Return on Investigation (ROI) Using SMART Characterization Approach for the Remedial Design of a TCE Plume in a Granitic Weathered Bedrock Aquifer in Brazil

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Background/Objectives. The site is located in Ribeirão Pires, São Paulo, Brazil. Geologically, the area is in a Paleoproterozoic weathered granite batholite faulted zone. The weathered granite comprises a heterogeneous dual porosity aquifer, 20 meters thick. High trichloroethene (TCE) concentrations were detected at the site. A wide TCE plume was detected in the site boundary, indicating the existence of TCE mass-flux towards the downgradient residential area and a creek. A preliminary transect was interpreted using existing conventional monitoring wells, leading to a biased hydrogeological conceptual model, which led to an over estimation of the impacted cross-sectional area. In order to enable the optimization of a remedial approach for plume containment, a SMART Investigation approach was implemented using high resolution coring and sampling to create a flux-based conceptual site model (CSM).

Approach/Activities. The detailed investigation was carried out in the cross-sectional area of the plume, along the site boundary. To characterize the complex tropical weathered granitic soil vertical profile, centimetric scale lithological logging was conducted using a combination of a ?3” continuous coring sampler attached to a hollow stem auger (HSA) and a diamond rotary drill (?H). Continuous PID readings and discrete soil sampling in target zones were carried out. Discrete multilevel wells were installed and sampled to establish a detailed contaminant vertical profile. The horizontal hydraulic conductivity (K) were obtained in all discrete screen wells. Soil samples were also collected for physical properties and organic carbon content analyses to evaluate contaminant partitioning. All hydrogeological and hydrochemical data was 3-D modeled (EVS) and the TCE plume mass-flux (Guilbeault, 2005) was calculated for the site boundary cross section using the transect method. The SMART approach made it possible to focus on the mass that matters for the study of alternatives to plume containment.

Results/Lessons Learned. The collected data revealed a considerable hydrogeological heterogeneity in an apparently homogeneous weathered granite. Horizontal hydraulic conductivity values ranged from 10^{-3} to 10^{-5} cm/s. Several preserved fractures were identified in the weathered rock, suggesting that both intergranular and fractured porosity are controlling TCE mass-fluxes. Bedrock/Saprolite interface was confirmed to occur in the refusal depth for HSA. The 2-D high-resolution mass-flux calculation indicates that most of the TCE mobile mass (about 70% of the total mass-flux) represent a small volume of the cross-sectional area (almost 10% of the plume cross sectional area). This information was key to make the best decision in the study of alternatives for effectively defining risks and remedial design. Therefore, in the study of remedial alternatives the CSM based on a SMART approach led to a ROI of six times the remedial system costs, saving money for the remediation actions.