Boulder Creek's bacteria battle

What high levels of E. coli actually mean for creek users

by Casey Flynn

Susan France

Not many sunbathers, tubers or other summer users of Boulder Creek know that for the past nine years the creek has had high counts of Escherichia coli (E. coli). From 13th Street to its confluence with South Boulder Creek, in-stream levels have exceeded Colorado water quality standards and have "impaired" it for recreational use.

E. coli bacteria live in the intestines of humans and other animals and find their way into water through human and animal feces. When an animal defecates in the creek, or near enough for surface water runoff to carry it in, E. coli can get introduced, and pathogens that cause illness can be transmitted through fecal matter. Plus, it's generally less enjoyable to go for a swim alongside a flotilla of feces.

Public health agencies have long used fecal indicator bacteria such as E. coli to monitor for fecal contamination of recreational waters. Under the Clean Water Act, the Environmental Protection Agency (EPA) establishes recommended water quality criteria for the amount of E. coli and other pollutants that can be discharged into waterways, which are then adopted by states as water quality standards. When pollutants surpass the standards, the water body becomes "impaired" and requires clean-up action. But don't panic. E. coli itself is unlikely to make you sick.

"One of the fundamental aspects of recreational water quality criteria that a lot of people probably don't understand is the difference between fecal indicator bacteria and pathogens," says Jane Clary, senior water resources scientist with Denver-based Wright Water Engineers. "Pathogens are what actually make you sick — like norovirus, cryptosporidium or a pathogenic strain of E. coli. Most E. coli strains are harmless, but are easier to monitor relative to the multitude of individual pathogens."

The validity and usefulness of E. coli as an indicator bacteria has been questioned by many researchers and water quality managers. For example, when the EPA published its 1986 Recreational Water Quality Criteria, it was believed that there were no significant environmental sources of fecal indicator bacteria, and therefore high counts of E. coli indicated recent fecal contamination. Multiple recent studies have since found that E. coli can survive and propagate for relatively long time periods in the environment and can falsely indicate recent contamination. Bacteria have been shown to incubate in stream or storm sewer sediment and be released later during rain events or disturbances. Nonetheless, the EPA stayed with E. coli as an indicator bacteria in its recently updated 2012 Recreational Water Quality Criteria since epidemiological studies did not support selection of an alternative indicator.

Another implicit assumption is that research conducted in coastal regions applies to inland flowing waters, like those found in Colorado. Much of the research informing EPA criteria focuses on marine coastal and Great Lakes regions with known human wastewater inputs. For the most part, that's not what we deal with in Colorado.

"In the metro Denver area, the source of elevated E. coli is typically not direct discharges from our wastewater treatment plants," says Clary. "Most have UV disinfection or chlorination that reduces bacteria to very low concentrations. Sometimes I think there's a stereotype that we have untreated, filthy wastewater being discharged into streams, and that's really not what's happening under most circumstances."

Where's the contamination coming from then? Potential origins include faulty septic systems, plumbing errors or leakage from wastewater piping into storm sewers, agriculture, domestic pets and wildlife. It requires advanced and expensive techniques to determine whether E. coli measured in streams is from animal or human sources, but it's an important distinction. According to a 2009 report by the E. coli Work Group of the Colorado Water Quality Forum, "Expert panels convened by EPA and the Water Environment Research Foundation have generally agreed that human sources of bacteria are expected to pose a greater health risk than animals and environmental sources, but have also recommended additional research to better quantify this risk." Due to the complexity of the issue, EPA did not recommend national-level alternative criteria in 2012 for streams affected primarily by non-human sources of bacteria. All E. coli contamination will continue to be treated as a public health risk unless the source can be definitively determined as non-human and not pathogenic. The EPA is working on tools and guidelines to allow states to develop site-specific standards that take into consideration various sources of bacteria.

Despite the debate around E. coli, the City of Boulder has been trying to comply with Clean Water Act standards since the creek was identified as "impaired" for E. coli in 2004.

"We know that E. coli isn't such a great indicator of pathogens," says Donna Scott, stormwater quality manager for the City of Boulder. "But we know that nobody really wants to have raccoon poop or dog poop in the creek, and there might be some indications of other pathogens associated with that."

In 2007 the City of Boulder received an EPA grant to investigate pathogen sources and persistence in Boulder Creek. The city partnered with the Colorado School of Mines and U.S. Geological Survey to conduct source tracking experiments using a variety of tools to discern potential sources and identify storm sewer outfall locations that were discharging high levels of E. coli into Boulder Creek.

In 2011 the city completed a Total Maximum Daily Load, which was required by the Clean Water Act and represents the maximum amount of E. coli that the creek can receive and still meet water quality standards. The Total Maximum Daily Load allocates allowable loads to various sources of pollutants, such as "point sources" with state discharge permits and "non-point" sources such as agricultural lands.

Wildlife and domestic animals — namely raccoons and dogs — are suspected to be the primary sources of E. coli in Boulder Creek.

"In the urban environment, we've created this perfect habitat for raccoons," Scott says. "It offers them shelter and food from trash cans and whatnot and protection from predation because all they have to do is run into the storm sewer system."

Last summer, the city conducted a pilot study to determine if raccoon waste was contributing to high levels of E. coli coming from a small basin into Boulder Creek. Researchers blocked off entry locations to the sewer system so raccoons couldn't get in, then washed out the system and monitored bacteria levels. E. coli plummeted to almost zero and has stayed there since. City officials are looking into further efforts to reduce the appeal and accessibility of storm sewers for raccoon habitat.

E. coli may or may not mean pathogens, but the city still wants to clean up the creek, and they're using a full tool box to do so.

"We know it's high, we know it exceeds standards," says Scott. "We don't know if it's a public health risk, so we're doing what's smart — managing pet waste and wildlife impacts and educating people."

Respond: info@bouldergranic.com