# Abstracts

Wednesday, April 30

## Session H4: Contaminants of Emerging Concern

1:30 – 3:00 pm | Room 237

***Bottoms up? Chemical and Microbial Contaminants of Emerging Concern in Source Water and Treated Drinking Water of the United States***

**Susan Glassmeyer[1], Edward Furlong[2], Dana Kolpin[3], Angela Batt[1], Bob Benson[4], Scott Boone[5], Octavia Conerly[6], Maura Donohue[1], Dawn King[1], Mitch Kostich[1], Heath Mash[1], Stacy Pfaller[1], Kathleen Schenck[1], Jane Ellen Simmons[7], Eunice Varughese[1], Stephen Vesper[1], Eric Villegas[1] and Vickie Wilson[7]**
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**Abstract**
The drinking water and wastewater cycles are integrally linked. Chemicals that are present in household wastewater may be sufficiently mobile and persistent to survive on-site or municipal wastewater treatment and post-discharge environmental processes. Such compounds have the potential to reach surface and ground waters which can be the sources of drinking water. The US Environmental Protection Agency (USEPA) and the US Geological Survey (USGS) have collaborated on two sampling campaigns assessing untreated and treated drinking water sources in the United States. In Phase I (2007), samples from nine drinking water treatment plants (DWTPs) were analyzed for over 80 contaminants of emerging concern (CECs). In Phase II (2010-2012), samples from 25 DWTPs were analyzed for over 250 organic, inorganic and microbial analytes (which includes the Phase I analytes). Five DWTPs were sampled in both Phase I and II. Sampled DWTPs utilized a mix of surface and ground water sources, and used a variety of disinfectants (*e.g.*, chlorine, chloramine, and advanced treatments such as ozone and UV). Of the organic and microbial analytes in Phase II, 135 were detected at least once in the source water, and 104 were detected at least once in the treated water. In a single DWTP, the maximum number of analytes detected was 96 in the source water and 59 in the treated water; the median number of analytes across the 25 DWTPs was 33 in the source water and 21 in the treated drinking water. An examination of the source water data suggests that CEC frequency may be associated with season of sample collection, watershed land use, waterbody type, and total organic carbon. When the source water data is compared to their corresponding treated drinking water samples, the qualitative efficacy of various treatment practices can be examined.

***Pharmaceuticals and Other Contaminants of Emerging Concern (CECs) in Source and Treated Drinking Waters from 25 Drinking Water Treatment Plants: Compositions, Concentrations, and Reductions***

**Edward Furlong[1], Angela Batt[2], Susan Glassmeyer[2] and Dana Kolpin[3]**
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**Abstract**
The widespread presence and distribution of pharmaceuticals & anthropogenic waste indicators (AWIs) in surface and ground water has created substantial scientific and public interest in their presence and distribution in water supplies and potential consumer exposure in drinking water. Thus, a comprehensive assessment of a wide range of CEC classes is necessary to assess potential for exposure to mixtures of these compounds.

In response, the U.S. Geological Survey and the U.S. Environmental Protection Agency jointly conducted a study of CECs in water from 25 drinking water treatment (DWTP) plants across the United States, sampling ground- and surface-water sources prior to and after treatment processes commonly used to produce drinking water. The DWTPs studied reflected diverse geographic locations, water sources, disinfectants, and plant sizes. Five complementary methods were used to determine 199 CECs, including 134 pharmaceuticals. Subsets of compounds common to two or more methods were used to verify detections.

Pharmaceuticals were detected in both source and treated water samples, ranging in concentration from 2.5 to 940 ng/L, with more frequent and higher concentrations generally occurring in source water samples. Metformin, tramadol, and carbamazepine were the most frequently detected pharmaceuticals in source water samples at maximum concentrations of 730, 42, and 40 ng/L, respectively. Metformin, carbamazepine and cotinine were most frequently detected in treated water samples at maximum

concentrations of 92, 17, and 16 ng/L, respectively. Concentrations of carbamazepine, frequently detected in source and treated waters and measured in four methods, were significantly correlated.

The AWIs caffeine, N,N-diethyl-meta-toluamide (DEET) , and tri(2- butoxyethyl) phosphate were most frequently detected in source water at maximum concentrations of 130, 98, and 470 ng/L, respectively. Bromoform, caffeine, and DEET were the most commonly detected AWIs in treated water samples at maximum concentrations of 3300, 75, and 25 ng/L, respectively. Frequent high concentrations of bromoform likely are due to formation as a disinfection by-product (DBP). These results suggest that multiple pharmaceuticals and AWIs are present at concentrations below 1000 ng/L in both source and treated drinking water. Treatment processes evaluated in this study reduce detections and maximum concentrations of many, but not all, measured CECs.

## *Effects of Treated Wastewater Effluent on Water-Quality, Sediment-Quality, and Biological Condition in Spirit Creek, Fort Gordon, Georgia*

**Paul Bradley and Celeste Journey**
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**Abstract**
Fort Gordon is a U.S. Department of the Army (Army) facility located in east-central Georgia, near Augusta. A wastewater treatment plant on Spirit Creek was closed prior to 2012. The U.S. Geological Survey, in cooperation with the Fort Gordon's Environmental and Natural Resources Management Office, has been conducting a two-phase study to assess the water quality, sediment quality, and biological conditions of Spirit Creek at sites upstream and downstream from the wastewater treatment plant outfall prior to (phase 1) and after (phase 2) closure of the plant. Specifically, concentrations of major ions, trace elements, nutrients, and contaminants of emerging concern (for example, fragrances, detergent agents, pharmaceuticals, and hormones) in water and sediment and benthic macroinvertebrate community structure were assessed and compared among sites and between phases. In phase 1, several types of contaminants of emerging concern were detected in water and sediment at sites downstream from the treated effluent outfall, including detergent agents, flame retardants, fragrances, and hormones. Many of the detected contaminants also are known endocrine disruptors. However, the frequency of detection and concentrations varied between the sediment and water. In the water column of Spirit Creek, total nitrogen and phosphorus concentrations increased by more than an order of magnitude downstream from the wastewater effluent discharge. Inorganic constituents, including metals and major ions, also demonstrated higher concentrations in water at downstream sites relative to the upstream site. Benthic macroinvertebrate richness and diversity metrics were determined at the upstream and one downstream site. The computed metrics demonstrated reduced richness and diversity at the downstream site, which indicated a cumulative negative effect on the biological community by environmental stressors at the downstream site. The post-closure ecosystem response will be presented.

## *Development of Indicators for Emerging Trace Organic Compounds*

**Drew McAvoy[1], Carrie Turner[2], John Wolfe[2] and Allen Burton[3]**
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**Abstract**

Trace organic compounds (TOrCs), such as pharmaceuticals and personal care products, are emerging pollutants of concern because of documented adverse effects on aquatic life. However, the effects and corresponding exposure levels of many TOrCs and mixtures of TOrCs are not well understood. Sampling and analyzing TOrCs is challenging because their physical and chemical properties are often quite different from conventional pollutants. In addition, highly sensitive analytical methodologies are needed to measure quantifiable amounts of TOrCs and to relate exposure levels to aquatic effects. These methods require the use of multiple preparatory and analysis procedures. As a result, the costs and equipment needed for sample collection, preparation, and analysis can exceed the resources of the typical municipal utility. A simpler and smaller list of compounds to function as indicators has been developed as part of a Water Environment Research Foundation (WERF) study (CEC6R12) to develop screening tools for evaluating the impact from TOrCs. The indicator list of TOrCs was developed to add clarity to the prioritization process, to facilitate the use of the site screening framework, and to potentially reduce analytical costs. This paper presents the development of the list of indicator TOrCs, the analytical methodology to measure the indicator TOrCs, and the factors used to develop the list, including ubiquitousness, chemical properties, fate and transport, toxicity, treatability through conventional wastewater treatment processes, reliability as an indicator, and aquatic effects.