Prepared in cooperation with the
UNIVERSITY OF TENNESSEE SPACE INSTITUTE

OPEN-FILE REPORT
OFR 92-41

INTRODUCTION

Ground water is one of the most important resources in the United States. In Tennessee, ground water is used for domestic needs, including drinking, by about 51 percent of the population (Hutson, 1991). Characterizing the quality of ground water is essential for the welfare of the people in the State.

The U.S. Geological Survey (USGS), as part of its water-resources investigation programs, collects and archives data on ground-water quality. In Tennessee, the data are used for the management and utilization of surface and ground waters by Federal, State, and local agencies. In areas within the State, where sinkholes and other karst features occur, data about the quality of ground water are scarce.

During June 1991, as part of the USGS data-collection programs, an investigation was conducted of the quality of ground water in the vicinity of the University of Tennessee Space Institute (UTSI), Franklin County, Tennessee (fig. 1). The project was conducted in cooperation with UTSI. The purpose of the study was to define background water-quality conditions and to determine if organic and inorganic contaminants occur in the area.

The study area is located within the campus of the UTSI (fig. 1). Woods Reservoir borders UTSI on the east, west, and south. Ground-surface elevations range from 960 to 1,020 feet above sea level. Surficial materials in the area consist of regolith from weathered Warsaw Limestone and Fort Payne Formation. These materials are underlain by the unweathered Fort Payne Formation of Mississippian age (Hart,1985). Most of the ground water occurs in the interstices between gravels in the regolith.

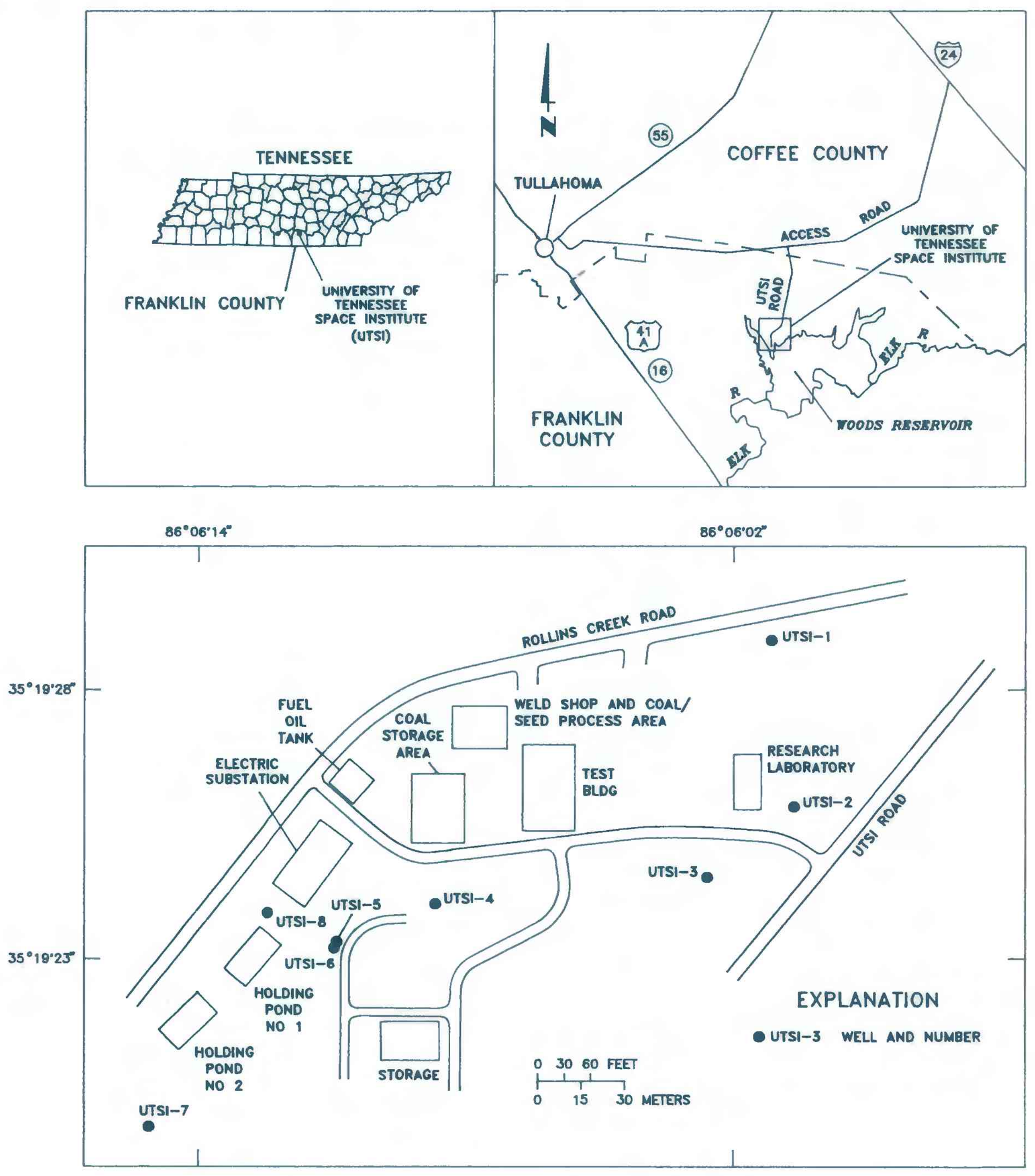

Figure 1.--Location of study area.

WELL DRILLING AND CONSTRUCTION

Well locations were selected in cooperation with UTSI personnel to monitor the shallow ground water for environmental contaminants. Well UTSI-1 was located upgradient of the campus. Wells UTSI-2 through UTSI-8 were located downgradient from areas where plant operations might have contaminated the ground water. Identified areas of concern included the lab leach field, the coal storage area, the coal fired generator area, and the Energy Conversion Facility (ECF). Monitoring wells were drilled using standard air-rotary techniques. Boreholes ranging in depth from 28 to 59 feet were drilled to approximately 3 feet below the first occurrence of water. Water levels ranged from 9 to 36 feet below land surface (table 1).

Table 1.--*Well construction and water-level data*

[UTSI, University of Tennessee Space Institute; altitude is feet above land surface; well-construction data and water levels are feet below land surface]

UTSI well number	Station number	Date of construction	Altitude of land surface (feet)	Depth drilled (feet)	Top of screen (feet)	Bottom of screen (feet)	Bottom of seal (feet)	Water level (feet)	Date measured	Water level (feet)	Date measured
UTSI-1	351930086060001	6-26-91	998.2	34.00	24.0	34.0	20	16.20	6-27-91	16.68	7-9-91
UTSI-2	351926086060001	6-26-91	1004.1	43.00	33.0	43.0	31	26.36	6-27-91	26.86	7-9-91
UTSI-3	351925086060301	6-26-91	1014.1	53.00	43.0	53.0	39	36.12	6-27-91	36.75	7-9-91
UTSI-4	351924086060901	6-26-91	993.4	28.00	18.0	28.0	16	10.79	6-27-91	11.52	7-9-91
UTSI-5	351924086061101	6-25-91	991.4	59.00	47.5	57.5	45	14.44	6-27-91	15.03	7-9-91
UTSI-6	351924086061102	6-25-91	990.3	43.00	33.0	43.0	31	13.48	6-27-91	14.12	7-9-91
UTSI-7	351920086061501	6-26-91	984.9	43.00	33.0	43.0	31	14.32	6-27-91	16.59	7-9-91
UTSI-8	351924086061301	6-26-91	982.1	28.00	18.0	28.0	16	9.72	6-27-91	10.32	7-9-91

Wells were completed with 4-inch-diameter polyvinyl-chloride (PVC) casing and screen, then sandpacked to at least 2 feet above the screen, and sealed with bentonite pellets and cement slurry (fig. 2). Each well was flushed with water and developed for at least one-half hour using compressed air. Well protectors were installed during the grouting phase. Construction and water-level data for each well are summarized in table 1.

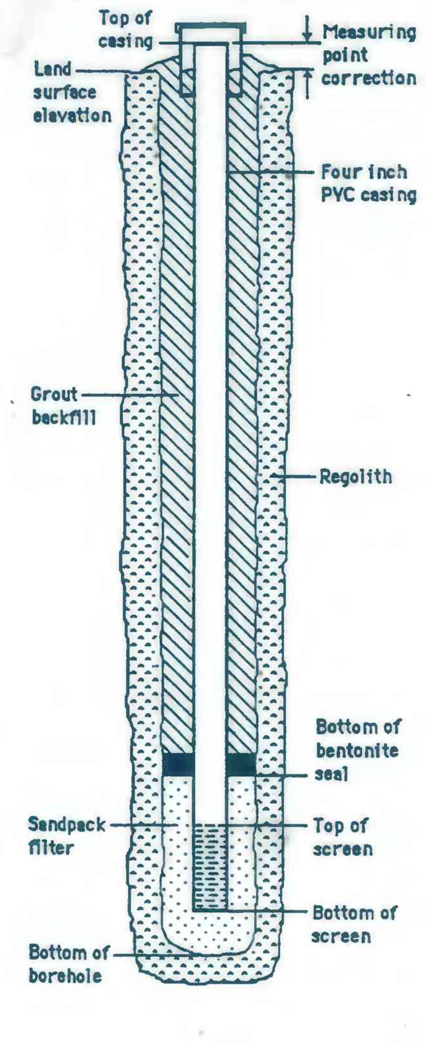

Figure 2.--Well-construction diagram.

WELL SAMPLING

Water samples were collected from each well after the casing was purged. In general, three to five casing volumes of water were withdrawn from each well, or until equilibrium of the pH and specific conductance values of the purged water was achieved. Temperature, specific conductance, pH, and alkalinity were measured in the field using standard USGS techniques (Wood, 1976). Water samples for analyses of inorganic constituents were collected using a 2-inch-diameter submersible pump. The pump was flushed with soapy tap water and rinsed thoroughly after each well was sampled. The samples were preserved using USGS standard methods (Pritt and Jones, 1989). Samples for analyses of organic compounds were collected using stainless-steel bailers. The bailers were lowered to just below the water table, filled, and rinsed three times before the sample was collected. After each well was sampled, the bailers were washed with detergent, rinsed with tap water, deionized water, isopropanol, and allowed to air dry. The bailers were wrapped in aluminum foil during storage and transport from one sampling site to another to prevent potential contamination.

WATER-QUALITY DATA

Laboratory and field analyses were performed on the water samples to determine values of selected physical properties, and concentrations of major ions, trace inorganic constituents, and selected organic compounds. The samples were analyzed at the USGS National Water Quality Laboratory (NWQL) in Arvada, Colorado, using techniques described by Wershaw and others (1987), and Fishman and Friedman (1989). The data were entered into the USGS Water Quality Data Storage and Retrieval System (WATSTORE). Results of field and laboratory analyses are summarized in tables 2 and 3.

Turbidity values in the water samples ranged from 0.6 to 55 nephelometric turbidity units (NTU's) (table 2). For comparison purposes, the primary drinking water standard for turbidity in the State of Tennessee is 1.0 NTU (Tennessee Department of Health and Environment[1], 1991). Manganese concentrations ranged from 12 to 740 micrograms per liter (μg/L). The secondary drinking water standard in Tennessee for manganese is 50 micrograms per liter (μg/L).

Chloroform, toluene, methylene chloride, 1,1-dichloroethane, 1,1-dichloroethylene, 1,1,1-trichloroethane, 1,4-dichlorobenzene, trichloroethylene, 1,2-dichloroethene, benzene, and xylene were detected in several of the water samples (table 3). The water sample from well UTSI-7 (fig. 1) had concentrations of 75 μg/L of carbon tetrachloride (CCl_4), 210 μg/L of tetrachloroethylene (PCE), and 13 μg/L of 1,1-dichloroethylene (DCE). The sample from well UTSI-3 (fig. 1) had a DCE concentration of 40 μg/L. For comparison purposes, the primary drinking water standard in Tennessee for CCl_4 and PCE is 5 μg/L, and 7 μg/L for DCE.

[1]Tennessee Department of Environment and Conservation as of late 1991.

REFERENCES CITED

Fishman, M.J., and Friedman, L.C., eds., 1989, Methods for determination of inorganic substances in water and fluvial sediments (3rd ed.): Techniques of Water-Resources Investigations of the U.S. Geological Survey, Book 5, chapt. A1, 545 p.

Hart, T.A., 1985, Geologic map and mineral resources summary of the Capitol Hill quadrangle, Tennessee: Tennessee Division of Geology GM 86-SE, scale 1:24,000.

Hutson, S.S., 1991, Ground-water use by public-supply systems in Tennessee in 1988: U.S. Geological Survey Open-File Report 91-176, 1 sheet.

Pritt, Jeffrey, and Jones, B.E., eds., 1989, 1990 National Water Quality Laboratory services catalog: U.S. Geological Survey Open-File Report 89-386, 119 p.

Tennessee Department of Health and Environment, 1991, Regulations for public water systems and drinking water supply, *in* Rules of Tennessee Department of Health and Environment-Bureau of Environment, Division of Water Supply: Tennessee Department of Health and Environment, Division of Water Supply, chapt. 1200-5-1, 103 p.

Wershaw, R.L., Fishman, M.J., Grabbe, R.R., and Lowe, L.E., eds., 1987, Methods for the determination of organic substances in water and fluvial sediments: Techniques of Water Resources Investigations of the U.S. Geological Survey, Book 5, chapt. A3, 80 p.

Wood, W.W., 1976, Guidelines for collection and field analysis of ground-water samples for selected unstable constituents: Techniques of Water-Resources Investigations of the U.S. Geological Survey, Book 1, chapt. D2, 24 p.

CONVERSION FACTORS AND VERTICAL DATUM

Multiply	*By*	*To obtain*
inch (in.)	25.4	millimeter
foot (ft)	0.3048	meter

Sea level: In this report, "sea level" refers to the National Geodetic Verical Datum of 1929 (NGVD of 1929)--a geodetic datum darived from general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

For additional information write to:

District Chief
U.S. Geological Survey
810 Broadway
Suite 500
Nashville, TN 37203

Copies of this report can be purchased from:

U.S. Geological Survey
Books and Open-File Reports Section
Federal Center, Building 810
Box 25425
Denver, CO 80225

Table 2.--*Water-quality data for inorganic compounds and trace metals*

[NTU, nepholometric turbidity units; mg/L, milligrams per liter; μg/L, micrograms per liter; μS/cm, microsiemens per centimeter; <, less than; deg. C, degrees Celsius]

UTSI well number	Station number	Date	Turbidity (NTU)	pH, field (standard units)	Calcium dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Chloride, dissolved (mg/L as Cl)	Specific conductance, field (μS/cm)	Alkalinity, field (mg/L as $CaCO_3$)
UTSI-1	351930086060001	08-05-91	0.60	5.5	4.7	2.6	3.7	0.40	7.4	21	11
UTSI-2	351926086060001	08-05-91	15	5.4	5.8	1.8	1.5	0.40	3.8	53	10
UTSI-3	351925086060301	08-06-91	17	5.3	2.8	0.66	0.90	0.20	1.3	72	11
UTSI-4	351924086060901	08-06-91	10	4.7	9.3	8.8	29	11	14	337	5.3
UTSI-5	351924086061101	08-07-91	3.0	6.4	13	2.0	0.70	0.20	0.50	80	42
UTSI-6	351924086061102	08-07-91	16	6.1	5.2	1.6	2.1	0.30	0.60	49	18
UTSI-7	351920086061501	08-08-91	55	6.3	4.9	1.3	2.6	3.5	1.0	62	24
UTSI-8	351924086061301	08-06-91	13	5.8	4.7	1.8	2.9	0.30	2.0	57	18

UTSI well number	Sulfate dissolved (mg/L as SO_4)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Arsenic dissolved (μg/L as As)	Barium, dissolved (μg/L as Ba)	Beryllium, dissolved (μg/L as Be)	Cadmium dissolved (μg/L as Cd)	Chromium, dissolved (μg/L as Cr)	Cobalt, dissolved (μg/L as Co)	Copper, dissolved (μg/L as Cu)	Lithium dissolved (μg/L as Li)	Selenium, dissolved (μg/L as Se)
UTSI-1	0.40	<0.10	8.4	<1	14	<0.5	<1.0	<1	<3	6	<4	<1
UTSI-2	0.40	<0.10	8.6	<1	4	<0.5	<1.0	1	<3	4	<4	<1
UTSI-3	0.40	<0.10	8.0	<1	<2	<0.5	<1.0	<1	<3	4	<4	<1
UTSI-4	110	<0.10	11	<1	110	<0.5	<1.0	2	10	13	<4	6
UTSI-5	0.80	<0.10	7.8	<1	3	0.6	<1.0	<1	<3	3	<4	<1
UTSI-6	1.5	<0.10	8.7	<1	3	<0.5	<1.0	1	<3	4	<4	<1
UTSI-7	1.5	0.10	8.3	<1	4	<0.5	<1.0	<1	<3	3	<4	<1
UTSI-8	2.4	<0.10	8.6	<1	3	0.6	<1.0	<1	<3	5	<4	<1

UTSI well number	Iron, dissolved (μg/L as Fe)	Lead, dissolved (μg/L as Pb)	Manganese, dissolved (μg/L as Mn)	Molybdenum, dissolved (μg/L as Mo)	Nickel, dissolved (μg/L as Ni)	Silver, dissolved (μg/L as Ag)	Strontium, dissolved (μg/L as Sr)	Vanadium, dissolved (μg/L as V)	Zinc, dissolved (μg/L as Zn)	Aluminum, dissolved (μg/L as Al)	Solids, residue at 180 deg. C dissolved (mg/L)
UTSI-1	5	1	63	<10	5	<1.0	20	<6	13	<10	40
UTSI-2	6	<1	13	<10	3	<1.0	9	<6	18	10	43
UTSI-3	40	<1	12	<10	2	<1.0	4	<6	10	70	25
UTSI-4	37	2	740	<10	24	<1.0	95	<6	47	650	215
UTSI-5	5	<1	56	<10	2	<1.0	9	<6	10	<10	51
UTSI-6	32	<1	47	<10	2	<1.0	9	<6	3	30	32
UTSI-7	10	<1	710	<10	5	<1.0	13	<6	5	30	37
UTSI-8	15	<1	130	<10	4	<1.0	7	<6	7	<10	48

Table 3.--*Water-quality data for organic compounds*

[μg/L, micrograms per liter; <, less than]

UTSI well number	Station number	Date	Dibromomethane water whole recover (μg/L)	Dichlorobromomethane total (μg/L)	Carbontetrachloride total (μg/L)	1,2-Dichloroethane total (μg/L)	Bromoform total (μg/L)	ChloroDibromomethane total (μg/L)	Chloroform total (μG/L)	Parachlorotoluene water, whole, total (μg/L)	123-Trichloropropane water whole total (μg/L)
UTSI-1	351930086060001	08-05-91	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
UTSI-2	351926086060001	08-05-91	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.30	<0.20	<0.20
UTSI-3	351925086060301	08-06-91	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	<0.20	<0.20
UTSI-4	351924086060901	08-06-91	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
UTSI-5	351924086061101	08-07-91	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
UTSI-6	351924086061102	08-07-91	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
UTSI-7	351920086061501	08-08-91	<0.20	<0.20	75	<0.20	<0.20	<0.20	11	<0.20	<0.20
UTSI-8	351924086061301	08-06-91	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20

UTSI well number	Benzene total (μg/L)	Chlorobenzene total (μg/L)	Chloroethane total (μg/L)	Ethylbenzene total (μg/L)	Methylbromide total (μg/L)	Methylchloride total (μg/L)	Methylene chloride total (μg/L)	Tetrachloroethylene total (μg/L)	Trichlorofluoro-Methane total (μg/L)	1,1-Dichloroethane total (μg/L)	1,1,1,2 Tetrachloroethane, wat, wh total (μg/L)	1,2-Dibromo ethane water whole total (μg/L)
UTSI-1	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.2
UTSI-2	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.90	<0.20	<0.2
UTSI-3	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.50	<0.20	<0.2
UTSI-4	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.50	<0.20	<0.2
UTSI-5	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.2
UTSI-6	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.2
UTSI-7	0.80	<0.20	<0.20	<0.20	<0.20	<0.20	0.50	210	<0.20	1.1	<0.20	<0.2
UTSI-8	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.2

UTSI well number	1,1-Dichloroethylene total (μg/L)	1,1,1-Trichloroethane total (μg/L)	1,1,2-Trichloroethane total (μg/L)	1,1,2,2 Tetrachloroethane total (μg/L)	1,2-Dichlorobenzene total (μg/L)	1,2-Dichloropropane total (μg/L)	1,3-Dichlorobenzene total (μg/L)	1,4-Dichlorobenzene total (μg/L)	DichloroDifluoromethane total (μg/L)	Trans-1,3-Dichloropropene total (μg/L)	Xylene total water whole tot rec (μg/L)	Bromobenzene water, whole, total (μg/L)
UTSI-1	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.2	<0.20
UTSI-2	0.20	0.60	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	<0.20	<0.20	<0.2	<0.20
UTSI-3	40	36	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.7	<0.20
UTSI-4	1.5	8.0	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.2	<0.20
UTSI-5	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.2	<0.20
UTSI-6	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.2	<0.20
UTSI-7	13	3.5	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	1.3	<0.20
UTSI-8	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.2	<0.20

UTSI well number	Cis 1,3-Dichloropropene total (μg/L)	Vinyl chloride total (μg/L)	Trichloroethylene total (μg/L)	1,2-Dichloroethene water whole recover (μg/L)	Styrene total (μg/L)	1,1-Di chloropropene, wat, wh total (μg/L)	2,2-Di chloropropane wat, wh total (μg/L)	1,3-Di chloropropane, wat, wh total (μg/L)	O-chlorotoluene water whole total (μg/L)	Toluene total (μg/L)
UTSI-1	<0.20	<0.20	<0.2	<0.2	<0.2	<0.2	<0.20	<0.20	<0.20	<0.20
UTSI-2	<0.20	<0.20	0.2	<0.2	<0.2	<0.2	<0.20	<0.20	<0.20	<0.20
UTSI-3	<0.20	<0.20	0.7	<0.2	<0.2	<0.2	<0.20	<0.20	<0.20	0.80
UTSI-4	<0.20	<0.20	<0.2	<0.2	<0.2	<0.2	<0.20	<0.20	<0.20	0.20
UTSI-5	<0.20	<0.20	<0.2	<0.2	<0.2	<0.2	<0.20	<0.20	<0.20	0.30
UTSI-6	<0.20	<0.20	<0.2	<0.2	<0.2	<0.2	<0.20	<0.20	<0.20	0.20
UTSI-7	<0.20	<0.20	1.4	0.6	<0.2	<0.2	<0.20	<0.20	<0.20	2.1
UTSI-8	<0.20	<0.20	<0.2	<0.2	<0.2	<0.2	<0.20	<0.20	<0.20	<0.20

GROUND-WATER QUALITY AT THE UNIVERSITY OF TENNESSEE SPACE INSTITUTE, FRANKLIN COUNTY, TENNESSEE

By
Kristie G. Hamilton

1992