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Department of Environmental Science and Policy
College of Science
George Mason University

Candidate: Cheyenne Hawkins
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Thesis Director: Dr. Scott Glaberman
Committee: Dr. T. Reid Nelson, Ms. Kelly Smalling

ABSTRACT

Detection of chemicals of emerging concern (CECs) in aquatic systems is raising concern about exposure limits and environmental health. New Approach Methodologies (NAMs), which include a range of molecular and computational techniques, are being developed to help reduce animal-intensive toxicity testing with risk-based prioritization approaches. Certain NAMs are aimed at translating concentration data into risk assessment by comparing target chemical concentrations to a range of available toxicity data, including high-throughput bioassays and whole-organism toxicity endpoints, to prioritize "high risk" chemicals. This thesis applies such a geographic-based chemical prioritization approach to forecast risk in tributaries of the Chesapeake Bay and identify problematic contaminants for further research. Our study encompasses two distinct geographic scales: a micro-scale analysis focusing on a Potomac River tributary, assessing the impact of a local wastewater treatment plant (WWTP) and combined sewer overflows (CSOs); and a macro-scale analysis across multiple Chesapeake Bay tributaries, evaluating urban and agricultural land-use contributions to contaminant risk. In the micro-scale study, we identified several "high risk" chemicals that exceeded toxicity thresholds, especially psychotropic compounds. We found the highest potential risk near the WWTP and CSO outfalls at the Potomac River tributary; however, the risk levels dramatically decreased in the mainstem Potomac River, likely due to its greater flow. In the macro-scale study, we also identified several "high risk" chemicals that exceeded toxicity thresholds. We found greater chemical concentrations, especially hormone and pesticide compounds, with highest potential risk at sites where land-use was predominantly agricultural. These results support the need for further organism-specific and landscape studies to research the biological effects of "high risk" chemicals and risk correlations to agricultural land-use and WWTP sources.