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 Tri-Districts, 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 Summer 2015 Water Quality Update provides a seasonal summary of the UCLP Watershed by highlighting streamflow and precipitation conditions, as well as water quality during the months of July, August and September. Water quality begins to stabilize following peak snowmelt runoff and routine monitoring is reduced to monthly sampling.

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).

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

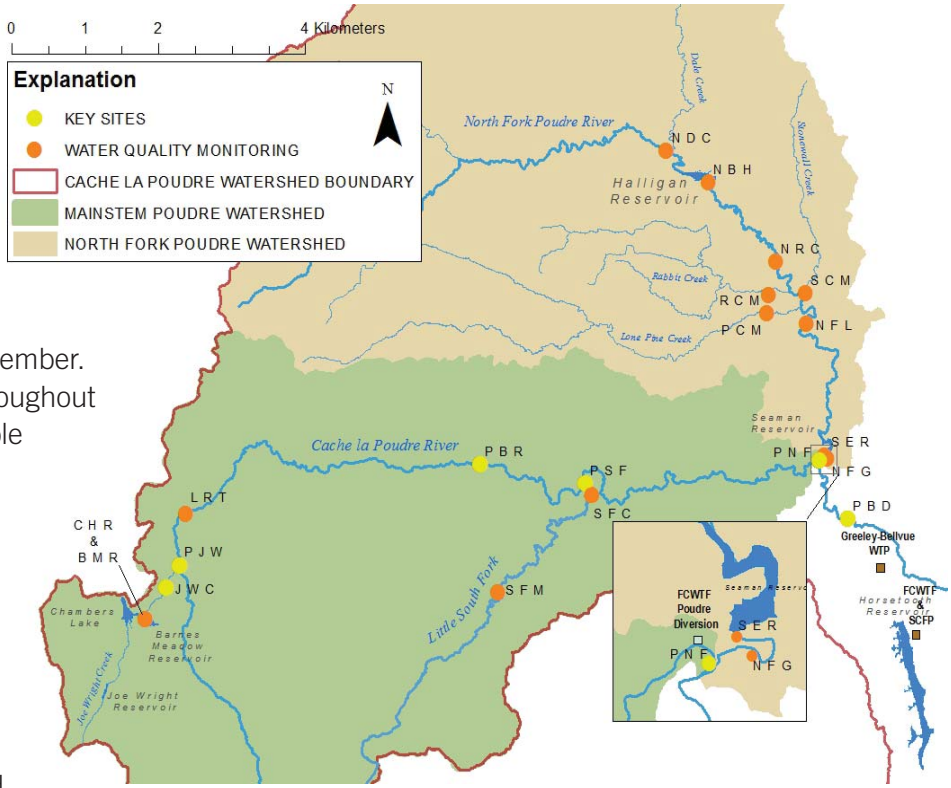


Figure 1 - Upper Cache la Poudre Collaborative Monitoring Program sampling locations

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

PRECIPITATION AND STREAMFLOW CONDITIONS

Total precipitation in the UCLP watershed in water year 2015 (Oct. 1, 2014 – Sept. 30, 2015) was near average for most of the year, before ending slightly below average. A total of 42 inches of water was measured near the top of Cameron Pass compared to an average of 44.7 inches (Figure 2a).

During the summer months, Colorado's monsoon season normally brings increased rainfall to the watershed. In 2015, higher than normal precipitation was observed in July, but in August and September the UCLP watershed received only 2.6 inches of water compared to an average of 5.3 inches (Figure 2b).

In general, summer streamflow in the UCLP watershed steadily decreased following peak snowmelt runoff (Figure 2c). Changes in summer streamflow are typically driven by high intensity rainfall events, water releases from upstream reservoirs and water withdrawals.

In July, one notable storm event brought steady rainfall over the entire watershed from July 4 through July 9, when precipitation totals exceeded 2 inches near Cameron Pass. Streamflow spiked from 1,100 cubic feet per second (cfs) to 1,990 cfs over the five day period and remained above average through July. By the end of the water year, streamflow was measured below average due to dry conditions in August and September.

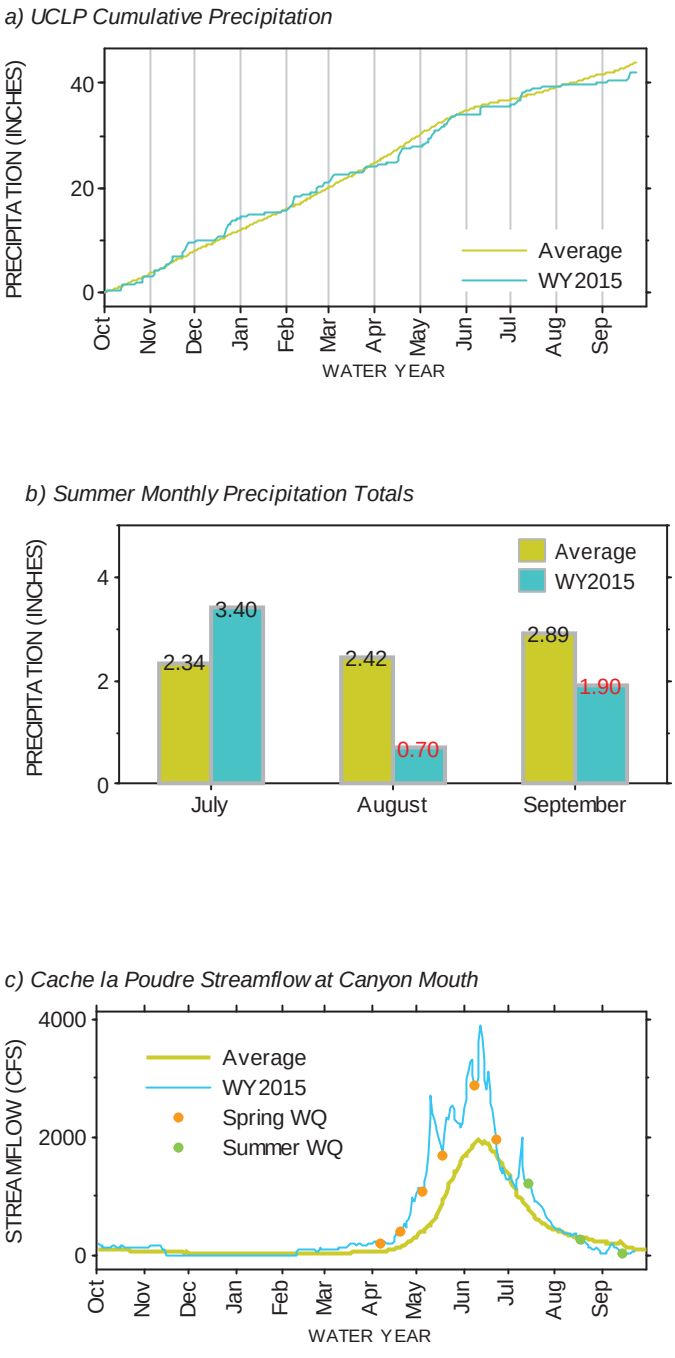


Figure 2 - Cumulative precipitation (a), summer monthly precipitation totals (b), and streamflow in the UCLP (c) during the 2015 water year. A water year is a common term used when evaluating precipitation and streamflow defining the 12-month period from October 1 through September 30.

WATER QUALITY INDICATORS

The Upper Cache la Poudre Collaborative Water Quality Monitoring Program tests for several key water quality indicators, including pH, conductivity, temperature and turbidity (Table 1). These key measurements provide a snapshot of water quality conditions, which are useful to identify trends or changes in water quality. Significant changes in water quality may provide an early warning of potential water pollution.

Table 1 - 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 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 storm water 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.

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 and streamflow.

In 2015, all water quality indicators were within the range of values observed over the long-term monitoring record for the summer season. Most sites and parameters reported near the long-term median, indicating normal water quality conditions. Temperature, pH and conductivity were above the long-term median at most sites, but more evident at monitoring locations below the South Fork (PSF). Water quality differences at these lower monitoring sites are likely associated with spatial and seasonal variations including: 1) elevational changes, 2) reduced dilution effects due to lower streamflow during the summer months and 3) warmer water temperatures. As expected, water clarity improved during the summer months as indicated by decreasing turbidity levels (Figure 3, next page).

Taking water quality samples in late summer on the Cache la Poudre River at PJW

WATER QUALITY INDICATORS CONTINUED

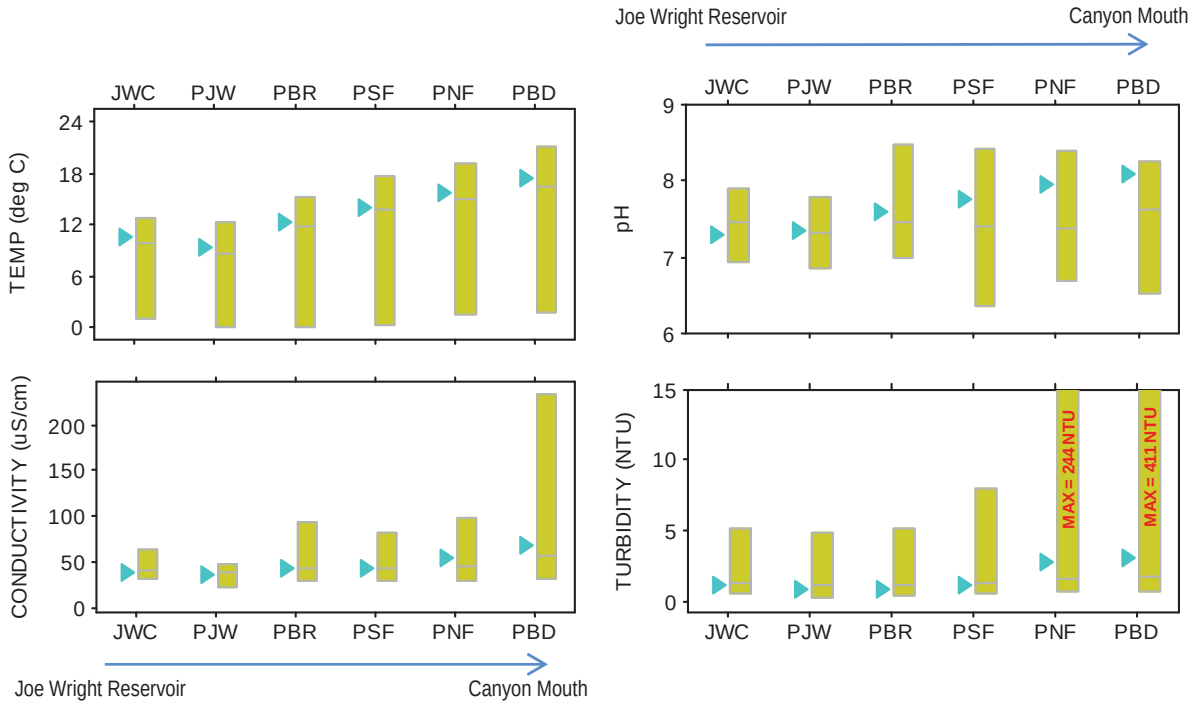
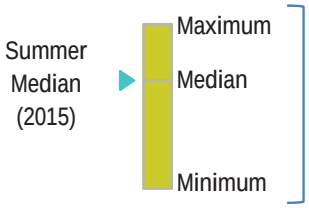


Figure 3 - Water quality indicator data collected at key monitoring sites during summer (July, August, September) 2015

Data range based on long-term data record 2008-2014.

Graphic Explanation



Most sites and parameters reported near the long-term median, indicating normal water quality conditions.

EVENT-BASED STORMWATER MONITORING

Following the 2012 wildfires, event-based or stormwater monitoring was initiated to evaluate the impact on raw water quality and to track watershed recovery. High intensity precipitation events can result in flash flooding and debris flows if they occur over wildfire burn scars.

During the summer season, one notable event was recorded on August 16 from early warning instrumentation upstream of the City's raw water intake structure. Prior to the event, river turbidity was 2 NTU. However, over a two hour period, turbidity increased to a peak value of 805 NTU (Figure 4). Turbidity values returned to pre-storm values within 24 hours of the observed peak.

High Park fire sediment at Picnic Rock in 2012

The "flashy" response in turbidity observed on August 16 indicates the 2012 wildfires continue to impact Cache la Poudre water quality.

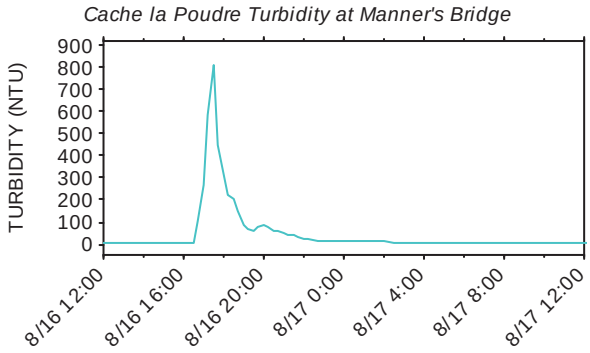


Figure 4 - Turbidity spike measured at the early warning turbidity sensor above the City of Fort Collins intake on August 16.

High intensity precipitation events that occur over wildfire burn scars can result in flash flooding and debris flows that degrade water quality.

MICROORGANISMS

Coliforms are types of bacteria found naturally in plant and soil material. They can also be found in the digestive tract of 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 Upper Cache la Poudre Collaborative Monitoring Program, the raw Poudre River water supply is routinely tested for the presence of bacterial contamination. This is done by measuring the total amount of coliforms, an indicator organism for the presence of pathogenic bacteria.

MICROOGRANISMS CONTINUED

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.

In summer 2015, *E. coli* and T. coli were within the range of values seen in previous years and slightly lower than the long-term median (Figure 5a, 5b). The large range of values observed over the long-term record at PNF and PBD are due to water quality impacts from the High Park and Hewlett Gulch wildfires. High intensity precipitation events in years following the fire provided a mechanism for the delivery of high amounts of soil and debris from burned hill slopes in the watershed, which harbor microorganisms, such as *E. coli* and T. coli. A lack of high intensity precipitation events in the summer of 2015 limited the delivery of these bacteria into the Poudre River.

In summer 2015, E. coli and T. coli *were within the range of values seen in previous years and slightly lower than the long-term median.*

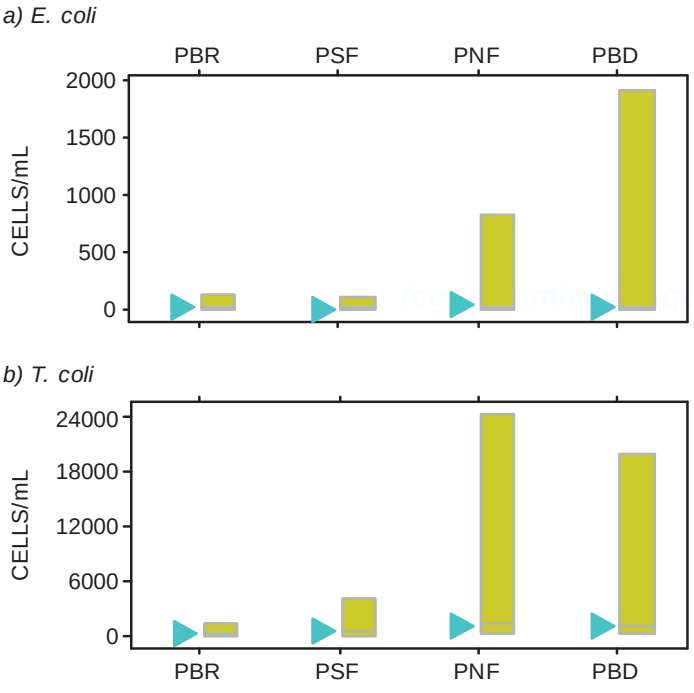


Figure 5 - E. coli (a) and (b) T. coli *counts on the Poudre River during the 2015 summer season*

The City of Fort Collins' Water Quality Lab plays an important role in the UCLP Collaborative Monitoring Program by performing laboratory analysis on all water samples collected in the UCLP watershed. In the photo above, Steve Stefko counts positive wells in an incubated quantitray. For this analysis, quantitray wells that show a color change and fluorescence indicate a positive result for E. coli. The number of positive wells is entered into a calculation to determine the concentration in the sample.

TASTE AND ODOR COMPOUNDS

Geosmin and 2-methlyisoborneol (MIB) are naturally occurring organic compounds that impart an earthy odor to water. They 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). These compounds do not pose a public health risk, but their presence can negatively affect customer confidence in the quality of drinking water. During the summer months of 2015, geosmin concentrations remained below detection at PBR. Concentrations were observed above detection at PNF in August and September, but remained below the taste and odor threshold of 4mg/L. MIB was not detected (ND) at either monitoring location (Table 2).

Concentrations remained

BELOW

the taste and odor threshold

Table 2 - Poudre River geosmin concentrations (ppt) in the summer of 2015 at Poudre above the North Fork (PNF) and Poudre below Rustic (PBR) monitoring locations

Monitor Date	PBR		PNF	
	Geosmin (ppt)	MIB (ppt)	Geosmin (ppt)	MIB (ppt)
7/13/2015	<1	ND	<1	ND
8/17/2015	<1	ND	2.5	ND
9/14/2015	<1	ND	2.4	ND

*Sensitive individuals can detect Geosmin and 2-*methlyisoborneol at concentrations as low as 4 ng/L.