

A Manager's "Tool Kit": Site Characterization and Evaluation of a Chlorinated-Solvent Contaminated Superfund Site in Tucson, Arizona

Tucson International Airport Area Federal Superfund Site (TIAA)

Project Description

The feasibility of various remediation strategies cannot be accurately evaluated, and specific systems cannot be optimally designed, without adequate understanding of contaminant distribution and transport behavior at the site. An extensive site-characterization project was conducted at a large chlorinated-solvent contaminated Superfund site in Tucson, AZ to provide information to enhance the site conceptual model, help optimize operation of the pump-and-treat system, and to evaluate the utility of source-zone remediation.

Research Activities:

- Analysis of induced-gradient contaminant elution tests conducted in a source zone at the site
- Investigation of the potential occurrence of immiscible liquid in the saturated zone
- Characterization of the relationship between mass-flux reduction and mass removal
- Evaluation of the impact of source zone management on site remediation

Field Trial Conditions

The source-zone at which the studies were conducted is one of three primary source zones associated with the South section of the Superfund site, and coincides with the former location of an unlined spent-solvent disposal pit. Groundwater concentrations of trichloroethene (TCE) ranged between 100-12,000 $\mu\text{g/L}$ prior to the tests.

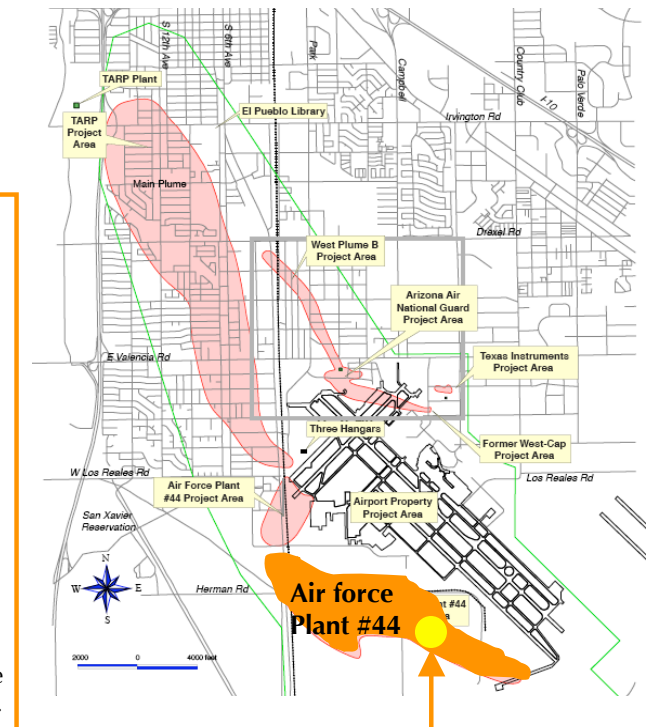


Figure 1. Location of Tucson International Airport Area Superfund Site. Yellow dot indicates the source zone that was the focus of the study.

Results

Relatively high aqueous concentrations, extensive elution tailing, and strong rebounding were observed for trichloroethene and dichloroethene during induced-gradient contaminant elution tests conducted within a source zone at the site. Several lines of evidence indicate that immiscible liquid is likely present in the saturated zone at the site. In such cases, source-zone management becomes of central importance to successful remediation efforts. Selected components of the TIAA advanced site-characterization project are briefly described below.

Component	Purpose	Results
Depth-specific sampling	Characterize vertical contaminant distribution	<ul style="list-style-type: none"> • Sediment-phase TCE concentrations ranged over two orders of magnitude. • Relatively high contaminant concentrations are associated with the lower-permeability zone above the aquifer.
Partitioning tracer tests	Detect and quantify immiscible liquid saturation	<ul style="list-style-type: none"> • Results indicate presence of immiscible liquid in or adjacent to the aquifer.
Contaminant elution and rebound	Characterize contaminant removal behavior	<ul style="list-style-type: none"> • Extensive elution tailing and strong TCE and Dichloroethylene (DCE) rebound indicating the possibility that a significant amount of contaminant mass within or adjacent to the aquifer is acting as a long term source. • Results suggest that contaminant mass-transfer processes such as desorption from the solid phase, diffusive mass transfer from low permeability zones, dissolution from an immiscible-liquid phase or some combination thereof are responsible.
Mass flux reduction/mass removal	Characterize mass flux reduction/mass removal relationship	<ul style="list-style-type: none"> • Utilizing a time-continuous analysis incorporates a complete characterization of the relationship between mass flux reduction and mass removal. • Greater than 90% reduction in mass flux was achieved for a mass removal of approximately 50%. The greater than 90% mass flux reduction was attained prior to the initiation of the source zone remediation efforts employing in-situ chemical oxidation. Please refer to figure 1.
Contaminant Transport modeling	Characterize TCE transport	<ul style="list-style-type: none"> • Immiscible liquid is likely present in the saturated zone at the site. • Effective remediation of the site requires management of the source zones, wherein they are controlled or remediated. The influence of source-zone management on site remediation was evaluated by conducting two predictive simulations, one for which no source-zone management was in effect and one for which it was not. The concentrations remain at a higher level for the case with no source control.
	Evaluate impact of source-zone management	

Table 1. Selected components of the TIAA advanced site-characterization project.

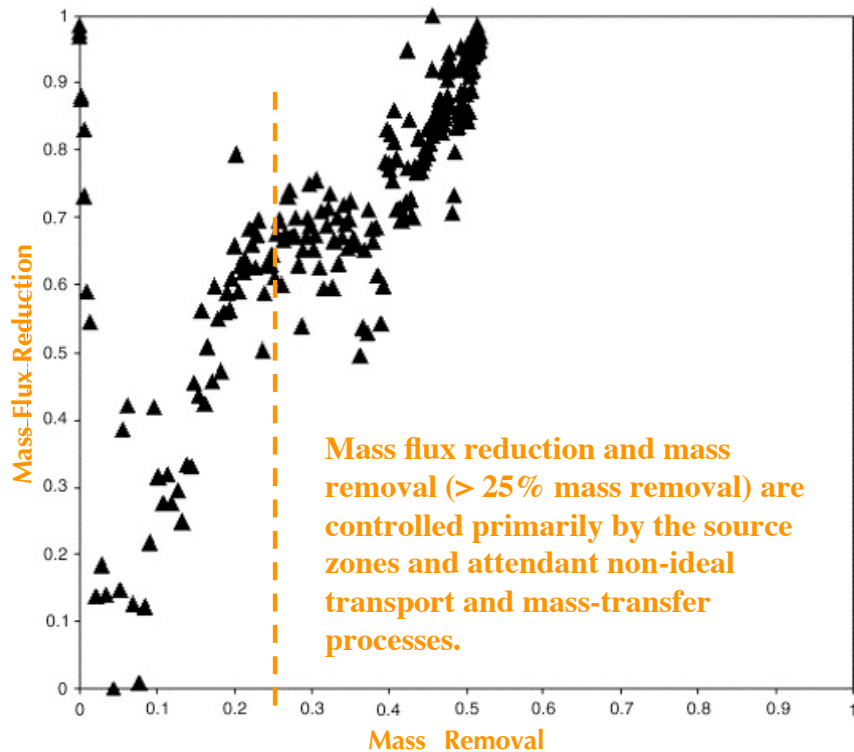


Figure 1. Measured time-continuous relationship between mass flux reduction and mass removal associated with the pump-and-treat operation.

Conclusion

Developing **time-continuous relationships** as determined for this site, provide knowledge critical to better understanding the impact of system properties and conditions on the relationship between mass-flux reduction and mass removal. This, in turn, will enhance the development of predictive tools useful for evaluating the utility of potential source-zone remediation efforts.

Mathematical modeling of the test data allowed an evaluation of the relative contributions of various mass-transfer processes to contaminant transport. **The contaminant-elution test and associated mathematical modeling** appears to be a useful method for assisting in the characterization of source zones.

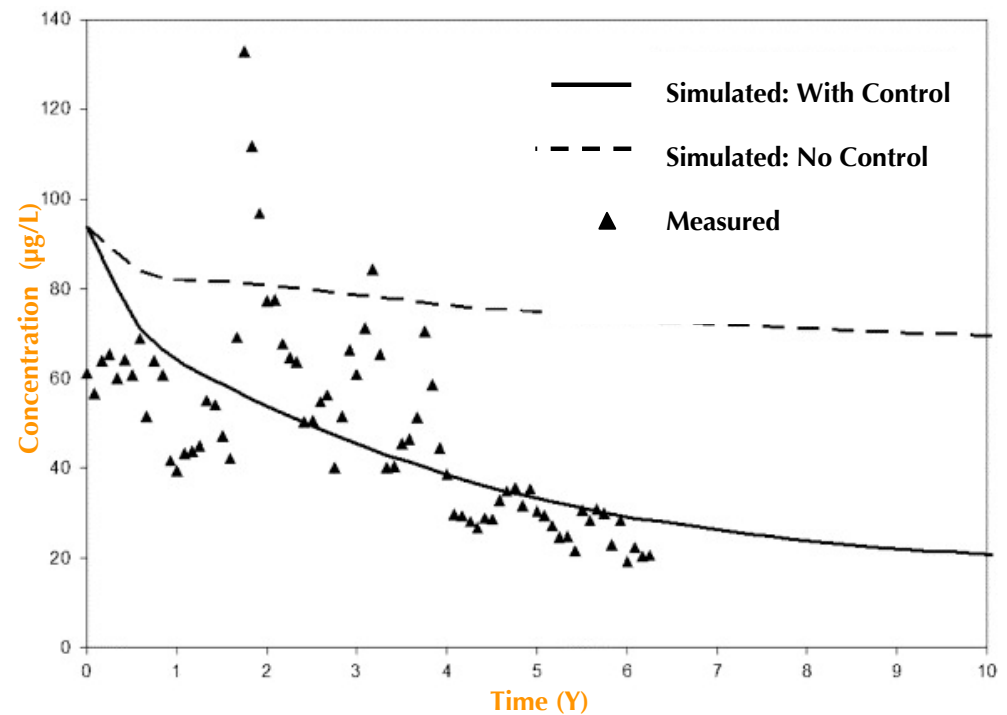


Fig. 2. Predicted and observed elution curves with and without source-zone control for trichloroethene concentrations in flow entering the groundwater treatment plant; flow is a composite of all extraction wells used in the pump-and-treat system. Time 0 corresponds to 2000.

For further information, please contact:

Mark Brusseau
 Department of Soil, Water and Environmental Science
 Department of Hydrology and Water Resources
 FCS Building 312
 Mail To: PO Box 210038 Tucson, AZ 85721-0038
 Phone: 520-621-3244
 FAX: 520-621-1647
 Email: brusseau@Ag.arizona.edu