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 UCLP. Water quality data provide valuable information about the health of our source watershed and raw water supply.

The *2017 Summer Water Quality Update* provides a seasonal summary of water quality conditions in the Upper CLP Watershed by highlighting precipitation, streamflow and drought conditions over the 2017 water year, as well as water quality during the summer season defined by the months of July, August and September.

Water quality begins to stabilize following peak snowmelt runoff and routine monitoring is reduced from bimonthly 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 diversion structures ***(Figure 1)***.

More information is available at *fcgov.com/source-water-monitoring*.

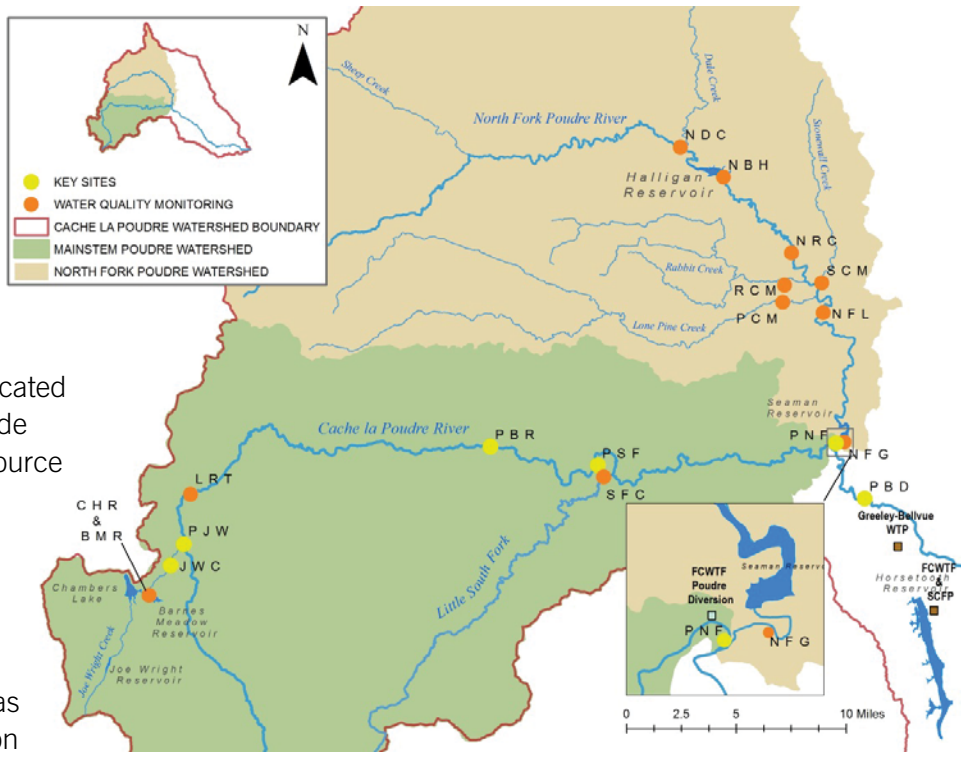


Figure 1 *- Upper Cache la Poudre Collaborative Monitoring Program sampling locations*

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

WATER YEAR REVIEW

PRECIPITATION

Total precipitation measured at the Joe Wright Snow Telemetry station in the UCLP watershed in water year 2017 (October 1, 2016 – September 30, 2017) was above average for most of the year ***(Figure 2)***. The 2017 water year began with dry conditions and above average temperatures through mid-November. Steady precipitation from mid-November through December brought cumulative precipitation above the long-term average.

Strong snowstorms beginning in January increased cumulative precipitation to 160 percent of normal by mid-February. This wet period was followed by warm, dry weather through March, with only 2.8 inches of precipitation. March is considered one of the wettest months with an average of 4.5 inches of precipitation ***(Figure 2)***.

Despite the lower than average precipitation in February and March, the high precipitation totals in December and January helped sustain above average conditions through mid-April. Precipitation was above average in both April and May, easing concerns of drought conditions. Very little precipitation was measured from June through mid-July, however, the summer monsoon returned precipitation to near and above average from mid-July through September. A total of 45.8 inches of water was measured near the top of Cameron Pass over the 2017 water year ending the water year 104 percent above average (44.2 inches) ***(Figure 2)***.

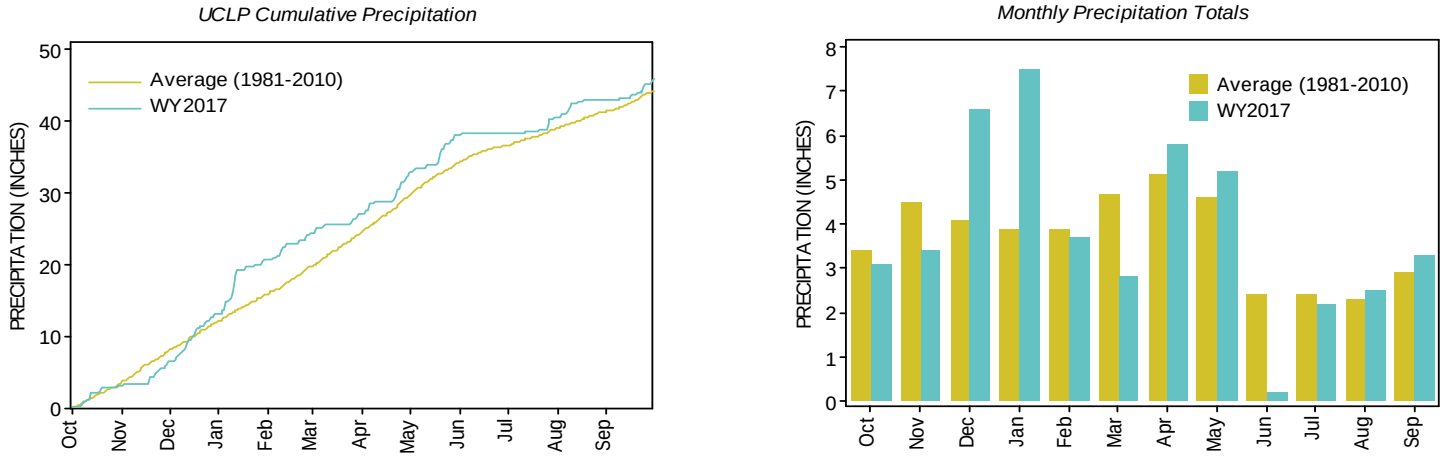


Figure 2 *– Cumulative precipitation (a) and monthly precipitation totals (b) during the 2017 water year compared to the long-term historical average. A water year is a common term used when evaluating precipitation and streamflow defining the 12-month period from October 1 through September 30.*

WATER YEAR REVIEW

STREAMFLOW

Streamflow in the UCLP watershed quickly decreased following peak snowmelt runoff in mid-June. Changes in streamflow during the summer are typically driven by high intensity rainfall events, water releases from upstream reservoirs, and water withdrawals. Summer streamflow was measured below the long-term average through the summer months. Streamflow was above average at the end of the water year as a result of water release higher in the canyon ***(Figure 3)***.

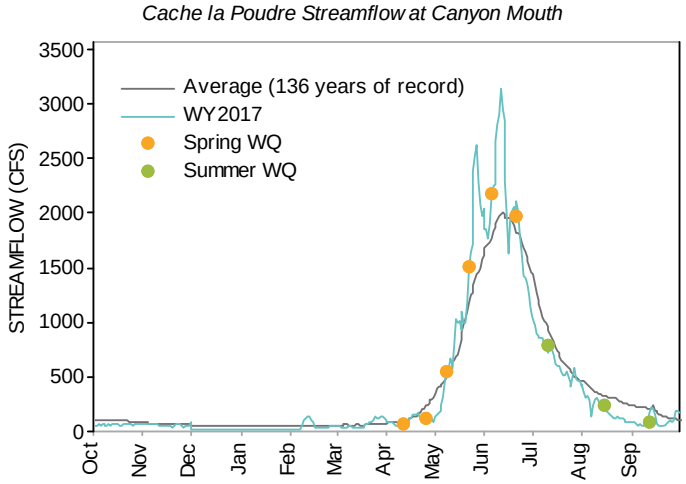
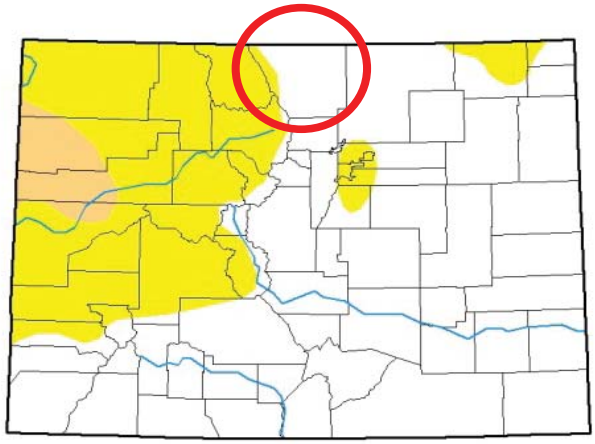


Figure 3 *– Streamflow measured on the Cache la Poudre River at the Canyon Mouth (CLAFTCCO) during the 2017 water year. This gaging station is operated by the Colorado Division of Water Resources.*

TEMPERATURE AND DROUGHT

Temperature measured at the Fort Collins weather station during the 2017 water year was above the long–term average for all months except December and August. The start of the water year was exceptionally warm with average monthly temperatures in October and November nearly 10º Fahrenheit higher than the long-term average. February and March showed similar trends followed by above average temperatures through July. Despite the warmer than average temperatures, abnormally dry drought conditions were only observed near the western boundary of the watershed as a result of above average precipitation ***(Figure 4)***.

U.S. Drought Monitor - Colorado (Sept. 26, 2017)



D0 Abnormally Dry | D1 Moderate Drought | D2 Severe Drought | D3 Extreme Drought | D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary.

Temperature measured at Fort Collins weather station

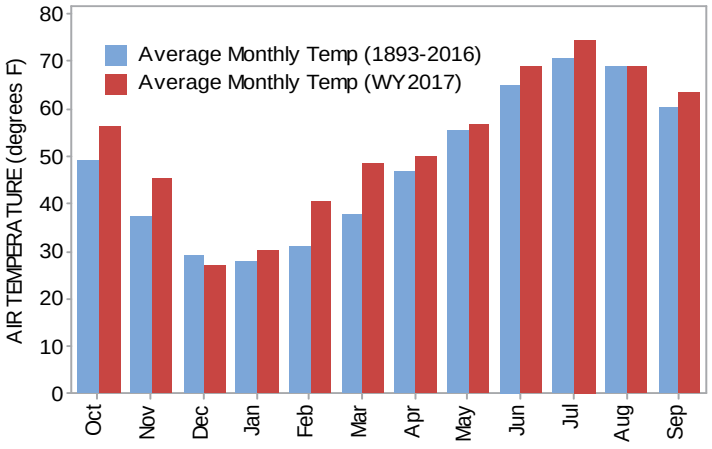


Figure 4 *– Drought conditions throughout Colorado measured by the U.S. Drought Monitoring on September 26, 2017 (right) and monthly average air temperature measured at the Fort Collins weather station over the 2017 water year. Note: Larimer County is outlined in red circle. Image from http://droughtmonitor.unl.edu.*

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 1)***. These indicators provide a snapshot of water quality conditions, which are useful for indentifying trends or changes in water quality. Significant changes in water quality may provide an early warning of potential water pollution for water treatment facilities.

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 compound, geosmin.
pH	pH is an important water quality parameter to monitor, as 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.
Conductivity	Conductivity is an index of dissolved ionic solids in water. Hardness is an index of the total calcium (Ca) and magnesium (Mg) in water.
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.

Table 1 - *Water quality indicators measured as part of the Upper Cache la Poudre Collaborative Water Quality Monitoring Program.*

Summer water quality monitoring captures water quality conditions following peak streamflow throughout the receding or falling limb of the hydrograph and into early baseflow (low flow) conditions observed late summer into early autumn. Water quality conditions vary with elevation, contributing watershed area, streamflow, and seasonal weather conditions. During the summer months of 2017 all water quality indicators were within the range of values observed over the long-term monitoring record.

The median water temperature was higher than normal at all sites. Warmer water temperatures were likely caused by a combination of warmer than average summer air temperatures and below average streamflow conditions following peak runoff. pH was below the long-term median on Joe Wright Creek (JWC) and the Poudre River above the confluence with Joe Wright Creek (PJW), but increased moving downstream from the Poudre River below the Town of Rustic to the City of Greeley's diversion near the Canyon mouth. Conductivity levels were mostly normal throughout the watershed.

Conductivity was marginally greater than normal, but still within the observed range of values, near PNF and PBD. As expected, turbidity decreased during the summer months at all monitoring locations ***(Figure 4)***. The following lists the range of values measured throughout the Mainstem watershed during summer water quality monitoring in 2017:

- Water temperature = 0.1º C – 13.6º C
- pH = 6.85 – 8.20
- Specific conductivity = 21.4 µS/cm – 109.4 µS/cm
- Turbidity =1.4 NTU – 14.0 NTU

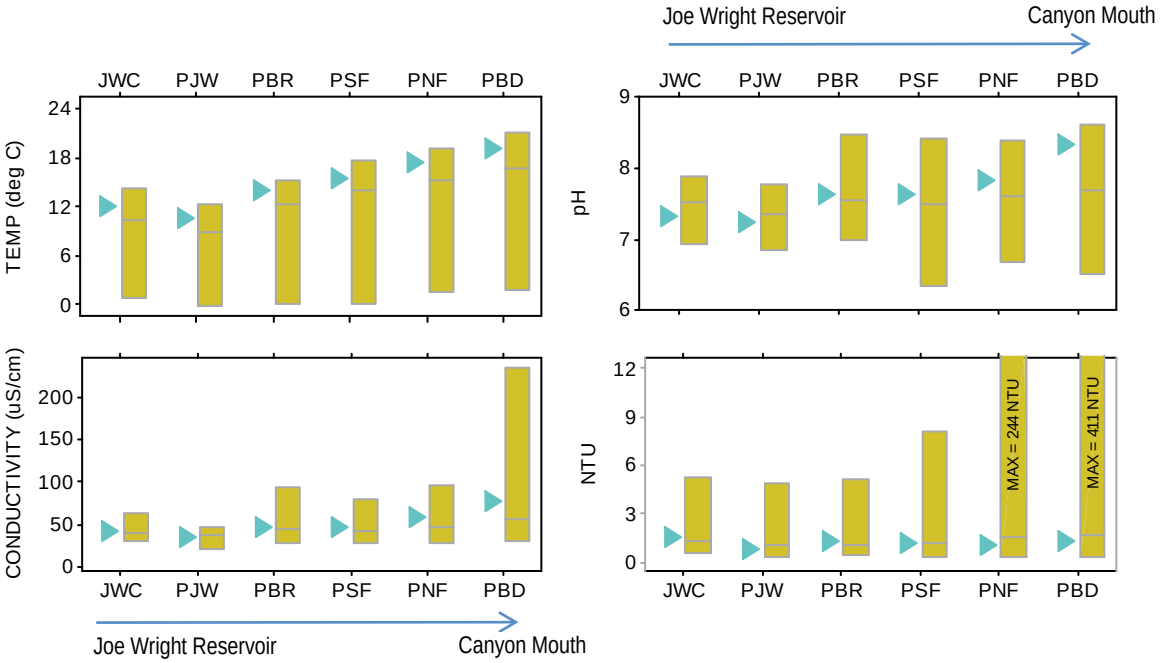
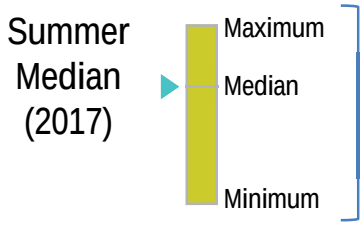


Figure 4 *– Water quality indicator data collected at key monitoring sites during Summer (July, August, September) 2017. Note: the large range of turbidity values observed at PNF and PBD are associated with water quality impacts from the High Park and Hewlett Gulch wildfires.*

Graphic Explanation



Data range based on long-term data record 2008-2016.

Low turbidity water on the Poudre River on August 14, 2017.

MICROORGANISMS

Coliforms are types of bacteria found naturally in the environment in plant and soil material, but can also be found in the digestive tract of warm-blooded animals, including humans. Disease causing bacteria or pathogens can be introduced to the raw drinking water supply from fecal contamination.

Although the water treatment process effectively eliminates pathogens, source watershed monitoring can provide indication of changes in the activity and location of pathogen sources over time. Through the UCLP Collaborative Monitoring Program, the raw Poudre River water supply is routinely tested for the presence of bacterial contamination by measuring the total amount of coliforms, an indicator organism for the presence of pathogenic bacteria. In addition, *Escherichia coli (E. coli)* is measured and used as an indicator of human or animal fecal waste pollution since the source of origin is more specific than total coliforms.

E. coli and total coliforms were within the range of values seen in previous years. *E. coli* concentrations were above the long-term median at monitoring sites located downstream of Rustic (PBR) and the Little South Fork of the Poudre River (PSF). Median concentrations decreased moving down the Poudre Canyon. *E. coli* concentrations were lower than the long-term median at monitoring sites located near the Cities of Fort Collins' (PNF) and Greeley's (PBD) diversions ***(Figure 5a and 5b)***. Total coliform concentrations were below the long-term median at all sites with the exception of the Poudre below Rustic monitoring site where concentrations were slightly above the long-term median. Total coliform concentrations were comparable between monitoring locations.

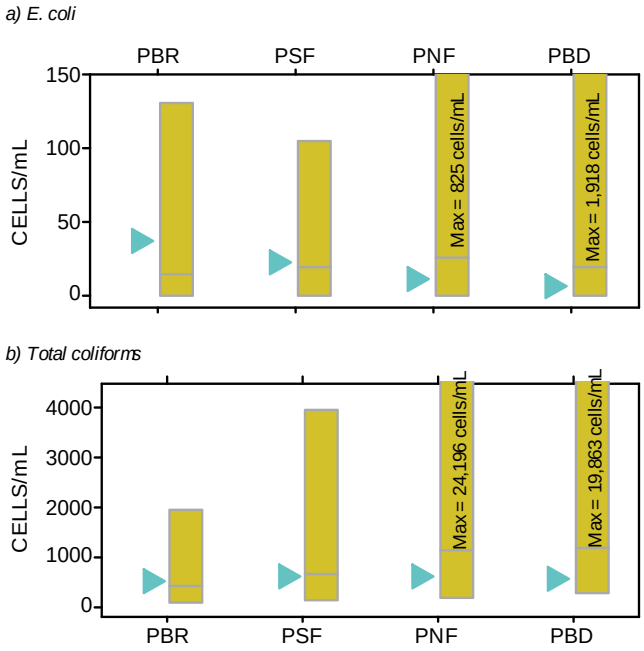


Figure 5 *– E. coli (a) and (b) total coliforms counts on the Poudre River during the 2017 summer season. Note: the large range of E.coli and total coliform values observed at PNF and PBD are associated with water quality impacts from the High Park and Hewlett Gulch wildfires.*

***E. coli* and total coliforms were within the range of values seen in previous years.**

TASTE AND ODOR

Geosmin is a naturally occurring organic compound produced by blue green algae, which introduces an earthy odor to water that can be detected by the most sensitive individuals at concentrations as low as 4 nanograms per liter (ng/L) or 4 parts per trillion (ppt). Geosmin does not pose a public health risk, but it is of concern because its detectable presence can negatively affect customer confidence in the quality of drinking water. Geosmin is monitored at PBR and PNF during routine UCLP monitoring events and it is expensive and challenging to remove during water treatment.

During the summer season in 2017 geosmin levels at PBR and PNF were below the taste and odor threshold of 4 ng/L. Concentrations were measured below the Water Quality Laboratory's detection in July. Geosmin was detected at PBR and PNF in August and September, but concentrations were measured at very low levels posing low risk to the Cache la Poudre River drinking water supply (***Table 2***).

Monitor Date	Geosmin (ng/L)	
	PBR	PNF
7/10/2017	BDL	BDL
8/14/2017	1.83	1.10
9/11/2017	1.60	1.22

Table 2 *– Poudre River geosmin concentrations (ng/L or ppt) during the summer of 2017 at Poudre above the North Fork (PNF) and Poudre below Rustic (PBR) monitoring locations. BDL = below laboratory detection limit.*