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Development of a Three-Dimensional Groundwater Flow and Contaminant Transport Model for NASA's Launch Complex 34

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A three-dimensional multi-species reactive transport model was developed for the National Aeronautic and Space Administration (NASA) to aid in the evaluation and selection of remedial technologies at Launch Complex 34 (LC34), Florida's largest known dense non-aqueous phase liquid (DNAPL) site. The model domain was developed to assess groundwater flow and transport processes within a coastal barrier-island system at Cape Canaveral Air Force Station, located in east-central Florida.

The calibrated groundwater flow and contaminant transport model domain was applied to analyze transport processes occurring at LC34. The model domain was calibrated to both field and laboratory data as part of on-going assessments. The calibrated model reproduced groundwater flow patterns as well as the overall distribution of trichloroethene (TCE), dichloroethylene (DCE), and vinyl chloride (VC). As part of the calibration efforts, decay-rates were assigned based on analytical laboratory microcosm studies as well as the overall distribution of discrete geochemical zones within the model domain. Zonation of discrete decay rates were assigned based on the measured dissolved oxygen concentrations of formation water and microcosm studies. In addition, DNAPL mass flux estimates were developed based on a model independent procedure which utilized three-dimensional solids modeling and visualization techniques. These operations allowed for a scaled reduction in the DNAPL source mass based on simplified dissolution processes. Explicit consideration of DNAPL dissolution was required since the selected transport code only considered dissolved phase transport and eventual biodegradation. The solids modeling efforts provide a basis for the contaminant mass flux relative to plume architecture and primary direction of groundwater flow within a complexly layered island hydrogeologic system.

The numerical model domain developed for this study was utilized as an engineering tool to quantify the fate and transport of a large dissolved phase contaminant plume and to predict the overall changes in the plume geometry relative to simulated remedial options and DNAPL source zone reductions. A total of thirteen simulations were completed to evaluate remedial alternatives. A no-action remedial approach was simulated and the corresponding time to achieve cleanup levels was estimated to be greater than 900 years. Similarly, an assumed DNAPL removal of 100% yielded an estimated time to cleanup for the 320-acre dissolved phase plume in excess of 220 years. The modeling work supported a conclusion that regardless of the DNAPL mass reduction achievable at the site, the estimated cleanup timeframes are lengthy.