Groundwater modeling: End-user needs from geologic characterization

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Successful site-scale groundwater flow and transport modeling is dependent on the quality and extent of geologic characterization, not only in the immediate area of interest, but also in a regional context. Aspects of geologic characterization important to numerical modeling of groundwater behavior include:

- The three-dimensional geometry of groundwater systems including aquifer and aquitard spatial relationships
- Lithologic variation with estimates of hydrogeologic properties and the spatial distribution of these properties
- Regional geologic controls on groundwater behavior for development of model boundary conditions

Using the results of Argonne National Laboratory’s QuickSiteJ expedited site characterization process, three-dimensional, numerical groundwater flow and transport models were developed to evaluate the fate and transport of carbon tetrachloride contamination in the shallow groundwater surrounding a former grain storage facility at Murdock, Nebraska. Integration of quality assured geologic, hydrogeologic, and geochemical data obtained from extensive field sampling through the QuickSiteJ program provided the conceptual basis for the modeling and the parametric constraints on the groundwater model attributes.

The specific purposes of the Murdock groundwater flow and CCl₄ transport modeling effort were to:
- Understand the dynamics of groundwater flow in and around the area of CCl₄ contamination as they are influenced by recharge from precipitation, discharges to local springs and seeps, and natural boundaries to groundwater flow
- Identify preferred pathways of groundwater flow
- Predict long-term migration of dissolved CCl₄ at the Murdock site
- Support development of an efficient, effective, and comprehensive, groundwater level and contaminant monitoring scheme

This poster presents the process of site-specific groundwater modeling in relation to the needs from geologic characterization. The experience from developing three-dimensional, numerical groundwater flow and solute transport models for the Murdock, Nebraska shallow groundwater system is the basis for the demonstration of the importance of detailed geologic characterization in groundwater modeling. The physical aspects of model development are described in association with the necessary geologic input and spatial scale of required data. Both site specific and regional data requirements are discussed.