NASA – WHITE SANDS TEST FACILITY

New Mexico

Computer Modeling of Groundwater Flow and Contaminant Transport

Alberto A. Gutiérrez served as principal in charge of this project while serving as President of GCL, predecessor to Geolex, Inc.

GCL provided computer modeling of groundwater flow and contaminant transport for NASA's White Sands Test Facility (WSTF). A plume of groundwater contamination extended more than three miles from source areas and impacted a potable aquifer. Modeling was performed to aid site characterization, determine transport and fate of contaminants, assist in monitor well locations, support a health risk assessment, and evaluate potential corrective measures.

The site was hydrologically complex and contaminated media consisted of several types of fractured bedrock and alluvium. The flow regime was transitional between deep basin alluvium and lacustrine deposits, and a thin base margin pediment cover with discrete alluvium-filled channels incised into fractured bedrocks. Contaminants moved through bedrock and intercepted alluvium-filled channels, then migrated to the thick basin aquifer that supplied groundwater for potable use.

The modeling of this complex site consisted of several phases and utilized a telescoped approach to account for basin-wide pumping effects while allowing definition and prediction of site-specific features. A regional-scale model of the entire basin was constructed and used to predict future drawdown from pumping wells across the area. Boundary conditions from this model were then used to supply local-scale conditions. Site-specific models (both two- and three- dimensional) were constructed with grid spacings sufficiently dense to account for local-scale features. These site-specific models were then used to predict contaminant fate and transport, evaluate remedial options, assist monitor well placement, and provide point concentrations for health risk assessments.

Bedrock was treated as a porous-media equivalent and aquifer parameter data was derived from slug-and-pump tests designed and performed by GCL. Information from geophysical logs and rock cores was also analyzed and used in model construction. The computer codes used were MODFLOW (the U.S. Geological Survey three-dimensional modular flow model); a particle tracking program; and the three-dimensional solute transport module, MT3D.

Results of the modeling work showed that the dominant control on the fate and transport of contaminants in the potable aquifer was future water use patterns as the basin aquifer became more exploited. Near-source migration of contaminants was controlled by bedrock permeability and interconnection with incised alluvium-filled channels.

Major Project Elements:

- Groundwater modeling
- Hydrology
- Program management/ QA/QC
- Database management
- RCRA
- RI/FS

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Recognition and understanding of the mechanics of flow and transport allowed GCL to recommend compliance strategies for WSTF that took advantage of the working of the natural system. For example, it was predicted that significant migration in the potable aquifer would not occur for one to two decades, until basin-wide pumpage reached critical levels. The client was, therefore, able to pursue a compliance strategy of land acquisition to control access and allow dilution and bioremediation to naturally remediate the basin aquifer while the plume was relatively sluggish. The modeling work also allowed the optimal placement of remedial wells for source area hot-spot remediation, and pinpointed areas where low-discharge wells would intercept contaminants before reaching the potable aquifer.

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