

# Investing in Data Visualization to Develop Adaptive Environmental Liability Management Strategies to Streamline Site Closure

**Joshua Orris** (Joshua.Orris@anteagroup.com) (Antea Group, Berwyn, PA, USA)  
Jason C. Ruf (S<sub>2</sub>C<sub>2</sub> Inc., Raritan, NJ, USA)

**Background/Objectives.** Incomplete conceptual site models (CSM) are often a result of a combination of inadequate data quality, data density, deficient data interpolation, poor management, and/or a failure to visualize and evaluate complex environmental systems in three-dimensional (3-D) platform. Business-based decisions are made upon these incomplete CSMs often leading to repeated site characterization events, failed remedy design and implementations, and poor communication of site conditions to stakeholders. Developing an accurate CSM that leverages data stored in a relational database integrated into 3-D visualization and volumetric analysis is a *best management practice (BMP)* that supports adaptive environmental liability strategies and consistently enhances stakeholder engagement for streamlining cost-effective site closures.

**Approach/Activities.** A comprehensive data management solution and visual CSM was completed for multiple industrial sites in the United States and Brazil that aided in site remediation evaluation, optimizing remedy strategy implementation, streamlined long-term monitoring strategies and facilitated business stakeholder engagement. For each site, historical groundwater and soil analytical data, geologic information, and water level gauging data were gathered and imported into a Geographic Information System (GIS) and EQulS database. These data sets were processed and exported for analysis in C Tech's Earth Volumetric Studio (Studio).

Once site data were processed within Studio, the initial 3-D CSM was presented to the project technical team to evaluate past and current Site conditions. Based upon feedback from the technical team, further calibrations to the 3-D CSMs were completed including focused data analysis and addition of key chemical indicator data for the evaluation of the microbiological/chemical environmental systems. The final 2-D/3-D CSMs were then used as a tool to assist the project team in the technical evaluation of natural dechlorination environmental systems, development of targeted investigation programs, refined remedial engineering design and construction strategies based upon the client's business needs.

**Results/Lessons Learned.** Creation of the 2-D/3-D data visualization as the key component of the Site CSMs ultimately assisted in the identification of additional source areas, defined residual contaminated mass, refined the groundwater plume architecture, provided intimate visual depiction of contaminant distribution over time, identified and closed data gaps, and provided for targeted site investigation and remediation design strategies. Leveraging innovation through technology supports improvements with infield site data collection, data quality assurance, field work efficiencies, a centralized data management process and data visualization facilitates a "Best-In-Class" approach for enhancing insights into environmental liability systems for more informed business decisions. These business decisions were further supported by economic lifecycle cost modeling in support of corporate reserve assessment planning. Integrating technology innovation as a standard practice into the daily environmental liability management process provides for more informed business decisions promoting tactical risk management strategies and reducing liability lifecycles and cost.