Appendix C—Tipton Farm Site Data

The hydrogeologic characterization of the Tipton Farm site is based on data collected and interpreted by the USGS and USEPA (Robinson and Yeskis, 1998). In addition, a substantial amount of data obtained by previous investigators (Ecology and Environment, 1985, 1986, 1990) also was summarized and subjected to analysis by the USGS and USEPA for this investigation. A total of 10 investigative methods were used to develop the hydrogeologic framework for the Tipton Farm site (table 7). Most of these methods contributed to the characterization.

Previous Studies

In 1985 and 1986, Ecology and Environment installed five monitoring wells (T1 - T5)(fig. 16) around the landfill area, collected ground-water-level measurements, performed a SAR survey, and sampled ground water. Ground-water-level data collected as part of this investigation indicated a northwestern direction of flow around the landfill area, with a more northerly component during periods of low water levels. A number of high and low resistivity anamolies were detected with the SAR survey, which could indicate the presence of unsaturated caverns/fractures (high resistivity) or saturated caverns/fractures (low resistivity). Four of the five wells were installed in areas with suspected karst features based on the SAR survey, however, only one small fracture was found in one well (Ecology and Environment, 1985). Analysis of water samples from the five wells indicated 24 parts per billion (ppb) of 2,4-dimethylphenol in the sample from well T1 and 5 ppb of trans-1,2-dichloroethene in the samples from well T5. Water from both wells contained phenolic compounds (Ecology and Environment, 1985, 1986).

A follow-up to the previous investigation by Ecology and Environment (1990), included the installation of 11 monitoring wells (DS1 - DS9, T6S, T6D)(fig. 16), ground-water-level measurements, soil sampling and ground-water-quality sampling. The investigation indicated that the ground-water flow generally mirrors surface topography (fig. 17). The major component of ground-water flow was to the west-northwest with seasonal variations and possible local variations because of fractures. Ground-water-quality samples collected in December 1987 and April 1988 indicated the presence of phenolic compounds and other organic compounds in water from wells T1 and T5 (Ecology and Environment, 1990).

Topographic Maps

Analysis of land-surface topography during site visits and from topographic maps (fig. 17) did not clearly indicate the presence of fracture traces or sinkholes at the Tipton Farm site. Comparison of surface topography with bedrock topography from lithologic logs obtained during previous investigations did indicate that topographic highs corresponded to locations where the bedrock surface is elevated in comparison to the rest of the site (fig. 18).

Lithologic logs

Because all of the wells were drilled during previous investigations, USGS analysis of the lithologic logs was restricted to the information on the logs, which was limited to identification of lithology. This analysis indicated the Galena-Platteville dolomite is overlain by 10-15 ft of unconsolidated material near the drum-storage area (figs. 17, 18) and less than 5 ft of unconsolidated material near the landfill.

Core Analysis

Core samples of the bedrock from wells DS8 and T6D were inspected by personnel from the ISGS (Mike Sargent and Steve Lasemi, Illinois State Geological Survey, written commun., 1992). Wells at the Tipton Farm site appear to penetrate the St. James, Beecher, Eagle Point, and Fairplay Members of the Dunleith Formation (fig. 18). These deposits, or at least the Eagle Point and Fairplay Members, appear to vary in thickness beneath the Tipton Farm site. Horizontal and healed vertical fractures were noted at about 814-816, 829, and 841 FANGVD29 in well T6D, and at about 819, 835-837, 842, 847, 849, 856-859, 867, and 869 FANGVD29 in well DS8.

Porosity values for three samples of the Fairplay Member ranged from 18 to 24 percent. Porosity values for four samples of the Eagle Point Member ranged from 9 to 31 percent. Porosity values for two samples of the Beecher Member ranged from 16 to 18 percent. Porosity values for two samples of the St. James Member ranged from 14 to 18 percent (Robinson and Yeskis, 1998).

Geophysical Logs

Caliper, natural gamma, and SPR logs were used for geologic characterization at the Tipton Farm site (table 7).

Caliper

Three-arm caliper logs indicate numerous small increases in diameter in each of the boreholes, most of which are above the water level. Large (greater than 1 in.) increases in diameter indicative of fractures were not detected. Increases in borehole diameter tend to correspond to fractured areas identified by the core analysis.

Natural Gamma

The natural-gamma log for well T5 shows a decrease in gamma activity below about 827 FANGVD29. This activity decrease may represent the location of the top of the Eagle Point Member at this location. The small interval of this well available for logging limits the utility of the log.

Single-Point Resistance

The SPR log resistance values from well T5 decreased slightly with depth. This log provided no conclusive information on site geology or the location of secondary-permeability features.

Water-Level Measurements

Water-level measurements were made in April 1990, November 1992, March 1993, and December 1994 (table 8). Water-level data indicate that the water-table configuration generally mirrors surface topography (fig. 19). Ground-water flow is from a ground-water divide near the drum-storage area toward low points west and northwest of the drum-storage area and the topographic low at the intermittent stream south of the landfill area (fig. 19). North of the intermittent stream, ground-water flow typically is west-southwest, although the direction of ground-water flow around the landfill is affected by seasonal changes in precipitation and also can be to the north and south.

Vertical hydraulic gradients at the DS4/DS8, DS6/DS7, and T6S/T6D well clusters indicate the potential for downward flow in the Galena-Platteville aquifer. Vertical gradients at the DS6/DS7 and T6S/T6D well clusters typically were about 0.05 ft/ft. These wells are located in the northern part of the site where the altitude of the bedrock surface is low in comparison to the rest of the site. Vertical hydraulic gradients at the DS4/DS8 cluster typically were about 0.2 ft/ft. The DS4/DS8 cluster is located in the southern part of the site where the bedrock surface is high. These gradients may indicate that the vertical hydraulic conductivity of the upper part of the Galena-Platteville aquifer is higher in the southern part of the site near the bedrock ridge than in the northern part of the site near the bedrock lows.

Vertical hydraulic gradients for well nest DS4/DS8 are fairly consistent over time. From 1990 to 1994, the average vertical gradient of 0.194 for well nest DS4/DS8 is near the 0.216 ft/ft average measured in 1987 and 1988 (Ecology and Environment, 1990). From 1990 to 1994, vertical hydraulic gradients for well nest T6S/T6D are larger during periods of lower water levels with the largest gradient (0.220 ft/ft) occurring in 1990 (Robinson and Yeskis, 1998).

Horizontal hydraulic gradients typically were about 0.03 ft/ft throughout the site. Horizontal hydraulic gradients were about 0.008 ft/ft near the landfill, indicating that the aquifer is this area may be more permeable than the rest of the site.

Geophysical Logging

SP logs were analyzed in an attempt to provide insight into the location of permeable features. The SP readings in wells T2, T4, and T5 indicated a large decrease in about the upper 8 ft of the water column, then decreased slightly with depth. The interval of large signal response may correspond to a permeable feature, but more likely was caused by the tool acclimating to water.

Aquifer Tests

Slug tests were performed on wells DS1, DS2, DS5, DS6, DS7, DS9, T6S, T6D, T4 and T5 in 1988 and 1990 (table C1). Slug tests were performed by the USGS on wells DS1 through DS9 in 1994. Water levels in 1988 and 1990 were from 7.1 to 15.5 ft lower than water levels in 1994 (Robinson and Yeskis, 1998). Kh values calculated from the slug tests ranges from 0.01 to 1.00 ft/d (table C1).

Those wells around the landfill area (T6S, T6D, T4, T5) typically had the lowest Kh values, indicating few saturated fractures during testing in 1990. Comparison of Kh values from wells tested in 1988 or 1990, and again in 1994, show that five wells had similar Kh and two wells had higher Kh values during 1994, when water levels were higher. The higher Kh at these wells might be due to higher water levels in 1994 resulting in saturated fractures being intercepted by the well that were not within the water column in 1988 or 1990 (Robinson and Yeskis,1998).

Table C1. Horizontal hydraulic conductivity values and date of testing, Tipton Farm site, Ill.

Well name (fig. 16)	Date of test (month and year)	Height of static water column (feet)	Horizontal hydraulic conductivity value (feet per day)
DS1	Apr-90	4.11	0.10
	Dec-94	19.58	1.00
DS2	Apr-90	6.56	.60
	Dec-94	20.96	.50
DS3	Dec-94	10.00	.40
DS4	Dec-94	22.54	.70
DS5	Apr-90	6.58	.50
	Dec-94	17.00	.50
DS6	Mar-88	20.13	.50
	Dec-94	20.38	.40
DS7	Mar-88	55.38	.30
	Mar-88	55.38	.30
	Dec-94	55.63	.30
	Dec-94	55.63	.30
DS8	Dec-94	53.94	.50
	Dec-94	53.94	.50
	Dec-94	53.94	.50
DS9	Apr-90	4.11	.30
	Dec-94	13.20	1.00
T6S	Jan-90	9.67	.10
T6D	Jan-90	33.27	.40
T4	Jan-90	7.44	.01
T5	Jan-90	12.72	.10

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