Collaborative Upper Cache la Poudre Monitoring Program

SOURCE WATER MONITORING

The Upper Cache la Poudre (UCLP) Watershed Collaborative Monitoring Program was established in 2008 between the City of Fort Collins, the City of Greeley and Soldier Canyon Water Authority, to help meet present and future drinking water treatment goals.

Water quality monitoring of our raw, Cache la Poudre River drinking water supply is conducted from April through November. Monitoring sites are strategically located throughout the Upper CLP watershed. Water quality data provide valuable information about the health of our source watershed and raw water supply.

The *Summer 2021 Water Quality Update* provides a seasonal summary of watershed conditions in the Upper CLP watershed by highlighting weather, drought, streamflow and water quality conditions over the summer season (June–August).

Water quality begins to stabilize following peak snowmelt runoff and routine monitoring is reduced to monthly sampling. Routine water quality monitoring results are reported for six key monitoring sites located throughout the Upper Cache la Poudre watershed, which capture water quality conditions above and below major tributaries and near water supply intake structures ***(Figure 1).*** Present water quality conditions are compared to baseline water quality conditions collected over the period of 2008 to 2012.

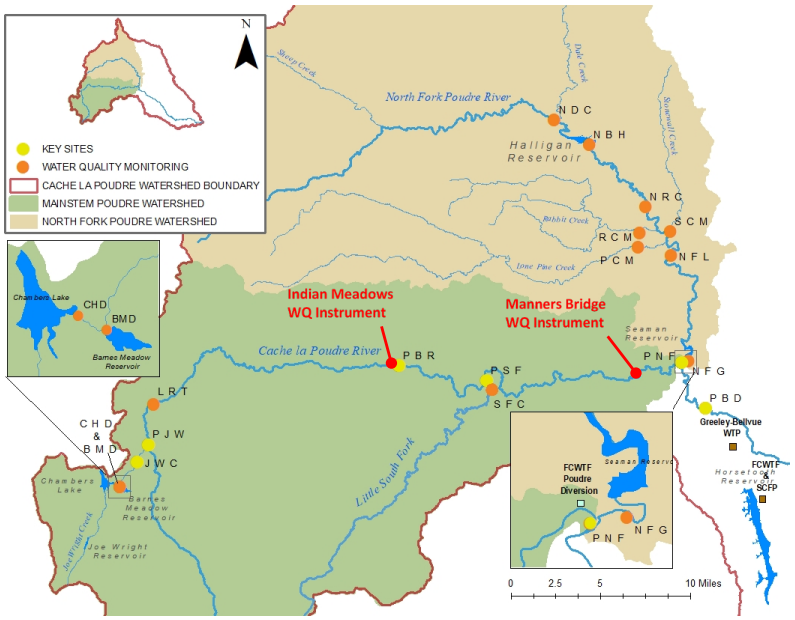


Figure 1 *- Upper Cache la Poudre Watershed Collaborative Monitoring Program water quality sampling sites and real-time water quality instrument locations.*

JWC - Joe Wright Creek above the confluence with the Poudre River
PJW - Poudre River above the confluence with Joe Wright Creek
PBR - Poudre River below the Town of Rustic
PSF - Poudre River below the confluence with the Little South Fork
PNF - Poudre River above the confluence with the North Fork at the City of Fort Collins' Intake
PBD - Poudre River below the confluence with the North Fork at the Bellvue Diversion

TEMPERATURE

Air temperature measured at the Joe Wright SNOTEL over the 2021 summer season was 3.4°F warmer than the long-term average and ranked as the warmest summer on record (32 years). The monthly mean air temperature for June, July and August were notably higher than average. June measured 5.0°F warmer than average, while July and August measured just over 2.5°F warmer than average ***(Table 1).***

Table 1 – *Monthly mean air temperatures measured at Joe Wright SNOTEL over the summer months of 2021 compared to the long-term average (1990–2019). Note: H = hottest and C = coldest*

Period of Record	Temperature			
	2021 (°F)	Average (°F)	Departure (°F)	2021 Rank
June	52.0	47.0	5.0	2nd (H)
July	55.0	52.4	2.6	2nd (H)
August	53.0	50.3	2.7	5th (H)
Summer	53.3	49.9	3.4	1st (H)

PRECIPITATION

Precipitation measured at the Joe Wright SNOTEL over the 2021 summer season was 75% of average and ranked as the 11th driest summer on record (43 years) ***(Table 2).*** Precipitation recorded over the month of June measured well below average and had the largest precipitation deficit over the summer season measuring only 33% of average. There was a slight improvement in July when precipitation measured 73% of average. The warm and dry conditions experienced over the summer season resulted in the return of abnormally dry (D0) drought conditions to the Upper CLP watershed ***(Figure 2).***

Table 2 – *Monthly accumulated precipitation totals measured at the Joe Wright SNOTEL over the 2021 summer season compared to the long-term average (1981 – 2010). Note: W = wettest and D = driest*

Period of Record	Total Precipitation			
	2021 (inches)	Average (inches)	% average	2021 Rank
June	0.8	2.4	33%	9th (D)
July	1.7	2.3	73%	18th (D)
August	2.8	2.4	119%	13th (W)
Summer	5.3	7.1	75%	11th (D)

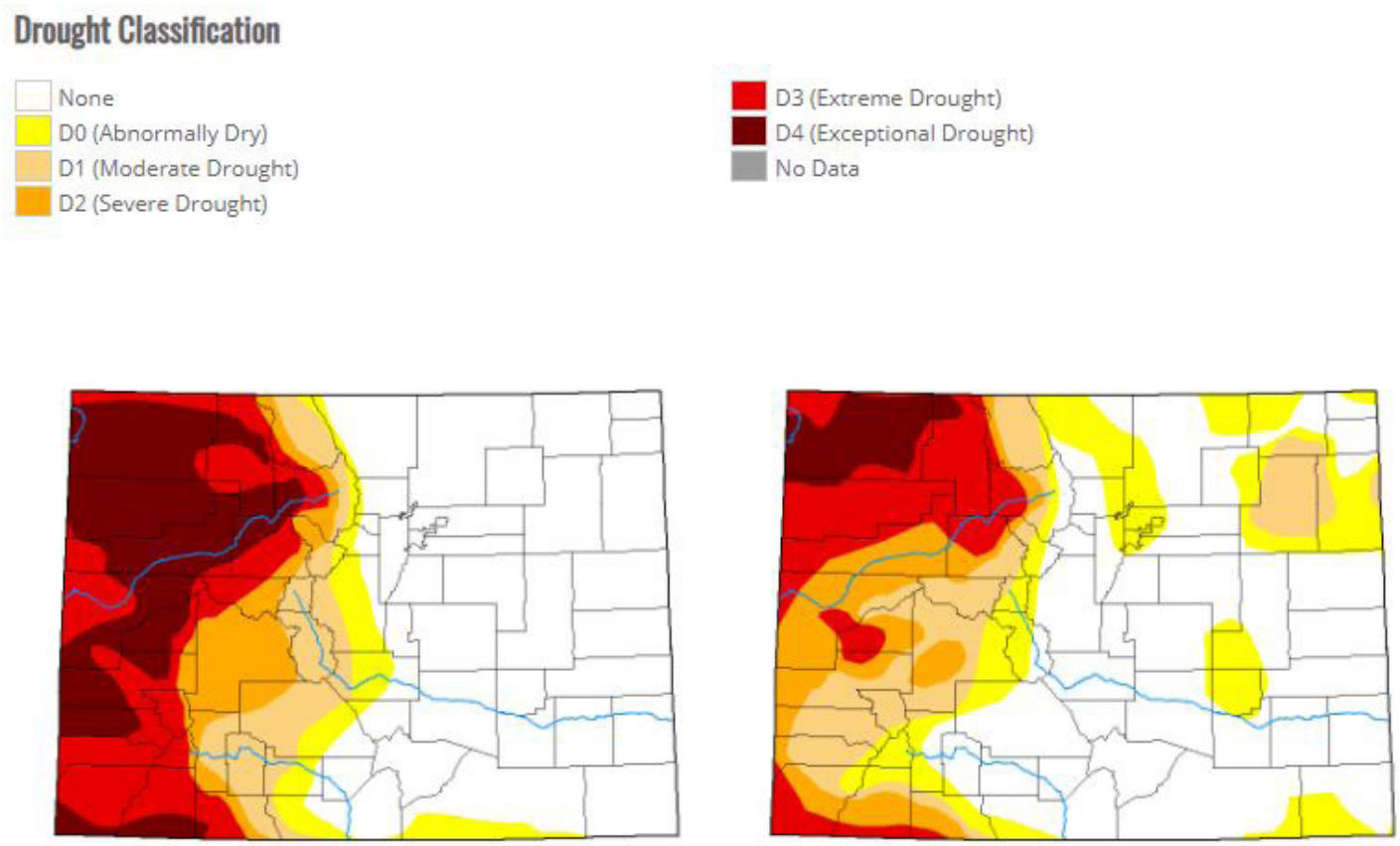


Figure 2 – *Drought conditions for the state of Colorado as monitored by the United States Drought Monitor on June 1(left) and September 2, 2021 (right). (map source: https://droughtmonitor.unl.edu/)*

STREAMFLOW CONDITIONS

Streamflow at the Cache la Poudre River near the Canyon Mouth (CLAFTCCO) stream gage measured 137,923 acre-feet over the summer season which was 80% of the long-term average. Streamflow was below average in June and July, and above average in August. Streamflow was notably lower than average in July, which measured 59% of average. In contrast, streamflow in August measured 120% of average **(Figure 3).**

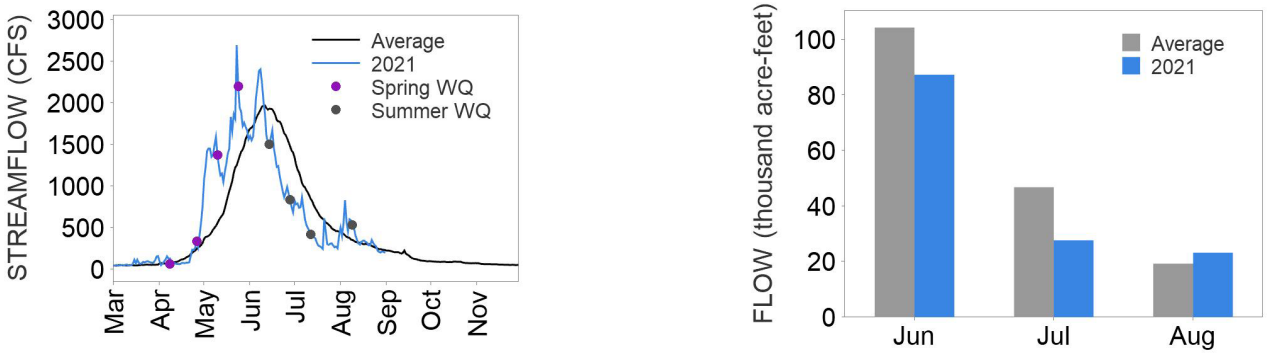


Figure 3 *– Streamflow conditions on the Poudre River over the 2021 summer season (left) and monthly total water volume measured over the summer season (right).*

WATER QUALITY INDICATORS

The Upper Cache la Poudre Collaborative Water Quality Monitoring Program uses several key water quality indicators, including pH, conductivity, temperature and turbidity, which act as surrogates for other parameters ***(Table 3)***. These indicators provide a snapshot of water quality conditions and are useful for identifying trends or changes in water quality. Significant changes in water quality indicators may provide an early warning of potential water pollution.

Table 3 *– Water quality indicators measured as part of the Upper Cache la Poudre Collaborative Water Quality Monitoring Program.*

Water Quality Indicator	Explanation
Temperature	Water temperature influences other water quality parameters and is a major driver of biological activity and algal growth in rivers, including certain phytoplankton species that produce the taste and odor compounds, geosmin and 2-methlyisoborneol.
pH	pH is an important water quality parameter to monitor, because it influences the solubility and biological availability of chemical constituents, including nutrients and heavy metals. pH near 7 is considered neutral, with more acidic conditions occurring below 7 and more basic, or alkaline, conditions occurring above 7.
Specific Conductivity	Conductivity is an index of dissolved ionic solids in water. Conductivity is used as a general measure of water quality. Significant increases in conductivity can be used as an indicator of increased pollution.
Turbidity	Turbidity is monitored to track changes in water clarity. Clarity is influenced by the presence of algae and/or suspended solids introduced to surface waters through various land use activities, including runoff and erosion, urban stormwater runoff and drainage from agricultural lands. For water treatment, turbidity is an important indicator of the amount of suspended material that is available to harbor pollutants, such as heavy metals, bacteria, pathogens, nutrients and organic matter.

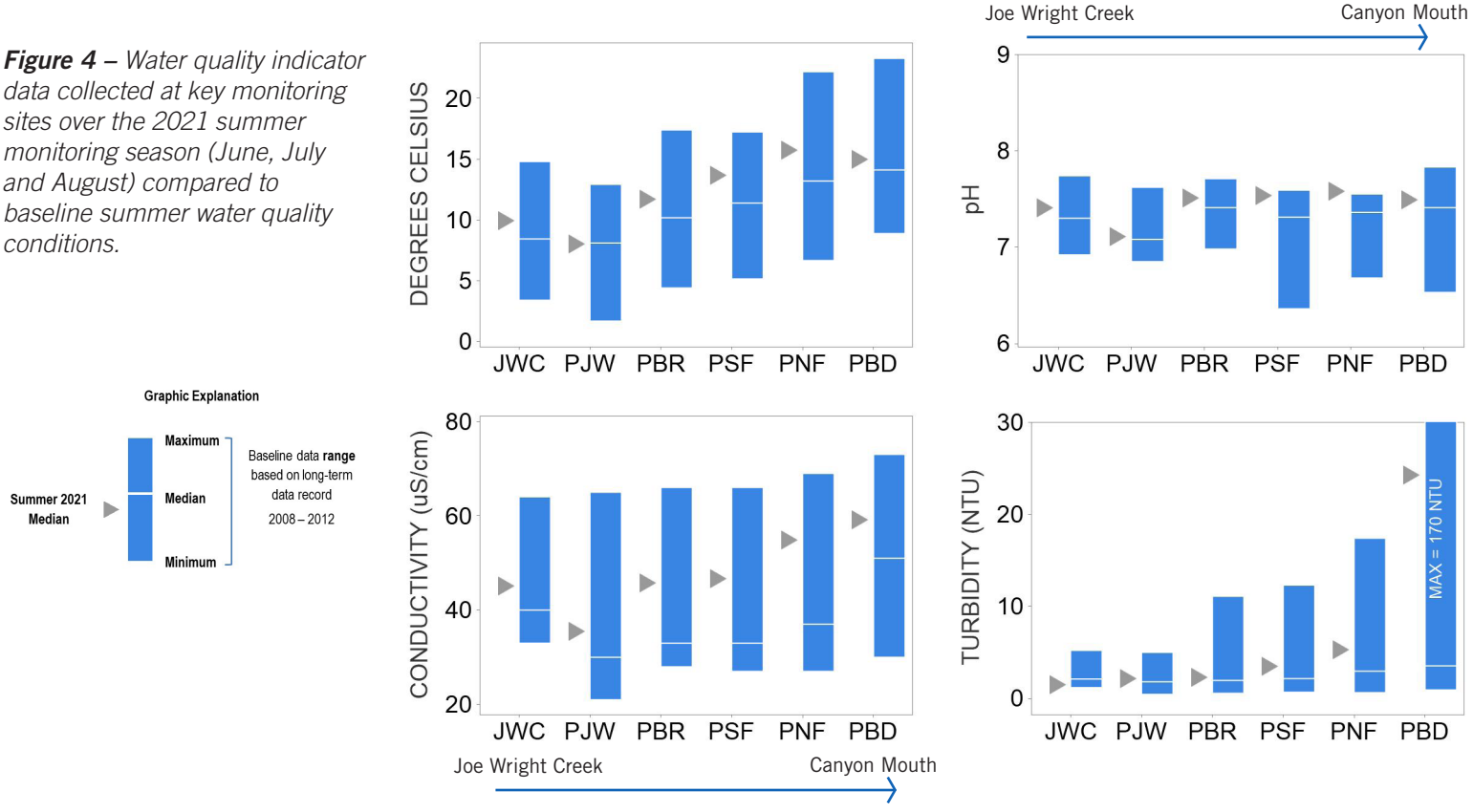
WATER QUALITY INDICATORS CONTINUED

Summer monitoring captures water quality conditions during the Poudre River's highest flow levels (peak streamflow) and when flow levels gradually decrease (the falling limb of the hydrograph) in the months following peak streamflow. Water quality conditions stabilize during this time of year. Constituents that were once diluted by high streamflow begin to concentrate as streamflow recedes. In general, water temperature and specific conductivity increase, while turbidity and pH levels decrease. The summer season also marks the beginning of the summer monsoon, which can lead to increased frequency of rain events. An active monsoon season, in combination with a post-fire landscape, can lead to flash flooding, debris flows and severe impacts to water quality.

Over the summer months of 2021, most water quality indicators at key sites along the Poudre River were within the baseline range of values ***(Figure 4).*** Water temperature was normal in the Poudre River above Joe Wright Creek (PJW) and warmer than normal at all other key monitoring sites. A similar trend was observed in pH; however, pH in the Poudre at the City of Fort Collins' raw water intake (PNF) was higher than any value observed over the baseline (7.58 compared to 7.55, respectively). Specific conductivity values were higher than normal at all key sites, but still within the baseline range of values. Turbidity levels were near normal from Joe Wright Creek (JWC) downstream to the Poudre River below Rustic (PBR) and slightly higher than normal from the Poudre River below the South Fork (PSF) downstream to the City of Greeley's raw water intake (PBD). Turbidity was notably higher at PBD compared to other sites upstream, but not outside the baseline range of values.

The notable departure from baseline of these water quality indicators were not extreme, but these changes do imply post-fire impacts from the Cameron Peak Wildfire, such as of ash, and elevated sediment and solids (dissolved and suspended), continued to impact Poudre River water quality during the summer season.

Figure 4 *– Water quality indicator data collected at key monitoring sites over the 2021 summer monitoring season (June, July and August) compared to baseline summer water quality conditions.*



POST-CAMERON PEAK WILDFIRE WATER QUALITY IMACTS

Water quality monitoring instruments were installed at two locations upstream of the Poudre supply intake facility in early April. The Poudre at Indian Meadows site is located one mile downstream of the Town of Rustic and the Manners Bridge site is located approximately one mile upstream of the City's raw water intake ***(Figure 1).*** This monitoring system provides water treatment operations near real-time water quality data to quickly respond to changes in Poudre River water quality that result from runoff from the Cameron Peak burn area or other upstream events.

High-intensity precipitation events driven by the summer monsoon caused several significant post-fire debris flows and flooding events on the Poudre River over the summer season. The Manners Bridge real-time water quality instrument measured nearly a dozen post-fire storm events over the summer season. Many of these events resulted in severely impacted water quality ("black water") and required water treatment plants to shut down their raw water intakes on the Poudre River for an extended period.

Black water on the Poudre River near the City of Fort Collins raw water intake on June 28.

The typical response in water quality during these events included a drastic increase in river turbidity, pH and specific conductivity corresponding to elevated amounts of sediment and ash being delivered from burned hillslopes and drainages into the Poudre River. The magnitude of these events was extreme with maximum turbidity values ranging from 400 NTU to 1,000 NTU compared to pre-storm event values of less than 5 NTU. The duration was relatively short lived. Water quality impacts lasted for approximately 24 hours following many of the storm events. In contrast, the Black Hollow event that occurred on July 20 resulted in elevated and highly variable turbidity values for over ten days following the event. This devastating event was followed by two additional storm events and turbidity on the Poudre River remains slightly higher than baseline following this turbulent period ***(Figure 5)***.

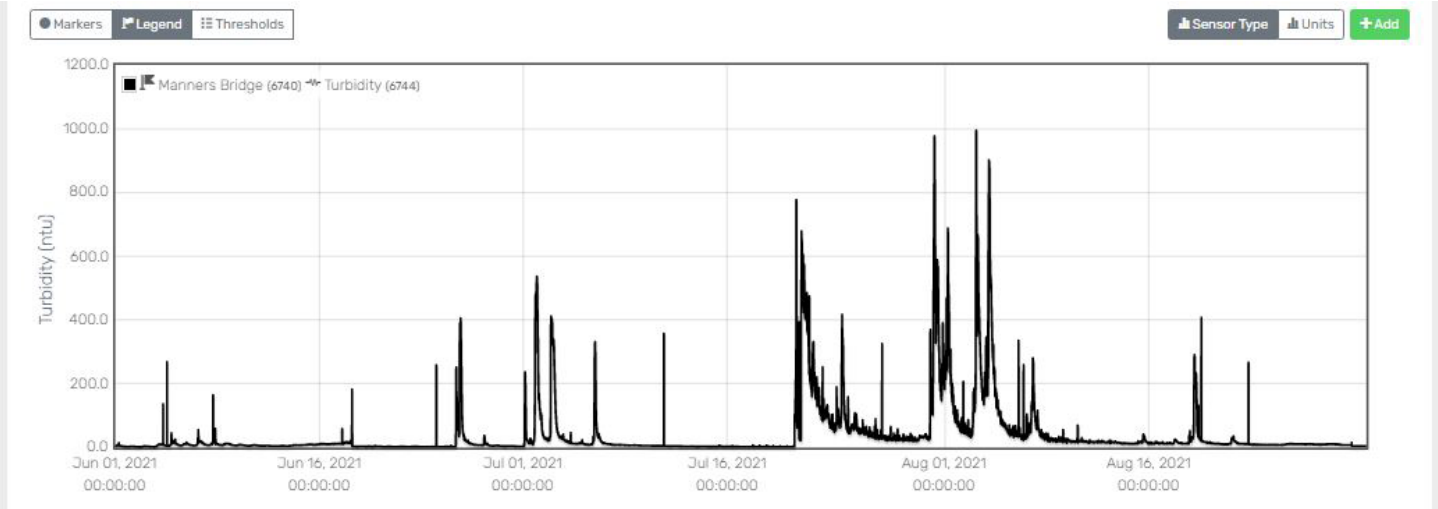


Figure 5 – Turbidity measured in the Poudre River at the Manners Bridge real-time water quality instruments. Several rain events over the Cameron Peak burn scar caused turbidity in the river to increase rapidly over a short amount of time and remain elevated for several hours before returning to normal. Note: These data are preliminary and subject to change and some outlier data may be present.