# Groundwater Model Development and Subaqueous Cap Design for PCB-Contaminated Sediments at the New Bedford Harbor Superfund Site

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**Background/Objectives.** Groundwater modeling analyses were conducted to support an interim remedy consisting of an interim cap to be placed over areas of polychlorinated biphenyl (PCB)-contaminated harbor sediment at the New Bedford Harbor Superfund Site adjacent to the primary upland PCB source area. A 3-D flow and transport model, representing both the on-land source and harbor area, was constructed utilizing all historic and site-specific information collected during field investigations for cap design.

**Approach/Activities.** To provide a detailed representation of the on-shore site and the harbor, a 3-D model was constructed using detailed land topography, harbor bathymetry, areal and vertical distribution of lithology, physical and hydraulic properties of the substrate, engineering features on the property, groundwater and surface water boundary conditions, and groundwater and surface water data. Detailed groundwater flow and fate-transport analyses were conducted to determine the PCB discharge to the harbor surface waters from both the on-land sources and contaminated harbor sediment sources via the groundwater pathway. The groundwater flow model was first used to develop the groundwater flow regime in the area and adjacent harbor under various tidal conditions to aid in the delineation of the extent of the cap. The interim cap incudes a levelling layer, an isolation layer consisting of a sand/organoclay mixture, a bioturbation layer, and an armor layer. Sensitivity runs were conducted to evaluate the impact of the key parameters and reduce the uncertainty in predicted groundwater flow. Afterwards, fate-transport modeling was conducted to determine the long-term movement of the PCBs in groundwater at the site and to quantify the potential PCB mass migration out of the contaminated areas and into the harbor surface waters. Lastly, the proposed cap design was incorporated into the model.

**Results/Lessons Learned.** Groundwater flow modeling based on the proposed interim cap suggests that there will be very little change in groundwater-surface water interaction in the area. The cap layers in the model are composed of highly conductive materials (gravel/sand) that would have minimal impact on the water flux out of the less conductive marine sediments. Fate-transport modeling of PCBs through the cap suggests a significant reduction of PCB mass flux rate into the harbor through groundwater discharge. Pre-cap flux estimates under average conditions are approximately 0.164 kg/yr. Post-cap flux estimates are between 0.001 and 0.007 kg/yr depending on the organic carbon fraction applied to the cap layers. Breakthrough of PCB mass through the cap is not predicted until year 50. The proposed cap design provides both a physical separation between the contaminated sediment and the harbor, and a geochemical barrier through retardation of PCBs due to the organoclay/sand mixing layer in the cap.