

Ground-Water Monitoring in the Area of Operable Unit 4, Hill Air Force Base, Utah, 1994-95, Volume II

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EXECUTIVE SUMMARY

Introduction

The U.S. Geological Survey (USGS), in cooperation with Hill Air Force Base (AFB), began a monitoring program in March 1991 to determine the spatial and temporal changes in concentrations of contaminants detected in the shallow ground water in the area of Operable Unit 4 (OU 4) on the north side of Hill AFB. The need for a monitoring program was recognized during a Remedial Investigation (RI) of contamination in the area of OU 4. The monitoring program was planned for an indefinite period depending on the behavior of the contaminants during and following remediation. This report is the second in a series of annual reports that describe the results of the monitoring program.

Hill AFB is located in northern Utah, about 25 mi north of Salt Lake City and about 5 mi south of Ogden. Hill AFB covers about 6,700 acres and is located on the Weber Delta, a terrace about 300 ft above the valley floor in Weber and Davis Counties. Landfills 1 and 2, the North Gate Dump areas, Munitions Dump, and Spoils area are in OU 4. The study area includes these sites and the area immediately surrounding these sites. Evaluations of data collected during 1988-92, contained in the Remedial Investigation Report for Operable Unit 4 (U.S. Geological Survey, 1992) and the Addendum to the Remedial Investigation Report for Operable Unit 4 (U.S. Geological Survey, 1993), indicated that Landfill 1, which covers about 5 acres, was the most probable source area for trichloroethylene (TCE) and other contaminants found at the site.

Problem

During the RI, 13 volatile organic compounds (VOCs), 2 suspected inorganic contaminants (sulfate and nitrate), and 14 trace elements were detected in shallow ground water at OU 4. TCE was the VOC detected most frequently and in the highest concentrations (U.S. Geological Survey, 1993). Sulfate and nitrate were suspected contaminants because their con-

centrations were higher in ground water contaminated by TCE than in nearby areas not contaminated by TCE. Plumes of TCE and sulfate were detected in the shallow ground water throughout a large part of OU 4. No contamination was detected in the underlying aquifers used for public water supply. OU 4 is adjacent to several residences that use water from aquifers underlying the contaminated shallow ground water.

Remediation was begun in July and August 1993 by installing horizontal drains and treating the outflow to remove the TCE. Determining the effects of remediation on contaminant behavior at OU 4 was complicated by climatic variations and by the relining of the Davis-Weber Canal, both of which affect recharge to the shallow ground-water system. Water-quality monitoring is needed to maintain a current assessment of the nature and extent of contamination and to evaluate the effects of remediation procedures.

Purpose and Scope

This report describes the results of the USGS monitoring program at OU 4 and evaluates and describes the spatial occurrence and temporal behavior during 1994-95 of the contaminants, including the plumes of TCE and sulfate, that are discussed in the "Problem" section of this report. Changes in contaminant concentrations are discussed in relation to structural and climatic changes that affected the ground-water hydrology and in relation to historical data. Selected data collected as part of the monitoring program, as well as previous historical data, are tabulated in appendixes A through D of this report. This report is an addendum to the previous RI and monitoring reports and does not include information on hydrologic setting, geology, well construction and completion, or water-quality sampling and analytical methods.

Ground-Water Quality

The ground-water-quality data collected during September 1994 through September 1995 were examined to determine (1) if previously undetected contaminants were present in water from any of the wells, and

(2) the spatial and temporal behavior of contaminants that had been previously identified in the RI and Addendum reports. Water-quality data collected during 1986-95 for the monitoring wells include concentrations of VOCs, selected trace elements, and major inorganic ions and are listed in appendixes B, C, and D.

In the 1995 water year (October 1994 to September 1995), water from 26 wells was sampled and analyzed at least once for TCE, trans-1,2-dichloroethylene, acetone, and other VOCs (appendix B). The Primary Maximum Contaminant Level (PMCL) of 5 µg/L for TCE was exceeded in water from 15 wells, and TCE concentrations were less than the PMCL in water from the other 11 wells. TCE concentrations for water from selected wells measured during 1986-95 are shown in figure ES-1. The maximum concentrations of TCE for the 1994 water year were compared to the maximum concentrations during the 1995 water year for a subset of 23 wells. Concentrations of TCE in water from nine wells in which the concentrations of TCE had been less than the PMCL during the 1994 water year remained below the PMCL during the 1995 water year. In water from the subset of wells where the concentration of TCE exceeded the PMCL during the 1995 water year, the maximum concentrations increased in three wells and decreased in nine wells.

Trans-1,2-dichloroethylene was detected in water from 1 of the 26 wells sampled (LF1GS4A) in the 1995 water year. Trans-1,2-dichloroethylene was not detected in the last sample collected in the 1995 water year at LF1GS4A. This non-detection indicates that concentrations continue to decline as indicated by earlier analytical results (U.S. Geological Survey, 1996). Acetone was detected in water from well P10A at a concentration of 160 µg/L in the 1994 water year and was not detected in the 1995 water year.

A plume of TCE was defined during the RI based on maximum concentrations determined from data collected during 1986-92 (U.S. Geological Survey, 1993, fig. 4.7.2.1-3). Comparison of the boundary of the TCE plume in 1995 with that for the plume defined using data from 1986-92 (U.S. Geological Survey, 1993, fig. 4.7.2.1-3) and 1991-94 (U.S. Geological Survey, 1996) indicates that the areal extent of contamination has not changed since 1992. Within the boundary of the plume, however, considerable change in TCE concentration has occurred.

Four sets of clustered wells were included in the monitoring program to determine if TCE or other contaminants were migrating deeper into the ground-water system. Only one of the four clusters (LF1GS4A, LF1GS4B) showed evidence of deeper migration of TCE. In December 1992, the TCE concentration in well LF1GS4A, which is screened about 6.3 ft below well LF1GS4B, began increasing and reached a maximum

of about 230 µg/L in the sample collected during November 1993. The maximum TCE concentration in LF1GS4A in the 1995 water year was 180 µg/L. The reason for the deeper migration in water from this well cluster and not in the upgradient cluster that includes wells LF1GS3A and LF1GS3B is not known.

TCE concentration in water from well U4-34 decreased from 14,000 µg/L to 3,500 µg/L during the 1995 water year (appendix B). This decrease, along with decreases in the TCE concentration in water from well U4-43, indicates that the upper drain set may be affecting the TCE source in Landfill 1 and that the drains may be causing the movement of TCE downgradient to well LF1T-1. Water levels throughout the area containing Landfills 1 and 2 and the North Gate Dump areas rose 2 to 4 ft during the 1995 water year. The decreases in TCE concentrations in many of the wells may be associated with dilution as a result of the water-level rise. Precipitation during the 1995 water year was about 23 in., or 16 percent greater than the 1979-95 average. This is only the second year during 1987-95 when precipitation equaled or exceeded the 1979-95 average.

Water samples were collected and analyzed for concentrations of selected trace elements from wells in which the concentrations previously measured more than the Maximum Contaminant Levels (MCLs). Water from wells with trace-element concentrations exceeding MCLs during the 1989-94 time period continued to have trace concentrations above the MCLs in the 1995 water year.

Water from 26 wells was sampled and analyzed for sulfate concentration during the 1995 water year. No sulfate was detected in three of the wells. A plume of sulfate defined during the RI, based on the maximum concentrations that exceeded 100 mg/L, was defined from data collected during January 1989 through August 1992 (U.S. Geological Survey, 1993, fig. 4.5.4.2-2). Comparison of the maps of the sulfate plume for 1994 and 1995 indicates that the plume is now one plume rather than two and that the overall shape of the plumes remained similar throughout both years. Analysis of samples collected at wells P22 and P10A in the 1995 water year, where no samples were collected in the 1994 water year, helped define the area between the previously separated plumes. Only one of the four sets of clustered wells selected for monitoring showed evidence of increased sulfate concentration in water from the deeper well, U4-33. Well U4-33 is screened about 18 ft below the bottom of the screen of the shallower well, U4-43. After the drains were installed, the sulfate concentrations in both wells decreased in 1995.

Most of the changes in the areal extent of the sulfate plume are likely caused by the drains installed dur-

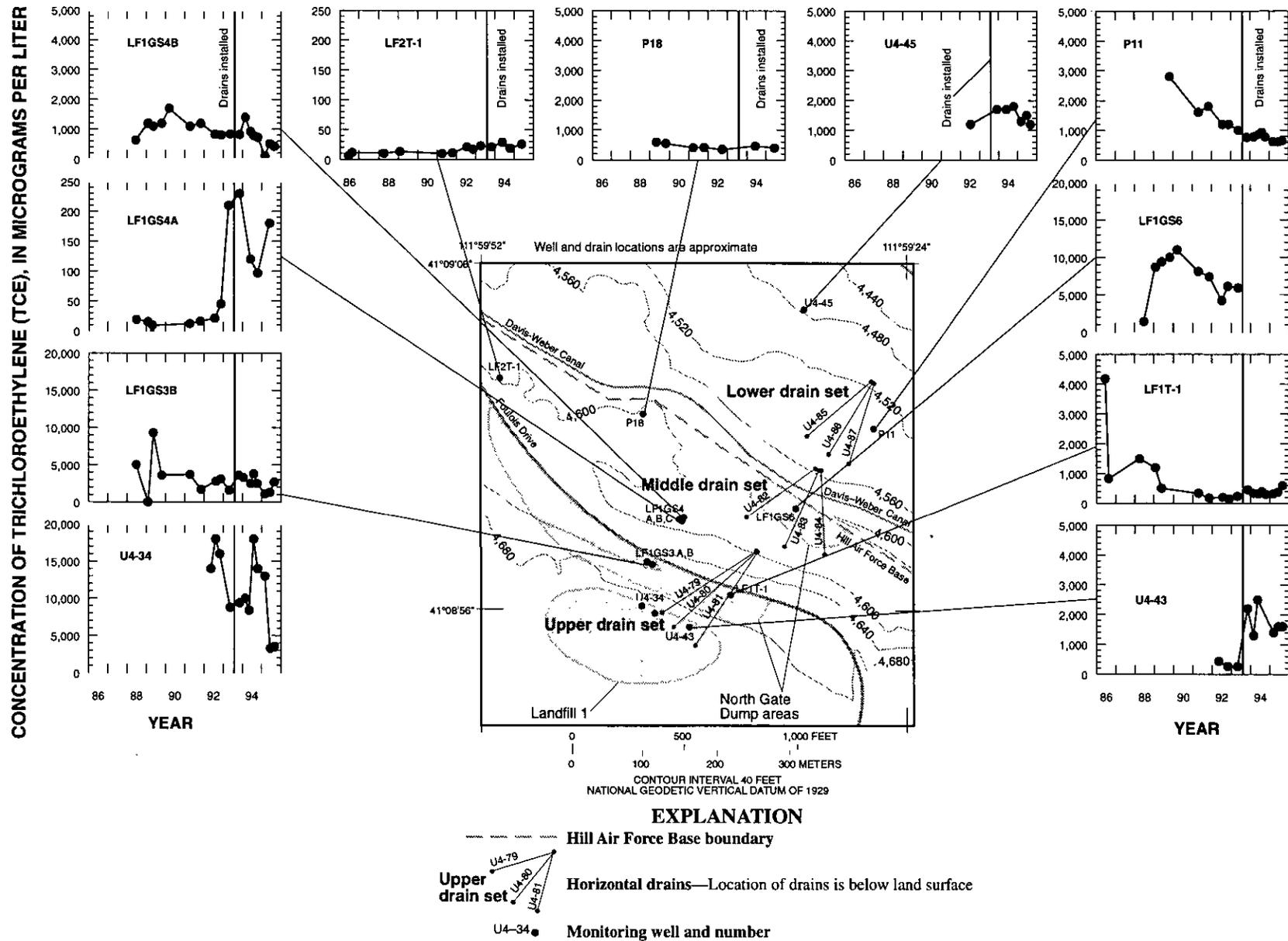


Figure ES-1. Location of selected wells and horizontal drains and concentrations of trichloroethylene in water from selected wells in the area of Operable Unit 4, Hill Air Force Base, Utah, January 1986 to August 1995.

ing July and August 1993 as part of remediation and to a lesser extent by variations in precipitation and the relining of the Davis-Weber Canal. The maximum concentrations of sulfate in water from wells for the 1994 water year were compared with maximum concentrations in water from wells for the 1995 water year. Concentrations increased in water from 10 wells and decreased in water from 9 wells. The increased concentrations are probably a result of the enhancement of the hydraulic connection between the source of sulfate in the landfills and the nearby wells and is indicated by the increased concentrations in water from wells U4-34, U4-43, and LF1GS3B.

Suggestions for Monitoring

The wells and seep suggested for monitoring of water quality and water levels at OU 4 are listed in table ES-1. After each round of sampling, the data need to be

reviewed to determine if changes have occurred that might necessitate revision of the monitoring program. Suggestions for revision of the monitoring program in 1994-95 include adding well P10 to the monitoring list and moving well P25A to the quarterly sampling schedule. Addition of P10 may provide information on the vertical movement of TCE in that part of the plume. Wells P10 and P10A are approximately 30 ft apart and, although they are screened at different altitudes, TCE has been detected in samples from both wells at similar concentrations. Well P25A seldom contains enough water from which to collect a sample, so attempts should be made to collect samples quarterly or whenever there is enough water to collect a sample. Any TCE- or sulfate-concentration data from well P25A would further enhance the definitions of the TCE and sulfate plumes. Monthly measurements of water levels by Montgomery Watson, Consulting Engineers, Incorporated, should be continued.

Table ES-1. Wells and a seep suggested for continued monitoring of water quality at quarterly, semiannual, or annual intervals and water levels at monthly intervals in the area of Operable Unit 4, Hill Air Force Base, Utah

[Unless otherwise noted, each sample analysis will include the following schedules: volatile organic compounds (SW8240), selected anions (A429 includes chloride, fluoride, sulfate, nitrate, and orthophosphate), total alkalinity (A403), nitrate+nitrite (E353.2), and selected inorganic constituents (SW6010 includes calcium, magnesium, potassium, silica as SiO₂, sodium, boron, and others as requested); Quarterly sampling: summer and winter sampling of these wells will include only analyses of volatile organic compounds]

Quarterly sampling (spring, summer, fall, winter)	Semiannual sampling (spring, fall)	Annual sampling (spring)
	Upgradient from canal	
LF1T-1	LF2T-1	P5A
¹ LF1GS3B	LF1GS3A	P5B
LF1GS4B	LF1GS4A	
^{1,2} LF1GS6	^{1,3} P18	
⁴ U4-34	U4-33	
^{2,4} U4-43	^{5,6} U4-35	
	U4-36	
	Downgradient from canal	
P11	¹ P3	² P2
P22	P4	P2A
U4-45	P10A	⁷ S9
² P25A		
	Colby	
	Weber River flood plain	
	P1	
	⁵ U4-41	
	⁵ U4-42	

- ¹ Add nickel (requested in schedule SW6010).
- ² Not enough water in well to collect a sample.
- ³ Add selenium (SW7740).
- ⁴ Add lead (SW7421).
- ⁵ Add arsenic (SW7060).
- ⁶ Sample for selected inorganic constituents (SW6010) only.
- ⁷ Sample for volatile organic compounds (SW8240) only.