Cherry Creek Reservoir Sediment Phosphorus Study

6/2/22 CCBWQA
TAC Meeting

Project Objectives

To understand the internal loading potential which can affect reservoir primary productivity (algal growth), and chlorophyll-a concentrations.

- Spatial variability of sediment phosphorus concentrations,
- Mobile phosphorus that may be involved in nutrient cycling/ readily available to drive algal growth, and
- Variability of concentrations/ fractions w/ sed. depth.

Methods

Phase 1 - Spatial Analysis

26 sample collection locations (~ 40 acres each)

- Composition
- Total P
- Moisture content

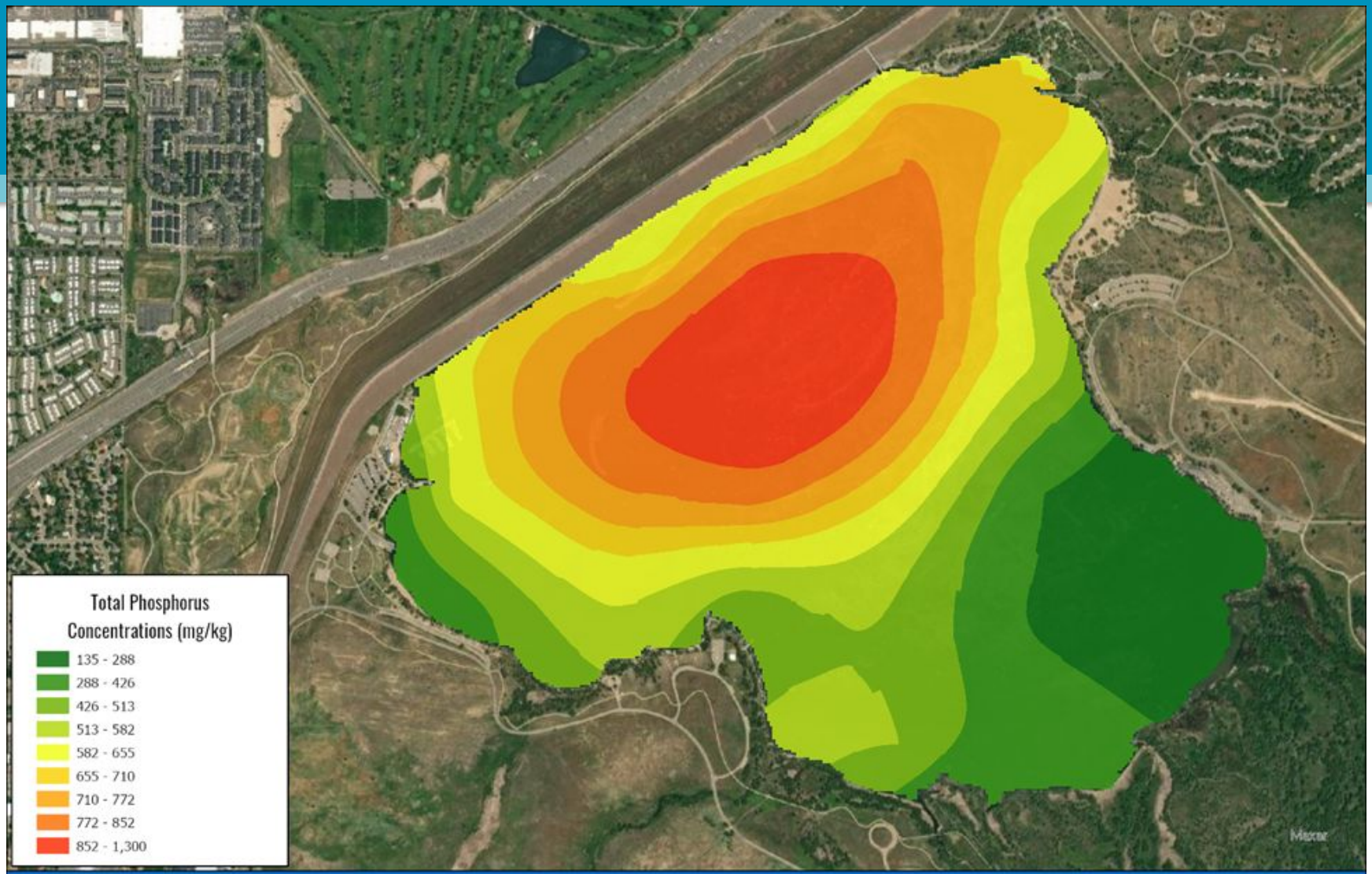
Phase 1 Spatial Analysis Results

Inlets and shorelines

- Larger particles (sand/ gravel)
- Lower P
- Lower moisture

Center of Reservoir

- Fine sediment size
- Higher P
- Increased moisture

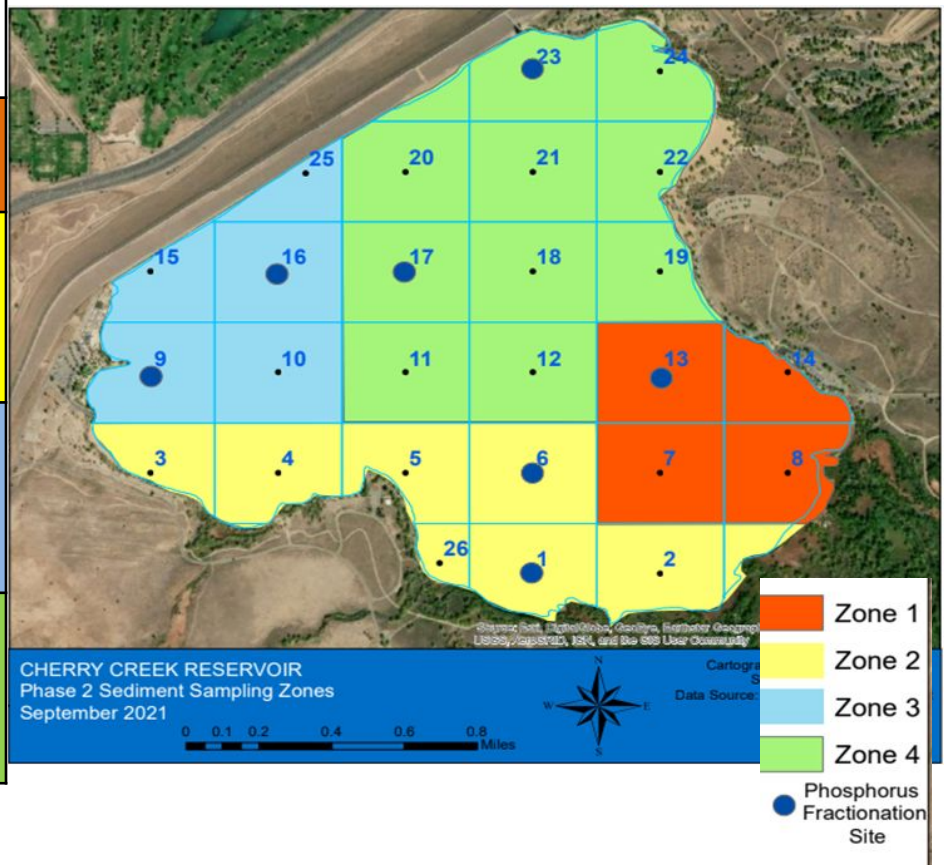


CHERRY CREEK RESERVOIR

Estimated Total Phosphorus Concentrations
May 2021

Phase 2 - Sampling Sites

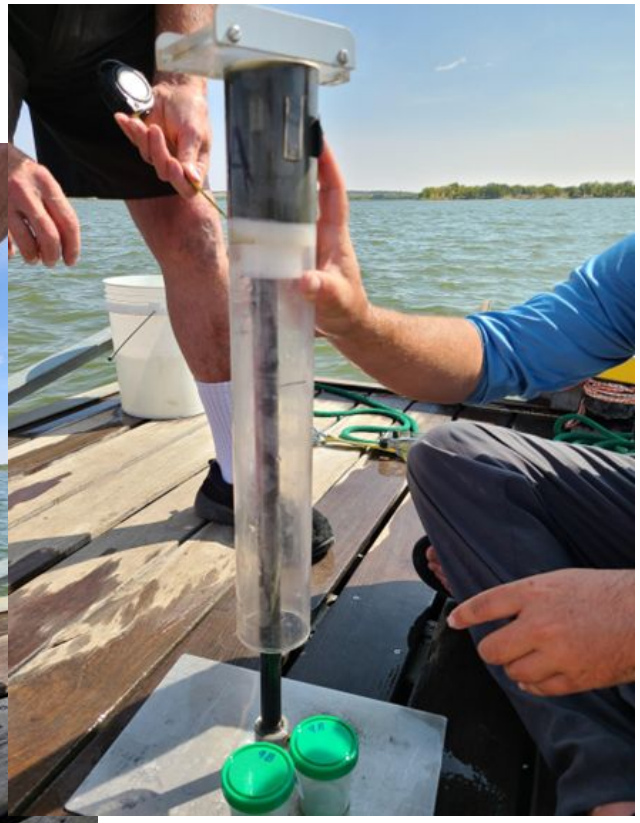
Zone	Average P	Phase 2 Sampling Site(s) – TP	General Location
1	134 mg/kg	13 - 112 mg/kg TP	South - Cherry Creek Inlet
2	510 mg/kg	1 -707 mg/kg and 6 - 551 mg/kg TP	South - Cottonwood Inlet and Western Shoreline
3	728 mg/kg	9 - 865 mg/kg and 16 - 886 mg/kg TP	Marina and Western side of Dam
4	862 mg/kg	17 - 1282 mg/kg and 23 - 988 mg/kg TP	Middle Reservoir, Eastern side of Dam and Swim Beach



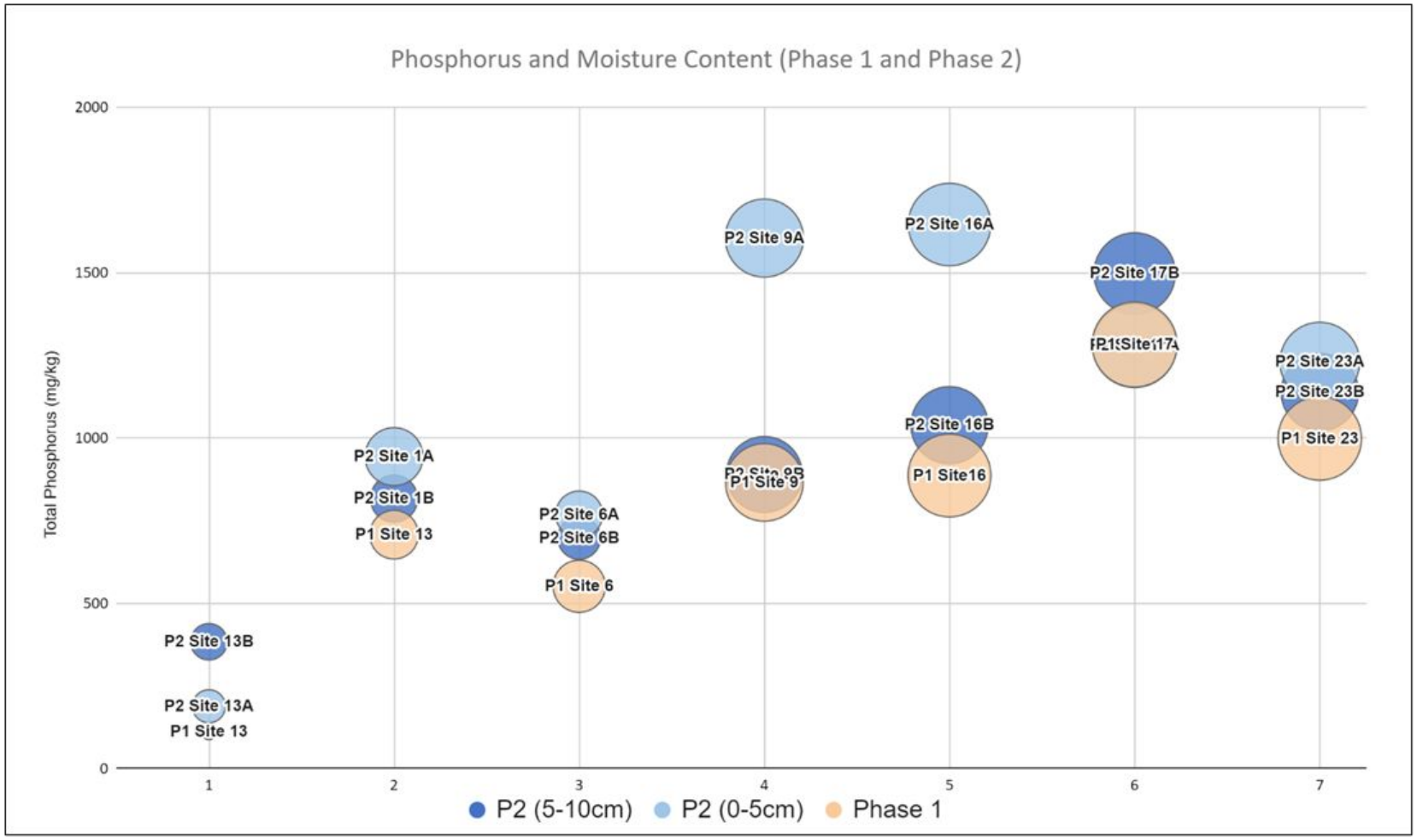
Phase 2 Methods

Core Samples

- 2 Depths
- 0-5cm
- 5-10cm
- Phosphorus
- Moisture
- P fractions
- Mineral/ Metal Concentrations



Phase 2 - Moisture and P Concentration



Phase 2 - P Fractionation

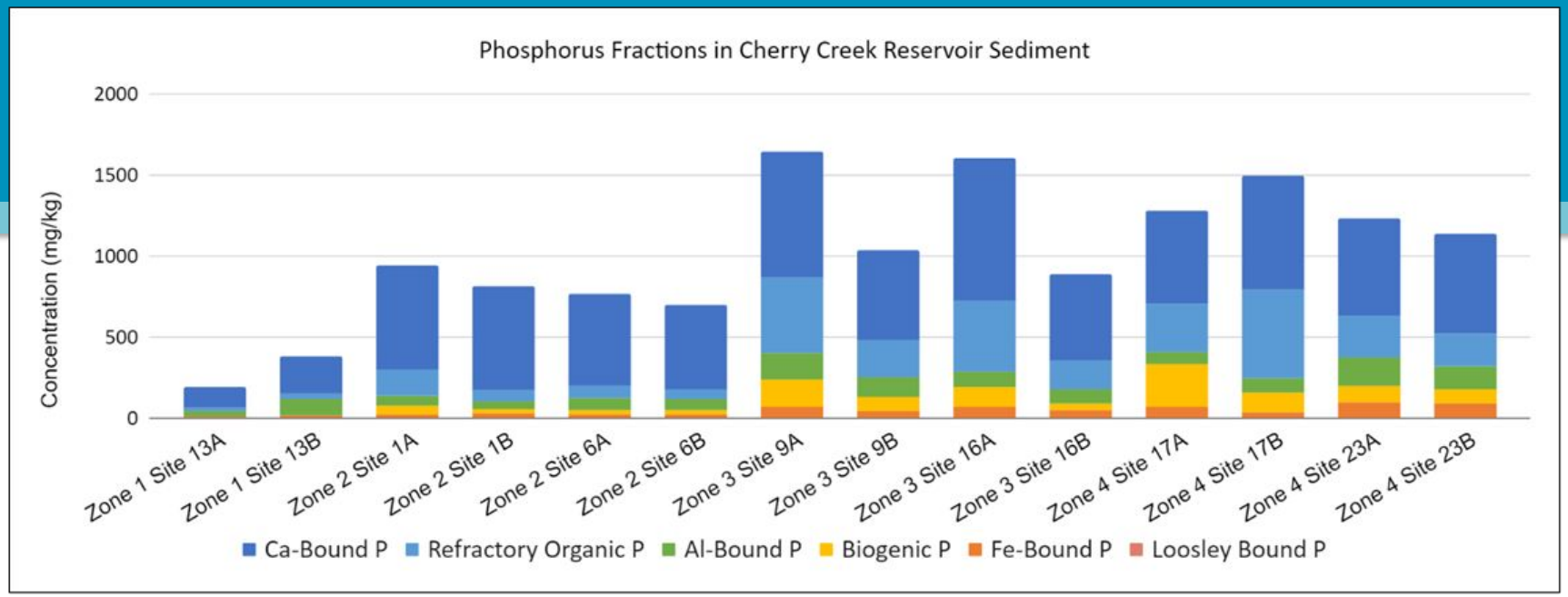
Sequential P Extraction

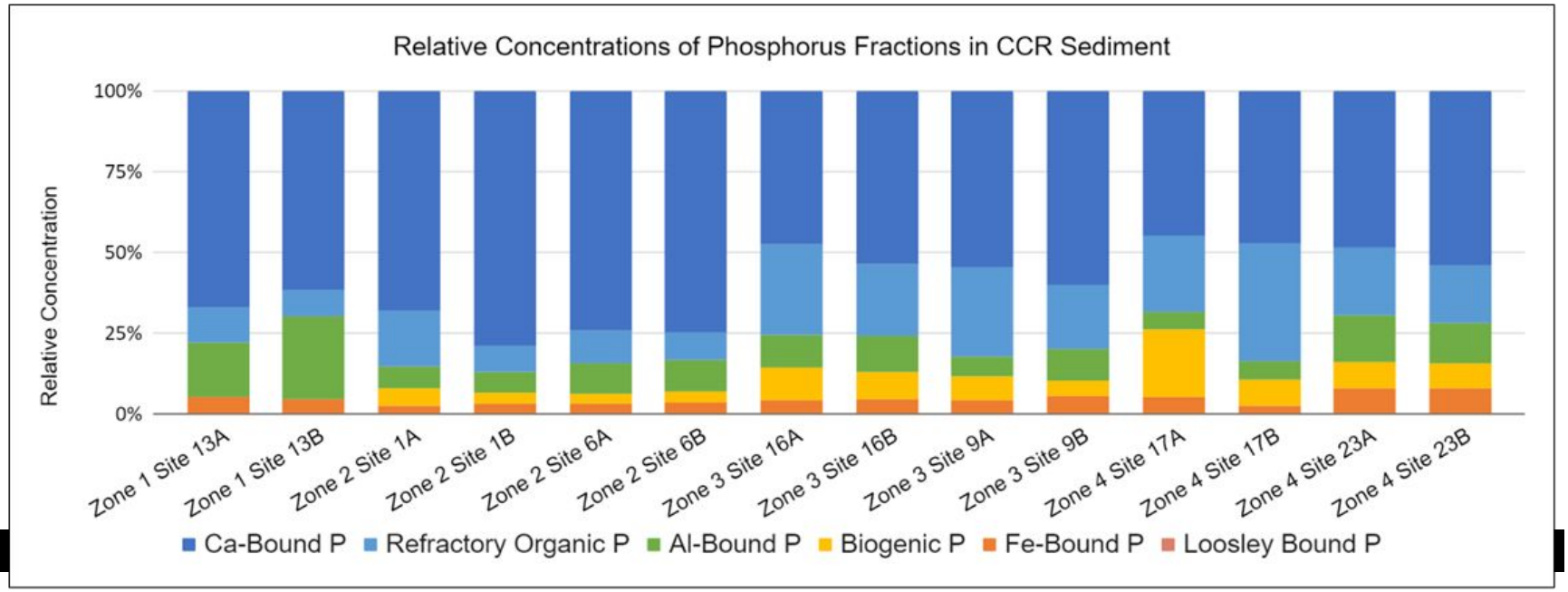
Mobile Fractions

- Loosley Bound - Readily Mobile (pore P)
- Iron Bound - Mobile (released in anoxia/ low DO)
- Biogenic - Mobile (released during decomposition)

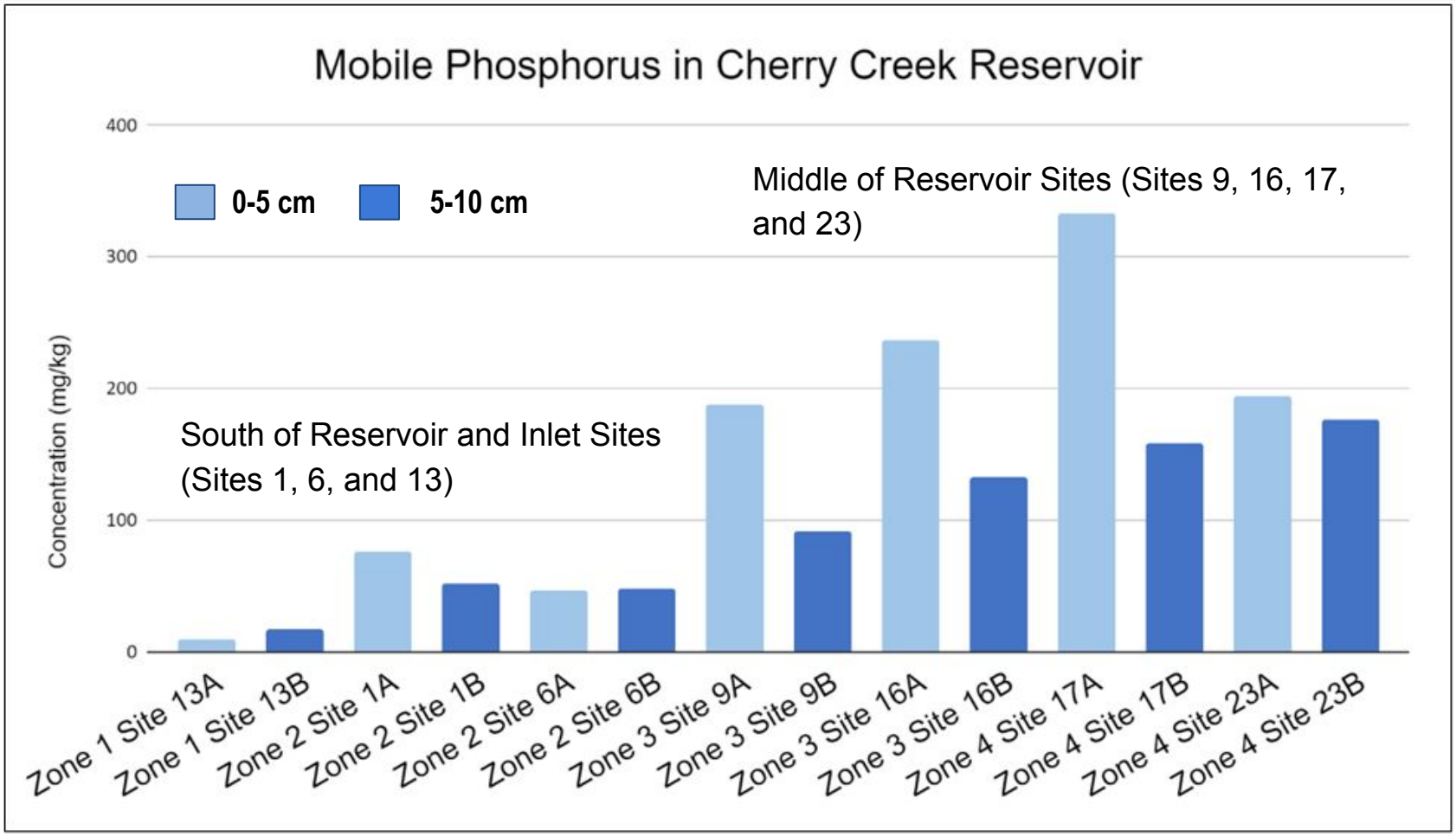
Permanent Fractions

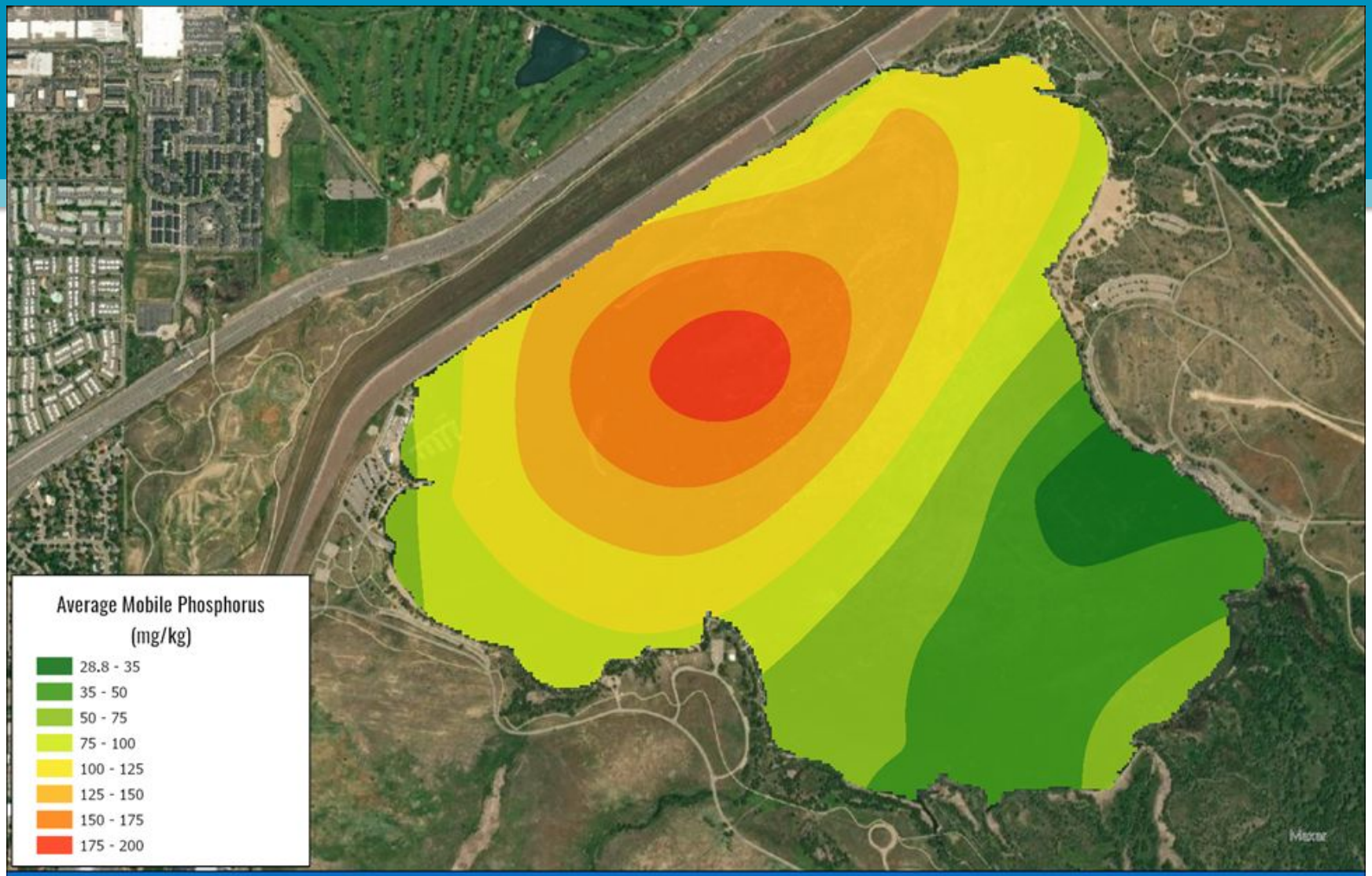
- Aluminum Bound - Refractory/ Permanent
- Refractory Organic - Permanent (biologically unavailable)
- Calcium bound - Permanent ($Ca\text{-}PO^4$ mineral P)


Phosphorus Fractions in Cherry Creek Reservoir Sediment
Concentration (mg/kg)
2000
1500
1000
500
0
Zone 1 Site 13A
Zone 1 Site 13B
Zone 2 Site 1A
Zone 2 Site 1B
Zone 2 Site 6A
Zone 2 Site 6B
Zone 3 Site 9A
Zone 3 Site 9B
Zone 3 Site 16A
Zone 3 Site 16B
Zone 4 Site 17A
Zone 4 Site 17B
Zone 4 Site 23A
Zone 4 Site 23B
Ca-Bound P
Refractory Organic P
Al-Bound P
Biogenic P
Fe-Bound P
Loosley Bound P


Relative Concentrations of Phosphorus Fractions in CCR Sediment
Relative Concentration
100%
75%
50%
25%
0%
Zone 1 Site 13A
Zone 1 Site 13B
Zone 2 Site 1A
Zone 2 Site 1B
Zone 2 Site 6A
Zone 2 Site 6B
Zone 3 Site 16A
Zone 3 Site 16B
Zone 3 Site 9A
Zone 3 Site 9B
Zone 4 Site 17A
Zone 4 Site 17B
Zone 4 Site 23A
Zone 4 Site 23B
Ca-Bound P
Refractory Organic P
Al-Bound P
Biogenic P
Fe-Bound P
Loosley Bound P

Phase 2 - Mobile P Depth Variability





CHERRY CREEK RESERVOIR

Estimated Mobile Phosphorus Concentrations September 2021

Summary

- P conc. and moisture spatial trends
- Highest P in middle of Reservoir (deep)
- Middle of Reservoir also contained highest mobile P (Fe-bound P, Biogenic P)
- Fe-bound P could release from sediments in the summer months when DO is low at the bottom
- Biogenic P may vary seasonally (algal / biological deposition) but mobile during decomposition

Considerations

- Accurate in-situ internal loading estimates would require P-flux study (incubated core samples/ water analysis)
- In-lake management options - Alum would bind mobile forms of P and convert them to more permanent (Al-bound)
- Oxidative environment at sediment water interface would reduce Fe-bound P release
- Input to Reservoir Model
- Compare concentrations to other Reservoirs