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WET WATER AND ENVIRONMENTAL TECHNOLOGY CENTER

Emerging Contaminants in the Delaware River Watershed

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Abstract

The goal of this research project is to increase our understanding of the occurrence of contaminants of emerging concern (CECs) in surface waters by collecting and analyzing ambient water samples from a targeted area of the Delaware River Basin. Concentrations of CECs are generally higher in urbanized and industrialized areas as was found in a previous study of the tidal Delaware River (report by DRBC; MacGillivray, 2012). The ten sampling sites in this study are in an area of southeastern Pennsylvania with numerous municipal and industrial discharges to surface water. The sampling locations are above and below potential source discharges for CECs in watersheds draining to the Delaware River (Figure 1). Data and information obtained from this study should advance our understanding of the prevalence of emerging contaminants in relation to potential sources and build on previous studies. Collectively, this information can provide environmental managers and other members of the environmental community and stakeholders with a greater awareness and better understanding of the presence of unregulated contaminants of concern in surface waters. This project can provide information needed for water quality planning and policy for emerging contaminants.
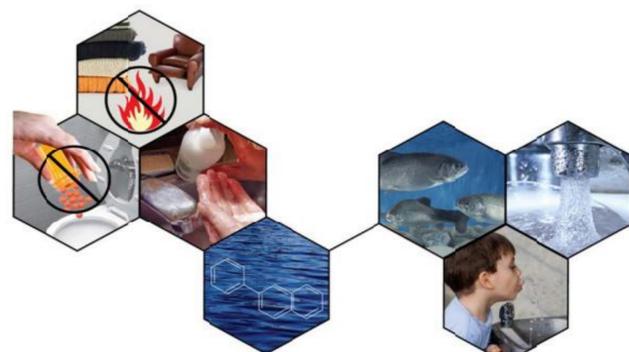
Photo from DRBC, MacGillivray, 2012

Emerging Contaminants

Contaminants of Emerging Concern (CECs) or often simplified as Emerging Contaminants (EC) are compounds who's discharge into the environment is not regulated. "In the past decade, polybrominated diphenyl ethers (PBDEs) and perfluorinated compounds (PFCs) have emerged as contaminants of concern because they are widely distributed and persistent in the environment. Both types of chemicals accumulate in human tissue or blood, and are associated with health effects including endocrine disruption" (EPA. 2014). This study will focus more on ECs that are in the Pharmaceutical and Personal Care Product (PPCP) group. Pharmaceuticals are widely used and the majority of pharmaceuticals are not fully metabolized by the human body. They are excreted through urine, which then becomes part the municipal sewer system that is treated in the wastewater treatment plant. What is not fully removed is ending up in our watershed. Therefore we need to know their presence in our watershed to determine the exposure.
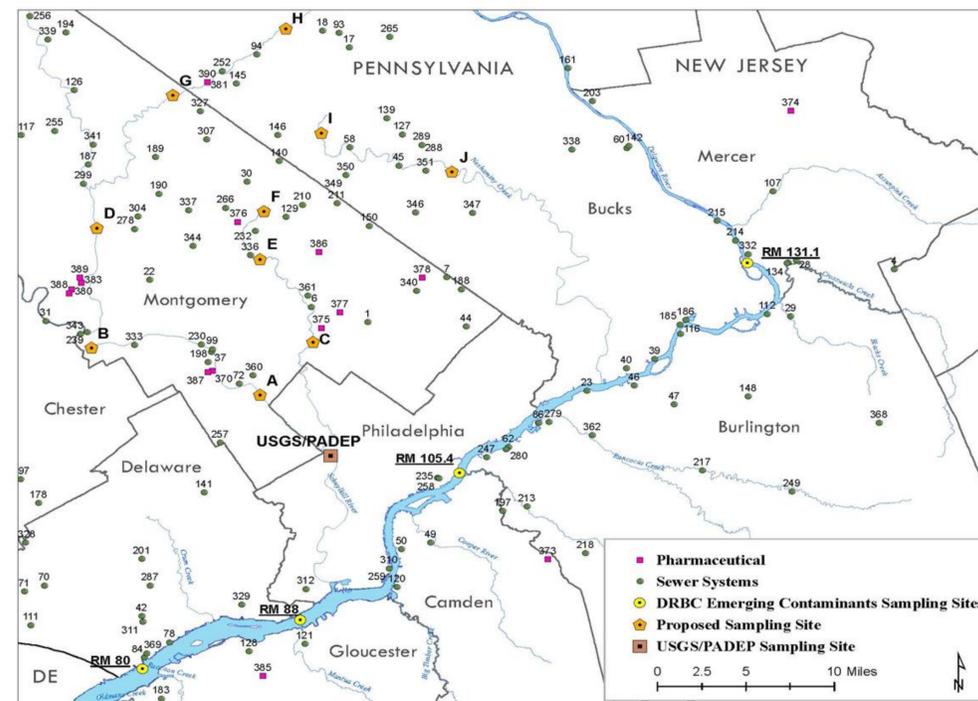
Sampling Map

Figure 1. Sampling map (DRBC, MacGillivray, 2012)

Processed water sample

Figure 2. Photo from the WET Center lab showing analytical instrument WATERS XEVO TQMS

Figure 3. Sample chromatograms from the HLPC/MS/MS

Analytical Method

The sample collection and analysis were performed based on the EPA Method 1694: Pharmaceuticals and Personal Care Products in Water, Soil, Sediment, and Biosolids by HPLC/MS/MS. Grab samples were taken at 10 different locations shown on the map. The 1L samples were further processed and analyzed on the Waters XEVO TQMS (Figure 2). Once the compounds are eluted by liquid chromatography (Figure 3.) then they are confirmed by two daughter ions that are obtained on the mass spectrometer. This allows us to quantify each compounds up to a low parts per trillion (a million times smaller then a milligram), in our case nanograms per liter.

Data

The data from this research study is still processed and analyzed. The data shown below is sample data from the previous DRBC, MacGillivray 2012 study.

Compound	Concentration (ng/L) by Site / River Mile					
	RM / 50	RM / 68.1	RM / 80	RM /88	RM / 105.4	RM / 131.1
Acetaminophen*	ND	ND	ND	105	ND	ND
Albuterol	ND	0.40	0.83	0.84	0.56	0.34
Alprazolam*	0.42	0.46	0.61	0.58	0.38	0.51
Amitriptyline*	0.49	1.01	1.17	1.39	0.83	0.76
Amphetamine*	ND	ND	3.83	5.53	4.52	ND
Atenolol*	13.80	20.20	53.80	58.80	28.60	11.60
Azithromycin	ND	ND	ND	ND	ND	9.53(6)
Benzoylecgonine*	6.92	16.20	30.50	39.60	10.60	6.04
Caffeine	18.25(8)	49.53(16)	106.57(15)	158.77(9)	71.50(3)	52.40(8)
Carbadox	ND	ND	7.48	5.89	2.20	ND
Carbamazepine	21.30(8)	47.20(16)	55.63(15)	42.60(9)	23.93(3)	18.50(8)
Clarithromycin	4.78*	ND	2.20(1)	8.38(5)	6.21(1)	4.24(2)

Progress

The contaminants might have an affect on the environment in which they are present. If a compound has a certain hazard and if there is exposure to it, then there is risk to the species that are living or are in contact with that environment. This study is the first step for evaluating the risk of these emerging contaminants. We are quantifying their presence and in turn the exposure to these compounds in the watershed.
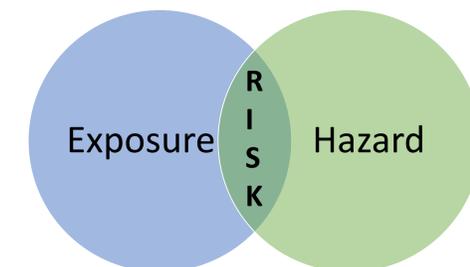
References

DRBC: MacGillivray R. (2012). Contaminants of Emerging Concern In the Tidal Delaware River. Pilot Monitoring Survey 2007-2009. Delaware River Basin Commission.

Environmental Protection Agency (EPA) (2014). Contaminants of Emerging Concern. http://water.epa.gov/scitech/cec/

Acknowledgments