Spatial Trends of Pharmaceuticals in an Urbanized Estuary: Influence of Wastewater Effluents in Narragansett Bay, RI, USA

David R. Katz†, Mark G. Cantwell†, Julia C. Sullivan‡, Robert M. Burgess†, and Kay T. Ho†

†U.S. Environmental Protection Agency, National Health & Environmental Effects Research Laboratory, Atlantic Ecology Division – Narragansett, RI, USA

‡Oak Ridge Institute for Science and Education – Narragansett, RI, USA

For years, pharmaceuticals have been routinely detected in wastewater treatment plant effluents and freshwater systems. Wastewater effluent serves as a primary source of pharmaceutical compounds to natural waters. Many marine and estuarine systems receive inputs either directly from wastewater effluents or from wastewater affected freshwater systems, and recent research has detected the presence of numerous pharmaceuticals in marine environments. However, the factors that influence the spatial variability of these compounds remain poorly understood. In natural waters, many pharmaceutical compounds remain largely in the dissolved phase due to their high aqueous solubility, and are therefore potentially bioavailable to aquatic life. The current study focused on the spatial distribution of a suite of 16 pharmaceuticals in Narragansett Bay (NB), Rhode Island, USA. These compounds were measured in the surface water at 8 stations throughout NB on March 16, 2015. Pharmaceutical concentrations ranged from below 1 ng/L to 155 ng/L at all NB sites. Concentrations of these pharmaceuticals exhibited a gradient from high to low along the north to south direction of NB respectively, which correlates with proximity from high volume wastewater effluent discharges and population density. Three sites in the northern section of NB receive significant volumes of treated effluent, and these contributions were reflected in the pharmaceutical concentrations determined in samples from these sites. Lower volume discharges are present near the other sites, but these discharges had a smaller effect on the observed data. At least 11 of the 16 compounds were present at each site. An antibacterial compound (sulfamethizole) was not present at any site, and a diuretic compound (furosemide) was only present at one site. All other compounds were present at three sites or more, and several (sulfamethoxazole, trimethoprim, atenolol, metoprolol, caffeine, diltiazem, valsartan, verapamil, and gemfibrozil) were present at all sites during the study period, with caffeine and valsartan were consistently present in the highest concentrations at all sites.