River Sub-Bottom Characterization of a Legacy Trichloroethene Release and Relationship to Bedrock Groundwater Contamination

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Background/Objectives. The objective of this presentation is to describe the conceptual site model (CSM) for a legacy trichloroethene (TCE) release from the Cold Regions Research and Engineering Laboratory (CRREL) in Hanover, New Hampshire to the Connecticut River and how it is related to TCE contamination detected in three former residential bedrock water supply wells across the river in Norwich, VT. In 1970, a 10,000 gallon above ground storage tank ruptured during maintenance. Five to six thousand gallons of TCE were released to the air and to the paved ground surface. TCE flowed across the pavement and flowed and was washed into a storm drain system by emergency responders. The system discharged TCE from the CRREL outfall into the Connecticut River. Extensive sampling was not performed following the release. In 1990 TCE was detected in CRREL's non-contact cooling water production wells that are screened in an esker deposit in contact with the river. As part of due diligence, CRREL sampled several bedrock water supply wells within a half mile radius including two residential bedrock wells located across the river in Norwich, VT. TCE was detected in the residential wells at 400 and 1,000 µg/L. Each affected residence was connected to a municipal water supply in the mid 1990's. Releases of TCE to the river from sources on the Norwich, VT side of the river, opposite from CRREL and the outfall, were investigated in 1991 by the Vermont DEC. No sources of TCE were found and reports concluded that further investigation of the river was needed.

Approach/Activities. Investigation of Connecticut River between the source release and the former receptors was conducted in a phased approach consisting of hydrographic surveying, former residential bedrock well sampling, surface water sampling, high resolution river sediment and soil sampling and bedrock matrix sampling from rock core beneath the river. Real time analysis of sediment and soil allowed for rapid decision making during the investigation. Data was incorporated into the three-dimensional CSM so that assessment could be done in relation to potential pathways, known source areas, and other impacted media.

Results/Lessons Learned. Investigations showed the 1970 release of TCE to the Connecticut River migrated in a northerly direction upriver towards a deeper portion of the river bottom, as would be expected for a gravity driven fluid. TCE infiltrated through the sediment and soils underlying the river. Sediment and soil sampling show TCE (up to 1,000 µg/kg) is retained by fine grained soils (till deposit) along the western shore of the river overlying bedrock approximately 20 feet below the bottom of the river. The primary source retention mechanisms include matrix diffusion and sorption to organic carbon and reactive mineral surfaces in the till. Sediment/soil data and bedrock groundwater data strongly suggest that abiotic dechlorination of TCE is occurring below the river bottom and in the bedrock groundwater system. These processes will enhance the rate of natural attenuation of the remaining source material in fine grained sediments. Abiotic processes may be sustainable due to the ubiquitous nature of iron oxides and other mineral oxides in these geologic materials.