

Session K7: Monitoring for Microbial Pathogens

Room C124
3:30 – 5:00 pm

0074
K7-1

Portland Water Bureau's One-Year *Cryptosporidium* Study in the Bull Run Watershed

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In June 2011, the Portland Water Bureau (PWB) submitted a request for a variance to the treatment requirements of the Long Term 2 Enhanced Surface Water Treatment Rule (LT2). To obtain a variance for the LT2 requirements, Portland must demonstrate to the satisfaction of the State of Oregon that the nature of its Bull Run raw water source makes treatment for *Cryptosporidium* unnecessary to protect public health. Portland sought a variance under this standard because no *Cryptosporidium* has been detected in the Bull Run since 2002, despite the implementation of an intensive monitoring program.

To gather data that would demonstrate whether treatment for *Cryptosporidium* is necessary, PWB developed a comprehensive sampling plan and study. The primary feature of the plan was an intensive year-long sampling program to evaluate the concentration and type of *Cryptosporidium* at the raw water intake of the Bull Run watershed. To supplement the intake sampling data, PWB also provided two additional study components, based on extensive feedback and input from the EPA: 1) an investigation into upstream locations to help determine whether potential "hot spots" exist in the watershed, and 2) the adaptation of a process-based model to better characterize the fate and transport of *Cryptosporidium* in the Bull Run watershed. The presentation will cover an overview of Portland's LT2 Variance Sampling Plan and Study and the data collected over the one-year period. PWB believes that this program is one of the most intensive *Cryptosporidium* sampling programs undertaken by a water utility in the U.S.

0132
K7-2

Monitoring Indicator Bacteria Growth in Marine Sediment Causing Shellfish Harvest Closures

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Oakland Bay (South Puget Sound, Mason County, Washington) has a critical summer period for indicator bacteria concentrations that are indicative of potential pathogen contamination in the marine water column. This has diminished harvest opportunities in a bay that hosts shellfish resources of North American significance. The lack of typical stormwater transport mechanisms during the summer months led to an investigation of fecal coliform (FC) bacteria concentrations in both freshwater and marine sediment as potential secondary sources of water pollution. Both sediment types serve as a reservoir of bacteria which re-suspend into the water column with sufficient shear stress from wind, wave, or current action.

Our data suggests that marine inter-tidal sediments are a more hospitable environment for summer FC bacteria survival than freshwater sediments. In 2010, freshwater sediment FC concentrations were fairly consistent between May and September, ranging between 150-570 MPN/100 g DW with no discernable seasonal trend. In marine sediments, FC concentrations ranged from 25-21,000 MPN/100 g DW with a clear upward trend as the summer progressed. Overall, monthly mean marine sediment FC concentrations from 2007-10 show a steady increase from 215 MPN/100 g DW in June to 846 MPN/100 g DW in October. Somewhat elevated FC concentrations lingered thru the end of some years, but declined by the end of winter.

A central question necessary to develop remediation strategies is whether FC bacteria are replicating or simply accumulating on sediment surfaces. Unlike some other studies, both a microcosm simulation of Oakland Bay and analysis of biofilm samples suggest the FC bacteria accumulate, but do not replicate. If true, other explanatory mechanisms are necessary to account for the large increase in bacteria concentrations in marine sediment over the summer months. This presentation will discuss trends in sediment FC monitoring results, describe the microcosm and biofilm monitoring methods and findings, and address potential mechanisms for sediment FC contamination during the dry summer months.

0159
K7-3

Non-Stormwater Discharge Pollution Loading in Two Mid-Atlantic Subwatersheds and Implications for Nutrient and Bacteria Total Maximum Daily Loads

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The Center for Watershed Protection (CWP) collaborated with local jurisdictions to comprehensively detect and quantify the nutrient and bacteria loads from non-stormwater discharges in two Mid-Atlantic watersheds. Based on water quality analysis, the discharges were likely from sewage sources and represent a controllable source of pollution whose systematic elimination could result in significant progress toward meeting nutrient and bacteria Total Maximum Daily Load (TMDL) reduction requirements. Results from the field assessments indicate that non-stormwater discharges are a significant yet unaccounted for source of pollution to the Chesapeake Bay. In one of the study watersheds, over 95% of E. coli from outfalls came from those that were suspect for non-stormwater discharges based on water quality screening. In addition, nearly 100% of the total dry weather nitrogen load and total dry weather phosphorus load in the watershed came from outfalls suspect for non-stormwater discharges. Elimination of non-stormwater discharges in the other study watershed could potentially meet 21% of the required TMDL phosphorus reduction, 43% of the required nitrogen reduction and 51% of the required TMDL bacteria reduction. Data and experience indicate that even though non-stormwater discharges are regulated under National Pollutant Discharge Elimination System stormwater permits, programs are frequently under-prioritized and ineffectively implemented. Detection and elimination of non-stormwater discharges is recommended as first step for addressing water quality impairments in urban watersheds and should be listed alongside common stormwater treatment practices, for example bioretention, in the Best Management Practice Toolbox.

0260
K7-4

Real-Time Monitoring of Water Quality Through a Holistic Approach to Particle Characterization

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Water quality assurance requires strict monitoring, which incurs substantial costs to utilities. Since most of the major determinants of water quality either consist of, or are controlled by, particles, monitoring costs could be decreased through rapid, real-time monitoring of particle profiles if adequate analysis methods were available. Some of the relationships between water quality and properties of particles are well characterized, such as the relationship between microbial pathogen size and their removal by coagulation and filtration-based water treatment technologies; however, most previous work has emphasized particular types of particles (*e.g.*, bacteria) in isolation or, less often, in binary combinations (*e.g.*, bacteria attached to sediment). We are pursuing an alternative approach using informatics-based methods to characterize the overall particle profile, rather than single particle properties. This more comprehensive, holistic approach borrows from the emerging fields of bioinformatics (including genomics and proteomics) and employs multivariate statistical analyses for the characterization of water quality. Once calibrated, this approach should decrease the degree of expertise required and the costs associated with verifying the presence/absence of organisms or properties of interest (pathogens or contaminants) in routine water quality monitoring. We will describe the characterization of particle profiles with data from imaging flow cytometry (iFCM), standard flow cytometry (FCM), as well as particle size characterization (from nano- to microscale using dynamic light scattering and Coulter counting) to detect changes in aquatic particle profiles. Data from natural river water samples revealed holistic changes in microbial populations across seasons that support the utility of this approach for the rapid, and yet potentially very powerful, assessment of water quality. We will discuss the strengths and potential limitations of this informatics-based approach for particle profiling and water quality assessment.