WATER-QUALITY AND WELL-CONSTRUCTION DATA FOR SELECTED FARMSTEAD WELLS IN TENNESSEE

By Michael W. Bennett, John K. Carmichael, and Angel Román-Más

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CONVERSION FACTORS

Multiply inch-pound units	By	To obtain
inch (in.)	25.4	millimeter (mm)
foot (ft)	30.48	centimeter (cm)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$°F = 1.8 * °C + 32$$

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ABSTRACT

An investigation of the quality of ground water consumed by farmers in Tennessee was conducted in 1989 and 1990 by the U.S. Geological Survey, U.S. Department of the Interior, in cooperation with the Tennessee State Planning Office. Ground-water samples were collected from 150 wells representing varied hydrogeologic conditions and agricultural areas throughout the State. Analyses were made for physical characteristics, bacteria, major and trace inorganic constituents, nitrogen species, and total organic carbon. A nonquantitative, semiqualitative analytical scan was conducted for semivolatile organic compounds. Well-construction data were compiled from the University of Tennessee Agricultural Extension Service, the Division of Ground Water Protection of the Tennessee Department of Health and Environment, and landowners. A map showing the location of wells sampled was prepared and tables summarizing the results of the field and laboratory analyses were compiled. Well-construction and ground-water-level data were entered into the Ground-Water Site Inventory data base of the U.S. Geological Survey.

INTRODUCTION

Domestic wells supply the water demands of about one million people in Tennessee, including their drinking water needs (Hutson, 1988). Data on the quality of the water withdrawn from these wells are scarce. Until recently, no systematic monitoring programs were in place in the State to assess the quality of the ground water consumed by farmers and their families. Preliminary investigations conducted by the Tennessee Department of Health and Environment (TDHE) indicate that ground water in Tennessee is subject to potential contamination from natural and anthropogenic sources (Tennessee Department of Health and Environment, 1986).

In 1989, the U.S. Geological Survey (USGS), U.S. Department of the Interior, in cooperation with the Tennessee State Planning Office, initiated an investigation of the ground-water quality of selected farmstead wells in the State. A network of 150 wells was established, representing different hydrogeologic conditions and agricultural areas throughout the State. At each site, samples were collected for field and laboratory analyses of chemical, physical, and bacteriological characteristics. The field analyses included determinations of pH, specific conductance, water temperature, alkalinity, fecal coliform, and fecal streptococci bacteria.

Laboratory analyses were performed for principal anions and cations, trace inorganic constituents, dissolved solids, nutrients, and total organic carbon. A nonquantitative, semiqualitative scan for semivolatile organic compounds was conducted for each sample.

WELL SELECTION AND ACQUISITION OF CONSTRUCTION DATA

The following criteria were used to select wells included in the network and sampling:

- Each well was a source of drinking water for the farmstead.
- All wells were located on farms engaged in some type of agricultural activity at the time of sampling.
- Documentation of past and present agricultural practices at the farm was available.
- Data on the construction of the well were available.

The Agricultural Extension Service of the University of Tennessee (UTAES) assisted the USGS in the selection of the wells. The UTAES staff provided records for 562 candidate wells, including data on the hydrogeology of the site, agricultural practices, and construction data. Drillers' logs provided by the Division of Ground Water Protection of the TDHE, were used to supplement the UTAES records; 215 wells met the selection criteria indicated above. Further screening resulted in the selection of 150 wells as primary sampling sites, while the remaining 65 wells were identified as alternate sites. The owners of the prospective sampling wells were contacted to solicit their support to the project, confirm the UTAES and TDHE records, and to schedule the sampling. Alternate sites were selected after determinations were made that sampling at the primary site was not feasible. Every attempt was made to select an alternate site within the same county and aquifer, and with land use of the same category as the original site. The location of the final sites selected for the network are shown on plate 1.

SAMPLE COLLECTION

Water samples were collected after each well was purged. Stabilization of field measurements (temperature, specific conductance, and pH) was used as a criteria for purging. In general, purging of three to five casing volumes of water was needed before stabilization of field measurements was achieved.

Temperature, specific conductance, pH, and alkalinity were measured in the field following standard techniques of the USGS (Wood, 1981). The membrane filter method (Greeson and others, 1977) was used for bacteriological analysis (fecal coliform and fecal streptococci). Water samples for laboratory analysis were collected and preserved according to standard methods of the USGS (Wood, 1981; Pritt and Jones, 1989). The samples were analyzed at the National Water Quality Laboratory of the USGS in Arvada, Colorado. Techniques described by Fishman and Friedman (1989) and Wershaw and others (1987) were used for the laboratory analyses. Results of field and laboratory analyses were entered into the USGS's Water Data Storage and Retrieval System (WATSTORE).

DATA SUMMARY

Construction data, water levels, and identification of the principal aquifer tapped by each well are shown in table 1. Water-level measurements prior to purging of each well were obtained when feasible. The principal aquifer tapped by each well was defined using geologic maps and hydrogeologic descriptions by Bradley and Hollyday (1985).

Results of the water-quality analyses are shown in table 2. Several wells were re-sampled to confirm high values of selected water-quality characteristics, as part of the quality-assurance program of the Tennessee District of the USGS (Gaydos, 1983), or to replace samples lost in shipment.

Concentrations of total dissolved solids are reported as the total solid residue at 105 degrees Celsius. However, at sites 19, 27, and 47 (table 2), concentrations of total dissolved solids are reported as the sum of all major cations and anions. Total-nitrate concentrations were calculated by subtracting the total-nitrite concentration from the total nitrite plus nitrate concentration. Bacteriological analyses labeled as non-ideal count (K) implies that the number of bacteria colonies that developed on the filter was outside the ideal range, 20 to 60 and 20 to 100 colonies for fecal coliform and fecal streptococci, respectively.

Nonquantitative, semiqualitative analyses of organic compounds were performed using a scanning procedure based on gas chromatography with a flame-ionization detector (GC/FID). The GC/FID scanning method separates individual organic compounds. Although individual compounds are not identified, this scanning procedure is an economical means of determining which wells warrant more costly quantitative and qualitative analyses. Results of the GC/FID scans are reported in terms of the number of peaks identified, estimated total concentration, and the number of peaks possibly identified by gas chromatography/mass spectrometry.

Table 1.--*Construction data for selected farmstead wells*

[--, data not available; perf., perforated; galv., galvenized; PVC, polyvinyl chloride]

Site number	County	Water level (feet)	Year well constructed	Principle aquifer	Well depth (feet)	Top of open interval (feet)	Bottom of open interval (feet)	Type of finish	Casing material
1	Hamilton	--	1969	Cambrian/Ordovician	100	42.0	100	Open hole	Steel
2	Lincoln	--	1865	Mississippian	25	--	25.0	Open hole	--
3	Hardin	--	--	Cretaceous	50	--	--	--	--
4	Bradley	--	1974	Cambrian/Ordovician	105	53.0	105	Open hole	Steel
5	Wayne	--	1959	Mississippian	140	--	140	Perf./Slotted	Steel
6	Bradley	46.9	1986	Cambrian/Ordovician	107	93.0	107	Open hole	Galv. iron
7	McNairy	--	1978	Cretaceous	385	180	385	Open hole	Steel
8	Franklin	--	1980	Mississippian	122	57.0	122	Open hole	Steel
9	Marion	--	1950	Cambrian/Ordovician	75	35.0	75.0	Open hole	Galv. iron
10	Marion	--	1962	Mississippian	30	25.0	30.0	Open hole	Steel
11	Hardeman	--	1960	Tertiary	153	143	153	Screen	PVC/Plastic
12	Giles	--	1975	Ordovician	100	--	100	Open hole	Steel
13	Fayette	120	1977	Tertiary	155	145	155	Gravel screen	PVC/Plastic
14	Polk	30.0	1977	Cambrian/Ordovician	87	61.0	87.0	Gravel screen	Galv. iron
15	Lincoln	--	1805	Ordovician	40	5.00	40.0	Open hole	Rock/Stone
16	McNairy	62.2	1972	Cretaceous	263	40.0	263	Open hole	PVC/Plastic
17	Franklin	40.6	1986	Mississippian	103	54.0	57.0	Perf./Slotted	Steel
18	Polk	66.2	1970	Cambrian/Ordovician	187	112	187	Open hole	Galv. iron
19	Shelby	50.0	1988	Tertiary	110	100	110	Screen	PVC/Plastic
20	McNairy	--	1964	Tertiary	32	29.0	32.0	Perf./Slotted	PVC/Plastic
21	Fayette	70.0	1968	Tertiary	100	96.0	100	Gravel screen	PVC/Plastic
22	Hardeman	13.9	1966	Alluvial	47	37.0	47.0	Gravel screen	PVC/Plastic
23	Wayne	--	1951	Alluvial	16	15.0	16.0	Open hole	Tile
24	Moore	14.3	1920	Alluvial	20	19.0	20.0	Open end	Concrete
25	Lawrence	47.0	1978	Mississippian	247	54.0	247	Open hole	Steel
26	Hamilton	--	1958	Pennsylvanian	87	15.0	87.0	Open hole	Steel
27	McMinn	36.3	1974	Cambrian/Ordovician	150	20.3	150	Open hole	Galv. iron
28	Grundy	25.0	1974	Mississippian	117	30.0	117	Open hole	Steel
29	Chester	--	1973	Cretaceous	120	110	120	Screen	PVC/Plastic
30	Giles	--	1950	Mississippian	60	30.0	60.0	Open hole	Steel
31	Chester	40.0	1978	Cretaceous	78	70.0	78.0	Screen	PVC/Plastic
32	Sequatchie	25	1930	Pennsylvanian	55	20.0	55.0	Open hole	Steel
33	Lewis	34.6	1987	Mississippian	164	20.6	164	Open hole	Steel
34	Meigs	72.0	1987	Cambrian/Ordovician	150	126	150	Open hole	Steel
35	Maury	70.0	1966	Ordovician	190	70.0	190	Open hole	Galv. iron
36	Bledsoe	59.5	1987	Pennsylvanian	125	20.4	125	Open hole	Steel
37	Decatur	--	1966	Cretaceous	26	--	--	--	Steel
38	Coffee	--	1987	Mississippian	67	60.0	67.0	Perf./Slotted	Steel
39	Warren	60.0	1979	Mississippian	65	32.0	65.0	Open hole	Steel
40	Bedford	17.5	1967	Ordovician	56	19.0	56.0	Open hole	Wrought iron
41	Monroe	--	1976	Cambrian/Ordovician	575	80.0	575	Open hole	Galv. iron
42	Tipton	--	1963	Tertiary	120	110	120	Open hole	PVC/Plastic
43	Bedford	--	1987	Ordovician	123	20.0	123	Open hole	Steel
44	Haywood	--	1968	Tertiary	90	85.0	90.0	Gravel screen	PVC/Plastic
45	Madison	--	1966	Tertiary	160	148	160	Screen	PVC/Plastic
46	Rhea	124	1987	Cambrian/Ordovician	282	260	280	Perf./Slotted	Steel
47	Marshall	--	1957	Ordovician	145	25.0	145	Open hole	Steel
48	Haywood	95.0	1973	Tertiary	152	140	152	Gravel screen	PVC/Plastic
49	Tipton	--	1963	Tertiary	90	82.0	110	Open hole	PVC/Plastic
50	Hickman	--	1957	Mississippian	200	--	200	Open hole	Steel
51	Monroe	24.4	1988	Cambrian/Ordovician	85	25.0	85.0	Open hole	Steel
52	Marshall	--	1961	Ordovician	195	63.0	195	Open hole	Steel
53	Maury	35.0	1973	Ordovician	175	20.0	175	Open hole	Steel
54	Rutherford	9.85	1955	Ordovician	55	--	--	Open hole	Steel
55	Decatur	30.0	1976	Cretaceous	51	--	--	--	Concrete
56	Loudon	54.7	1985	Cambrian/Ordovician	390	75.0	390	Open hole	Steel
57	Van Buren	--	1954	Mississippian	100	--	100	Open hole	Steel
58	Henderson	--	1973	Cretaceous	150	110	150	Screen	PVC/Plastic

Table 1.--*Construction data for selected farmstead wells*--Continued

[--, data not available; perf., perforated; galv., galvenized; PVC, polyvinyl chloride]

Site number	County	Water level (feet)	Year well con-structed	Principle aquifer	Well depth (feet)	Top of open interval (feet)	Bottom of open interval (feet)	Type of finish	Casing material
59	Perry	14.5	1954	Mississippian	23	--	--	Open hole	Concrete
60	Perry	--	1985	Mississippian	225	40.0	225	Open hole	Steel
61	Sevier	15.6	1981	Cambrian/Ordovician	105	94.0	105	Open hole	Steel
62	Crockett	--	1974	Tertiary	85	--	--	--	PVC/Plastic
63	Van Buren	--	1963	Mississippian	160	--	160	Perf./Slotted	Steel
64	Madison	--	1976	Tertiary	90	80.0	90.0	Screen	PVC/Plastic
65	Blount	--	1970	Cambrian/Ordovician	451	170	451	Open hole	Steel
66	Henderson	--	1976	Cretaceous	110	90.0	110	Screen	PVC/Plastic
67	Sevier	28.0	1964	Crystalline	166	20.0	166	Open hole	Steel
68	Hickman	--	1889	Ordovician	20	--	--	--	Brick
69	Cannon	47.0	1964	Ordovician	55	20.0	55.0	Open hole	Steel
70	Loudon	25.0	1965	Cambrian/Ordovician	100	38.0	100	Open hole	Steel
71	Cumberland	--	1985	Pennsylvanian	183	24.0	183	Open hole	Steel
72	Cumberland	40.0	1979	Pennsylvanian	58	40.0	58.0	Perf./Slotted	Steel
73	Roane	133	1968	Cambrian/Ordovician	288	134	288	Open hole	Galv. iron
74	Blount	--	1955	Cambrian/Ordovician	190	--	--	--	Steel
75	Roane	81.1	1981	Cambrian/Ordovician	180	147	180	Open hole	Steel
76	Rutherford	22.0	1948	Ordovician	150	32.0	150	Open hole	Steel
77	White	--	1960	Mississippian	121	20.0	121	Open hole	Steel
78	Williamson	--	1949	Ordovician	75	--	--	Open hole	Steel
79	Hickman	7.72	1979	Mississippian	125	21.0	125	Open hole	Galv. iron
80	Gibson	--	1971	Tertiary	125	--	--	--	PVC/Plastic
81	Cannon	5.46	1965	Ordovician	37	8.00	37.0	Open hole	PVC/Plastic
82	Gibson	4.00	1988	Tertiary	140	130	140	Screen	PVC/Plastic
83	Williamson	10.5	1900	Ordovician	14	--	--	--	Rock/Stone
84	Carroll	--	1978	Cretaceous	120	100	120	Screen	PVC/Plastic
85	Benton	--	1964	Cretaceous	110	100	110	Screen	PVC/Plastic
86	Crockett	30.0	1977	Tertiary	54	46.0	54.0	Screen	PVC/Plastic
87	Humphreys	20.4	1984	Mississippian	54	32.0	52.0	Screen	PVC/Plastic
88	Unicoi	13.4	1987	Crystalline	105	63.0	105	Open hole	Steel
89	Cocke	119	1974	Cambrian/Ordovician	270	104	270	Open hole	Steel
90	White	--	1975	Mississippian	120	80.0	120	Open hole	Steel
91	Carroll	51.7	1978	Tertiary	115	95.0	115	Screen	PVC/Plastic
92	Cocke	66.6	1975	Cambrian/Ordovician	415	42.0	415	Open hole	Steel
93	Knox	--	1951	Cambrian/Ordovician	250	210	250	Open hole	Steel
94	Dyer	--	1985	Alluvial	47	--	--	Screen	PVC/Plastic
95	Greene	92.0	1969	Cambrian/Ordovician	400	19.0	400	Open hole	Steel
96	Jefferson	125	1979	Cambrian/Ordovician	210	84.0	210	Open hole	Steel
97	Humphreys	--	1961	Mississippian	315	80.0	315	Open hole	Steel
98	Dyer	40.0	1973	Tertiary	86	76.0	86.0	Screen	PVC/Plastic
99	Wilson	20.0	1945	Ordovician	45	--	--	Open hole	Steel
100	Putnam	--	1914	Ordovician	60	--	--	Open hole	Steel
101	Benton	--	1981	Mississippian	59	58.0	59.0	Open end	PVC/Plastic
102	Davidson	22.7	1940	Ordovician	96	--	--	Open hole	Steel
103	Weakley	--	1974	Tertiary	250	242	250	Screen	PVC/Plastic
104	Wilson	55.0	1965	Ordovician	70	41.0	70.0	Open hole	Steel
105	Morgan	28.7	1984	Pennsylvanian	90	35.0	90.0	Open hole	Steel
106	Unicoi	34.7	1987	Crystalline	255	142	255	Open hole	Steel
107	Anderson	23.1	1981	Cambrian/Ordovician	150	63.0	150	Open hole	Steel
108	Grainger	32.1	1985	Cambrian/Ordovician	128	79.0	128	Open hole	Steel
109	Cheatham	35.0	1978	Mississippian	75	21.0	75.0	Open hole	PVC/Plastic
110	Washington	28.6	1977	Cambrian/Ordovician	228	97.0	228	Open hole	Steel
111	Lake	--	1985	Alluvial	60	40.0	60.0	Screen	PVC/Plastic
112	Overton	25.0	1975	Mississippian	50	42.5	50.0	Open hole	Steel
113	Carter	300	1981	Cambrian/Ordovician	340	295	340	Open hole	Steel
114	Smith	--	1953	Ordovician	80	30.0	80.0	Open hole	Steel
115	Fentress	--	1968	Pennsylvanian	100	15.0	100	Open hole	Steel
116	Obion	--	1987	Tertiary	70	66.0	70.0	Screen	PVC/Plastic
117	Hamblen	46.0	1988	Cambrian/Ordovician	255	20.0	255	Open hole	Steel

Table 1.--*Construction data for selected farmstead wells*--Continued

[--, data not available; perf., perforated; galv., galvenized; PVC, polyvinyl chloride]

Site number	County	Water level (feet)	Year well con-structed	Principle aquifer	Well depth (feet)	Top of open interval (feet)	Bottom of open interval (feet)	Type of finish	Casing material
118	Weakley	69.0	1964	Tertiary	90	69.0	90.0	Gravel screen	PVC/Plastic
119	Dickson	--	1975	Mississippian	50	20.6	50.0	Open hole	Wrought iron
120	Morgan	79.0	1980	Pennsylvanian	114	21.0	114	Open hole	Steel
121	Scott	--	1960	Pennsylvanian	40	--	--	Open hole	Steel
122	Greene	--	1989	Cambrian/Ordovician	105	21.0	105	Open hole	Steel
123	Henry	--	1969	Tertiary	150	140	150	Gravel w/perf.	PVC/Plastic
124	Henry	--	1986	Cretaceous	58	48.0	58.0	Screen	PVC/Plastic
125	Union	80.0	1978	Cambrian/Ordovician	226	21.0	226	Open hole	Steel
126	Houston	5.35	1969	Mississippian	133	20.0	133	Open hole	Galv. iron
127	Jackson	50.0	1977	Ordovician	70	45.0	70.0	Open hole	Steel
128	Montgomery	25.7	1900	Mississippian	30	--	--	--	Concrete
129	Trousdale	71.0	1955	Ordovician	170	--	170	Open hole	Steel
130	Obion	--	1984	Tertiary	78	68.0	78.0	Screen	PVC/Plastic
131	Johnson	94.1	1981	Cambrian/Ordovician	190	189	190	Open hole	Wrought iron
132	Fentress	--	1984	Mississippian	100	60.0	100	Open hole	Steel
133	Stewart	--	1975	Mississippian	20	--	20.0	Perf./Slotted	Steel
134	Scott	--	1951	Pennsylvanian	95	--	--	Open hole	Wrought iron
135	Sumner	19.6	1974	Ordovician	70	20.0	70.0	Open hole	Steel
136	Jackson	--	1978	Ordovician	95	20.5	95.0	Open hole	Steel
137	Campbell	73.2	1988	Cambrian/Ordovician	287	27.0	287	Open hole	Steel
138	Sullivan	--	1952	Cambrian/Ordovician	200	20.0	200	Open hole	Wrought iron
139	Hawkins	17.8	1977	Cambrian/Ordovician	300	19.8	300	Open hole	Steel
140	Claiborne	160	1986	Cambrian/Ordovician	188	145	188	Open hole	Steel
141	Macon	24.1	1953	Mississippian	30	10.0	30.0	Open hole	Concrete
142	Lake	--	1984	Alluvial	70	60.0	70.0	Screen	PVC/Plastic
143	Robertson	--	1956	Mississippian	105	21.0	105	Open hole	Steel
144	Hancock	--	1973	Cambrian/Ordovician	100	--	--	--	--
145	Clay	--	1958	Ordovician	120	21.0	120	Open hole	Steel
146	Scott	--	1973	Pennsylvanian	110	30.0	110	Open hole	Galv. iron
147	Sullivan	--	1969	Cambrian/Ordovician	365	40.0	365	Open hole	Steel
148	Stewart	--	1975	Mississippian	84	--	84	Open hole	Steel
149	Montgomery	90.9	1976	Mississippian	145	80.0	145	Open hole	Galv. iron
150	Pickett	30.0	1974	Mississippian	72	58.0	72.0	Open hole	Steel

Table 2.--Water-quality data for selected farmstead wells

[--, no data; <, less than; K, non-ideal colony count; *, computed value; µS/cm, microsiemens per centimeter at 25 degrees Celsius; deg. C, degrees Celsius; cols./100 mL, colonies per 100 milliliters; mg/L, milligrams per liter; conc., concentration; wat wh tot it, water whole total incremental titration; GC/MS, gas chromatography/mass spectrometer; µg/L, micrograms per liter]

Site number	Date	Specific conductance (µS/cm)	pH (standard units)	Temperature water (deg C)	Coliform, fecal, 0.7 UM-MF (cols./100 mL)	Streptococci fecal, Kf agar (cols./100 mL)	Nitrogen, nitrite total (mg/L as N)	Nitrogen, nitrate total* (mg/L as N)	Nitrogen, NO_2+NO_3 total (mg/L as N)	Carbon, organic total (mg/L as C)	Calcium total recoverable (mg/L as Ca)	Magnesium, total recoverable (mg/L as Mg)	Sodium, total recoverable (mg/L as Na)	Potassium, total recoverable (mg/L as K)
1	06-07-90	300	7.77	17.0	<1	<1	<0.010	2.10	2.10	0.1	48	6.5	3.1	0.7
2	05-22-90	45	5.40	15.0	20	<1	<0.010	1.30	1.30	0.2	2.1	1.0	2.2	1.9
3	01-04-90	41	6.51	16.0	<1	<1	<0.010	<0.100	<0.100	<0.1	2.1	0.80	4.3	0.3
4	05-12-90	260	7.91	16.5	<1	K1	<0.010	2.60	2.60	<0.1	38	3.8	2.0	0.7
5	06-22-90	17	5.48	16.5	<1	<1	<0.010	0.800	0.800	0.1	1.8	0.60	1.1	0.1
6	10-31-89	193	7.21	16.0	K1	K2	<0.010	0.500	0.500	0.4	18	11	0.8	1.9
7	08-29-89	400	7.53	19.0	<1	<1	<0.010	<0.100	<0.100	0.3	40	16	6.4	4.6
8	05-17-90	490	7.50	16.5	K1	<1	0.010	0.690	0.700	0.1	63	17	4.0	0.3
9	06-12-90	380	7.21	15.0	<1	<1	<0.010	3.90	3.90	0.9	59	4.6	6.1	4.3
10	06-06-90	240	7.78	15.0	2300	K1700	<0.010	0.600	0.600	0.9	36	4.0	1.3	0.7
11	07-31-89	60	5.40	18.0	K2	<1	<0.010	1.20	1.20	0.2	3.2	1.8	4.6	4.7
	11-17-89	--	--	--	--	--	--	--	--	--	--	--	--	--
12	05-10-90	325	7.97	15.5	K1	26	<0.010	0.100	0.100	0.2	34	14	5.5	1.0
13	07-26-89	50	5.63	17.0	<1	<1	<0.010	1.20	1.20	0.1	2.2	0.90	5.3	0.8
14	12-13-89	365	7.45	16.0	<1	<1	0.020	5.78	5.80	0.5	60	4.5	2.9	0.5
15	05-21-90	500	7.30	16.5	K100	340	0.060	2.04	2.10	0.7	82	8.8	4.4	1.8
16	08-30-89	260	7.42	18.0	<1	<1	<0.010	<0.100	<0.100	0.6	29	11	7.5	8.0
17	04-26-90	174	6.80	15.5	K8	<1	<0.010	2.10	2.10	3.4	45	20	1.4	0.8
18	01-03-90	268	7.82	16.0	<1	<1	<0.010	0.900	0.900	1.8	28	17	0.9	1.0
19	07-20-89	100	5.96	18.0	<1	<1	<0.010	0.900	0.900	<0.1	6.7	3.4	7.7	1.0
20	08-28-89	140	5.00	18.0	<1	<1	<0.010	10.0	10.0	0.3	36	5.2	9.3	0.6
21	08-01-89	40	5.69	17.0	<1	<1	<0.010	0.400	0.400	0.3	1.6	0.70	4.0	0.7
	11-17-89	--	--	--	--	--	--	--	--	--	--	--	--	--
22	07-31-89	75	5.31	17.0	220	<1	<0.010	2.50	2.50	0.3	3.2	2.5	3.3	2.2
23	06-21-90	33	5.68	14.5	<1	<1	<0.010	0.100	0.100	0.1	2.2	0.90	1.6	0.6
24	11-30-89	251	7.91	16.0	K1100	K100	<0.010	1.90	1.90	5.9	37	5.3	1.6	2.5
25	06-20-90	225	7.42	17.0	<1	<1	<0.010	3.40	3.40	0.1	42	1.5	2.1	0.5
26	06-13-90	120	6.57	17.5	<1	<1	<0.010	<0.100	<0.100	0.8	11	3.3	1.5	1.1
27	11-30-89	370	7.38	15.0	220	88	<0.010	5.00	5.00	0.3	44	20	3.3	1.5
28	05-25-90	330	7.69	15.5	51	25	<0.010	0.100	0.100	0.5	53	8.3	1.2	0.5
29	01-03-90	180	5.65	16.5	<1	<1	<0.010	1.40	1.40	0.2	2.3	0.90	7.9	0.2
30	05-16-90	45	5.34	17.0	K1000	K11	<0.010	1.70	1.70	0.3	1.5	0.80	2.4	0.9
31	09-08-89	70	5.51	18.0	<1	<1	<0.010	2.50	2.50	0.2	1.3	0.60	8.1	4.2
32	04-25-90	91	5.30	16.5	<1	<1	<0.010	2.10	2.10	--	3.3	1.5	6.9	0.7
33	06-15-90	280	7.11	16.0	<1	<1	<0.010	0.300	0.300	1.4	37	8.9	1.8	0.9

Table 2.--Water-quality data for selected farmstead wells--Continued

[--, no data; <, less than; K, non-ideal colony count; *, computed value; µS/cm, microsiemens per centimeter at 25 degrees Celsius; deg. C, degrees Celsius; cols./100 mL, colonies per 100 milliliters; mg/L, milligrams per liter; conc., concentration; wat wh tot it, water whole total incremental titration; GC/MS, gas chromatography/mass spectrometer; µg/L, micrograms per liter]

Site number	Date	Specific conductance (µS/cm)	pH (standard units)	Temperature water (deg C)	Coliform, fecal, 0.7 UM-MF (cols./100 mL)	Streptococci fecal, Kf agar (cols./100 mL)	Nitrogen, nitrite total (mg/L as N)	Nitrogen, nitrate total* (mg/L as N)	Nitrogen, NO_2+NO_3 total (mg/L as N)	Carbon, organic total (mg/L as C)	Calcium total recoverable (mg/L as Ca)	Magnesium, total recoverable (mg/L as Mg)	Sodium, total recoverable (mg/L as Na)	Potassium, total recoverable (mg/L as K)
34	11-03-89	352	7.52	16.5	<1	<1	<0.010	1.10	1.10	0.5	61	4.3	2.5	2.5
35	11-16-89	933	8.08	15.0	<1	<1	0.010	<0.100	<0.100	0.2	30	17	110	3.9
36	05-08-90	149	6.48	15.0	<1	<1	<0.010	0.900	0.900	0.5	13	4.1	5.2	1.0
	06-08-90	150	--	16.0	--	--	--	--	--	--	--	--	--	--
37	11-15-89	58	5.61	17.0	<1	<1	<0.010	<0.100	<0.100	0.4	2.7	0.70	6.9	0.1
38	12-06-89	141	6.67	15.0	K4	K1	<0.010	2.60	2.60	0.2	14	4.1	2.1	0.3
39	05-23-90	262	7.13	14.5	K3	21	<0.010	0.100	0.100	0.4	42	5.9	1.2	0.7
40	11-21-89	520	7.38	16.5	80	120	<0.010	0.800	0.800	0.8	62	12	15	3.2
41	11-28-89	305	7.92	15.5	K8	950	<0.010	1.40	1.40	0.2	32	20	0.9	1.2
42	08-02-89	300	6.86	17.5	K54	<1	<0.010	<0.100	<0.100	0.6	33	16	5.8	1.0
43	12-01-89	625	8.77	12.0	K130	K19	<0.010	1.80	1.80	1.2	22	3.8	120	1.5
44	08-01-89	120	6.18	18.0	<1	<1	<0.010	3.20	3.20	0.5	3.6	1.4	15	0.4
	11-26-89	--	--	--	--	--	--	--	--	--	--	--	--	--
45	08-22-89	60	5.63	17.0	<1	<1	<0.010	2.70	2.70	0.1	3.6	1.3	6.6	0.3
46	05-24-90	200	8.01	15.5	<1	<1	0.040	0.360	0.400	0.3	21	13	0.8	0.9
47	11-07-89	525	7.57	16.0	<1	<1	<0.010	<0.100	<0.100	<0.1	44	24	18	2.9
48	08-21-89	80	5.82	17.0	<1	<1	<0.010	2.50	2.50	0.2	3.1	1.2	15	0.3
49	08-02-89	480	6.66	14.0	K3	<1	<0.010	<0.100	<0.100	0.6	53	28	10	0.7
50	06-19-90	108	6.52	19.0	<1	<1	<0.010	0.400	0.400	0.1	18	1.8	2.8	0.4
51	11-14-89	620	7.15	15.5	K1	K2	0.030	14.0	14.0	0.6	110	6.8	8.3	2.1
52	11-29-89	481	7.76	16.0	<1	<1	<0.010	<0.100	<0.100	0.2	42	23	11	3.7
53	10-27-89	810	7.36	16.0	<1	<1	0.040	5.16	5.20	1.2	110	24	6.7	2.0
54	10-02-89	378	7.12	16.5	420	3400	0.010	0.290	0.300	4.0	64	3.8	1.2	2.6
55	12-06-89	118	6.57	16.5	<1	<1	<0.010	0.900	0.900	0.3	11	3.1	2.9	2.7
56	10-13-89	340	7.74	16.0	<1	<1	<0.010	0.700	0.700	0.2	40	17	0.7	0.6
57	07-12-90	100	8.42	15.0	<1	<1	0.020	0.980	1.00	0.7	5.3	1.3	12	0.7
58	11-30-89	50	5.40	16.0	<1	<1	<0.010	2.10	2.10	0.1	2.0	1.3	4.0	0.7
59	11-29-89	300	6.65	16.0	23	K5	0.010	6.29	6.30	0.4	37	3.1	5.2	4.2
60	12-01-89	605	7.71	15.0	K2	K3	<0.010	0.500	0.500	0.3	56	19	26	2.2
61	10-03-89	238	7.79	15.5	K12	54	0.020	1.68	1.70	0.5	37	5.0	2.0	1.0
62	08-03-89	98	5.94	14.0	46	<1	<0.010	2.20	2.20	0.5	3.1	1.3	12	0.2
63	07-13-90	355	7.50	16.5	<1	<1	0.010	0.790	0.800	0.2	60	5.4	0.8	0.4
64	08-30-89	40	5.51	16.0	<1	<1	<0.010	0.300	0.300	<0.1	1.1	0.70	1.9	0.7
65	05-10-90	220	7.93	16.0	<1	<1	<0.010	1.00	1.00	<0.1	27	12	1.3	1.6
66	12-04-89	48	5.73	16.0	<1	<1	<0.010	2.10	2.10	0.1	1.6	0.70	4.6	0.5
67	10-05-89	570	7.68	15.5	K4	K3	<0.010	<0.100	<0.100	0.6	46	10	58	0.4

Table 2.--Water-quality data for selected farmstead wells--Continued

[--, no data; <, less than; K, non-ideal colony count; *, computed value; µS/cm, microsiemens per centimeter at 25 degrees Celsius; deg. C, degrees Celsius; cols./100 mL, colonies per 100 milliliters; mg/L, milligrams per liter; conc., concentration; wat wh tot it, water whole total incremental titration; GC/MS, gas chromatography/mass spectrometer; µg/L, micrograms per liter]

Site number	Date	Specific conductance (µS/cm)	pH (standard units)	Temperature water (deg C)	Coliform, fecal, 0.7 UM-MF (cols./100 mL)	Streptococci fecal, Kf agar (cols./100 mL)	Nitrogen, nitrite total (mg/L as N)	Nitrogen, nitrate total* (mg/L as N)	Nitrogen, NO_2+NO_3 total (mg/L as N)	Carbon, organic total (mg/L as C)	Calcium total recoverable (mg/L as Ca)	Magnesium, total recoverable (mg/L as Mg)	Sodium, total recoverable (mg/L as Na)	Potassium, total recoverable (mg/L as K)
68	11-21-89	160	5.91	17.0	K3	<1	<0.010	10.0	10.0	0.3	15	3.4	2.6	2.7
69	03-06-90	490	7.41	15.0	K750	260	0.040	1.66	1.70	1.5	84	6.3	2.2	1.2
70	10-12-89	310	7.36	16.0	K1	K3	<0.010	4.70	4.70	0.6	50	2.8	3.1	0.6
71	06-19-90	230	7.79	15.5	<1	<1	<0.010	0.500	0.500	0.1	21	5.2	12	1.3
72	06-14-90	121	6.41	15.0	<1	<1	1.00	3.20	4.20	0.2	14	2.5	1.6	1.1
73	11-17-89	265	7.85	16.0	<1	<1	<0.010	0.500	0.500	0.3	28	17	0.7	1.4
74	09-01-89	638	7.21	15.5	K10000	K13000	<0.010	5.10	5.10	1.0	62	33	8.0	6.0
75	10-20-89	280	7.73	15.0	<1	<1	<0.010	<0.100	<0.100	0.4	29	15	2.4	1.7
76	09-19-89	410	7.65	16.0	530	790	<0.010	1.80	1.80	0.6	68	7.7	2.2	0.9
77	07-03-90	560	7.79	15.5	<1	<1	<0.010	2.00	2.00	<0.1	47	33	12	1.0
78	09-22-89	450	7.87	16.5	K15	K24	<0.010	0.400	0.400	0.7	41	19	13	4.0
79	11-30-89	308	7.54	15.0	K1	<1	<0.010	0.600	0.600	0.8	45	8.6	2.1	0.9
80	11-01-89	100	6.28	15.0	<1	<1	<0.010	3.60	3.60	0.3	3.6	1.1	12	0.3
81	12-07-89	285	8.15	11.0	K14000	K1100	<0.010	0.300	0.300	1.7	42	6.3	2.2	0.9
	04-03-90	--	--	--	--	--	--	--	--	--	--	--	--	--
82	11-01-89	60	5.75	15.0	<1	<1	<0.010	<0.100	<0.100	0.3	2.2	0.90	4.5	0.4
83	08-11-89	387	7.15	19.0	25	170	<0.010	0.300	0.300	0.5	56	6.4	2.9	0.9
84	12-05-89	59	6.15	16.0	<1	<1	<0.010	0.400	0.400	0.2	0.90	0.40	2.6	0.4
85	11-16-89	75	5.72	18.0	<1	<1	<0.010	0.400	0.400	0.2	0.40	0.40	1.9	0.5
86	01-04-90	70	5.90	16.0	<1	<1	<0.010	2.30	2.30	0.3	2.4	0.90	7.8	0.4
87	11-15-89	115	6.39	16.0	K1	<1	0.010	1.39	1.40	0.8	15	1.1	1.8	1.3
88	04-18-90	80	7.15	12.5	<1	<1	<0.010	0.700	0.700	<0.1	8.3	1.7	4.1	0.6
89	05-11-90	300	7.53	15.5	<1	<1	<0.010	0.200	0.200	0.2	47	6.2	3.3	0.3
90	06-21-90	310	7.76	16.5	<1	<1	0.040	0.760	0.800	0.1	39	13	1.2	0.3
91	10-31-89	50	5.78	16.0	K3	<1	<0.010	1.30	1.30	0.3	2.5	1.2	4.0	0.6
92	08-31-89	700	7.22	15.0	<1	K1	<0.010	3.80	3.80	0.3	85	31	1.9	1.7
93	07-28-89	370	7.74	15.5	<1	K3	0.020	0.180	0.200	0.6	49	8.9	6.9	0.5
94	08-04-89	580	7.31	14.0	<1	<1	0.050	3.75	3.80	1.3	74	20	4.0	3.2
95	12-14-89	710	7.22	15.0	<1	<1	<0.010	1.20	1.20	0.8	86	42	3.5	5.7
96	09-12-89	540	7.31	16.0	K11	K2	<0.010	3.20	3.20	0.4	78	11	5.2	<0.1
	10-11-89	--	--	--	--	--	--	--	--	--	--	--	--	--
97	11-16-89	364	7.55	15.5	<1	<1	<0.010	1.50	1.50	0.2	46	9.3	4.1	0.2
98	08-04-89	340	7.24	17.5	<1	<1	<0.010	0.800	0.800	0.4	31	18	6.5	0.3
99	10-16-89	655	7.15	17.0	220	100	0.020	4.38	4.40	1.6	100	9.5	5.2	2.0
100	05-09-90	479	7.22	16.0	61	360	<0.010	1.20	1.20	0.7	81	5.0	2.0	1.1
	06-15-90	498	--	16.0	--	--	--	--	--	--	--	--	--	--

Table 2.--Water-quality data for selected farmstead wells--Continued

[--, no data; <, less than; K, non-ideal colony count; *, computed value; µS/cm, microsiemens per centimeter at 25 degrees Celsius; deg. C, degrees Celsius; cols./100 mL, colonies per 100 milliliters; mg/L, milligrams per liter; conc., concentration; wat wh tot it, water whole total incremental titration; GC/MS, gas chromatography/mass spectrometer; µg/L, micrograms per liter]

Site number	Date	Specific conductance (µS/cm)	pH (standard units)	Temperature water (deg C)	Coliform, fecal, 0.7 UM-MF (cols./100 mL)	Streptococci fecal, Kf agar (cols./100 mL)	Nitrogen, nitrite total (mg/L as N)	Nitrogen, nitrate total* (mg/L as N)	Nitrogen, NO_2+NO_3 total (mg/L as N)	Carbon, organic total (mg/L as C)	Calcium total recoverable (mg/L as Ca)	Magnesium, total recoverable (mg/L as Mg)	Sodium, total recoverable (mg/L as Na)	Potassium, total recoverable (mg/L as K)
101	12-05-89	65	6.14	16.5	<1	<1	<0.010	<0.100	<0.100	0.3	6.0	1.0	2.1	1.4
102	10-05-89	430	7.16	15.5	<1	<1	<0.010	4.80	4.80	0.3	68	2.8	2.3	0.5
103	12-07-89	100	6.26	16.0	<1	<1	<0.010	<0.100	<0.100	0.1	2.0	0.80	3.6	0.4
104	10-11-89	550	7.43	17.0	440	2000	<0.010	<0.100	<0.100	2.9	87	8.0	7.3	1.8
105	03-28-90	143	6.26	14.5	<1	<1	<0.010	<0.100	<0.100	0.4	7.0	4.6	3.2	1.6
106	04-19-90	165	8.27	14.0	<1	<1	<0.010	0.300	0.300	<0.1	15	8.2	4.1	0.7
107	08-29-89	360	7.52	14.0	K2	K3	<0.010	0.800	0.800	0.3	32	20	1.9	2.4
108	10-16-89	380	7.49	15.0	K1	K3	<0.010	1.50	1.50	0.3	36	23	1.1	1.3
109	10-03-89	520	7.31	16.5	<1	<1	0.030	7.17	7.20	0.2	70	12	8.3	0.7
110	04-17-90	550	7.59	15.0	<1	<1	<0.010	0.500	0.500	0.3	62	26	5.6	1.4
	05-31-90	--	--	--	--	--	--	--	--	--	--	--	--	--
111	09-14-89	350	6.99	18.0	<1	<1	0.010	<0.100	<0.100	1.4	37	16	12	1.8
112	05-25-90	278	7.60	16.0	<1	<1	<0.010	0.700	0.700	0.2	20	7.6	1.3	0.3
113	04-04-90	160	7.52	13.0	<1	<1	<0.010	0.700	0.700	<0.1	17	9.4	0.8	2.7
114	10-17-89	460	7.03	15.0	K4	100	<0.010	9.50	9.50	0.5	64	4.8	4.8	2.4
115	06-13-90	219	4.29	14.0	<1	<1	0.020	13.0	13.0	0.4	12	3.5	4.0	6.2
116	09-13-89	1200	6.99	19.5	<1	<1	0.010	18.0	18.0	1.0	110	67	30	0.5
117	09-15-89	790	7.41	15.0	<1	K3	0.020	0.880	0.900	0.5	85	44	7.6	3.0
118	10-18-89	180	6.42	16.5	<1	K11	<0.010	4.20	4.20	0.6	6.4	2.5	20	0.4
119	02-28-90	493	7.46	15.0	<1	<1	0.010	7.49	7.50	0.1	72	12	4.1	1.2
120	11-08-89	190	7.10	14.5	K1	<1	<0.010	<0.100	<0.100	1.0	27	4.7	4.7	0.5
121	01-04-90	520	7.73	13.5	<1	<1	<0.010	<0.100	<0.100	1.0	10	4.9	100	2.4
122	05-16-90	940	7.14	15.5	<1	<1	<0.010	<0.100	<0.100	0.8	130	35	22	1.1
123	12-06-89	100	5.60	16.0	<1	<1	<0.010	3.60	3.60	<0.1	2.9	1.1	4.6	0.7
124	10-19-89	46	5.20	16.0	<1	<1	<0.010	3.30	3.30	0.3	2.2	1.2	2.9	1.0
125	10-19-89	575	8.21	15.0	<1	K2	<0.010	<0.100	<0.100	0.7	9.4	8.9	99	6.9
126	11-08-89	440	7.44	16.0	K2	<1	<0.010	<0.100	<0.100	0.1	52	20	1.7	0.4
127	11-14-89	480	7.15	15.0	--	73	<0.010	1.60	1.60	0.3	80	5.0	1.0	0.4
128	10-26-89	408	7.11	16.5	29	K22	<0.010	0.500	0.500	0.6	72	4.7	1.6	0.5
129	07-12-90	500	7.02	15.5	80	37	0.010	5.09	5.10	0.9	79	8.8	2.8	2.5
130	02-23-90	855	6.95	16.0	<1	<1	<0.010	2.20	2.20	0.4	23	14	7.3	0.3
131	04-05-90	125	7.60	14.0	<1	<1	<0.010	2.00	2.00	0.3	12	6.9	1.4	0.9
132	05-10-90	655	7.85	16.0	K4	<1	<0.010	<0.100	<0.100	0.2	61	29	9.7	1.2
133	06-27-90	205	6.67	16.5	K20	<1	<0.010	0.300	0.300	0.3	31	2.8	3.4	0.6
134	11-16-89	1000	8.95	14.5	K1	K3	0.010	<0.100	<0.100	0.7	0.80	0.20	220	0.5
	03-27-90	--	--	--	--	--	--	--	--	--	--	--	--	--
135	10-04-89	345	7.57	15.5	K2	K1	<0.010	2.00	2.00	0.3	42	9.2	3.0	0.6

Table 2.--Water-quality data for selected farmstead wells--Continued

[--, no data; <, less than; K, non-ideal colony count; *, computed value; µS/cm, microsiemens per centimeter at 25 degrees Celsius; deg. C, degrees Celsius; cols./100 mL, colonies per 100 milliliters; mg/L, milligrams per liter; conc., concentration; wat wh tot it, water whole total incremental titration; GC/MS, gas chromatography/mass spectrometer; µg/L, micrograms per liter]

Site number	Date	Specific conductance (µS/cm)	pH (standard units)	Temperature water (deg C)	Coliform, fecal, 0.7 UM-MF (cols./100 mL)	Streptococci fecal, Kf agar (cols./100 mL)	Nitrogen, nitrite total (mg/L as N)	Nitrogen, nitrate total* (mg/L as N)	Nitrogen, NO_2+NO_3 total (mg/L as N)	Carbon, organic total (mg/L as C)	Calcium total recoverable (mg/L as Ca)	Magnesium, total recoverable (mg/L as Mg)	Sodium, total recoverable (mg/L as Na)	Potassium, total recoverable (mg/L as K)
136	11-07-89	490	7.30	15.5	K12	K20	<0.010	<0.100	<0.100	1.0	49	18	16	1.9
137	11-29-89	480	7.53	14.5	<1	<1	<0.010	2.30	2.30	0.4	52	24	13	3.1
138	04-03-90	250	7.21	14.0	380	260	<0.010	1.00	1.00	4.7	38	12	6.0	3.2
139	10-04-89	470	7.48	15.0	K1	K9	0.010	1.79	1.80	0.8	51	26	1.3	1.9
140	04-21-90	325	7.82	15.0	<1	<1	<0.010	1.30	1.30	<0.1	35	22	1.0	0.6
141	03-01-90	226	7.38	14.5	<1	91	0.020	4.38	4.40	0.6	32	2.7	3.8	1.0
142	12-20-89	300	6.78	16.5	<1	<1	0.020	0.080	0.100	10	85	24	8.3	2.9
143	10-20-89	610	7.08	15.5	<1	K4	<0.010	2.70	2.70	0.2	110	15	3.1	0.6
144	11-09-89	215	7.56	15.0	<1	<1	<0.010	<0.100	<0.100	0.7	20	9.6	5.8	4.4
145	04-13-90	600	7.51	15.0	<1	<1	<0.010	0.200	0.200	0.6	70	23	9.8	1.0
146	06-05-90	310	7.82	14.0	<1	<1	<0.010	<0.100	<0.100	0.4	30	5.3	24	1.1
147	06-06-90	440	7.58	15.0	<1	<1	<0.010	0.600	0.600	0.7	46	28	0.7	1.0
148	07-02-90	320	7.56	15.0	K5	<1	--	--	--	0.2	59	2.4	3.9	0.5
149	10-24-89	500	7.33	16.5	K7	77	<0.010	5.10	5.10	<0.1	84	8.3	2.3	<0.1
150	03-07-90	125	7.15	15.0	<1	<1	<0.010	0.500	0.500	<0.1	27	5.3	1.1	0.4

Table 2.--Water-quality data for selected farmstead wells--Continued

[--, no data; <, less than; K, non-ideal colony count; *, computed value; µS/cm, microsiemens per centimeter at 25 degrees Celsius; deg. C, degrees Celsius; cols./100 mL, colonies per 100 milliliters; mg/L, milligrams per liter; conc., concentration; wat wh tot it, water whole total incremental titration; GC/MS, gas chromatography/mass spectrometer; µg/L, micrograms per liter]

Site number	Alkalinity wat wh tot it field (mg/L as $CaCO_3$)	Sulfate dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, residue at 105 deg. C, total (mg/L)	Iron, total recoverable (µg/L as Fe)	Manganese, total recoverable (µg/L as Mn)	GC/FID estimated total conc. (µg/L)	GC/FID number of peaks reported	GC/FID number peaks poss. identified by GC/MS
1	160	3.6	5.6	<0.10	10	186	20	<10	0.0	0.0	0.0
2	8	1.7	4.0	<0.10	6.7	27	20	<10	2.6	3.0	0.0
3	50	2.0	2.4	<0.10	14	38	50	10	0.70	1.0	0.0
4	104	5.2	8.7	0.30	17	147	60	<10	0.0	0.0	0.0
5	3	<1.0	1.4	<0.10	8.2	14	<10	<10	1.2	3.0	0.0
6	98	<1.0	1.0	<0.10	8.9	113	530	40	1.4	1.0	0.0
7	184	34	3.8	0.20	16	226	260	40	0.0	0.0	0.0
8	174	81	8.4	0.30	7.8	504	40	20	0.0	0.0	0.0
9	168	9.0	10	<0.10	6.5	340	4900	700	3.1	5.0	0.0
10	121	6.9	0.20	<0.10	5.6	139	200	10	1.7	3.0	0.0
11	5	<1.0	4.8	<0.10	13	66	<10	<10	120	34	4.0
	--	--	--	--	--	--	--	--	1.5	4.0	0.0
12	120	53	1.4	0.20	9.7	175	60	<10	0.50	1.0	0.0
13	10	3.0	4.5	<0.10	14	32	<10	10	0.20	1.0	0.0
14	166	4.0	5.2	<0.10	12	228	120	10	0.20	1.0	0.0
15	253	22	9.6	<0.10	7.4	310	20	40	0.40	1.0	0.0
16	124	18	1.6	0.20	13	217	3400	50	2.4	3.0	0.0
17	61	22	1.1	0.10	9.4	135	5200	710	34	14	1.0
18	143	<1.0	1.4	0.20	10	152	210	10	1.7	5.0	0.0
19	50	2.0	4.6	<0.10	16	*92	80	<10	0.0	0.0	0.0
20	4	<1.0	15	<0.10	19	112	20	110	0.60	2.0	0.0
21	8	<1.0	3.7	<0.10	14	37	<10	<10	45	31	1.0
	--	--	--	--	--	--	--	--	0.30	1.0	0.0
22	8	<1.0	11	<0.10	14	61	<10	330	0.0	0.0	0.0
23	5	4.4	2.4	<0.10	8.1	20	30	<10	0.0	0.0	0.0
24	124	7.0	2.0	0.10	8.0	487	11000	1300	1.3	2.0	0.0
25	102	1.4	6.9	<0.10	8.8	164	110	<10	36	14	3.0
26	48	3.7	2.7	<0.10	11	62	6600	440	3.6	5.0	0.0
27	178	3.0	6.3	<0.10	9.0	*271	70	<10	0.50	1.0	0.0
28	175	11	0.30	0.20	5.8	196	960	30	0.80	2.0	0.0
29	9	2.0	9.5	<0.10	12	54	40	20	1.1	2.0	0.0
30	4	1.8	3.4	<0.10	7.5	21	130	30	1.6	3.0	0.0
31	6	<1.0	6.5	<0.10	17	52	60	<10	0.30	1.0	0.0
32	5	2.0	13	<0.10	8.2	54	130	80	7.7	8.0	0.0
33	132	88	1.3	0.20	8.8	472	3400	240	6.0	14	0.0

Table 2.--Water-quality data for selected farmstead wells--Continued

[--, no data; <, less than; K, non-ideal colony count; *, computed value; µS/cm, microsiemens per centimeter at 25 degrees Celsius; deg. C, degrees Celsius; cols./100 mL, colonies per 100 milliliters; mg/L, milligrams per liter; conc., concentration; wat wh tot it, water whole total incremental titration; GC/MS, gas chromatography/mass spectrometer; µg/L, micrograms per liter]

Site number	Alkalinity wat wh tot it field (mg/L as $CaCO_3$)	Sulfate dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, residue at 105 deg. C, total (mg/L)	Iron, total recoverable (µg/L as Fe)	Manganese, total recoverable (µg/L as Mn)	GC/FID estimated total conc. (µg/L)	GC/FID number of peaks reported	GC/FID number peaks poss. identified by GC/MS
34	190	4.0	3.8	<0.10	15	211	50	20	1.2	2.0	0.0
35	204	94	99	4.0	9.0	518	150	10	0.0	0.0	0.0
36	52	7.6	6.3	<0.10	2.3	182	69000	740	22	7.0	1.0
	--	--	--	--	--	--	--	--	16	15	2.0
37	11	1.0	8.4	<0.10	27	66	1000	50	0.0	0.0	0.0
38	45	2.0	3.8	<0.10	8.0	86	70	20	3.8	6.0	0.0
39	108	25	0.4	0.20	6.0	166	520	<10	0.0	0.0	0.0
40	228	23	12	1.4	8.0	305	790	50	0.50	1.0	0.0
41	153	11	2.6	0.30	32	166	40	30	0.80	2.0	0.0
42	187	2.0	1.8	0.20	26	187	2500	90	0.20	1.0	0.0
43	320	19	13	1.7	9.0	371	550	70	3.7	7.0	0.0
44	25	5.0	11	<0.10	22	88	50	<10	46	31	1.0
	--	--	--	--	--	--	--	--	1.5	2.0	0.0
45	14	<1.0	8.8	<0.10	70	62	70	<10	1.5	4.0	0.0
46	118	2.0	2.4	0.20	8.5	116	580	30	1.3	1.0	0.0
47	258	24	5.8	0.40	8.7	*386	80	20	1.2	3.0	0.0
48	28	<1.0	10	0.10	27	81	10	<10	0.0	0.0	0.0
49	266	21	3.4	0.20	26	294	880	40	0.20	1.0	0.0
50	52	2.7	3.1	<0.10	8.8	66	10	<10	1.0	3.0	0.0
51	252	13	23	<0.10	8.2	403	410	20	0.30	1.0	0.0
52	220	20	7.7	0.50	8.0	269	10	<10	0.50	1.0	0.0
53	230	180	11	0.80	9.5	554	110	30	0.0	0.0	0.0
54	187	10	1.9	0.10	6.6	219	170	<10	0.50	2.0	0.0
55	19	14	5.1	0.10	18	69	160	10	0.30	1.0	0.0
56	185	4.0	1.3	0.10	8.7	152	260	<10	0.0	0.0	0.0
57	44	1.1	3.4	<0.10	7.7	74	500	20	4.8	10	0.0
58	6	<1.0	5.4	0.40	15	45	80	10	1.6	3.0	0.0
59	105	12	5.3	0.10	11	176	80	10	1.5	5.0	0.0
60	151	150	8.3	0.10	9.0	377	870	40	1.0	4.0	0.0
61	112	5.0	1.9	0.10	6.0	157	2100	60	0.30	1.0	0.0
62	18	1.0	11	<0.10	22	67	20	10	0.30	1.0	0.0
63	190	2.4	15	0.20	8.1	207	20	<10	2.5	2.0	0.0
64	8	2.0	1.8	<0.10	14	16	<10	<10	0.30	1.0	0.0
65	120	<1.0	1.2	0.20	12	124	<10	<10	1.1	3.0	0.0
66	2	<1.0	3.9	<0.10	17	43	30	<10	1.9	3.0	0.0
67	228	63	15	0.50	17	350	310	150	0.0	0.0	0.0

Table 2.--Water-quality data for selected farmstead wells--Continued

[--, no data; <, less than; K, non-ideal colony count; *, computed value; µS/cm, microsiemens per centimeter at 25 degrees Celsius; deg. C, degrees Celsius; cols./100 mL, colonies per 100 milliliters; mg/L, milligrams per liter; conc., concentration; wat wh tot it, water whole total incremental titration; GC/MS, gas chromatography/mass spectrometer; µg/L, micrograms per liter]

Site number	Alkalinity wat wh tot it field (mg/L as $CaCO_3$)	Sulfate dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, residue at 105 deg. C, total (mg/L)	Iron, total recoverable (µg/L as Fe)	Manganese, total recoverable (µg/L as Mn)	GC/FID estimated total conc. (µg/L)	GC/FID number of peaks reported	GC/FID number peaks poss. identified by GC/MS
68	39	5.0	6.2	0.10	9.0	117	50	40	1.5	3.0	0.0
69	226	29	7.1	<0.10	5.7	314	210	70	1.1	2.0	0.0
70	130	7.0	7.2	0.10	13	197	360	30	0.0	0.0	0.0
71	124	2.4	5.6	0.30	12	121	70	70	5.2	6.0	0.0
72	31	1.6	6.1	<0.10	9.1	90	80	<10	5.6	8.0	0.0
73	144	2.0	1.2	<0.10	11	146	140	<10	0.0	0.0	0.0
74	286	19	14	0.20	9.0	356	<10	<10	1.5	1.0	0.0
75	152	4.0	0.60	0.20	15	176	2200	10	0.0	0.0	0.0
76	196	12	5.2	0.10	8.0	161	150	10	2.7	4.0	0.0
77	188	95	13	1.2	9.0	257	20	<10	1.8	3.0	0.0
78	193	37	6.0	0.50	8.0	260	210	20	1.5	3.0	0.0
79	162	8.0	2.1	0.10	8.3	275	3000	170	4.4	8.0	0.0
80	16	<1.0	9.5	<0.10	20	69	30	<10	0.50	1.0	0.0
81	130	15	1.9	0.10	8.0	193	930	170	--	--	--
	--	--	--	--	--	--	--	--	5.4	6.0	0.0
82	17	<1.0	1.9	<0.10	12	25	50	10	0.0	0.0	0.0
83	177	12	4.7	0.20	9.0	414	240	20	0.20	1.0	0.0
84	6	<1.0	1.7	<0.10	15	27	50	10	1.2	3.0	0.0
85	5	<1.0	1.1	<0.10	11	27	<10	50	0.80	2.0	0.0
86	20	<1.0	2.9	0.10	38	80	50	10	0.50	1.0	0.0
87	38	5.0	2.6	0.10	9.0	92	590	210	3.9	5.0	0.0
88	36	1.4	0.70	<0.10	19	47	1200	10	2.6	6.0	0.0
89	149	15	1.1	0.20	19	159	3000	80	0.50	1.0	1.0
90	164	1.3	2.5	0.40	8.7	184	<10	<10	87	5.0	5.0
91	12	<1.0	4.2	<0.10	16	11	80	40	0.40	1.0	0.0
92	35	17	6.7	0.50	11	401	180	<10	0.0	0.0	0.0
93	151	10	9.8	0.10	9.0	158	100	<10	0.40	2.0	0.0
94	287	27	9.7	0.20	18	376	20	200	0.0	0.0	0.0
95	362	53	4.1	1.1	13	438	4200	30	2.7	6.0	0.0
96	263	3.0	12	<0.10	11	309	60	<10	58	1.0	1.0
	--	--	--	--	--	--	--	--	0.0	0.0	0.0
97	181	4.0	5.9	0.20	8.0	208	<10	<10	0.70	2.0	0.0
98	145	2.0	1.5	0.30	26	202	20	<10	0.0	0.0	0.0
99	285	25	15	0.10	8.4	447	730	80	0.30	1.0	0.0
100	234	13	4.8	0.30	7.0	276	300	30	140	26	2.0
	--	--	--	--	--	--	--	--	9.5	12	0.0

Table 2.--Water-quality data for selected farmstead wells--Continued

[--, no data; <, less than; K, non-ideal colony count; *, computed value; µS/cm, microsiemens per centimeter at 25 degrees Celsius; deg. C, degrees Celsius; cols./100 mL, colonies per 100 milliliters; mg/L, milligrams per liter; conc., concentration; wat wh tot it, water whole total incremental titration; GC/MS, gas chromatography/mass spectrometer; µg/L, micrograms per liter]

Site number	Alkalinity wat wh tot it field (mg/L as $CaCO_3$)	Sulfate dissolved (mg/L as SO_4)	Chloride, dissolved (mg/L as Cl)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, residue at 105 deg. C, total (mg/L)	Iron, total recoverable (µg/L as Fe)	Manganese, total recoverable (µg/L as Mn)	GC/FID estimated total conc. (µg/L)	GC/FID number of peaks reported	GC/FID number peaks poss. identified by GC/MS
101	17	5.0	2.0	0.20	17	54	80	10	0.0	0.0	0.0
102	172	21	7.7	0.20	9.7	264	70	<10	0.50	2.0	0.0
103	12	<1.0	1.5	<0.10	13	33	90	<10	6.7	9.0	0.0
104	276	14	6.9	0.10	7.7	307	1400	90	0.0	0.0	0.0
105	67	1.3	2.1	<0.10	17	69	18000	1000	2.6	5.0	0.0
106	84	7.9	0.40	0.20	19	94	50	<10	1.4	4.0	0.0
107	180	5.0	2.7	<0.10	7.0	185	40	<10	0.0	0.0	0.0
108	204	3.0	2.1	0.10	9.5	195	780	10	0.20	1.0	0.0
109	177	42	15	0.10	9.5	323	<10	<10	1.4	3.0	0.0
110	194	100	1.8	0.50	13	375	4800	20	10	1.0	1.0
	--	--	--	--	--	--	--	--	2.2	3.0	0.0
111	152	32	6.2	0.40	30	264	5900	290	0.0	0.0	0.0
112	97	5.7	2.7	<0.10	13	104	1800	30	0.40	4.0	0.0
113	84	2.5	0.80	0.20	15	96	340	30	0.30	1.0	0.0
114	175	7.0	10	0.10	8.8	283	50	10	0.0	0.0	0.0
115	2	5.6	20	0.20	5.8	161	140	370	5.4	6.0	0.0
116	396	29	120	0.30	33	807	200	<10	0.0	0.0	0.0
117	241	190	3.6	1.5	9.2	539	120	<10	5.5	9.0	0.0
118	32	5.0	19	0.10	21	109	<10	<10	1.0	3.0	0.0
119	176	12	12	0.20	11	306	50	<10	0.30	1.0	0.0
120	101	6.0	1.5	0.10	23	124	2400	270	0.0	0.0	0.0
121	268	2.0	20	0.50	14	319	360	110	0.0	0.0	0.0
122	366	190	26	0.10	17	667	1200	40	3.1	6.0	0.0
123	6	<1.0	3.4	<0.10	16	41	50	<10	0.0	0.0	0.0
124	2	<1.0	3.1	<0.10	12	40	60	10	0.0	0.0	0.0
125	280	22	14	1.1	12	351	50	20	0.0	0.0	0.0
126	238	6.0	3.2	1.1	8.6	221	80	10	0.0	0.0	0.0
127	268	15	3.8	0.10	8.0	273	<10	60	0.0	0.0	0.0
128	224	6.0	2.6	0.10	9.5	221	80	<10	0.90	1.0	0.0
129	207	8.8	22	0.10	9.5	332	40	40	2.0	4.0	0.0
130	253	2.0	3.6	0.20	22	164	160	10	2.2	1.0	0.0
131	55	1.4	1.5	<0.10	8.0	66	1400	30	0.70	2.0	0.0
132	161	240	14	0.30	13	412	310	20	0.0	0.0	0.0
133	89	9.6	5.2	<0.10	8.7	94	90	10	0.60	2.0	0.0
134	354	<1.0	120	1.2	8.8	579	110	<10	--	--	--
	--	--	--	--	--	--	--	--	0.40	1.0	0.0
135	147	25	3.3	0.10	10	206	30	<10	0.0	0.0	0.0

Table 2.--Water-quality data for selected farmstead wells--Continued

[--, no data; <, less than; K, non-ideal colony count; *, computed value; µS/cm, microsiemens per centimeter at 25 degrees Celsius; deg. C, degrees Celsius; cols./100 mL, colonies per 100 milliliters; mg/L, milligrams per liter; conc., concentration; wat wh tot it, water whole total incremental titration; GC/MS, gas chromatography/mass spectrometer; µg/L, micrograms per liter]

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136	206	23	20	0.70	11	273	330	90	0.60	2.0	0.0
137	238	20	9.3	0.30	9.0	291	20	<10	7.5	12	1.0
138	107	8.8	4.2	0.20	12	945	120000	4800	0.40	1.0	0.0
139	242	12	3.9	0.10	2.0	233	60	20	0.0	0.0	0.0
140	183	2.3	2.6	0.20	7.9	186	530	10	0.30	1.0	0.0
141	80	6.6	6.4	0.10	7.6	136	320	260	0.90	2.0	0.0
142	144	12	35	0.30	40	868	110000	2800	1.4	3.0	0.0
143	308	60	4.0	0.40	11	396	30	10	0.0	0.0	0.0
144	90	23	0.80	0.20	20	94	720	300	0.80	2.0	0.0
145	267	38	17	0.30	11	347	90	10	1.1	2.0	0.0
146	172	<1.0	0.20	<0.10	25	194	760	20	3.2	5.0	0.0
147	252	2.5	3.4	0.20	9.2	228	880	10	0.0	0.0	0.0
148	162	3.0	6.7	<0.10	9.5	--	140	<10	0.40	1.0	0.0
149	259	4.0	3.3	0.10	12	319	580	10	0.40	1.0	0.0
150	92	5.2	<0.50	0.20	8.1	80	70	<10	5.1	5.0	0.0

SELECTED REFERENCES

Bradley, M.W., and Hollyday, E.F., 1985, Tennessee ground-water resources in National water summary 1984-Ground-water resources: U.S. Geological Survey Water-Supply Paper 2275, p. 391-396.

Britton, L.J., and Greeson, P.E., eds., 1987, Methods for collection and analysis of aquatic biological and microbiological samples: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 5, Chapter A4, 363 p.

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

Gaydos, M.W., 1983, Quality assurance plan for water-quality activities of the Tennessee District: unpublished data on file in Tennessee District office of the U.S. Geological Survey, Nashville, Tennessee.

Hutson, S.S., 1988, Estimated use of water in Tennessee, 1985: U.S. Geological Survey Open-File Report 88-348, 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, 1986, Tennessee State Superfund Program, legislative report: Tennessee Department of Health and Environment, Division of Superfund, 437 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 (3rd ed.): U.S. Geological Survey Techniques of Water-Resources Investigations, Book 5, Chapter A3, 80 p.

Wood, W.W., 1981, Guidelines for collection and field analysis of ground-water samples for selected unstable constituents (2d ed.): U.S. Geological Survey Techniques of Water-Resources Investigations, Book 1, Chapter D2, 24 p.