# Triad: The Fast Track to Reducing Conceptual Site Model Uncertainty

***Kim-Lee Yarberry*** (Kim-Lee.Yarberry@ch2m.com) (CH2M HILL, Atlanta, GA, USA); Chris Hood (CH2M HILL, Navarre, Florida, USA); Artur Kolodziejski, Air Force Special Operations Command (AFSOC, Hurlburt Field, Florida, USA), Hurlburt Field); and Tom Palaia (CH2M HILL, Denver, Colorado, USA)

Storage Tank Site 123 (Site ST-123), also known as the Petroleum, Oils, and Lubricants (POL) Fuel Yard, is located at Hurlburt Field on Florida's Panhandle. In 1994, the site was identified as a potential source for petroleum compounds in the Sand-and-Gravel Aquifer. During preliminary investigations, chlorinated volatile organic compounds (CVOCs) were discovered in a deeper groundwater zone north of the fuel yard.

Although numerous investigations have been conducted at Site ST-123 since 1994, a final remedy had not been selected for the site. CH2M HILL used the Triad approach at Site ST-123 to resolve uncertainties in the conceptual site model (CSM) needed to develop an Exit Strategy for the site. Using historical data and current groundwater and geologic information, a preliminary CSM was developed for the Systematic Planning phase of the investigation. Site data gaps were identified and the Dynamic Work Strategies were developed for the field implementation. The data gaps included potential unidentified sources of CVOCs to groundwater, the mass of the contamination, a sufficient understanding of semiconfining layers and their impact on groundwater flow directions, vertical delineation of the plume, and migration pathways for CVOCs.

One of the priorities during the field investigation was to routinely update the CSM to aid in dynamic decision making. The field investigation involved numerous technologies, including membrane interface probe (MIP), cone penetrometer testing (CPT), direct push technology (DPT), groundwater and soil sampling, field and laboratory volatile organic compound (VOC) analysis, soil bore logging, and monitoring well installation. These methods produced a large dataset that was often incorporated daily into the existing CSM. The CSM evolved throughout the investigation using the following methods: 3-dimensional visualization modeling, new data point mapping, CPT cross-section construction, and continuous updating of the analytical database.

As a result of the investigation, the preliminary CSM evolved dramatically. The largest modification to the CSM occurred when the main contaminant mass was identified above the intermediate groundwater zone (previously assumed to be the location of the contaminant mass). The investigation results showed that the contaminant mass was not adequately monitored. Another significant change to the CSM was the source of CVOCs to groundwater. A soil sample with a CVOC concentration over 700 parts per million (ppm) was collected adjacent to a building, different from the original suspected source. Based on these revelations, the MIP and DPT sampling was modified in the field, using the dynamic decision logic, to meet the primary investigation objectives. Other changes to the CSM included more defined lithology, groundwater flow, and groundwater plume refinement. Because the CSM could continually be updated with new data, the project team could identify the most pertinent uncertainties in the CSM and address them cost effectively. Time and money were therefore used more effectively and project objectives were met.