

Environmental Health - Toxic Substances Hydrology Program

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Are Pharmaceuticals in Your Watershed? Understanding the Fate of Pharmaceuticals and Other Contaminants in Watersheds

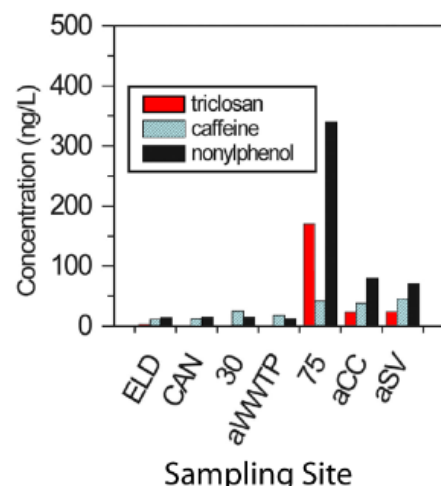


In streams and rivers across the Nation, scientists are finding detectable concentrations of pharmaceuticals and other organic wastewater chemicals. For example, a recent study of the water-quality of streams in the Boulder Creek Watershed, Colorado, found a diverse set of pharmaceuticals and organic wastewater chemicals in water samples. In fact, U.S. Geological Survey (USGS) scientists found 12 of the 22 (55 percent) pharmaceuticals, and 32 of the 47 (77 percent) organic wastewater chemicals looked for in the watershed. Many of the water samples contained a complex mixture of pharmaceuticals, wastewater chemicals, pesticides, and trace metals (see [supporting information](#) for a full listing). Understanding the fate and ecological effects of this complex chemical mixture on a watershed scale is the objective of a team of USGS scientists studying the Boulder Creek Watershed. The scientists found that:

- The concentration of many of these chemicals, such as sulfamethoxazole (an antibiotic used to treat a wide range of bacterial infections), triclosan (an antimicrobial agent commonly used in soaps), and caffeine, increased dramatically downstream from the first major wastewater treatment plant (see [sampling location map](#)). However, some organic wastewater indicators (such as triclosan) were also found in much lower concentrations in the relatively pristine upper part of the watershed, and scientists attributed their occurrence to home septic systems and other sources on the landscape.
- Few of the detected compounds exceeded



USGS scientists collecting water-quality samples for the analysis of emerging contaminants, Boulder Creek, Colorado. Photo Credit: Jennifer A. Beck, USGS.



Triclosan, caffeine, and nonylphenol concentration profiles for Boulder Creek, Colorado, showing downstream (left to right) variations during spring-runoff (June 2000). The increase in concentrations in the stream from site aWWTP to site 75 is the result of the discharge from a wastewater treatment plant into

water-quality standards; however, many do not have water-quality standards. Although it is difficult to assess the potential for adverse ecological effects of such complex chemical mixtures in the wastewater affected part of Boulder Creek ([see sampling location map](#)), native fish populations were found to exhibit endocrine disruption, including low male-to-female sex ratio and fish having both female and male reproductive organs (gonadal intersex).

Boulder Creek.
([Complete description, and a site map.](#))

- Identifying what controls the fate and occurrence of chemicals in streams such as Boulder Creek requires an understanding of the diverse factors present in a watershed, such as the geology, ground-water quality, types of ecosystems, multiple contaminant sources, climate, land use, and amount of urbanization.

Water-resource managers can use this watershed approach to understand the complex interaction of a watershed's characteristics (land use, population density, geology, hydrology, ...) and the fate and impact of contaminants, such as pharmaceuticals and organic wastewater chemicals, and to make more effective water management policies.

Reference

Barber, L.B., Murphy, S.F., Verplanck, P.L., Sandstrom, M.W., Taylor, H.E., and Furlong, E.T., 2006, [Chemical loading into surface water along a hydrological, biogeochemical, and land use gradient—A holistic watershed approach](#): Environmental Science and Technology, v. 40, no. 2, p. 475-486, doi: 10.1021/es051270q. ([Supporting Information](#))

More Information

- [Chemical Transformations in Water Reclamation and Reuse](#)
- [In-Stream Processes](#) that Control the Fate of Emerging Contaminants
- [Water Quality of the Boulder Creek Watershed, Colorado](#)

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- [Developing Methods to Measure New Contaminants in Aquatic Environments](#)
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- [National Reconnaissance of Pharmaceuticals, Hormones and Other Organic Wastewater Contaminants in U.S. Streams is Making an Impact](#)
- ["National Reconnaissance of Pharmaceuticals, Hormones, and Other Organic Wastewater Contaminants in Streams" Named as One of the Top 100 Science Stories of the Year](#)
- [What's in Our Wastewaters and Where Does it Go?](#)

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