Group #4: Plum Creek at Chatfield Reservoir – 2023

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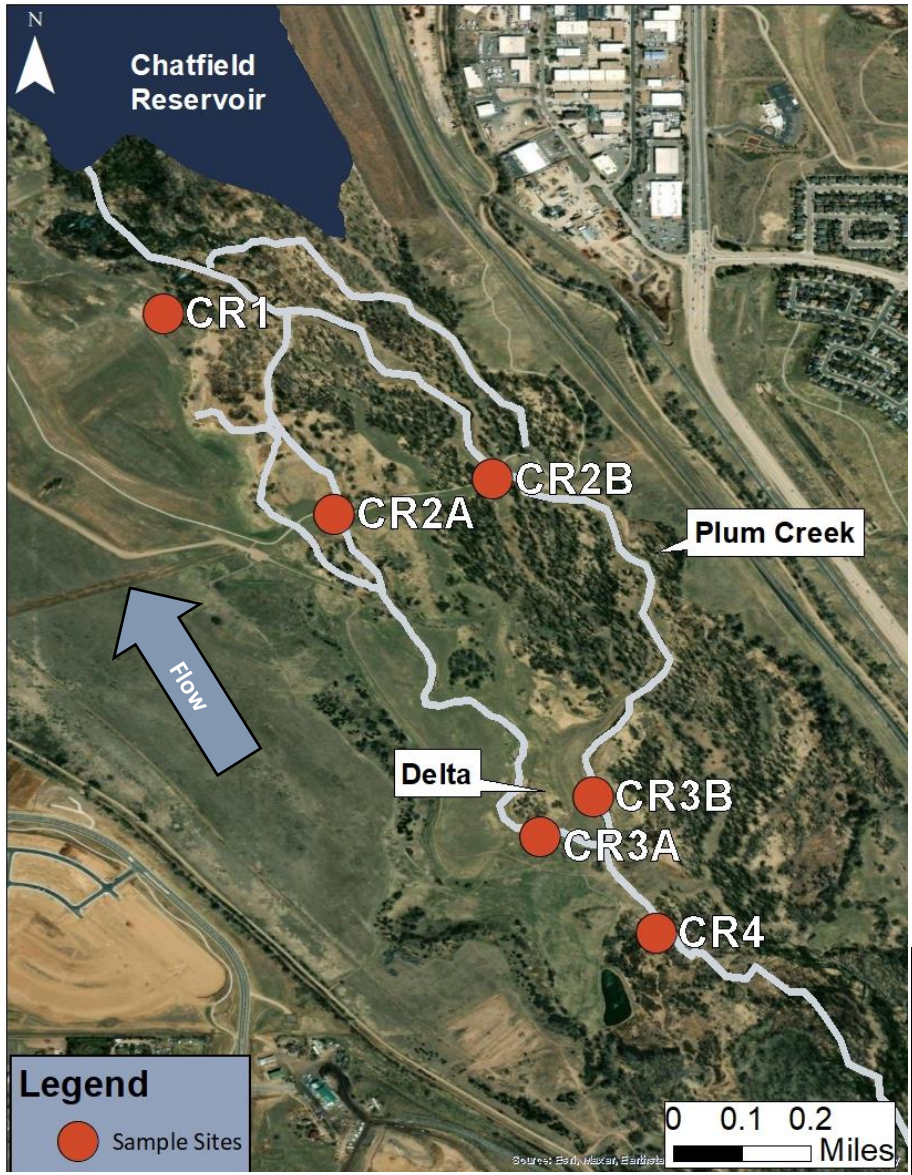

Figure 1. Site map

Table 1. Site information

Site ID	Latitude	Longitude	Site Description
CR1	39°18'14.66"N	104°58'30.10"W	Plum Creek Delta at mouth of Chatfield Reservoir
CR2A	39° 31'58.15"N	105° 2' 8.57"W	Plum Creek Delta mid-delta West
CR2B	39° 32'1.56"N	105°2'26.52"W	Plum Creek Delta mid-delta East
CR3A	39° 31'33.93"N	105° 2'21.46"W	Plum Creek Delta below gaging station West
CR3B	39° 31'33.82"N	105° 2'17.88"W	Plum Creek Delta below gaging station East
CR4	39° 31'29.51"N	105° 2'16.08"W	Plum Creek Delta above gaging station

Main Findings

- Phosphorus did not exceed tributary standards at any site according to Regulation 38. All sites exceeded reservoir standards, which is concerning given proximity to Chatfield Reservoir.
    - Total phosphorous loading from Plum Creek is 5.15E+04 lbs/year based on Titan Road flows, a ~900% increase from 2021, likely due to historic flows.
- Total nitrogen exceeded the CDPHE's proposed regulation at every site except CR2A.
    - Nitrite was primary contributor, exceeding regulations at CR1 and CR2A.
- Total coliform exceeded standard at all sites by a minimum of 400%. *E. coli* exceeded standards by ~160%.
- East creek divergence is 10x greater than West
- Compared to 2022 data at CR2B, there was a 543% increase in total coliform, 236% increase in *E. coli*, and a minimum 190% increase in total phosphorous concentrations.

Table 2. Measured water quality parameters and flow rates

Date	Site ID	pH*	Conduct-ivity (µs/cm)	Temp** (°C)	Dissolved Oxygen▲ (mg/L)	Alkalinity• (mg $CaCO_3$/L)	Turbidity (mg/L)	Flow Rate (cfs)
5/16/2023	CR1	7.09	394	21.7	5.56	69.3	108	N/M
5/16/2023	CR2A	7.44	258	16.9	7.68	41.7	263	32.5
5/16/2023	CR2B	7.55	241	15.5	7.77	45.0	266	N/M
5/16/2023	CR3A	7.34	237	15.0	8.22	47.7	283	35.6
5/16/2023	CR3B	7.31	284	14.6	8.00	39.7	253	N/M
5/16/2023	CR4	7.29	271	14.2	8.45	39.3	265	417

N/M = Not Measured; *Standard limit 6.5 to 9 [4]; **Daily Max 24.3°C; ▲Standard min 6.0 mg/L [4]; •Standard limit 20 mg $CaCO_3$/L [1]; Flow rates from 5/19/2023.

Table 3. Metals, anions, solids, organics, nutrients, and pathogens

2023 Group 4 – Plum Creek at Chatfield Reservoir			Concentrations												
			Metals (mg/L)					Anions (mg/L)		Solids (mg/L)	Organics (mg/L)	Nutrients (mg/L)		Pathogens (mpn/100 mL)	
			As	Fe	Mn	Se	Tl	NO_2^--N	NO_3^--N	TSS	TOC	P	TN	Coliform	*E. coli*
EPA	Aquatic Life Chronic [1]		0.15	1.0	-	-	-	-	-	-	-	-	-	-	-
	Aquatic Life Acute [1]		0.34	-	-	-	-	-	-	-	-	-	-	-	-
	Human Recreation [2]		1.8E-05	-	0.05	0.17	2.4E-04	-	10	-	-	-	-	-	-
	Drinking Water [3]		0.01	-	-	0.05	0.002	1	10	-	-	-	-	-	-
	Secondary Drinking Water [3]		-	0.3	0.05	-	-	-	-	-	-	-	-	-	-
CDPHE	Regulation 38 Chronic [4]		2.0E-05*	1.0*	1.7**	0.0046	-	0.05	-	-	-	0.11▲	0.53•	-	126
	Regulation 38 Acute [4]		0.34	-	3.1**	0.0184	-	-	10	-	-	-	-	-	-
USDA	USDA Livestock [5]		0.01	0.3	0.05	0.05	-	10	30	-	-	-	-	200	-
	Detection Limit (mg/L)		0.0168	0.0003	0.0001	0.0109	0.0049	0.1	0.1	-	0.17	0.029	0.17	1	1
Sample	**Site ID**	**Date**	**As**	**Fe**	**Mn**	**Se**	**Tl**	**NO_2^--N**	**NO_3^--N**	**TSS**	**TOC**	**P**	**TN**	**Coliform**	***E. coli***
Water	CR1	5/16/2023	BDL	0.042	0.129	BDL	BDL	0.101	BDL	48	11.00	0.063	0.96	3730	200
	CR2A	5/16/2023	BDL	0.032	0.053	BDL	BDL	BDL	0.21	166	8.10	0.055	0.49	7270	318
	CR2B	5/16/2023	BDL	0.049	0.063	BDL	BDL	BDL	0.20	124	8.68	0.057	0.64	3500	410
	CR3A	5/16/2023	BDL	0.101	0.059	BDL	BDL	BDL	0.25	160	8.65	0.040	0.65	1890	410
	CR3B	5/16/2023	BDL	0.054	0.058	BDL	BDL	BDL	0.20	80	8.44	0.054	0.65	840	200
	CR4	5/16/2023	BDL	0.031	0.056	0.014	BDL	BDL	0.23	160	9.03	0.038	0.67	1340	200
Soil	CR4	5/16/2023	0.043	2.625	0.245	0.001	0.033	BDL	0.48	N/M	N/M	0.501	N/M	N/M	N/M

Notes:
A/BDL = Above/Below Detection Limit
N/M = Not Measured
*Total Recoverable Standards (all other standards are for dissolved metals)
**Calculated using Table Value Standards assuming 111 mg $CaCO_3$/L average low flow hardness [6]
▲Phosphorus standard is 0.03 mg/L within Chatfield Reservoir and 0.11 mg/L for most tributaries
•Average of Regulation 38 proposed standards for cold and warm waters.
Bold values represent total metal concentrations. All other concentrations are dissolved.
For information on other constituents, please see Data Appendix

[1] US EPA National Recommended Water Quality Criteria - Aquatic Life Criteria Table; freshwater standards (https://www.epa.gov/wqc/national-recommended-water-quality-criteria-aquatic-life-criteria-table)
[2] US EPA National Recommended Water Quality Criteria - Human Health Criteria Table; consumption of water & organisms (https://www.epa.gov/wqc/national-recommended-water-quality-criteria-human-health-criteria-table)
[3] US EPA Drinking Water (https://www.epa.gov/ground-water-and-drinking-water/national-primary-drinking-water-regulations)
[4] CDPHE Regulation 38 for Upper South Platte River Basin (https://cdphe.colorado.gov/water-quality-control-commission-regulations)
[5] USDA Livestock Drinking Water (https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_051302.pdf)
[6] Chatfield Reservoir Storage Reallocation Feasibility Study 2013

Recommendations

- Continue testing and monitoring to understand the Chatfield Reservoir 2020 Reallocation Plan on water quality and flow.
- Conduct streamflow measurements at both branches of Plum Creek to understand delta's impact on loading values for nutrients and coliform.
- Improve stream gage measurements along Plum Creek to ensure appropriate range of discharge values are available.
- Coordinate with Colorado School of Mines Senior Design to design accessible and affordable phosphorous filter for the confluence of Chatfield Reservoir.
- Determine water quality at High Line Canal to see if runoff affects Plum Creek.