Executive Summary

The purpose of this report is to present the findings of the three-dimensional groundwater modeling effort conducted to evaluate proposed remedial alternatives at Operable Unit 4, Hill Air Force Base, Utah. The work was performed under contract F42650-92-D0006 and Delivery Order 5041 Modification 1. The objectives of the modeling effort were as follows:

- Refine the 1996 two-dimensional SUTRA modeling work (Montgomery Watson, 1996) using a three-dimensional model. The three-dimensional modeling enables evaluation of potential vertical contaminant migration and the extraction systems capture zones.
- Evaluate the fate and transport of the existing trichloroethylene (TCE) plume with both the existing and the proposed extraction systems in operation.
- Evaluate the model sensitivity to variations in transport parameters.
- Evaluate the impact on contaminant migration from a continuous source located within the base boundary versus a transient dissolved-phase source.

A three-dimensional modeling investigation was conducted to evaluate the fate and transport of trichloroethylene (TCE) in the shallow groundwater. A set of models, MODFLOW, MODPATH, and MT3D were selected for the application. MODFLOW simulates the flow conditions at the site, MODPATH simulates particle tracking to evaluate capture zones of extraction systems, and MT3D evaluates contaminant conditions with the shallow groundwater system. The Groundwater Modeling System (GMS) was used in this study to facilitate pre- and post-processing of model related information.

A flow model was developed and partially calibrated, a particle-tracking model was applied, and a transport model application was developed for the site. In this investigation, a number of specified scenarios were simulated to evaluate long-term site response. A number of simplifying assumptions were also put forward for the application. The flow model was partially calibrated to known groundwater levels by using layer hydraulic conductivity and vertical conductance as the calibration parameters. Calibration of the transport model was not attempted in this study.

The results of the modeling investigation show the proposed extraction trenches are not likely to significantly reduce the TCE concentrations over time. However, the trenches will produce an upgradient capture zone proportional to the length of the extraction trench and will result in the removal of a small quantity of contaminant mass over an extended period of operation.

The base contaminant transport parameters (K_d = 0.0977, decay = 0.00074/day and longitudinal, transverse and vertical dispersivity = 150, 120, and 15 feet) result in significant reduction of concentration over time. The contaminant transport decay rate parameter was found to dominate the behavior of the TCE plume. The model results were not as sensitive to changes in the value of the soil TCE adsorption coefficient as they were to changes in the decay parameter. TCE adsorption appears to be a secondary decay process at the site.

The model indicated that limited vertical downward contaminant migration is likely to occur over time. The contaminant concentrations in the uppermost zone are expected to decrease slightly with time. The contaminant concentrations in the lowermost zone are expected to increase with time. Eventually, after a period of 20 years or more, the concentrations in the uppermost zone and the lowermost zone are expected to be similar in magnitude.

Introduction of a continuous source term resulted in significantly higher concentrations at the end of the simulation period compared to the transient source scenarios. However, the continuous source scenario, with the base case transport parameters, indicated only limited additional advance of the leading edge of the plume.

We recommend the model predictive capability continue to be enhanced through acquisition of detailed site-specific information. This may include information on hydrogeologic parameters (primarily hydraulic conductivity) from the area included in the model domain, identification of governing natural degradation processes and their rate parameters and, where possible, long-term pump tests. Calibration of the transport model is recommended to enhance the level of confidence of the predictive capability of the model.