Estimating the Annual Mass Transfer of NAPL and Contaminants from Sediment to Surface Water in Newtown Creek via Ebullition

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Background/Objectives. Newtown Creek is a tidal tributary to the East River in New York City, with a long history of impacts from municipal and private/industrial discharges. It is listed as a Superfund site, and a Remedial Investigation/Feasibility Study (RI/FS) is underway with U.S. Environmental Protection Agency (USEPA) oversight. During the RI, field investigations delineated the extent of nonaqueous phase liquid (NAPL) and contaminants in sediment, and evaluated extent of ebullition-facilitated NAPL transport through boat-based surveys and a pilot-scale ebullition study. USEPA requested further testing to estimate annual NAPL and contaminant loads to the creek to update the conceptual site model and support FS alternatives development and screening. In response, an innovative, year-long field investigation program, using flux chambers, boat-based surveys, and video cameras, is in progress to better quantify significance of ebullition-facilitated transport as a pathway for NAPL and contaminant movement from sediment to surface water, recognizing the seasonal and spatial limitations of ebullition.

Approach/Activities. A field program to estimate ebullition-facilitated NAPL and contaminant loads in Newtown Creek must consider many variables that can control the extent and rate of such processes, including presence and extent of NAPL and total organic carbon (TOC) in sediments, seasonal changes in water and sediment temperature, and tidal elevation variation. Boat-based visual surveys identified areas where ebullition occurs and indicated ebullition rates were highest over a 2- to 3-hour time period around low tide, in areas with higher TOC, and when surface water was warmer. Sheen blossoms were most prominent in areas where NAPL and sheens were observed in underlying sediments. The pilot study highlighted benefits of using flux chambers placed on the sediment surface to obtain direct measurements of time-averaged ebullition-facilitated NAPL and contaminant fluxes. Collectively, these findings were used to design a field program to estimate annual ebullition-facilitated NAPL and contaminant loads.

For the field program, 31 flux chambers will be placed throughout the creek during one summer and one fall 2018 sampling event to obtain direct measurements of NAPL and contaminant fluxes associated with ebullition during spring tide cycles, and to record ebullition gas volumes and composition. Boat-based visual observations will be performed near each flux chamber to estimate gas and blossom fluxes while flux chambers are deployed, with the goal of developing relationships between visual and instrument fluxes. Video cameras will be stationed near flux chamber sampling locations to document gas and sheen blossom densities during deployment of flux chambers and over a 1-year period. Field program data will be used to estimate annual ebullition-facilitated NAPL and contaminant loads from sediments to surface water.

Results/Lessons Learned. The presentation will describe flux chamber design considerations and field program components, as well as discuss the process used to integrate flux chamber empirical data with spatial and temporal observations obtained from boat-based surveys and
shoreline-mounted cameras to estimate creek-wide annual NAPL and contaminant flux. Based on the 2018 data, the utility of each component in supporting the flux estimate, and the relative significance of ebullition as a NAPL and contaminant transport mechanism, will be discussed.