Multiple Contaminants and Aquifers: 4D Mass Flux and Volumetric Analyses

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Background/Objectives. Conceptual site model (CSM) understanding frequently and primarily relies on recent and historical site contaminant data. These data are often qualitatively illustrated in two-dimensional (2-D) contaminant concentration spatial extent figures, year over year, or quantitatively graphed in trend analyses diagrams over time. Many important and costly decisions regarding future operations and remediation at the site are and will be based upon these illustrations, diagrams, and overall CSM interpretations.

Approach/Activities. Site decision-making, remediation efficiency, and improved closure forecasting can be enhanced with the incorporation and use of four-dimensional (4-D) mass flux/discharge and volumetric analyses for CSMs. While a flux analysis generally always represents at least two measurements in time over a short duration, this 4-D type of analysis incorporates recent (short duration) and historical site data (long duration). Mass discharge and volumetric analyses enrich the quantitative component of CSMs, providing meaningful metrics regarding soil volumes, subsurface contaminant mass, average plume concentrations, and spatial center of mass movements for contaminant plumes over time. Volumetrics can be isolated to a particular area(s) and integrated to groundwater flow and preferential subsurface lithology pathways, individual aquifers or aquitards, and changing groundwater elevations over time, aiding in the development of an enhanced, quantitative, and innovative understanding of the CSMs. In addition, multiple contaminants can be analyzed using this technique to comprehend/assess biodegradation patterns/trends across multiple aquifers.

Results/Lessons Learned. A mass flux/discharge and volumetric analysis case study from a fuel terminal in the western US is provided, built from recent and historical site data employing C Tech's Earth Volumetric Studio (EVS). The case study illustrates both qualitatively and quantitatively the dynamic mass and volumetric changes that have occurred since site data collection began approximately 30 years ago. The analyses at the site indicate among many other things, that the methyl tertiary butyl ether (MTBE) plume has biodegraded significantly to tertiary butyl alcohol (TBA) due to the remediation technologies implemented.