

Ground-Water Monitoring in the Area of Operable Unit 4, Hill Air Force Base, Davis and Weber Counties, Utah, October 1997 through September 1998, and Compilation of Ground-Water Data, 1986-98, Volume V

EXECUTIVE SUMMARY

Introduction

In March 1991, the U.S. Geological Survey (USGS), in cooperation with Hill Air Force Base (AFB), initiated a monitoring program 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 (fig. ES-1). The need for a monitoring program was recognized during a Remedial Investigation (RI) of contamination in the area of OU 4 during July 1988-August 1992 by the USGS. The monitoring program was planned to continue for an indefinite period depending on the behavior of the contaminants during and following remediation. This report is the fifth 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 in Weber and Davis Counties. The area of OU 4 includes Landfills 1 and 2, the North Gate Dump areas, Munitions Dump, and Spoils area (fig. ES-2). The study area includes these sites and the area immediately surrounding these sites. Evaluations of data collected during July 1988-August 1992, contained in the Remedial Investigation Report for Operable Unit 4 (U.S. Geological Survey, 1992a, and referred to in this report as the RI report), and the Addendum to the Remedial Investigation Report for Operable Unit 4 (U.S. Geological Survey, 1993a, and referred to in this report as the Addendum report), indicated that Landfill 1, which covers about 5 acres, was the most probable source area for trichloroethylene (TCE) and other contaminants found in the study area.

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 (less than about 300 ft below land surface) in the area of OU 4. TCE was the VOC detected most frequently and in the highest concentrations, as concluded in the Addendum report. Sulfate and nitrate were suspected contaminants because their concentrations were higher in ground water contaminated by TCE than in nearby areas not contaminated by TCE. Plumes of TCE and sulfate were detected in shallow ground water throughout a large part of the area of OU 4. No contamination was detected in the underlying aquifers used for public water supply. The area of OU 4 is adjacent to several residences that use water from aquifers that underlie the contaminated shallow ground water.

Remediation began in July 1993 with the installation of horizontal drains and treatment of the outflow to remove the TCE. Determination of the effects of remediation on contaminant behavior in the area of 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 (U.S. Geological Survey, 1996a). 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 evaluates and describes the spatial occurrence and temporal behavior of the chemicals that were detected during the RI, including the plumes of TCE and sulfate. Changes in contaminant concentrations are discussed in relation to structural and climatic changes that affected the ground-water hydrology. Selected data collected as part of the monitoring program, as well as previous historical data, are tabulated in appendixes A-E.

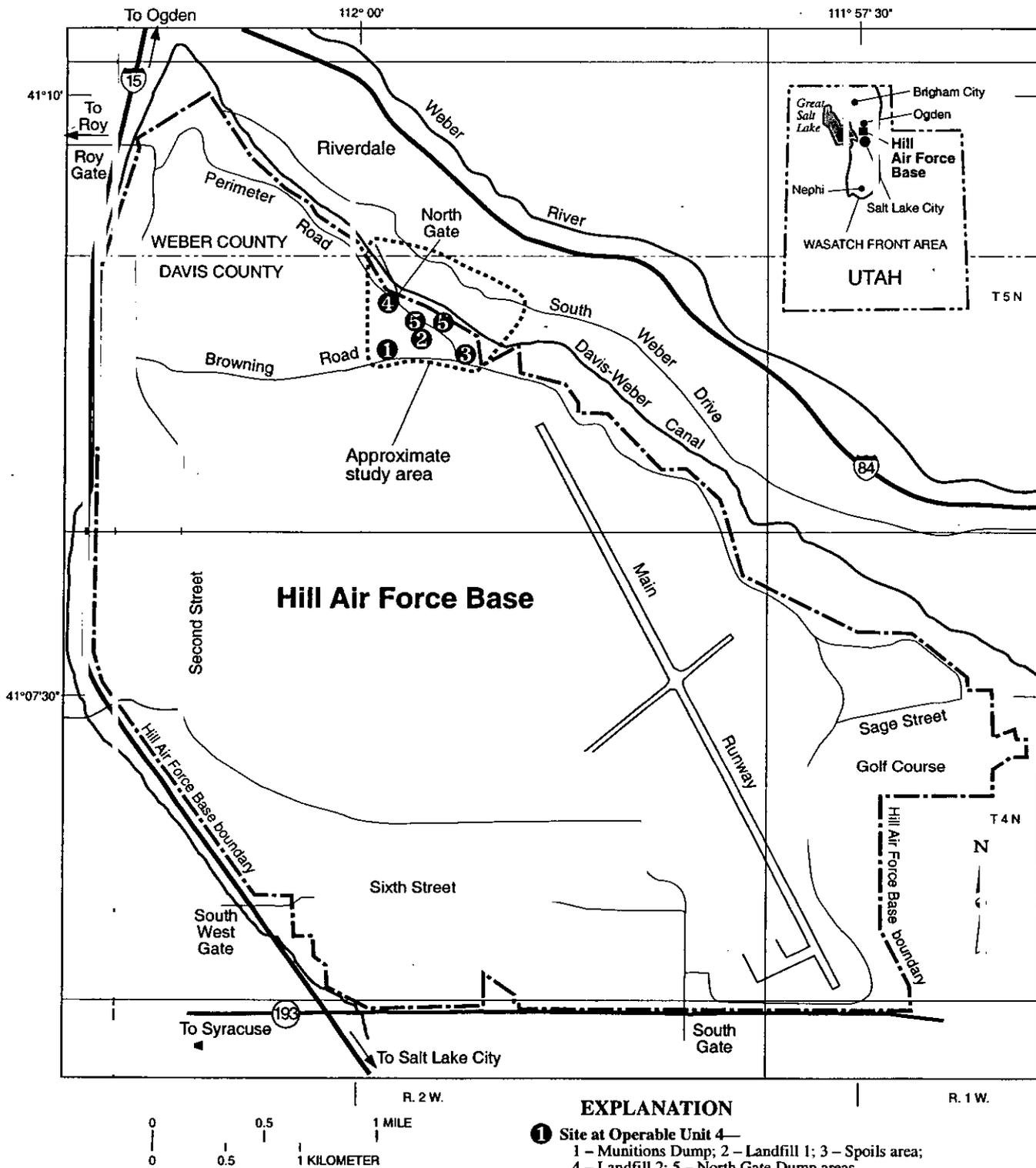
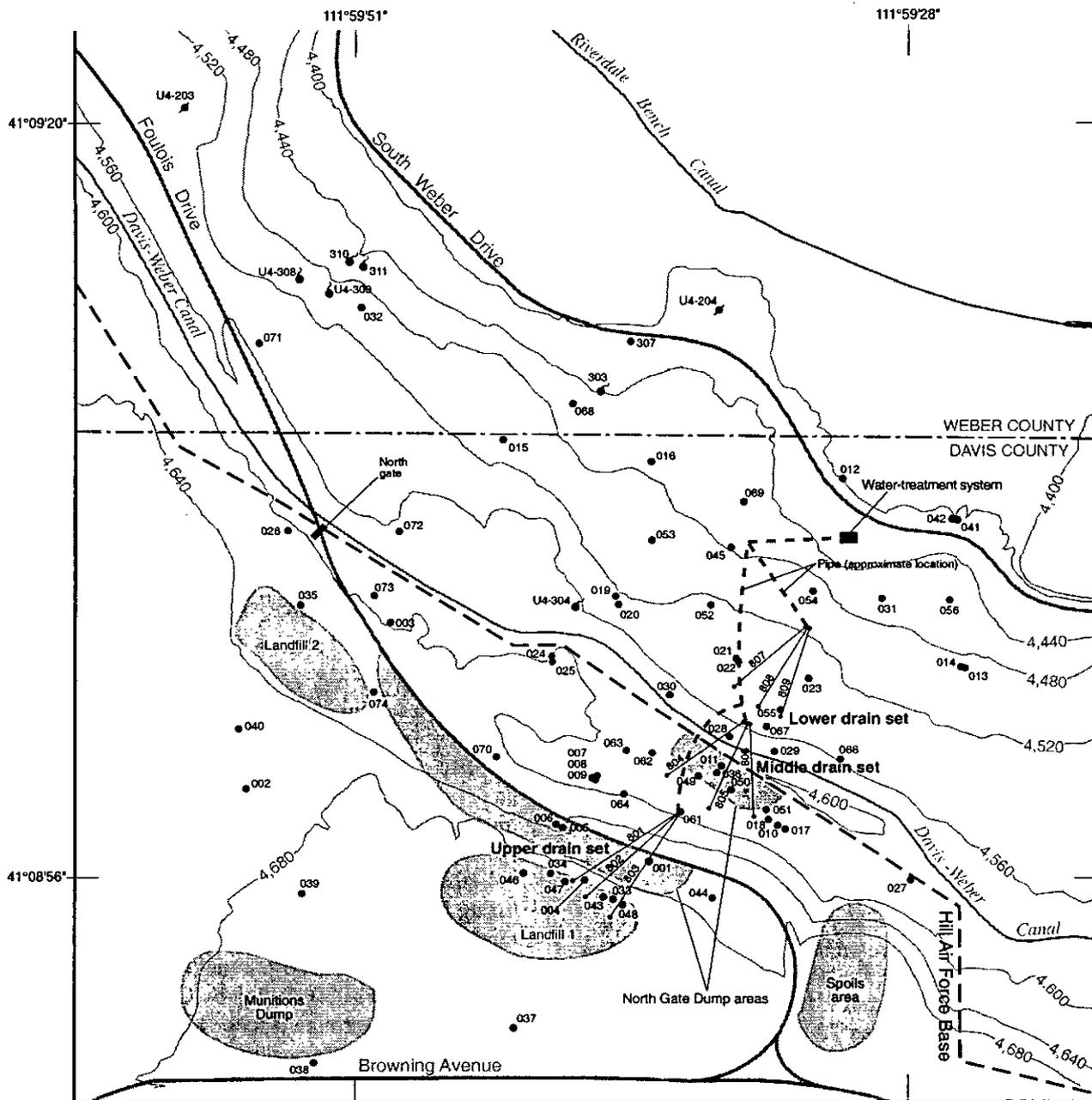


Figure ES-1. Location of study area, Hill Air Force Base, Utah



EXPLANATION

- Hill Air Force Base boundary
- Upper drain set
- Monitoring well and number—Well number is preceded by the designation 'U4-' (example: 038 is U4-038)
- Private or public well and number
- Seep and number
- Horizontal drains—Drains are below land surface. Number is drain designation

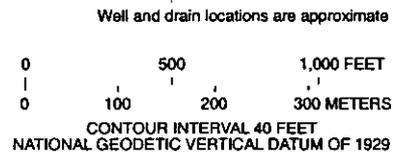


Figure ES-2. Location of monitoring wells and horizontal drains in the area of Operable Unit 4, Hill Air Force Base, Utah.

Ground-Water Quality

The ground-water-quality data collected during the 1998 water year 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 previously identified in the RI and Addendum reports. Water-quality data collected during June 1986-September 1998 from monitoring wells included VOCs, major inorganic ions, selected trace elements, and field measurements, and are listed in appendixes B, C, D, and E.

In the 1998 water year (October 1997 to September 1998), 37 wells were sampled and the water analyzed at least once for VOCs (appendix B). TCE, cis-1,2-dichloroethylene (c-1,2-DCE), trans-1,2-dichloroethylene (t-1,2-DCE), total-1,2-dichloroethylene (1,2-DCE), chloroform, methylene chloride (MC), 1,2-dichloroethane (1,2-DCA), 1,1-Dichloroethylene (1,1-DCE), and acetone were each detected in at least one sample. The concentration of TCE exceeded the Maximum Contaminant Level (MCL) of 5 µg/L in water from 21 wells and ranged from 6.2 to 6,000 µg/L. Temporal changes in TCE concentrations in water from selected wells are shown in figure ES-3.

Water samples were collected and analyzed for selected trace elements from wells where concentrations of trace elements previously exceeded MCLs. Water from wells with trace-element concentrations that exceeded MCLs during 1989-97 continued to have concentrations that exceeded the MCLs in the 1998 water year with only two exceptions.

Water from 32 wells was sampled and analyzed for sulfate during the 1998 water year. The sulfate plume during the 1998 water year included the area where concentrations are greater than 100 mg/L. During the 1998 water year, the area immediately surrounding wells U4-021 and U4-022 had sulfate concentrations greater than 100 mg/L, which it did not have during the 1997 water year. The area immediately surrounding U4-007 and U4-008 within the sulfate plume had concentrations less than 100 mg/L during the 1998 water year but greater than 100 mg/L during the 1997 water year (fig. ES-4).

Only one of the five sets of clustered wells selected for monitoring showed evidence of increased sulfate concentration in water from the deeper well. Well U4-033 is screened about 18 ft below the bottom of the screen of the shallower well, U4-043. In 1993, after the drains were installed, the sulfate concentrations in water from both of these wells increased. Sulfate concentrations in water from both wells remained relatively constant during 1994-98.

Most of the changes in the areal extent of the sulfate plume likely are caused by the drains that were installed during July and August 1993 as part of remediation, and to a lesser extent by variations in precipitation. The maximum concentrations of sulfate in water from selected wells were compared between the 1997 and the 1998 water years. This comparison shows that sulfate concentrations increased in water from 12 wells, decreased in water from 14 wells, and remained the same in water from three wells.

Suggestions for Monitoring

The wells suggested for use in continued monitoring of water quality and water levels in the OU 4 area 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 1998-99 include the deletion of U4-028 from and the addition of U4-024 to the monitoring list. Past water-quality data from wells U4-046 through U4-064, drilled by Montgomery Watson, Consulting Engineers, Incorporated (MW), and wells U4-075 through U4-080, drilled by CH2M Hill, should be reviewed to determine if these wells should be incorporated into the monitoring program. Also, it is suggested that water levels from wells currently monitored for water quality be measured quarterly and water levels from all other wells in the OU 4 area be measured in July only.

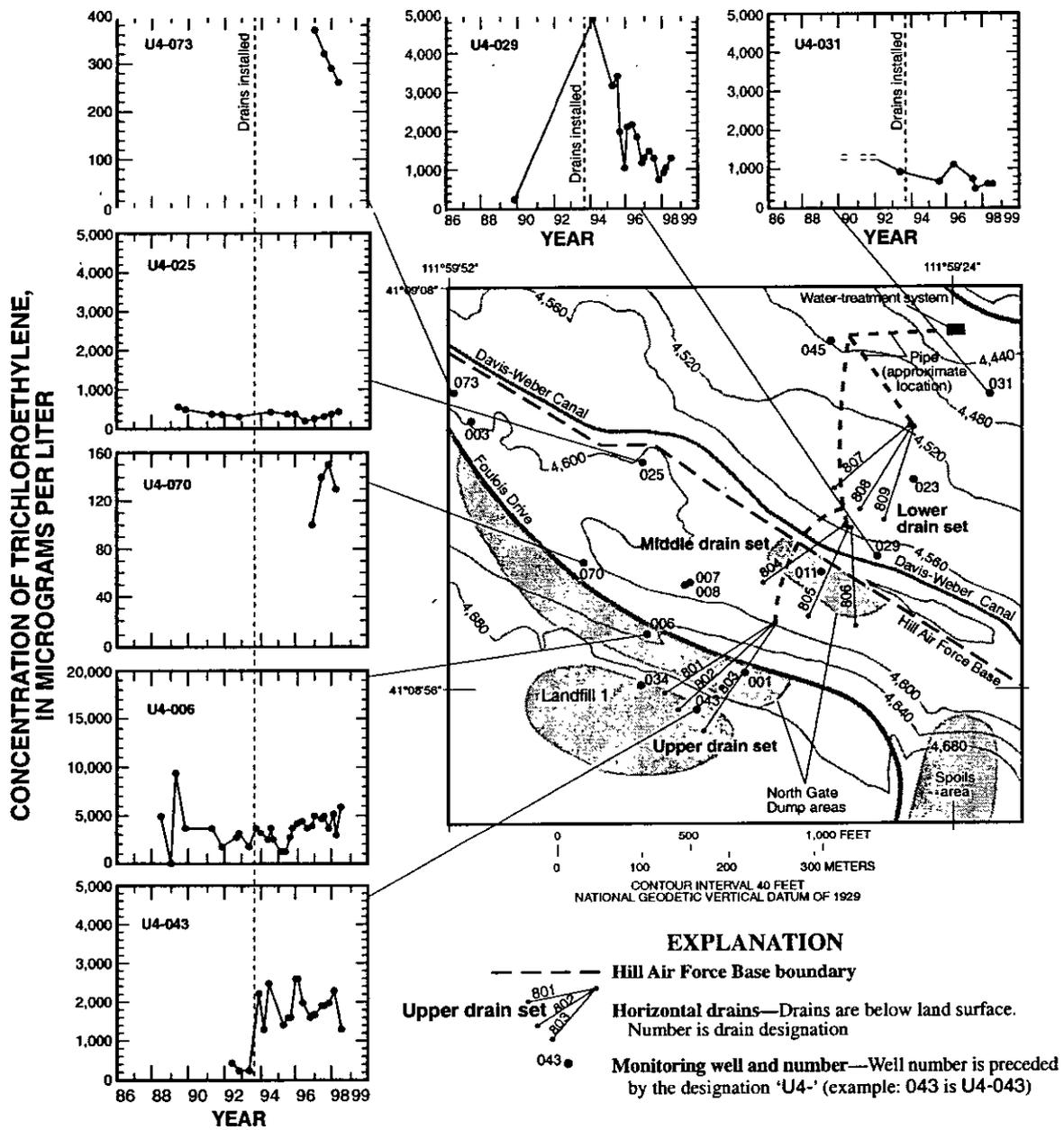
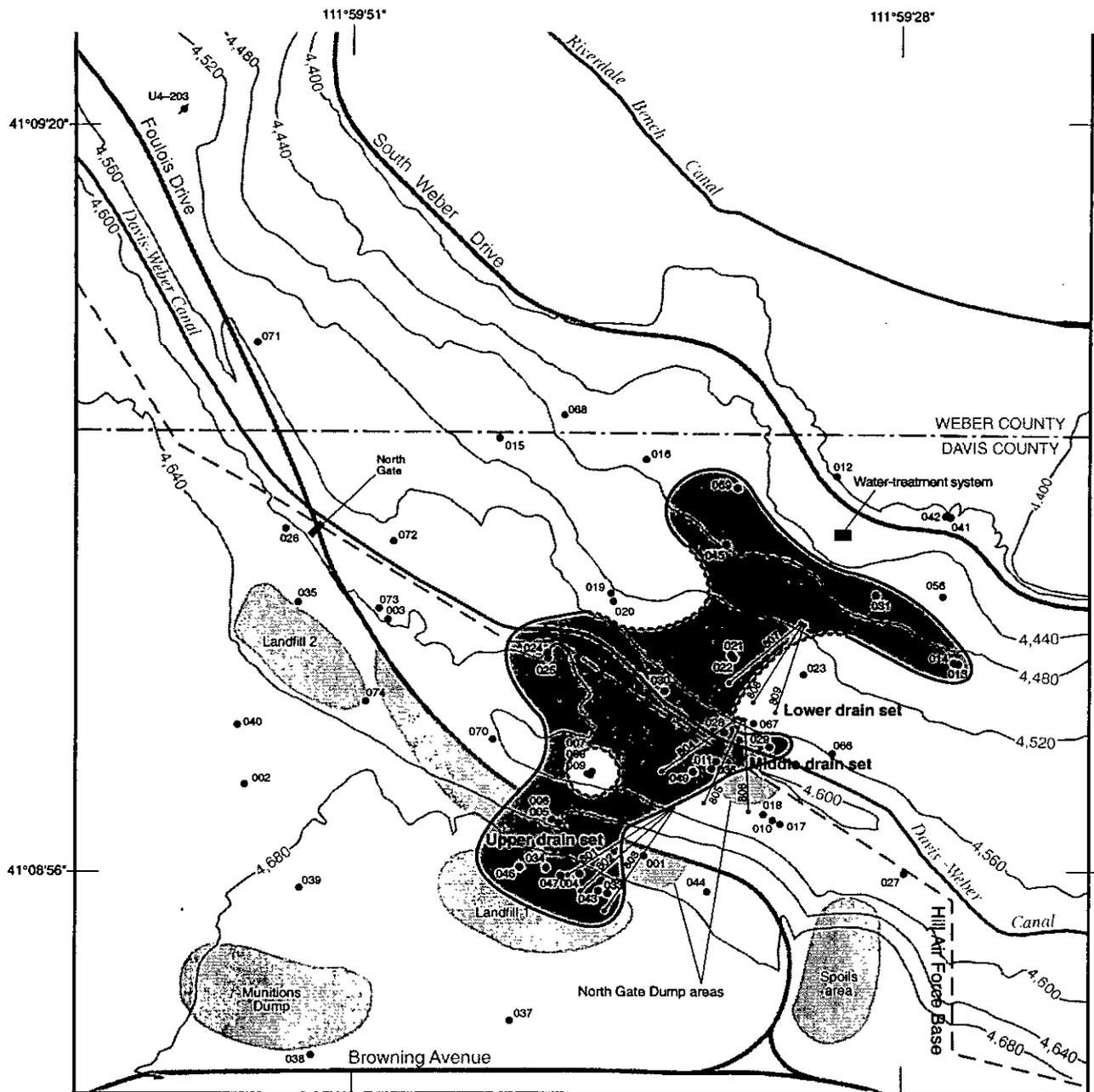


Figure ES-3. Location of selected wells and horizontal drains and concentration of trichloroethylene in water from selected wells in the area of Operable Unit 4, Hill Air Force Base, Utah, January 1986 to September 1998—Continued.



Well and drain locations are approximate

EXPLANATION

-  Area where concentration of sulfate exceeded 100 milligrams per liter, April 1998—Dashed where approximately located. At sites with well pairs, the well with the greater concentration of sulfate was used
-  Hill Air Force Base boundary
-  Upper drain set
Horizontal drains—Drains are below land surface. Number is drain designation
-  038 ● Monitoring well and number—Well number is preceded by the designation 'U4-' (example: 038 is U4-038)
-  U4-203 ● Private or public well and number

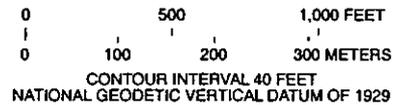


Figure ES-4. Area where concentration of sulfate exceeded 100 milligrams per liter in the shallow ground water in the area of Operable Unit 4, Hill Air Force Base, Utah, April 1998.

Table ES-1. Wells suggested for use in continued monitoring of water quality at quarterly, semiannual, or annual intervals and for continued monitoring of water levels at quarterly 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 should include only analyses of volatile organic compounds]

Quarterly sampling (spring, summer, fall, winter)	Semiannual sampling (spring, fall)	Annual sampling (spring)
Upgradient from Davis-Weber Canal		
U4-001	U4-003	U4-017
U4-006	U4-005	U4-018
U4-008	U4-007	¹ U4-037
² U4-011	³ U4-024	¹ U4-039
⁴ U4-034	U4-025	¹ U4-070
⁴ U4-043	U4-033	
	^{5,6} U4-035	
	U4-036	
	U4-070	
	U4-072	
	U4-073	
	⁵ U4-074	
Downgradient from Davis-Weber Canal		
U4-023	⁷ U4-015	U4-013
U4-029	U4-016	U4-014
U4-045	U4-021	¹ U4-066
⁸ U4-031	U4-022	¹ U4-068
	⁵ U4-067	
	U4-069	
	U4-203	
Weber River flood plain		
	U4-012	
	⁵ U4-041	
	⁵ U4-042	

¹ Analyze for volatile organic compounds only.

² Well may not contain enough water to collect a sample, but continued monitoring is suggested because of high trichloroethylene concentrations in previous samplings.

³ Add selenium (SW7740) to schedule.

⁴ Add lead (SW7421) to schedule.

⁵ Add arsenic (SW7060) to schedule.

⁶ Analyze for selected inorganic constituents (SW6010) only.

⁷ Currently (1998) not able to collect sample.

⁸ Only enough water in well to sample once or twice a year.