



Henry's Fork Watershed Phosphorus Study

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Water Monitoring Project at BYU

- Starting in 2019, I have worked with a group of 10-20 students every spring semester (April 15 – July 25) on various monitoring projects across the Henry's Fork Watershed
- The primary goal is to train water quality scientists



The Oregon Water Quality Index (OWQI) is the framework for data collection and interpretation

- Goal of the OWQI is to identify areas of concern

OWQI
Total solids
Temperature
pH
DO
BOD
Ammonia and nitrate
Total phosphate
Fecal coliform

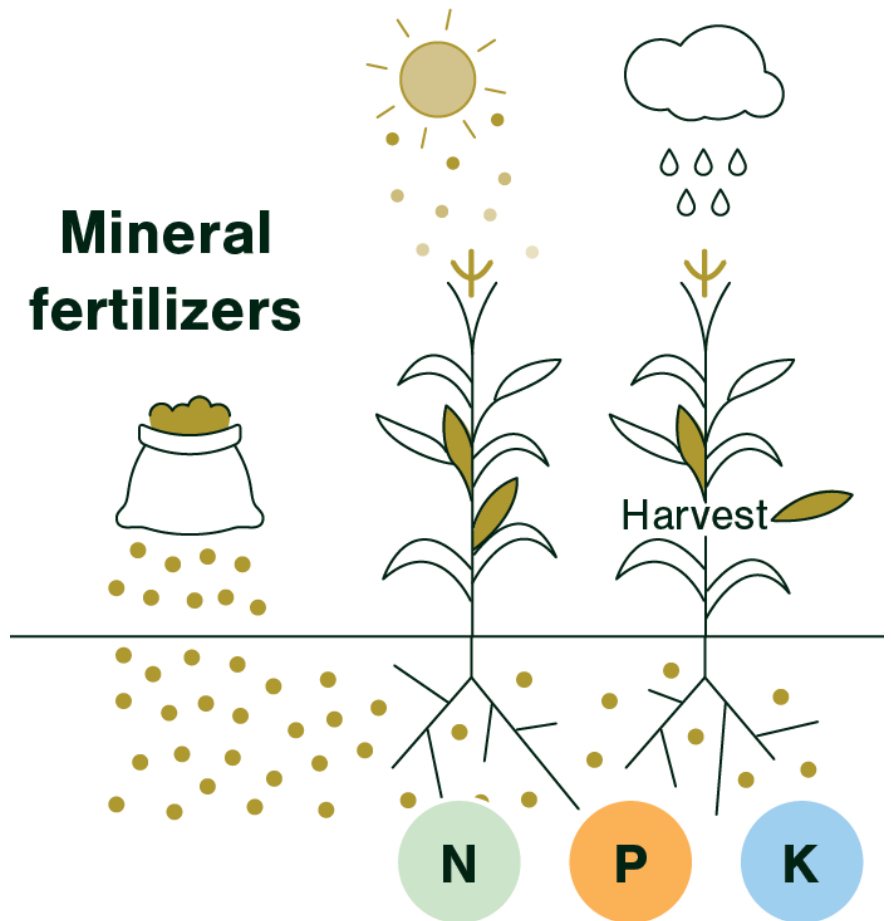
N

P

OWQI	
Index	Quality Status
90–100	Very Good
85–89	Good
80–84	Fair
60–79	Bad
0–59	Very Bad

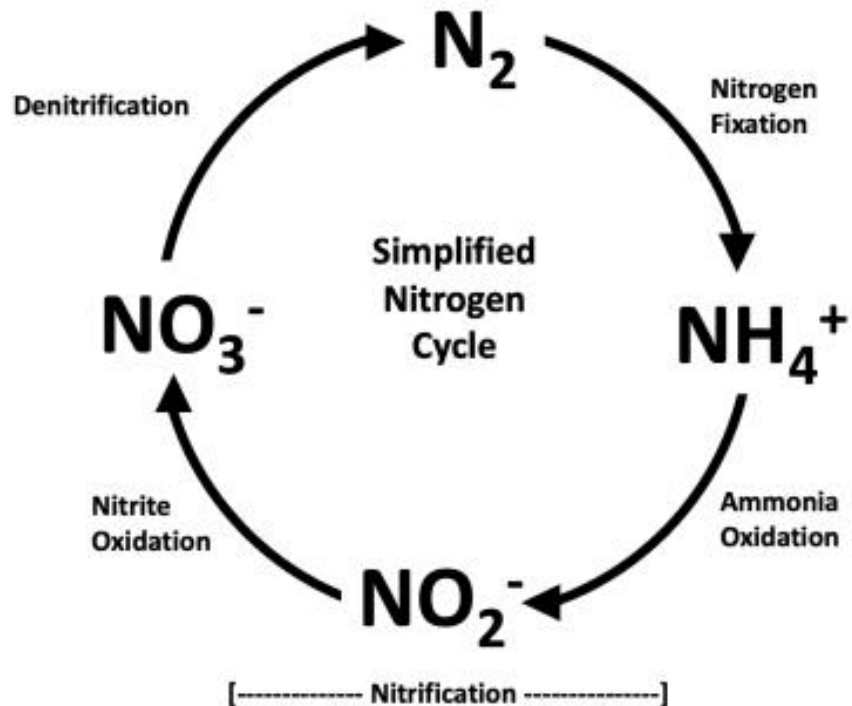
Nitrogen and Phosphorus are key indicators of agricultural pollution

- The Henry's Fork Watershed contains ~125,000 acres of irrigated farmland
- Assuming 150 lbs/acre of fertilizer, >9000 tons of fertilizer enter the watershed every year
- Where does it go?

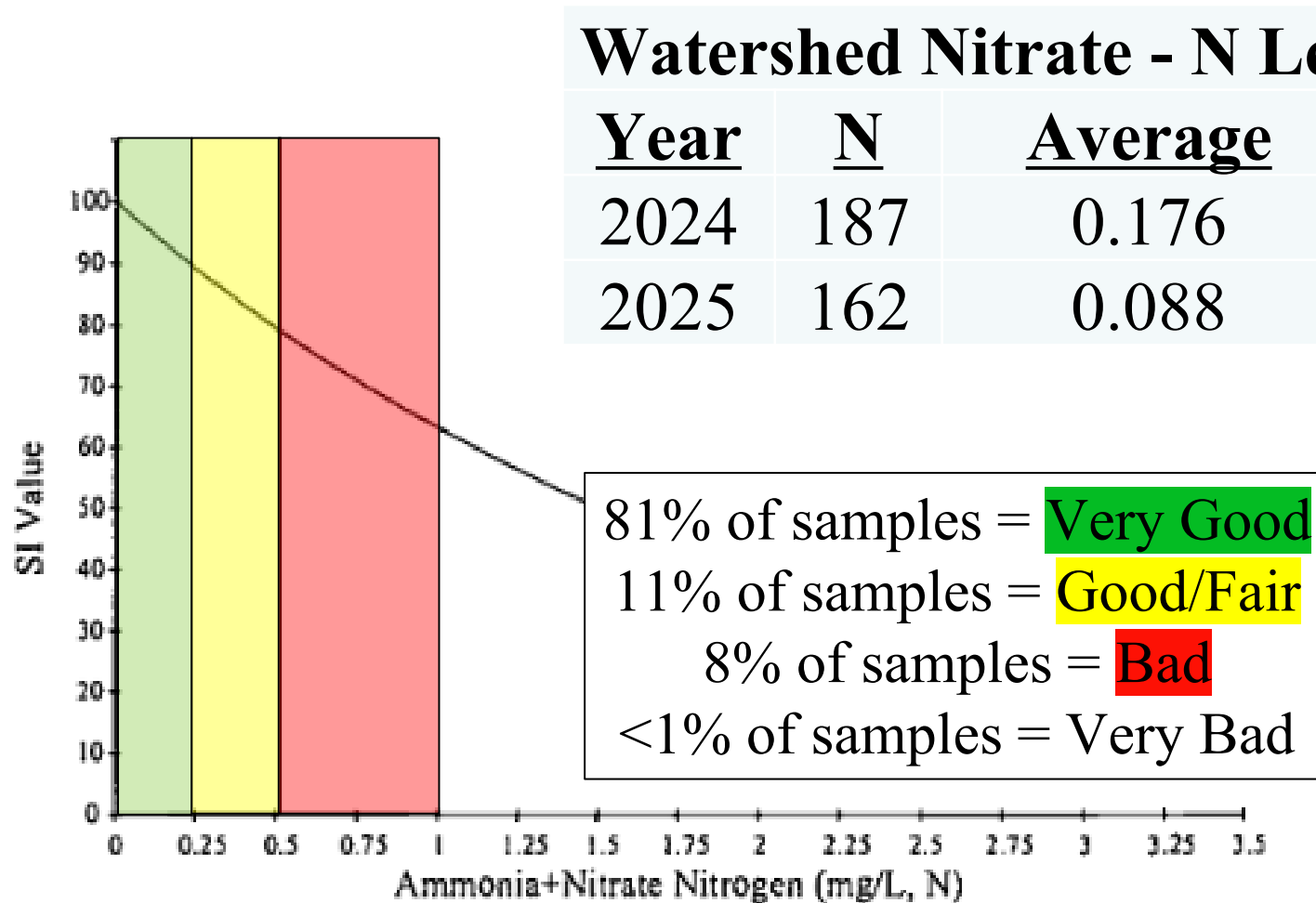


Nitrogen is ~exclusively found as nitrate throughout the watershed

- We monitor NH_4^+ , NO_2^- , NO_3^-
- In highly oxygenated, shallow streams, we expect to mostly find NO_3^-
- **We do!**
- Of 162 samples from 5/25 – 7/25, only 2 samples showed detectable NO_2^- or NH_4^+



2024 – 2025 Show Low Values for Nitrate - N



Watershed Nitrate - N Levels (ppm)

<u>Year</u>	<u>N</u>	<u>Average</u>	<u>StdDev</u>
2024	187	0.176	0.258
2025	162	0.088	0.145

Cude, 2001

Total Nitrogen Monitoring is Expensive, Nitrate Monitoring is Not

- Dionex Ion Chromatograph (IC) has been the workhorse for monitoring NH_4^+ , NO_2^- , and NO_3^-
- Hach DR 900 Colorimeter allows “accurate enough” nitrate determination at much (!!) lower cost



Key Nitrogen Findings

1. Nitrate is the primary chemical form of inorganic aquatic nitrogen
2. From 2024 – 2025, surface water nitrate levels were low across the watershed
3. We have an inexpensive and reliable method for measuring aquatic nitrate

Algal blooms suggest lake/reservoir phosphorus levels are elevated



- Both Island Park Reservoir and Henry's Lake experience recurrent algal blooms

Data from 2023 – 2025 Show Low Values for Orthophosphate - Phosphorus

2023 - 2025 oPhos - P Data (ppm)

<u>Region</u>	<u>Ave</u>	<u>N</u>	<u>Min</u>	<u>Max</u>
Teton Valley	0.031	78	0	0.170
Island Park	0.012	248	0	0.104
Henry's Lake	0.004	132	0	0.062
Lower HF	0.012	85	0	0.222
Kilgore	0.016	102	0	0.098

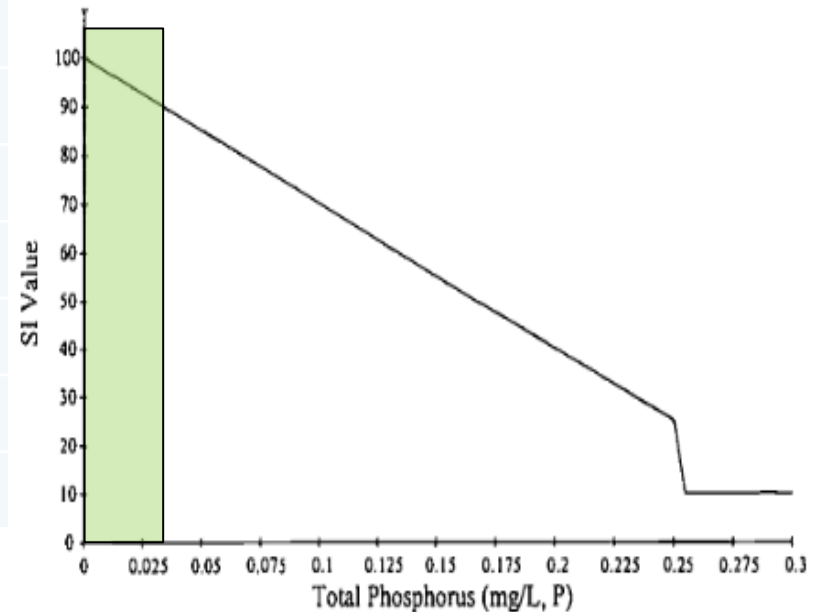


Figure 5. Total Phosphorus Subindex (SIp).

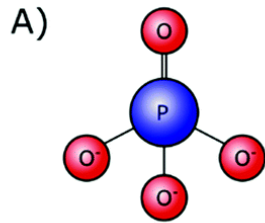
86% of sites are **Very Good***

*If orthoP = total P

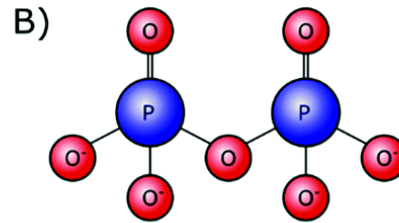
Cude, 2001

Lab Complications

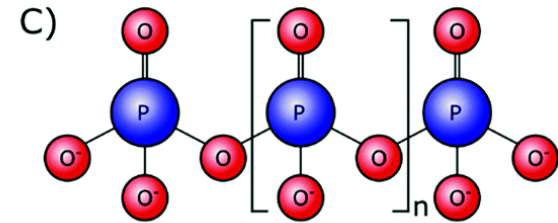
Orthophosphate vs Total Phosphate



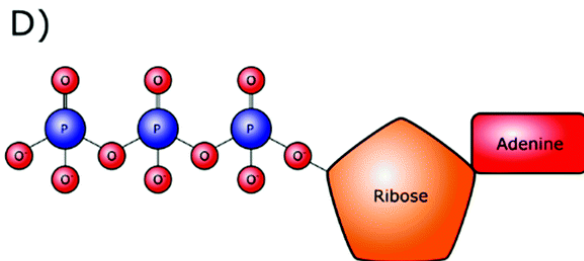
Orthophosphate



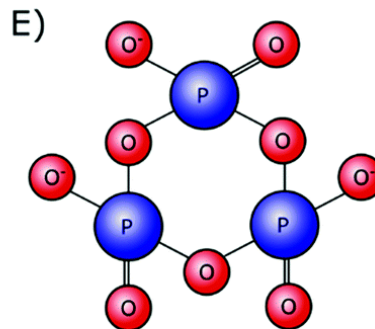
Pyrophosphate



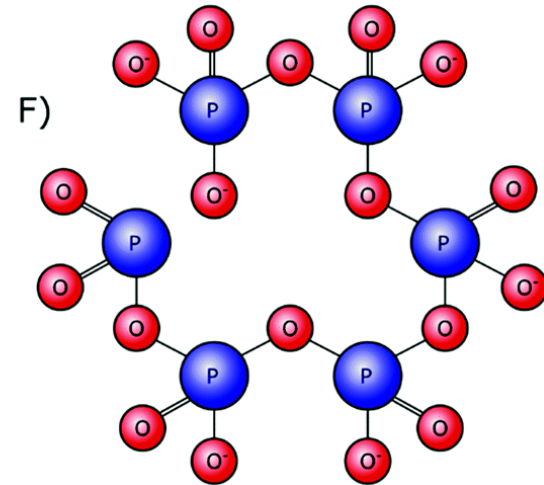
Polyphosphate



Adenosine Triphosphate



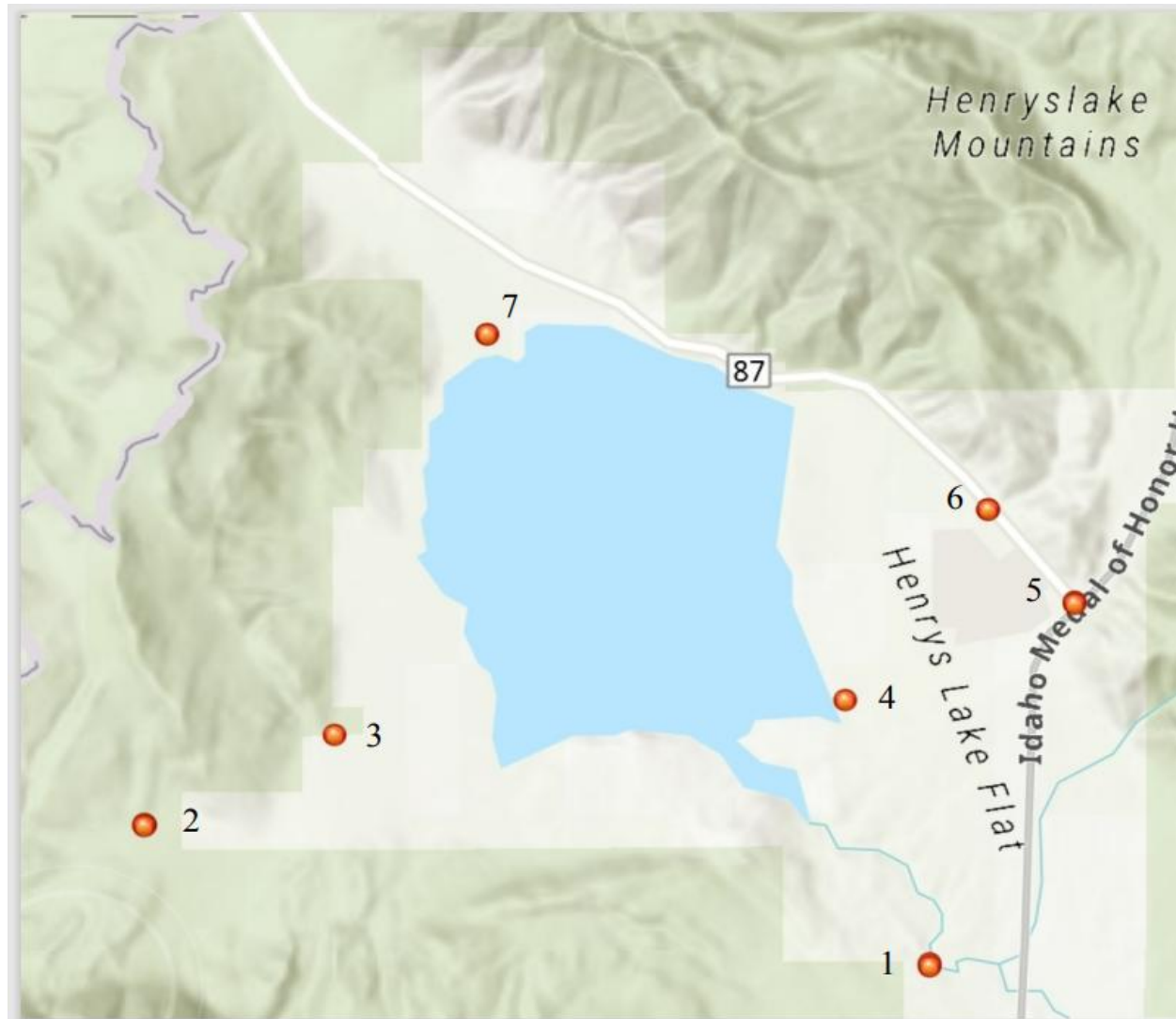
Trimetaphosphate



Hexametaphosphate

Monitoring the tributaries of Henry's Lake suggests yearly P input is minor

- With no obvious point source pollution, we are now looking at long term accumulation in the lake sediment



Cherry Creek Reservoir Sediment Phosphorus Study
2021-2022
LRE Water

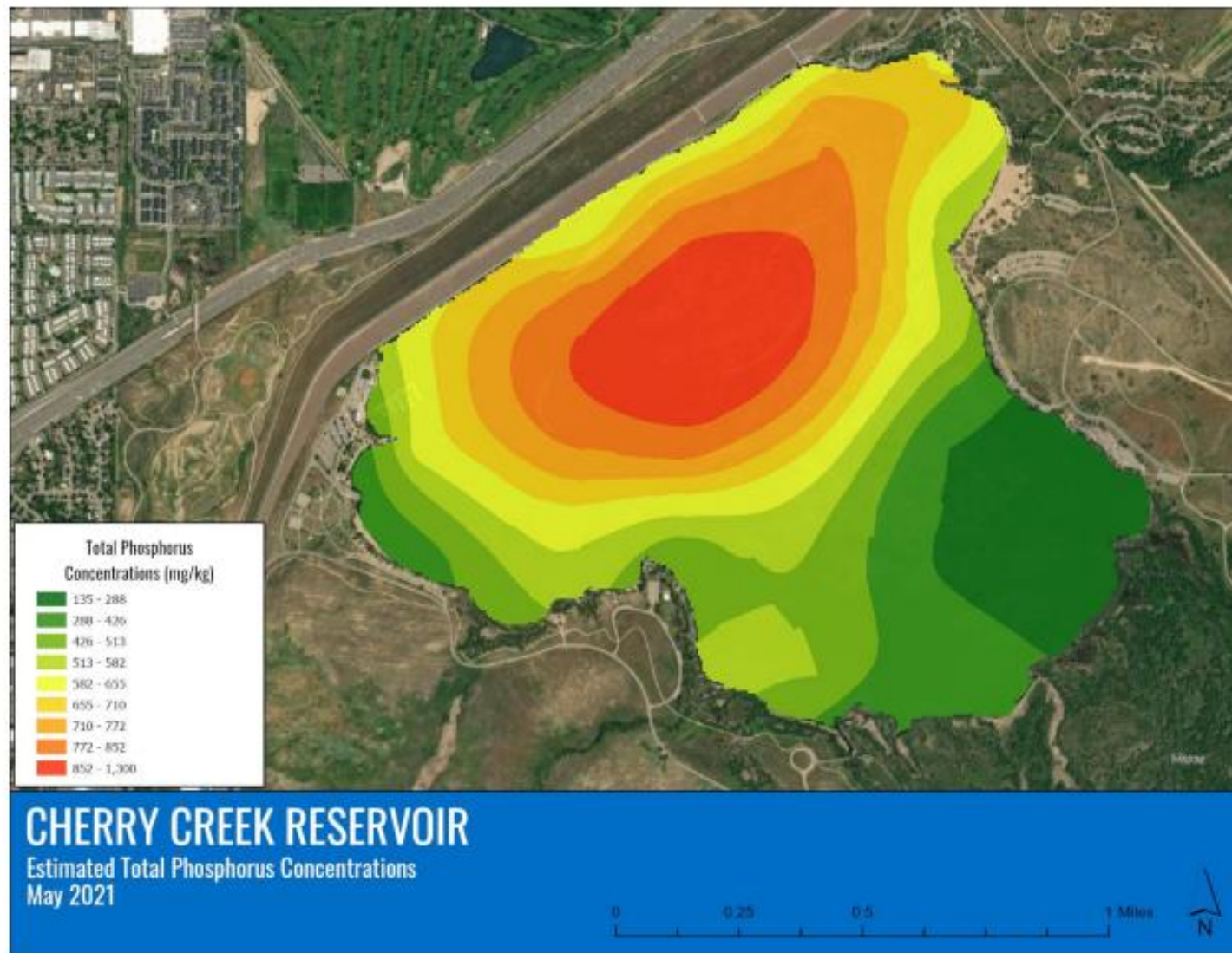


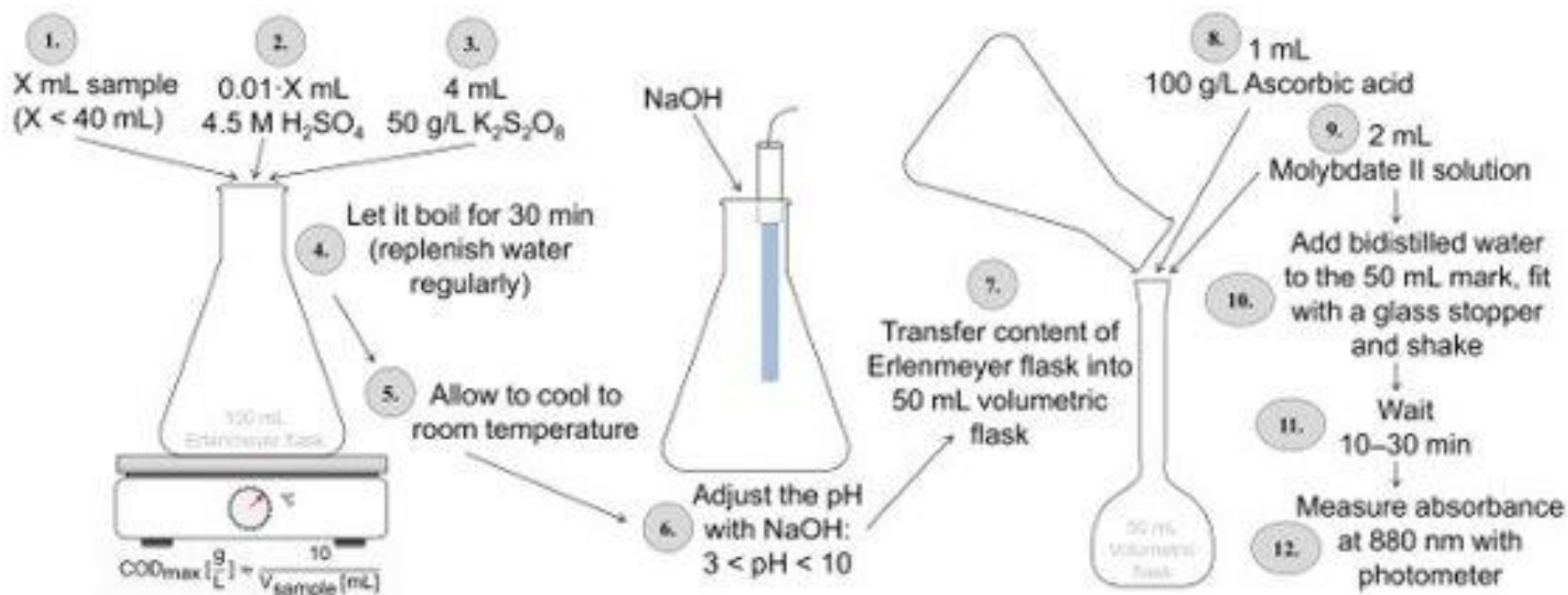
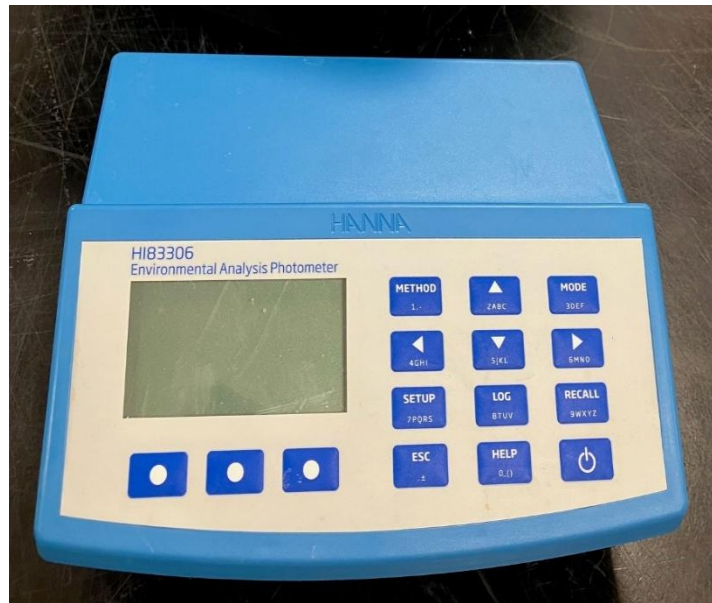
Figure 4. Estimated Total Phosphorus Concentrations in Cherry Creek Reservoir Sediments. Phase 1 (May 2021)

2025 Feasibility Study

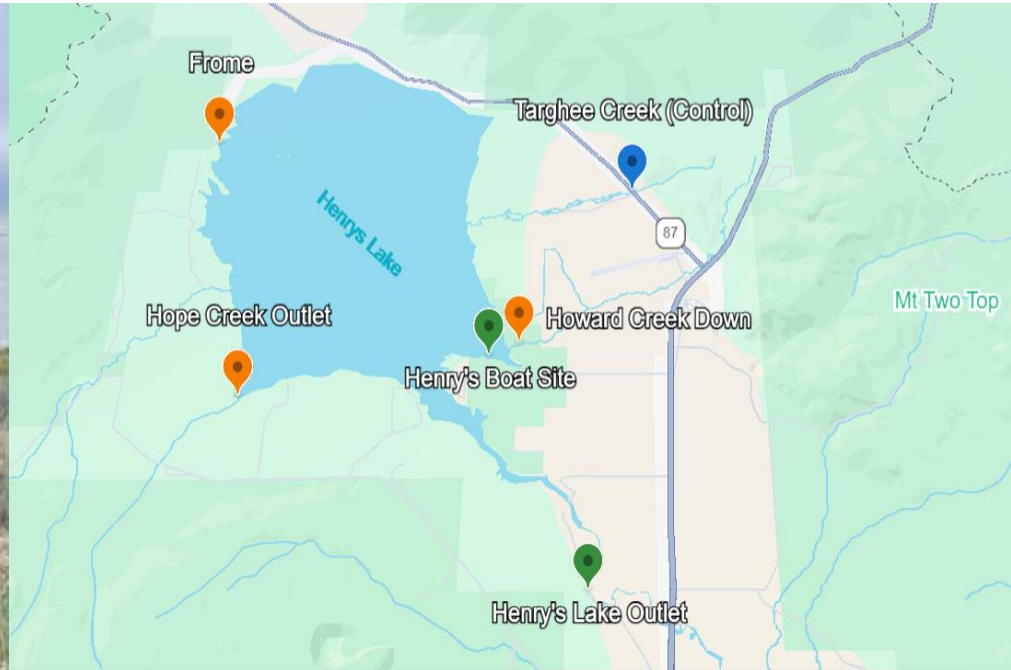
- Can we measure sediment phosphate?
- How phosphate rich are the Henry's Lake sediments?

Benchmarks used for mg PO₄-P/ kg Sediment

Category	Approx. mg/kg TP	Meaning
Low	<10–15 mg/kg	Low risk for internal P release; background levels
Moderate	10–30 mg/kg	Moderate; can contribute to internal loading if anoxic
High	>30–50 mg/kg	High; significant internal loading risk
Very high	>50–100 mg/kg	Elevated; likely to fuel algal blooms
Extreme	>200–1000+ mg/kg	Eutrophic, heavily impacted lakes



2025 Results



Sites	mg/Kg of PO_4^{3-} Average	N
Targhee Creek (Control)	0.77	1
Henry's Lake Outlet	8.41	6
Henry's Boat Site	8.45	6
Howdown	10.61	2
Hope Outlet	11.15	6
Frome	16.17	12

Moderate

Key Phosphate Findings

1. Stream orthophosphate-P levels appear to be low across the watershed
2. We have an inexpensive and reliable method for measuring aquatic orthophosphate-P
3. We should be able to monitor total phosphate-P
4. We have a functional protocol for monitoring sediment phosphate-P

The Future

- **The primary goal is to train water quality scientists**
- Projects are chosen based on:
 1. Available resources
 2. Student educational needs
 - Teamwork/collaboration
 - Problem solving
 - Laboratory competence
 3. Student interest

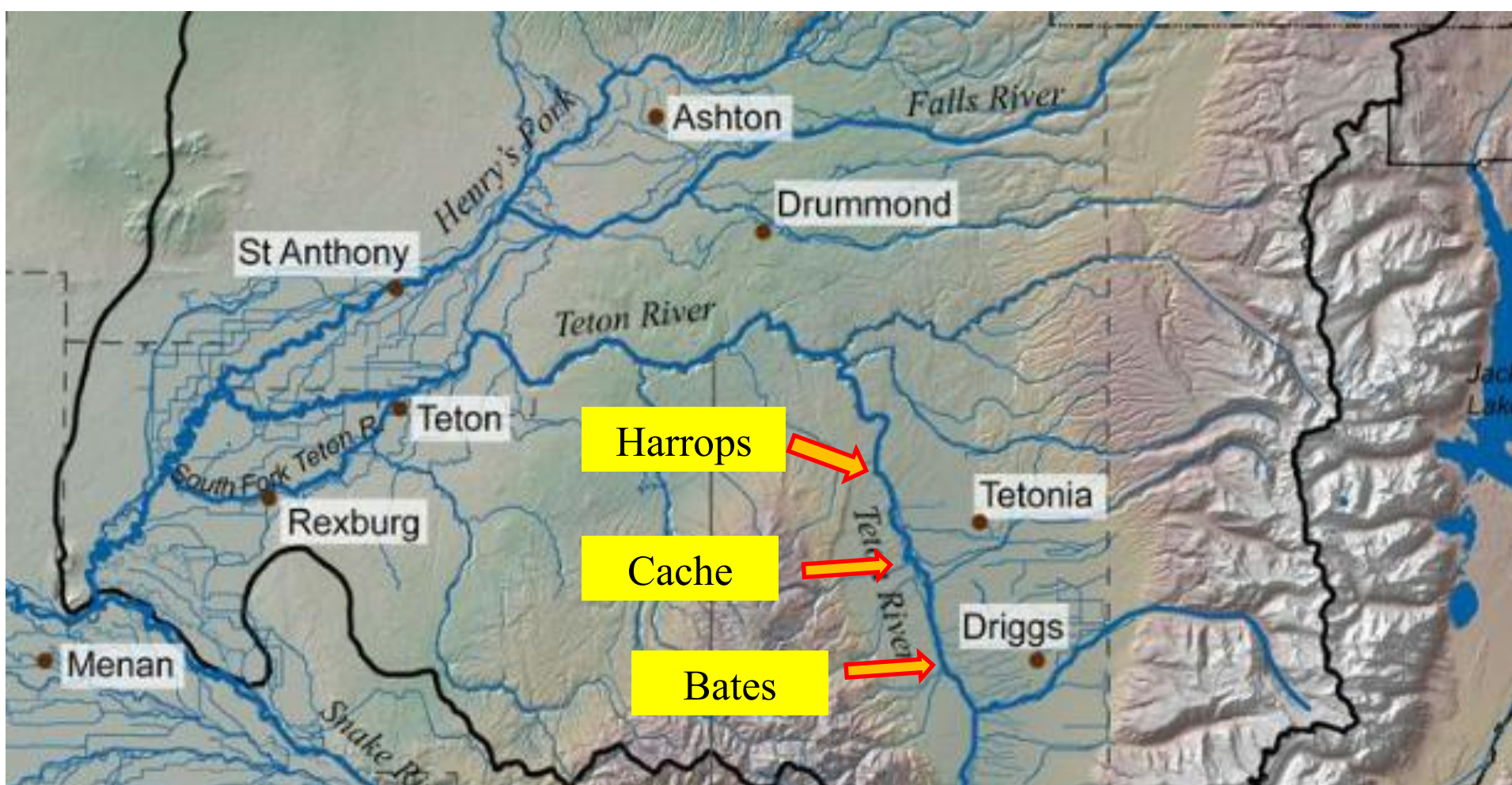


Thank you!

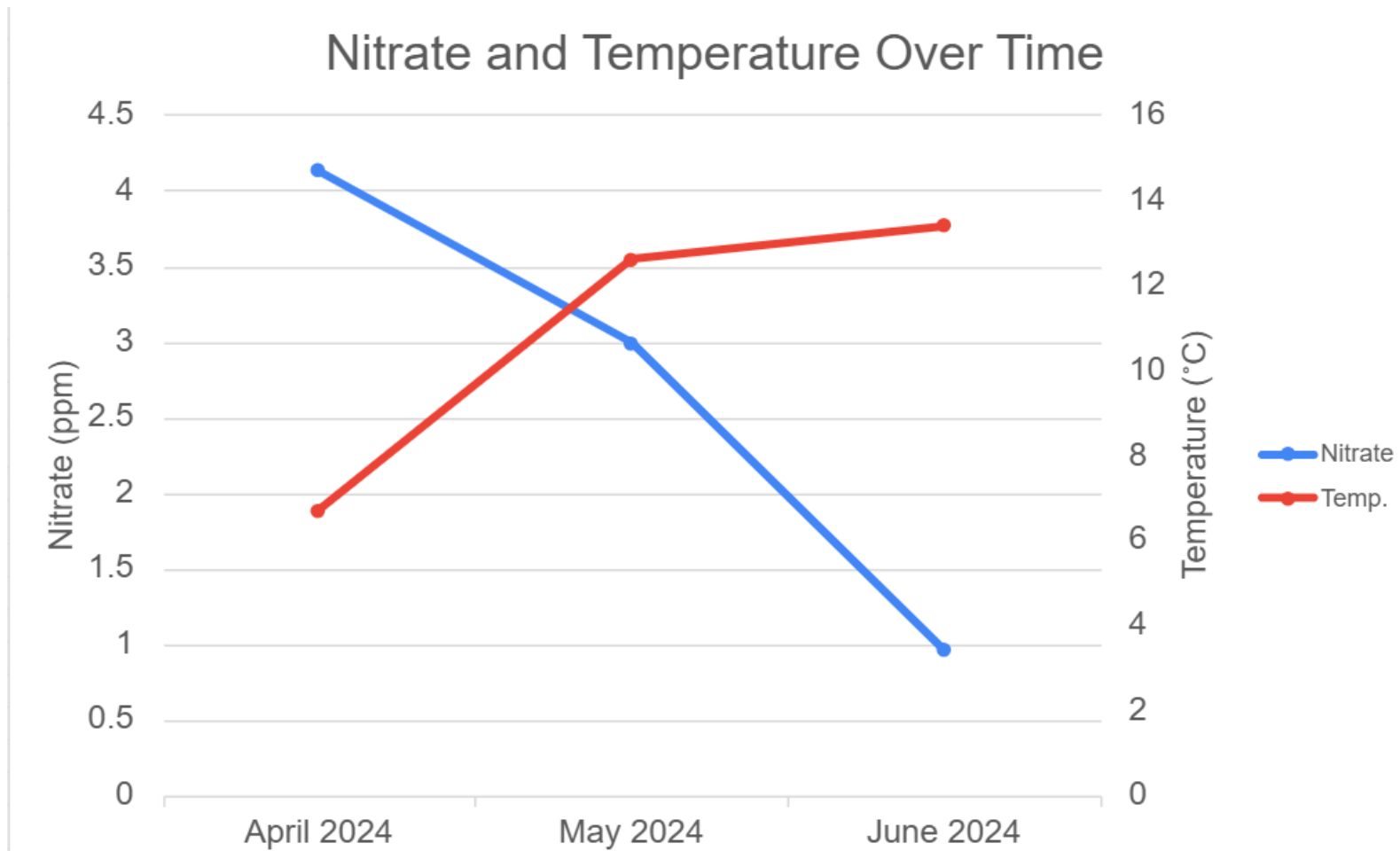
- This project has been supported by:
 - Brian Lemon and Scott Johnson (BYU-Idaho Chem)
 - Seth Ririe (BYU-Idaho Biology)
 - Susan Ward (ACS)
 - Greg Roselle (BYU-Idaho Geology)
 - Cody Diehl (INBRE)
 - Tom Hallberg (Greater Yellowstone Coalition)
 - So many students!



Upper Teton River: Nitrate levels are the highest in the watershed

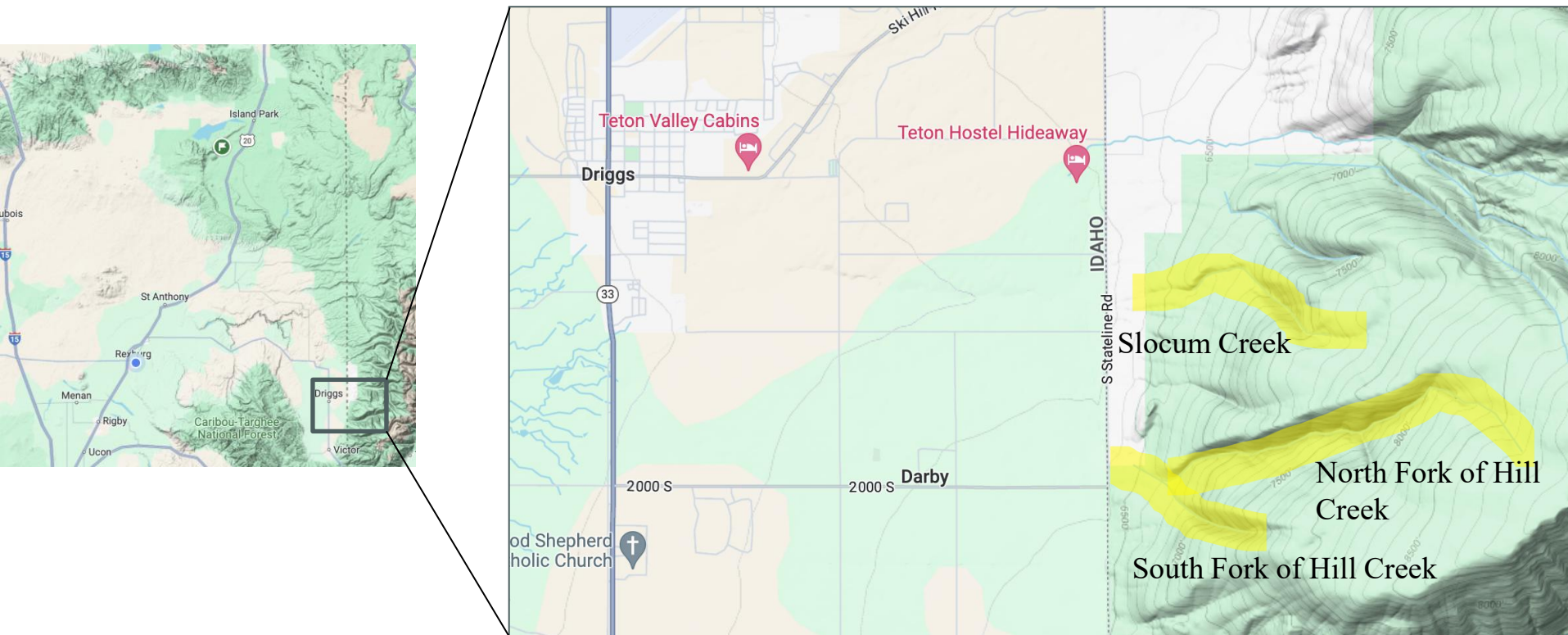


Upper Teton River: Nitrate levels decrease during the early summer





Elevated Ortho Phosphate has primarily been identified at three sites – all in the same region



W Overby, 7/2024