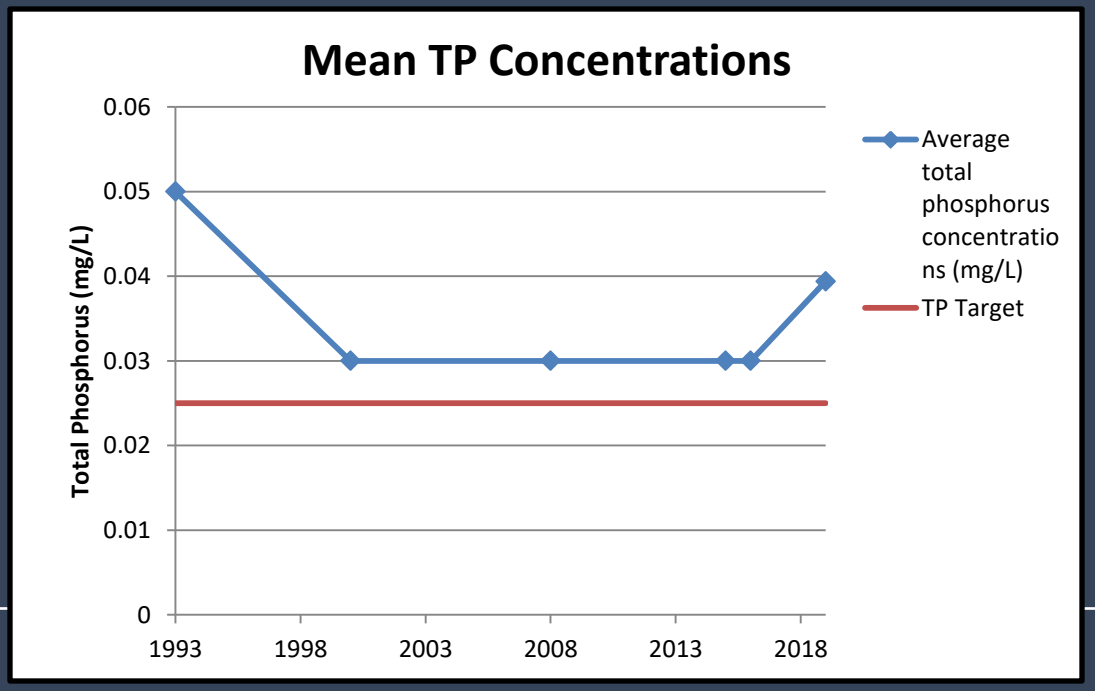
Total Phosphorous



Chlorophyll - a







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Looking Forward

- Data Analysis
  - Trend Analysis
- Cascade Reservoir Monitoring
- Assessing additional tributary listings
- Continued WAG consultation
  - TAC? WAG? VSWCD?

Cascade Reservoir Cyanobacteria Bloom – 2019

Monitoring and Managing Harmful Algae Blooms

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History of Cyanobacteria in Idaho

- Historical reports of cyanotoxin issues:
  - Black Lake (1985 and 1986) – death of dogs, cattle, and deer
  - Cascade Reservoir (1993 to 1996) – 23 cattle died
- Reports increasing in recent years
- HABs detected in all 6 Idaho DEQ Regions
- National and Global issue

Cyanotoxins

- Hepatotoxins
  - Microcystins
    - Liver & Kidney toxicity
    - Tumor Promoter
    - Produced by all species observed in Idaho
- Neurotoxins
  - Anatoxin-a
    - Neurological Toxicity
    - Loss of Coordination, muscle spasms, convulsions, death by respiratory paralysis
    - Produced by most species observed in Idaho

Cascade Reservoir Bloom - 2019

- Two criteria in place
  - Toxin concentrations in the water must be < 4 ppb for microcystin, or < 8 ppb for cylindrospermopsin
  - Cell Enumeration must be < 20,000 cells/mL for *Microcystis,* or < 40,000 cells/mL for species other than *Microcystis*
- Numbers exceeding these criteria will trigger a health advisory
- No measurement exceeding toxin criteria, but easily exceeding enumeration

Cascade Reservoir Bloom - 2020

June 2020
- Initial Reports from Public
- CyAN hits

August 2020
- First samples taken
- No toxin detected

October 1, 2020
- Second samples taken
- Microcystin detected >40 ppb

October 5, 2020
- Advisory issued for Cascade Reservoir

November 25, 2020
- Advisory Lifted from Cascade Reservoir

Cascade Reservoir Bloom - 2020

October 2, 2020

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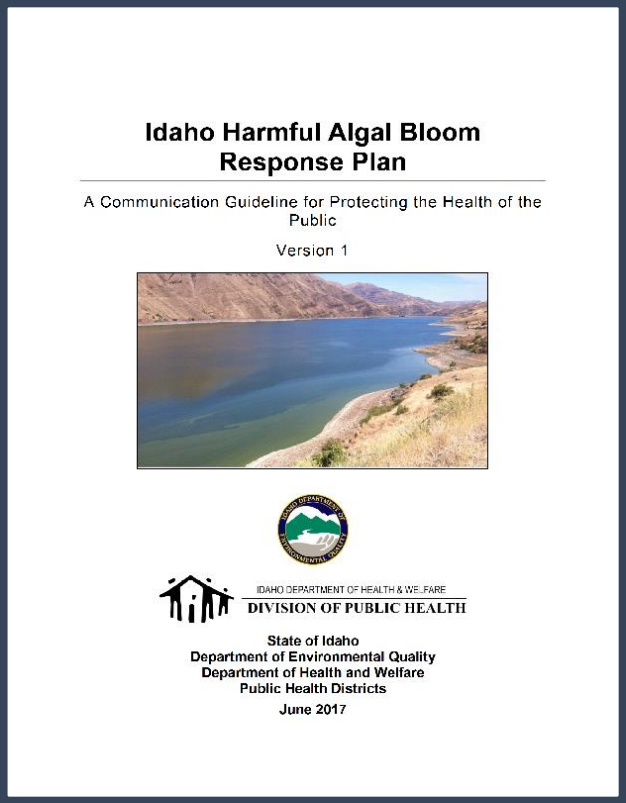
Collaborating Agencies

- Idaho Dept. of Environmental Quality
  - http://www.deq.idaho.gov/water-quality/surface-water/recreation-health-advisories/
- Idaho Dept. of Health and Welfare – Division of Public Health
  - Idaho Bureau of Laboratories
  - Bureau of Communicable Disease Prevention
  - Bureau of Community and Environmental Health
- Idaho Public Health Districts
- Idaho Dept. of Fish and Game
- Idaho State Dept. of Agriculture
- Cyanobacteria Analysis Laboratories
- U.S. Fish and Wildlife
- U.S. Bureau of Land Management



Big Payette Lake Monitoring 2019 -2020

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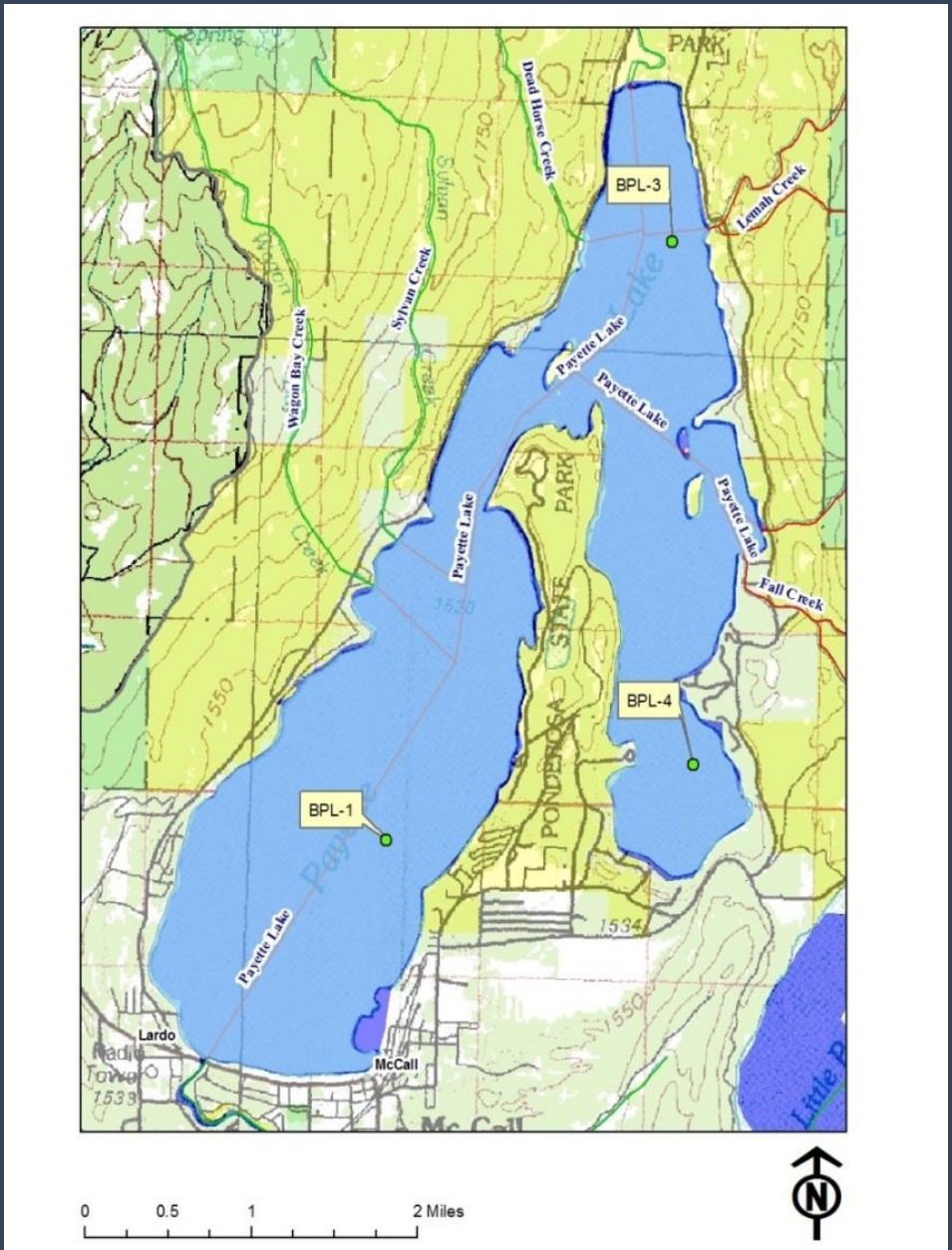
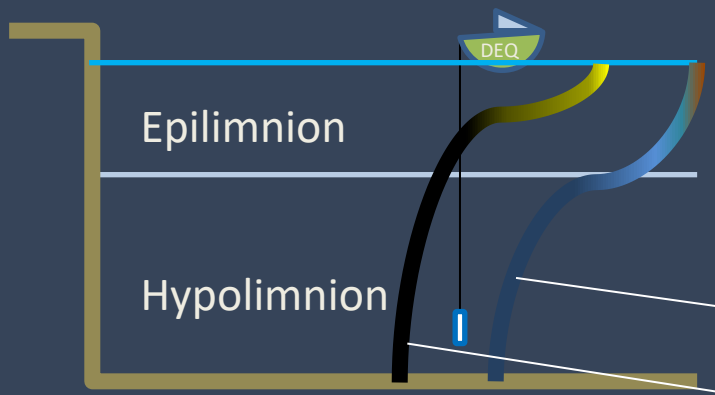
Sampling

- Long-term annual sampling dating back to 1997
- Four objectives
  - Minimum Dissolved Oxygen (DO)
  - Mean DO
  - Median Total Phosphorus (TP)



Sampling

- Full-depth water column profiles
  - Temperature
  - Specific Conductance
  - pH
  - Dissolved Oxygen
- Epilimnion Sampling (composite)
  - Secchi Disc Depth
  - Nitrogen and Phosphorus
  - Total Kjeldahl Nitrogen
  - Ammonia
  - Dissolved Orthophosphorus
  - Chlorophyll a
- Hypolimnion Sampling (1 meter from bottom)
  - Everything above but Chlorophyll a



Theoretical thermal profile associated with stratified lakes

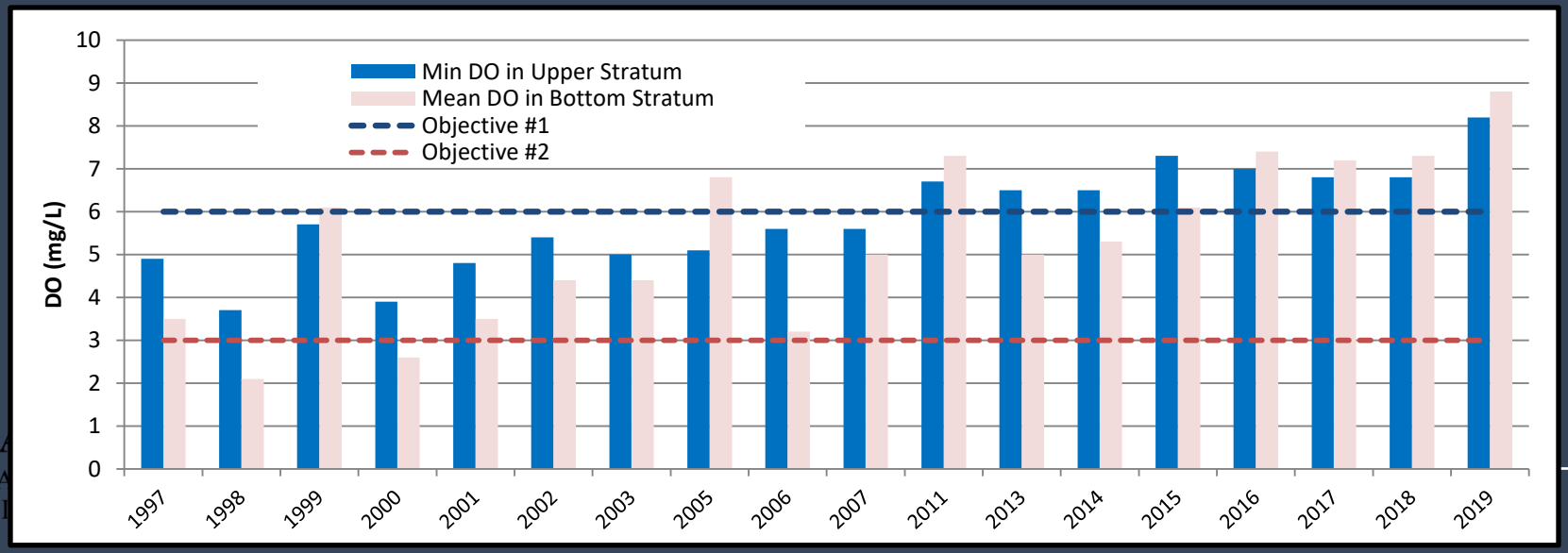
Theoretical light penetration profile associated with deep lakes

Objective 1

- DO Concentrations June-Sept ≥ 6.0 mg/L between 0-61.5 meters at all times in SW Basin (BPL-1)
- 2018-2019
  - Objective met
- 1997-2019
  - Objective met consistently since 2011

BPL-1 DO Mg/L Concentrations In Epilimnion 1997-2019

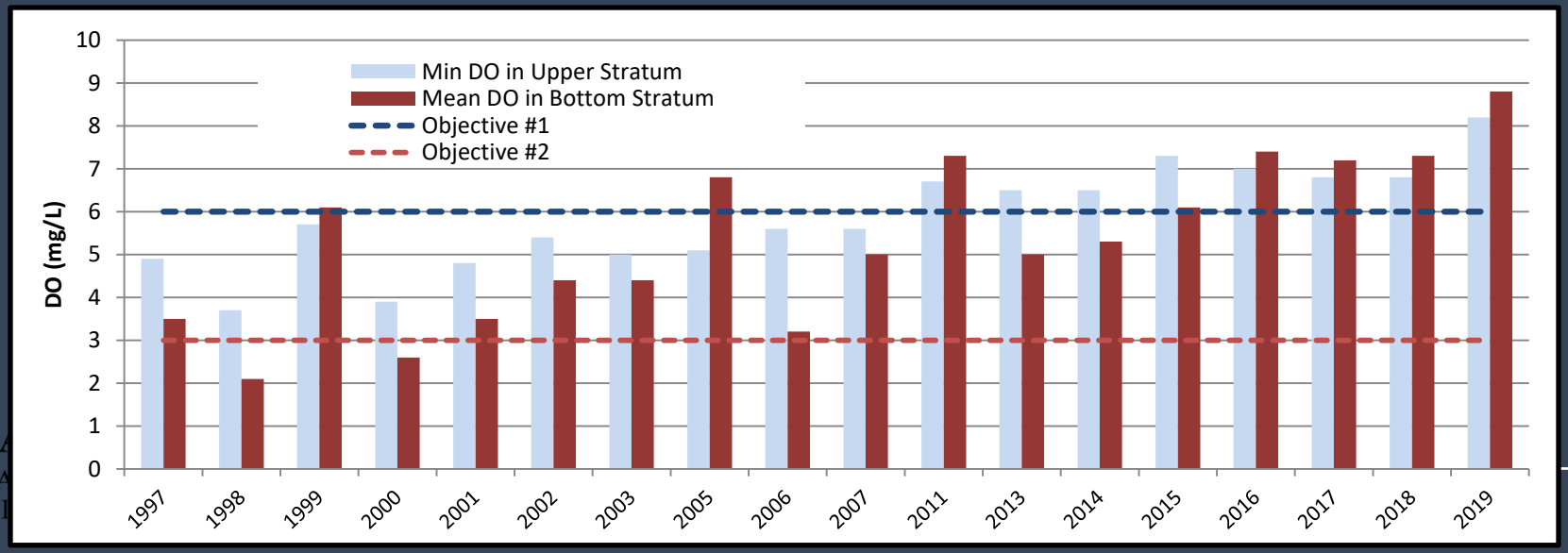
	1997	1998	1999	2000	2001	2002	2003	2005	2006	2007	2011	2013	2014	2015	2016	2017	2018	2019
Mean	8.5	7.9	8.9	8.5	8.8	9.1	8.8	8.1	8.0	7.7	9.0	8.5	8.6	9.1	8.9	9.5	9.1	10.3
Median	8.3	7.9	8.9	8.6	8.7	9.1	8.7	8.2	8.0	7.6	8.8	8.5	8.6	8.9	8.8	9.4	9.1	10.3
Min	4.9	3.7	5.7	3.9	4.8	5.4	5.0	5.1	5.6	5.6	6.7	6.5	6.5	7.3	7.0	6.8	6.8	8.2
Max	10.6	9.7	11.3	10.8	12.7	12.1	11.0	10.4	10.9	9.8	11.7	10.7	10.3	11.4	12.5	11.9	10.7	12.4



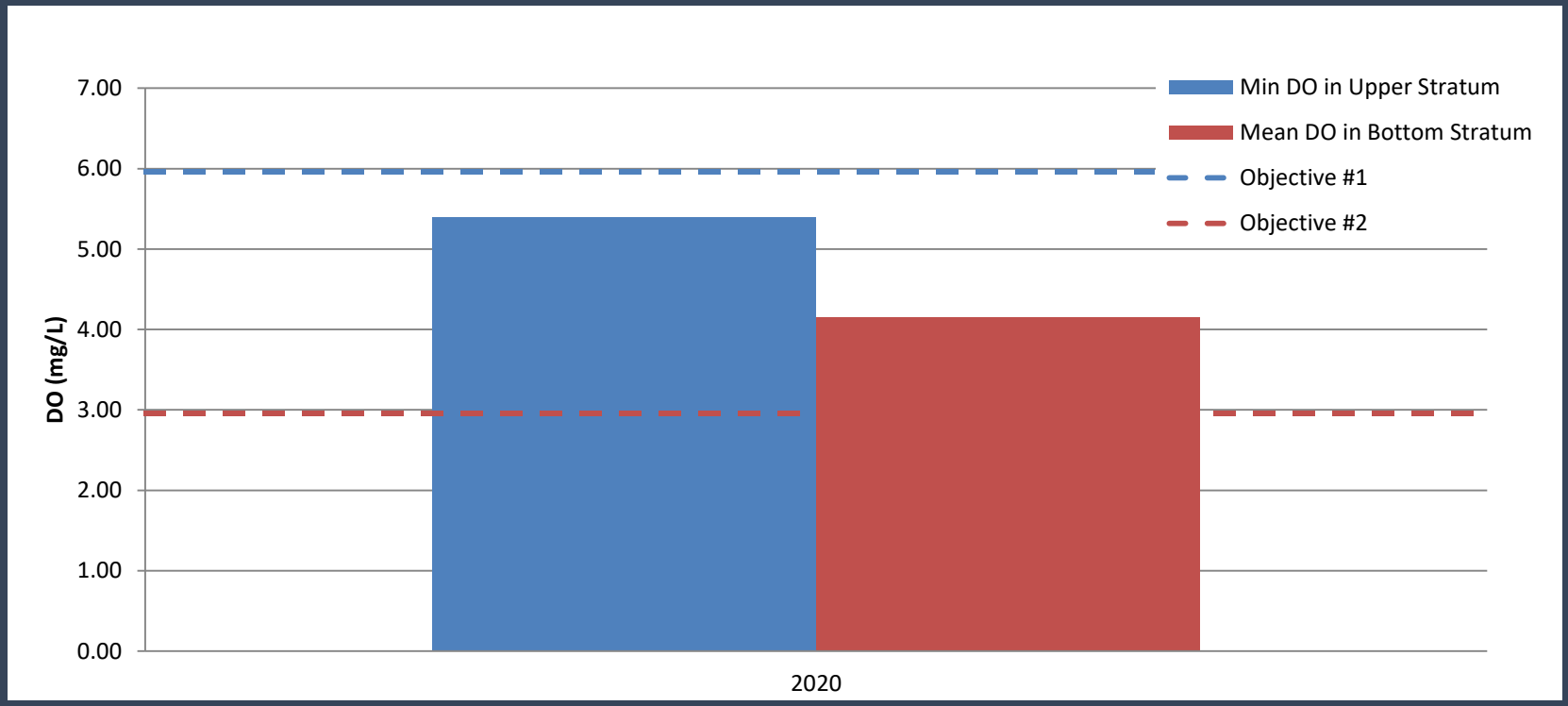
Objective 2

- Mean DO June-Sept ≥ 3.0 mg/L below 61.5 meters and 1 meter above lakebed in SW basin (BPL-1)
- 2018-2019
  - Objective met
- 1997-2019
  - Objective met in all sampling years, with exception to 1998 and 2000

BPL-1 DO mg/L Concentrations In Hypolimnion Zone 1997-2019																		
	1997	1998	1999	2000	2001	2002	2003	2005	2006	2007	2011	2013	2014	2015	2016	2017	2018	2019
Mean	3.5	2.1	6.1	2.6	3.5	4.4	4.4	6.8	3.2	5.0	7.3	5.0	5.3	6.1	7.4	7.2	7.3	8.8
Median	3.6	1.9	6.9	3.2	3.5	4.8	4.8	6.8	3.6	4.6	6.6	5.0	6.1	6.1	7.3	7.4	7.7	8.8
Min	0.3	0.3	0.5	0.0	0.0	0.8	0.4	5.6	1.2	3.6	6.0	0.7	2.1	2.4	2.9	6.2	5.6	7.9
Max	7.0	4.0	8.2	5.5	6.3	6.6	7.0	8.0	4.8	6.6	9.9	8.0	7.8	7.8	10.5	8.7	8.5	9.7



BPL -1 -2020



Objective #1: Minimum Epilimnion DO observed in 2020 was < 6.0 mg/L

Objective #2: Mean DO below 61.5 and 1 meter from lake bottom was > 3.0 mg/L

Objective 3

- Median TP in epilimnion May-Sept < 6.0 mg/m^3 (ppb,µg/L)
- 2018-2019
  - Objective met at all three sites
- 1997-2019
  - Objective met fairly regularly at most sites
  - Exceedances observed in 2003, 2005, 2011, 2014, and 2017 at multiple sites.
- 2013-2019 Median TP 18% higher in hypolimnion (1 meter from lakebed)
  - Longer residence time
  - Organics in lakebed sediments
  - Same criteria = more than twice the exceedances

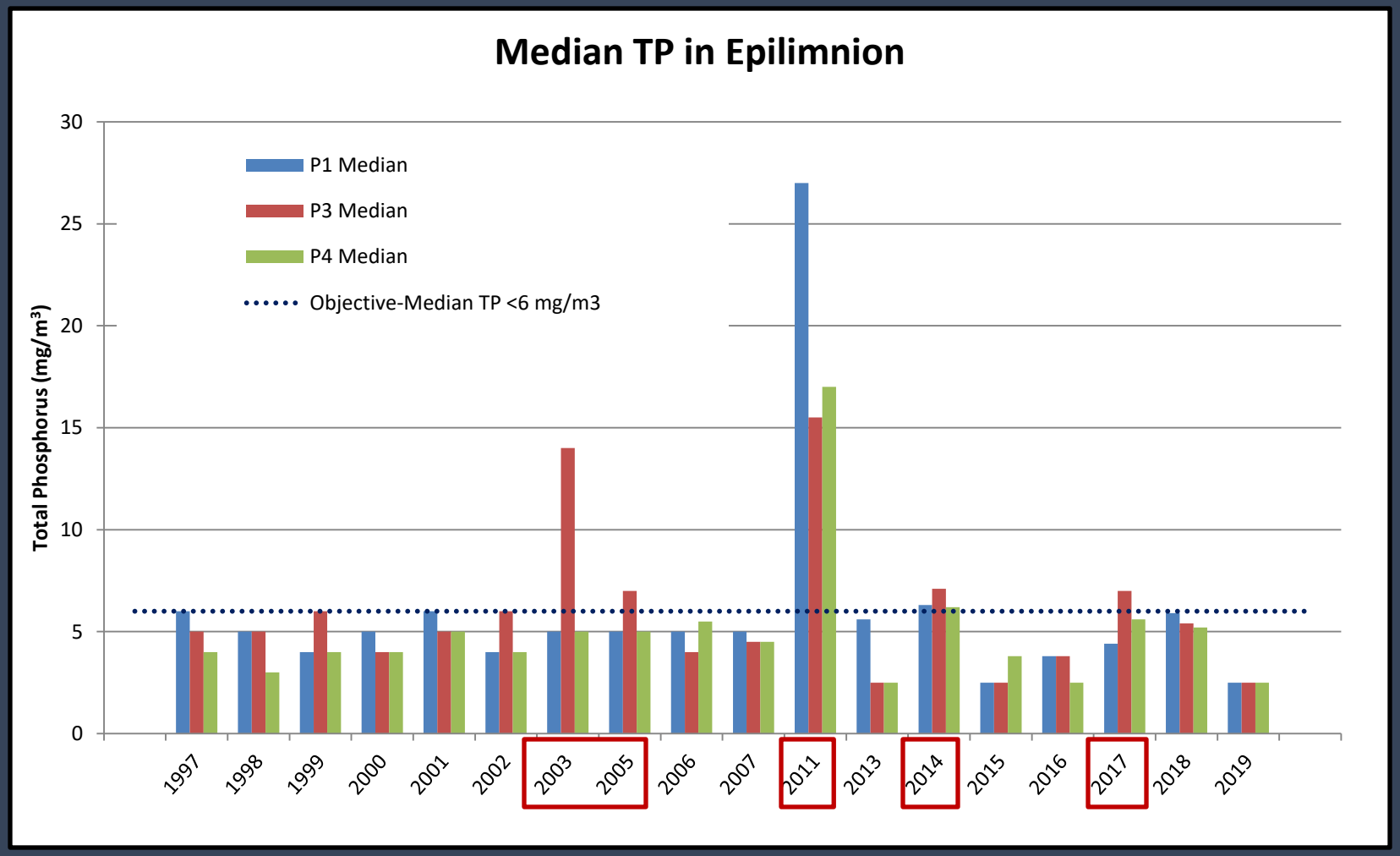
Total Phosphorus mg/m^3 Concentrations In Epilimnion Zone 2013-2019

Year	2013			2014			2015			2016			2017			2018			2019		
Site	BPL-1	BPL-3	BPL-4	BPL-1	BPL-3	BPL-4	BPL-1	BPL-3	BPL-4	BPL-1	BPL-3	BPL-4	BPL-1	BPL-3	BPL-4	BPL-1	BPL3	BPL-4	BPL-1	BPL-3	BPL-4
Mean	5.1	3.7	4.2	7.3	7.2	6.2	3.6	2.5	3.9	3.9	4.0	3.1	9.7	6.6	7.0	5.6	5.2	4.5	3.3	3.2	3.3
Median	5.6	2.5	2.5	6.3	7.1	6.2	2.5	2.5	3.8	3.8	3.8	2.5	4.4	7.0	5.6	5.9	5.4	5.2	2.5	2.5	2.5
Min	2.5	2.5	2.5	5.1	5.2	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	5.1	2.5	2.5	2.5	2.5	2.5	2.5
Max	6.8	5.6	8.3	13.0	10.0	8.9	6.0	2.5	5.8	5.4	6.0	6.1	38.0	9.0	14.0	8.0	6.8	6.6	5.8	5.1	5.8

Total Phosphorus mg/m^3 Concentrations In Hypolimnion Zone 2013-2019

Year	2013			2014			2015			2016			2017			2018			2019		
Site	BPL-1	BPL-3	BPL-4	BPL-1	BPL-3	BPL-4	BPL-1	BPL-3	BPL-4	BPL-1	BPL-3	BPL-4	BPL-1	BPL-3	BPL-4	BPL-1	BPL3	BPL-4	BPL-1	BPL-3	BPL-4
Mean	7.5	5.6	4.1	8.4	7.5	11.4	9.4	7.6	6.4	4.0	4.1	3.7	9.6	7.5	10.1	8.0	5.1	5.0	3.7	5.8	6.1
Median	5.7	5.2	2.5	9.0	6.9	10.0	6.5	7.9	6.6	4.0	3.9	2.5	7.0	6.9	5.2	5.8	5.3	5.5	2.5	5.5	2.5
Min	2.5	2.5	2.5	6.1	6.3	6.7	2.5	5.0	2.5	2.5	2.5	2.5	5.7	2.5	5.0	2.5	2.5	2.5	2.5	2.5	2.5
Max	16.0	12.0	7.0	11.0	9.6	20.0	27.0	9.9	9.6	5.7	6.4	6.4	16.0	14.0	31.0	22.0	8.4	8.0	7.4	9.7	17

Objective 3



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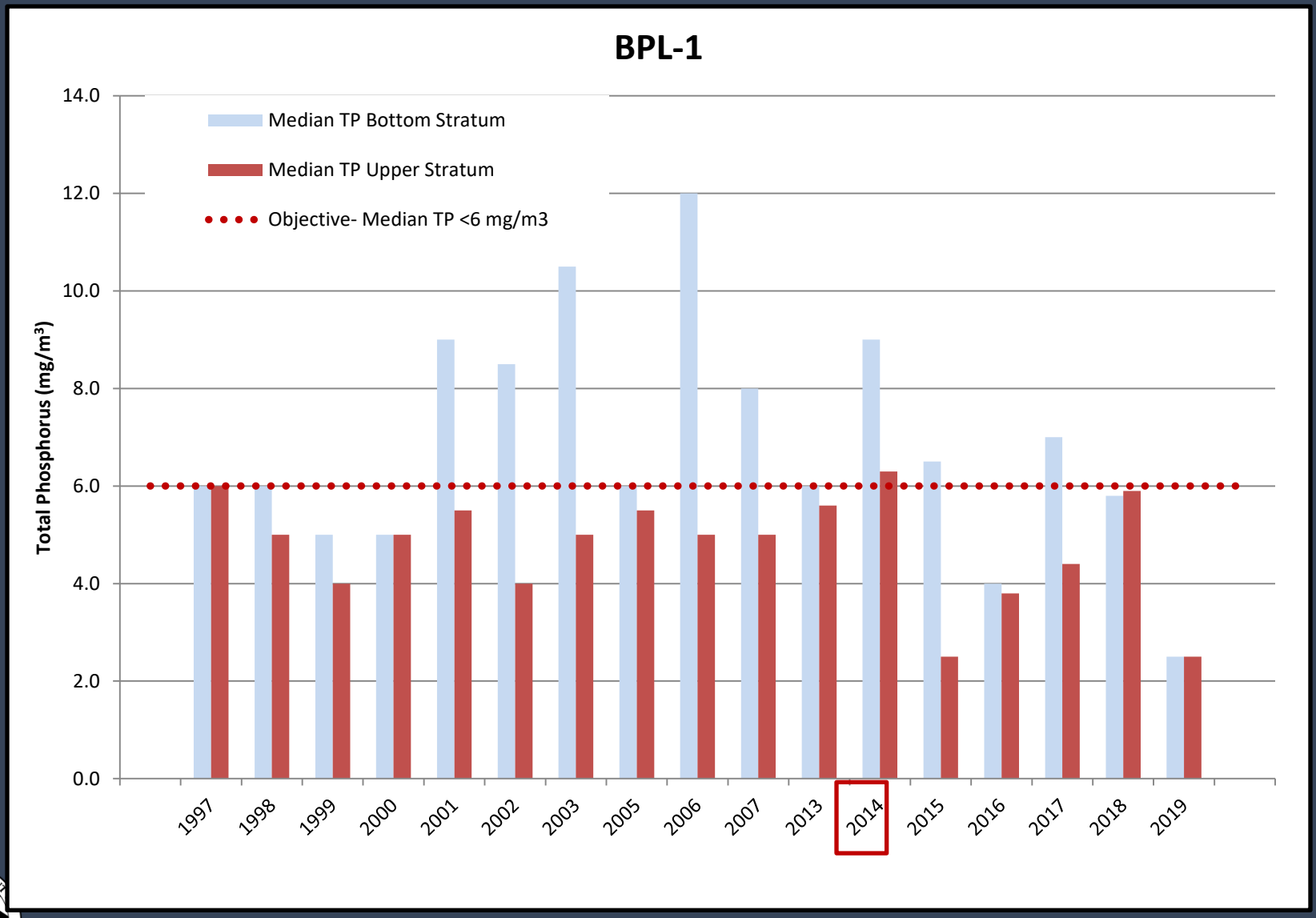
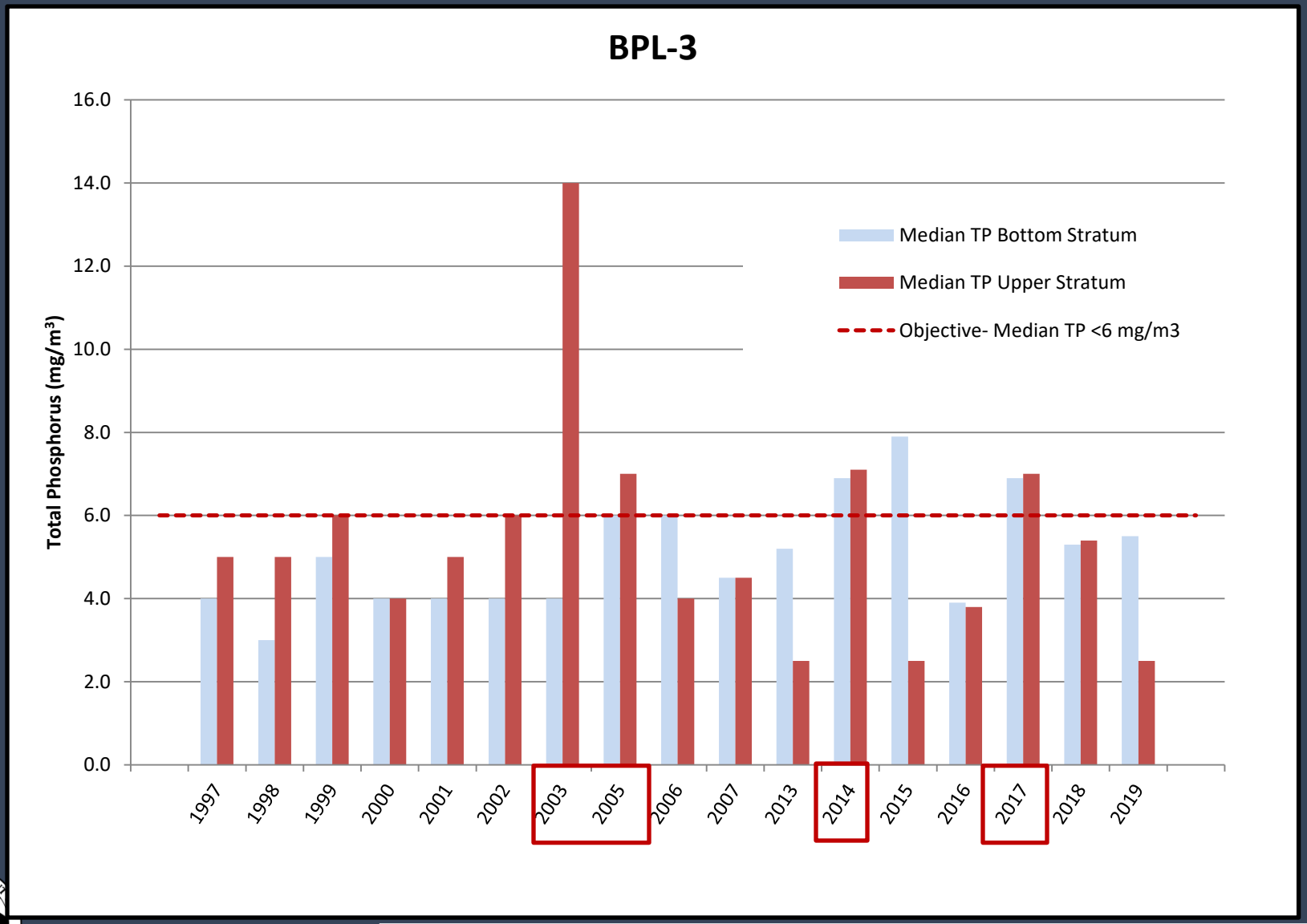
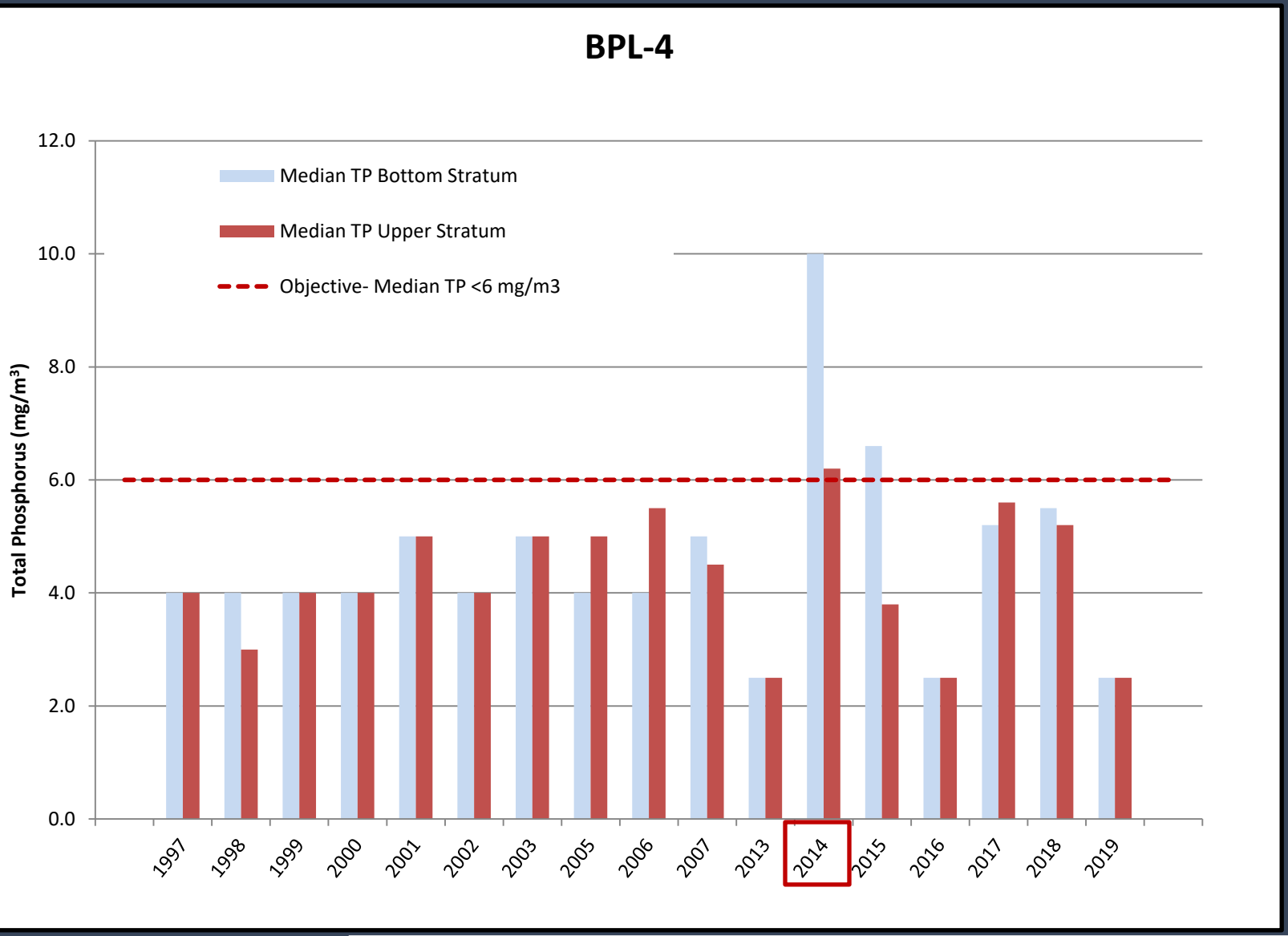
Objective 3


BPL-1
Median TP Bottom Stratum
Median TP Upper Stratum
Objective- Median TP <6 mg/m3
Total Phosphorus (mg/m³)
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
1997
1998
1999
2000
2001
2002
2003
2005
2006
2007
2013
2014
2015
2016
2017
2018
2019

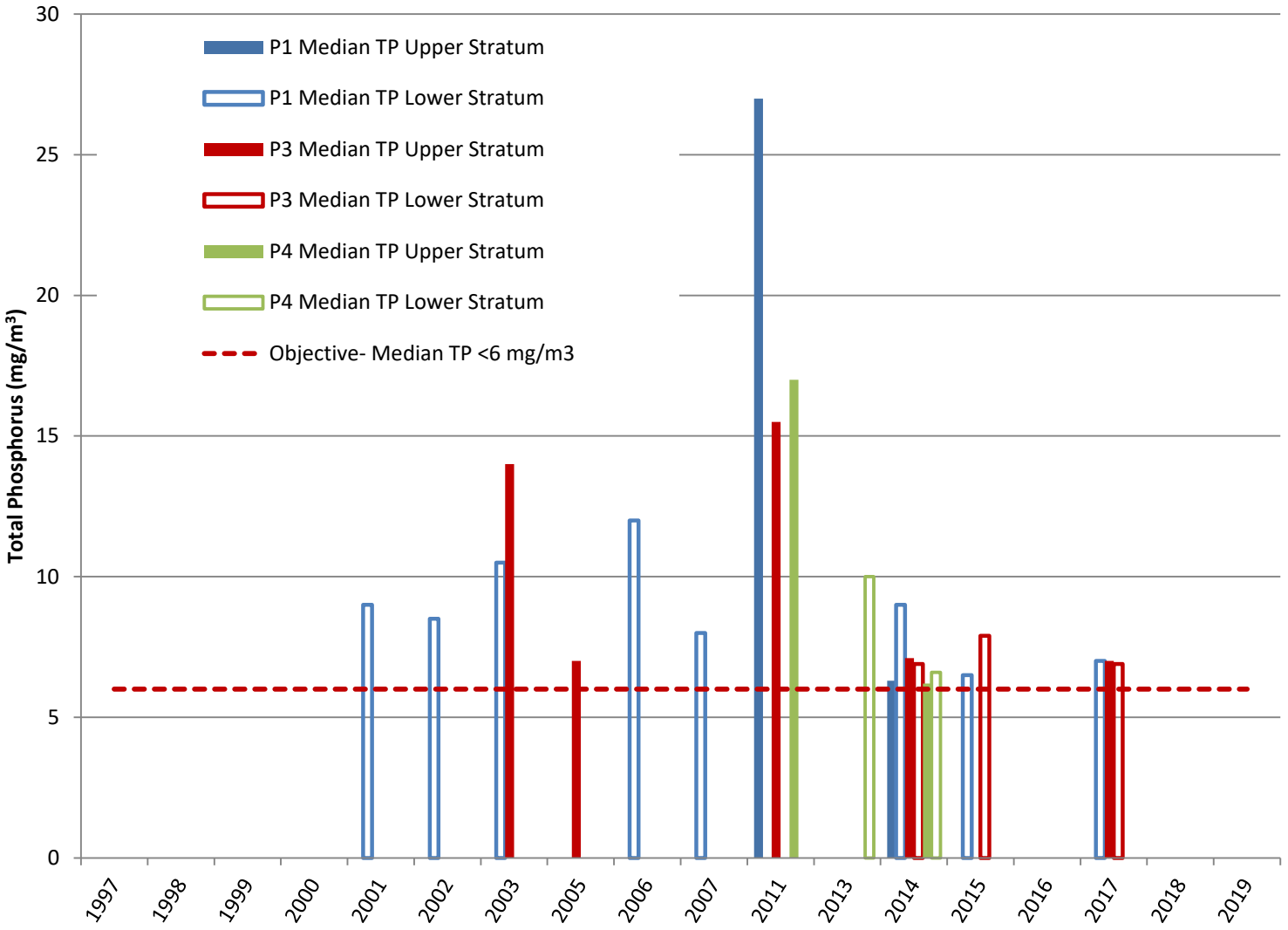
Objective 3


BPL-3
Total Phosphorus (mg/m³)
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Median TP Bottom Stratum
Median TP Upper Stratum
Objective- Median TP <6 mg/m3
1997
1998
1999
2000
2001
2002
2003
2005
2006
2007
2013
2014
2015
2016
2017
2018
2019

Objective 3


BPL-4
Median TP Bottom Stratum
Median TP Upper Stratum
Objective- Median TP <6 mg/m3
Total Phosphorus (mg/m³)
12.0
10.0
8.0
6.0
4.0
2.0
0.0
1997
1998
1999
2000
2001
2002
2003
2005
2006
2007
2013
2014
2015
2016
2017
2018
2019

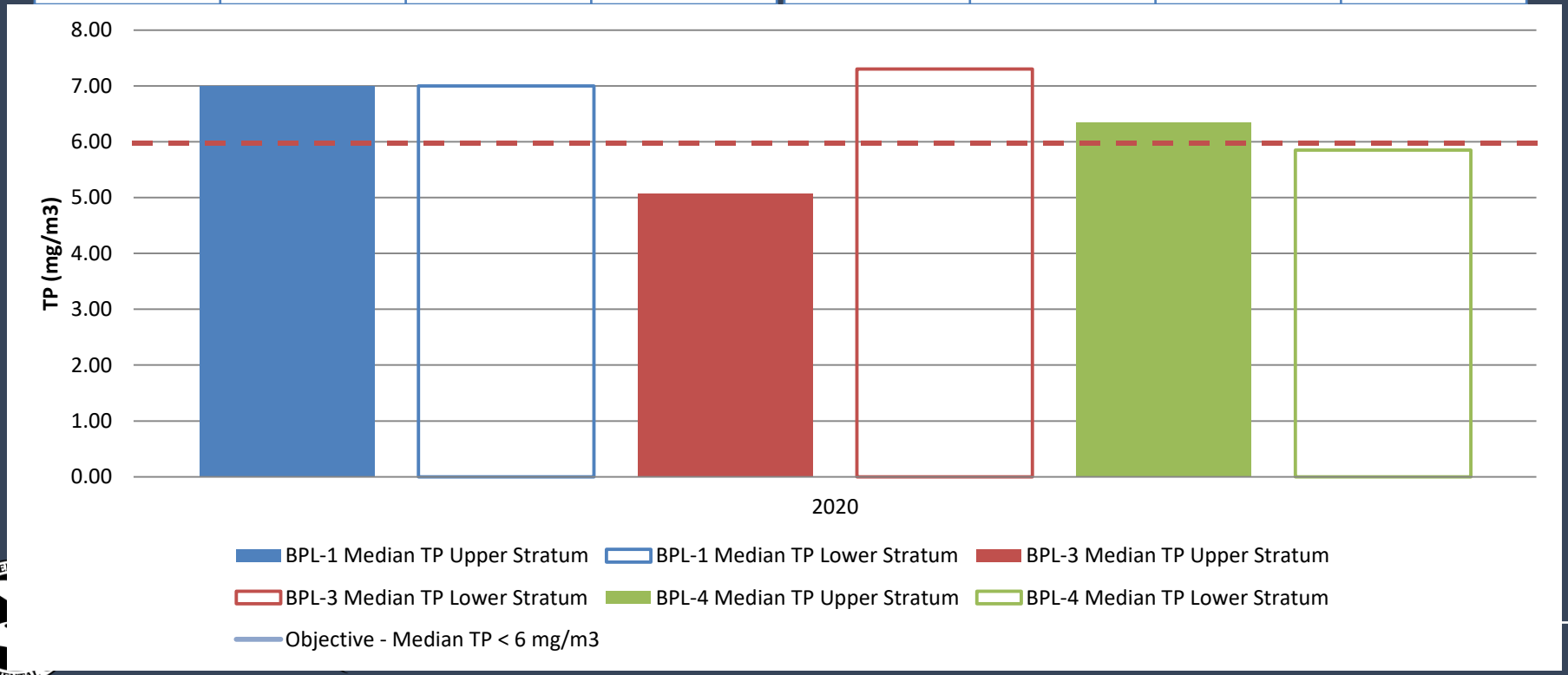
Objective 3


P1 Median TP Upper Stratum
P1 Median TP Lower Stratum
P3 Median TP Upper Stratum
P3 Median TP Lower Stratum
P4 Median TP Upper Stratum
P4 Median TP Lower Stratum
Objective- Median TP <6 mg/m3
Total Phosphorus (mg/m³)
30
25
20
15
10
5
0
1997
1998
1999
2000
2001
2002
2003
2005
2006
2007
2011
2013
2014
2015
2016
2017
2018
2019

2020

Total Phosphorus (mg/m3) Concentration in Epilimnion			
	2020		
Site	BPL-1	BPL-3	BPL-4
Mean	6.48	5.22	6.33
Median	7.00	5.07	6.35
Min	3.54	3.54	5.30
Max	8.40	7.20	7.30

Total Phosphorus (mg/m3) Concentration in Hypolimnion			
	2020		
Site	BPL-1	BPL-3	BPL-4
Mean	7.13	7.33	6.78
Median	7.00	7.30	5.85
Min	3.54	5.80	5.40
Max	11.00	8.90	10.00

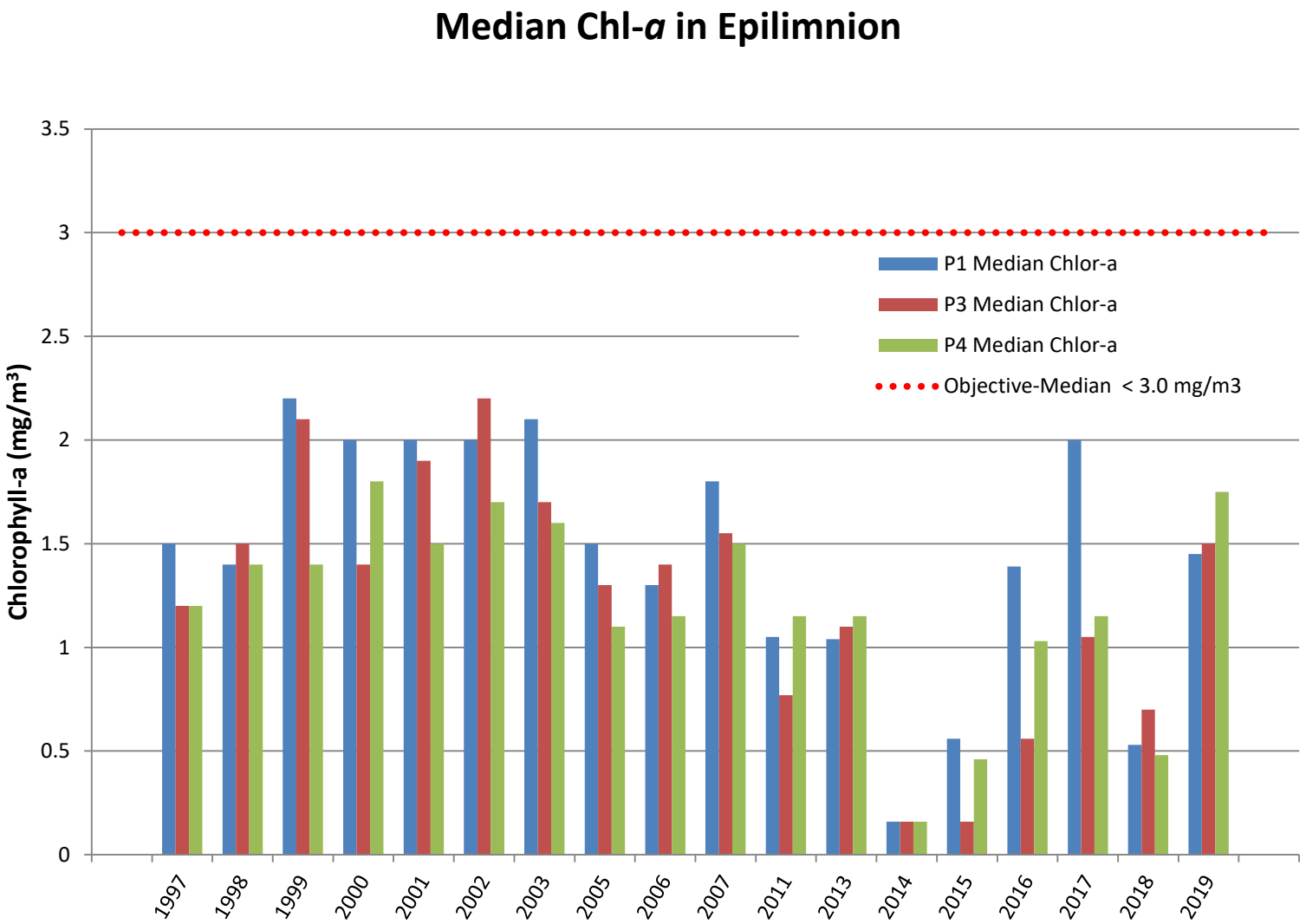


Objective 4

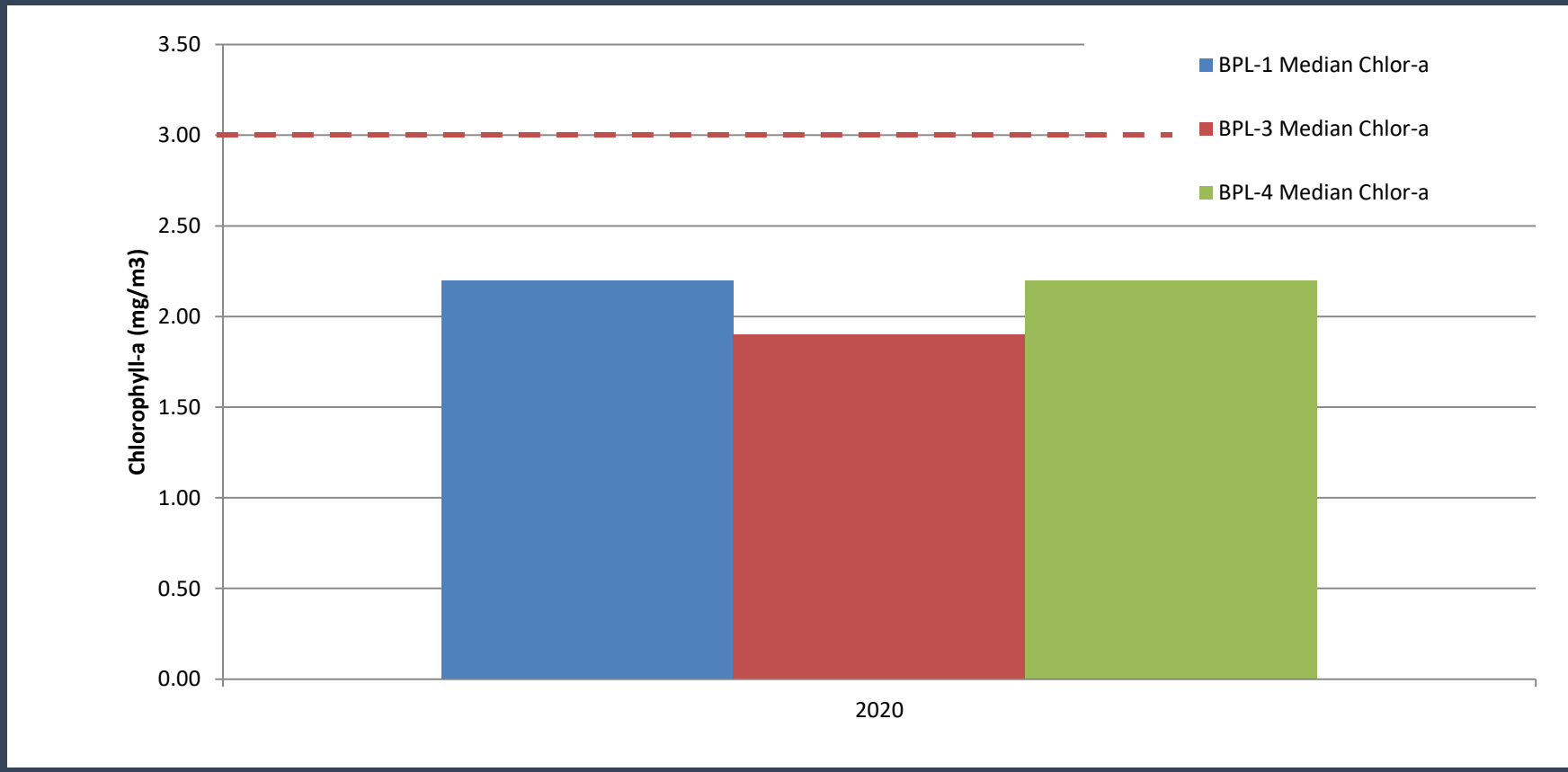
- Median chlorophyll-*a* in epilimnion May-Sept < 3.0 mg/m^3 (ppb,µg/L)
- 2018-2019
  - Objective met at all three sites
- 1997-2019
  - Objective has been met consistently throughout monitoring

Chlorophyll-a mg/m^3 Concentrations In Epilimnion 2013-2019																				
Year	2013			2014			2015			2016			2017			2018			2019		
Site	BPL-1	BPL-3	BPL-4	BPL-1	BPL-3	BPL-4	BPL-1	BPL-3	BPL-4	BPL-1	BPL-3	BPL-4	BPL-1	BPL-3	BPL-4	BPL-1	BPL-3	BPL-4	BPL-1	BPL-3	BPL-4
Mean	1.02	1.18	1.17	0.16	0.29	0.20	0.59	0.44	0.51	1.32	0.72	0.83	1.85	1.07	1.23	0.60	0.67	0.53	2.53	1.43	2.40
Median	1.04	1.10	1.15	0.16	0.16	0.16	0.56	0.16	0.46	1.39	0.56	1.03	2.0	1.05	1.15	0.53	0.70	0.48	1.45	1.50	1.75
Min	0.78	0.91	0.98	0.16	0.16	0.16	0.16	0.0	0.16	0.58	0.42	0.36	0.25	0.60	0.25	0.25	0.25	0.25	1.10	1.10	1.40
Max	1.20	1.60	1.40	0.16	0.91	0.39	1.12	0.90	0.92	1.98	1.17	1.09	3.0	1.80	2.0	1.10	1.0	0.90	6.10	1.60	4.70

Objective 4


Median Chl-a in Epilimnion
Chlorophyll-a (mg/m3)
3.5
3
2.5
2
1.5
1
0.5
0
P1 Median Chlor-a
P3 Median Chlor-a
P4 Median Chlor-a
Objective-Median < 3.0 mg/m3
1997
1998
1999
2000
2001
2002
2003
2005
2006
2007
2011
2013
2014
2015
2016
2017
2018
2019

2020 Chlorophyll-a



Nutrients

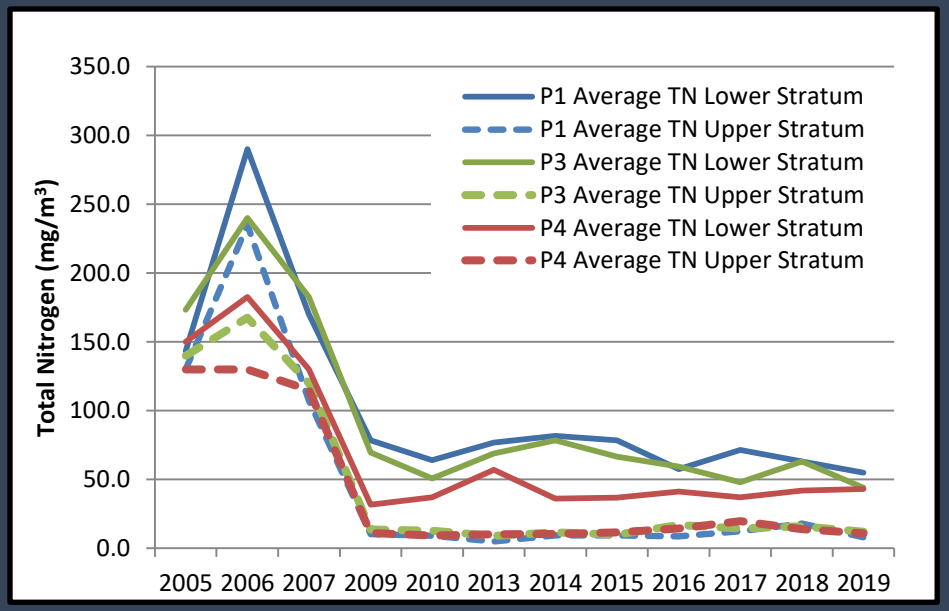
Total phosphorus

- Met 11/18 years
- 56% of exceedances occur at N Basin Site (BPL-3)
- Historically meeting objective

For all Years (1997-2019)	BPL-1	BPL-3	BPL-4
Mean (mg/m^3)	7.0	6.4	5.0
Median (mg/m^3)	5.5	5.2	5.0

Total Nitrogen

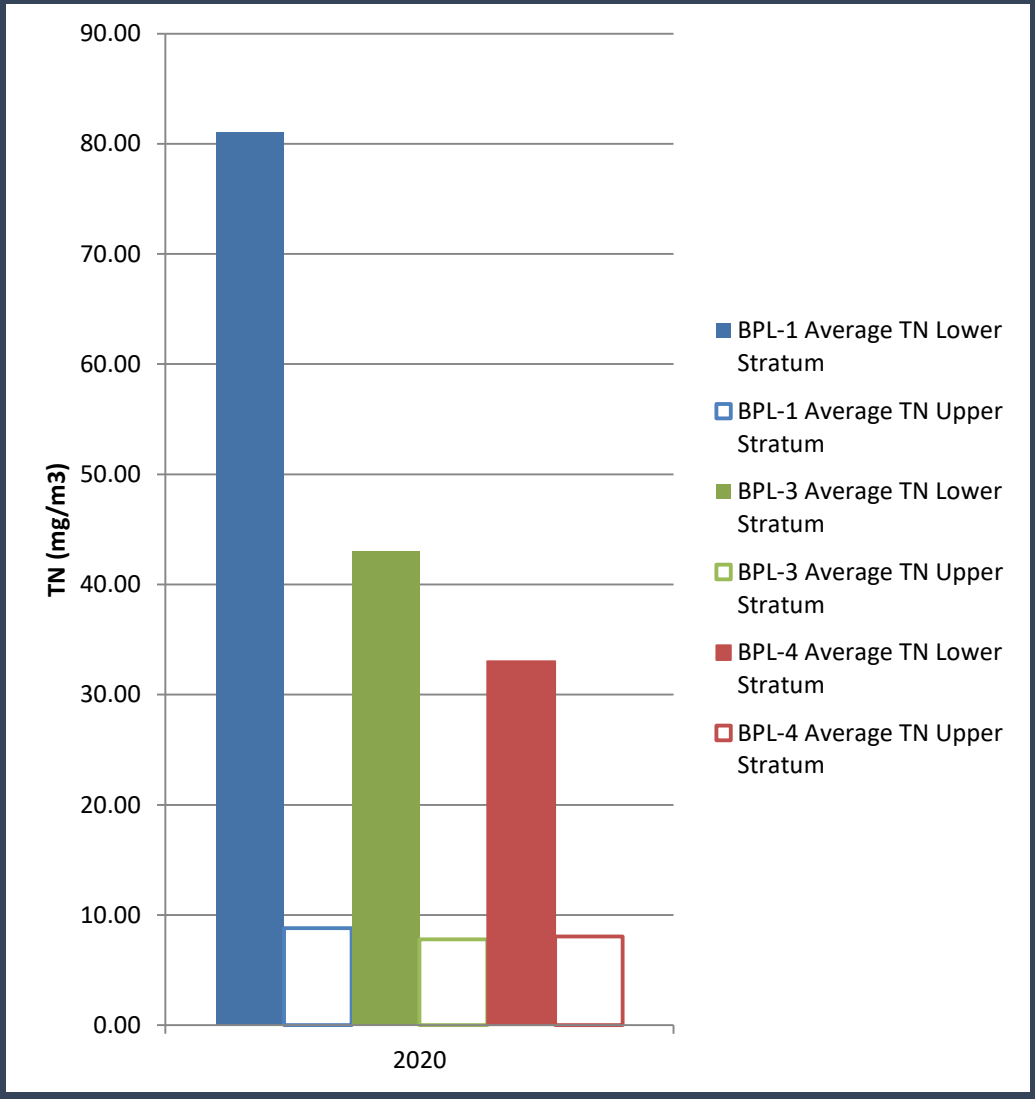
- Significant decreases
- Higher concentrations in lower hypolimnion
- No numeric objective



Nutrients 2020

Total Phosphorus (mg/m3) Concentration in Epilimnion			
	2020		
Site	BPL-1	BPL-3	BPL-4
Mean	6.48	5.22	6.33
Median	7.00	5.07	6.35

Total Phosphorus (mg/m3) Concentration in Hypolimnion			
	2020		
Site	BPL-1	BPL-3	BPL-4
Mean	7.13	7.33	6.78
Median	7.00	7.30	5.85



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Conclusions

- Objectives met in 2018-2019, increases seen in 2020
  - 2020 TP objectives not met at all sites
  - DO at BPL-1 in Epilimnion less than 6 mg/L
- DO concentrations at lake bottom
  - Low nutrients, low assimilative capacity, limited mixing
- Higher chl-*a* levels in 2019 and 2020
- Continued Eurasian Milfoil removal
  - Decrease in weight removed likely due to lack of funding after 2017
  - 2020?

Year	Pounds of Eurasian Milfoil Removed
2014	7,100
2015	8,122
2016	8,050
2017	4,320
2018	8,670
2019	7,860

Thank you

MORE CONTACT AT CHASE.CUSACK@DEQ.IDAHO.GOV