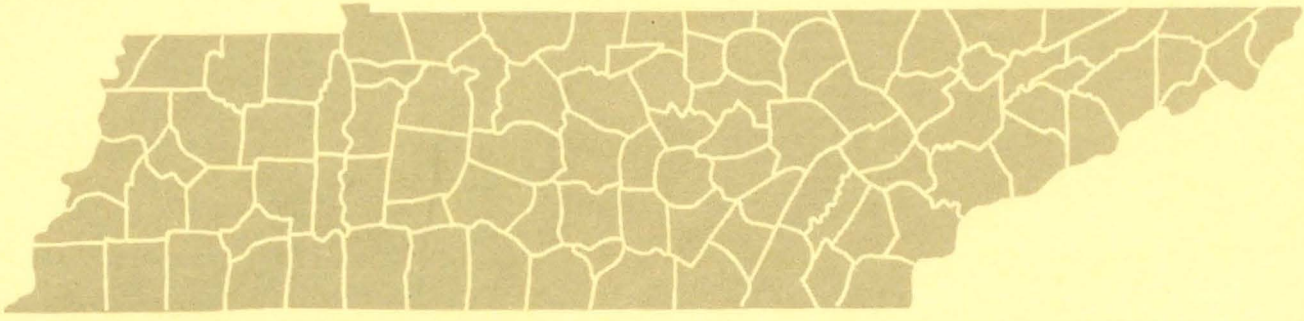
WATER-QUALITY DATA FOR 35 SITES, SEPTEMBER 1984, NEAR THE Y-12 PLANT, THE OAK RIDGE RESERVATION, TENNESSEE



U.S. GEOLOGICAL SURVEY
Open-File Report 85-553

Prepared in cooperation with the
U.S. DEPARTMENT OF ENERGY

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Pamela J. Pulliam

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Nashville, Tennessee

1985

UNITED STATES DEPARTMENT OF THE INTERIOR

DONALD PAUL HODEL, Secretary

GEOLOGICAL SURVEY

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TABLES

FACTORS FOR CONVERTING INCH-POUND UNITS TO INTERNATIONAL SYSTEM OF UNITS (SI)

Multiply	By	To obtain
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
foot (ft)	0.3048	meter (m)
acre	0.4047	square hectometer (hm^2)
square mile (mi^2)	2.590	square kilometer (km^2)
mile (mi)	1.609	kilometer (km)
picocuries (pCi)	27.0	disintegrations per second

WATER-QUALITY DATA FOR 35 SITES, SEPTEMBER 1984, NEAR THE Y-12 PLANT, THE OAK RIDGE RESERVATION, TENNESSEE

Pamela J. Pulliam

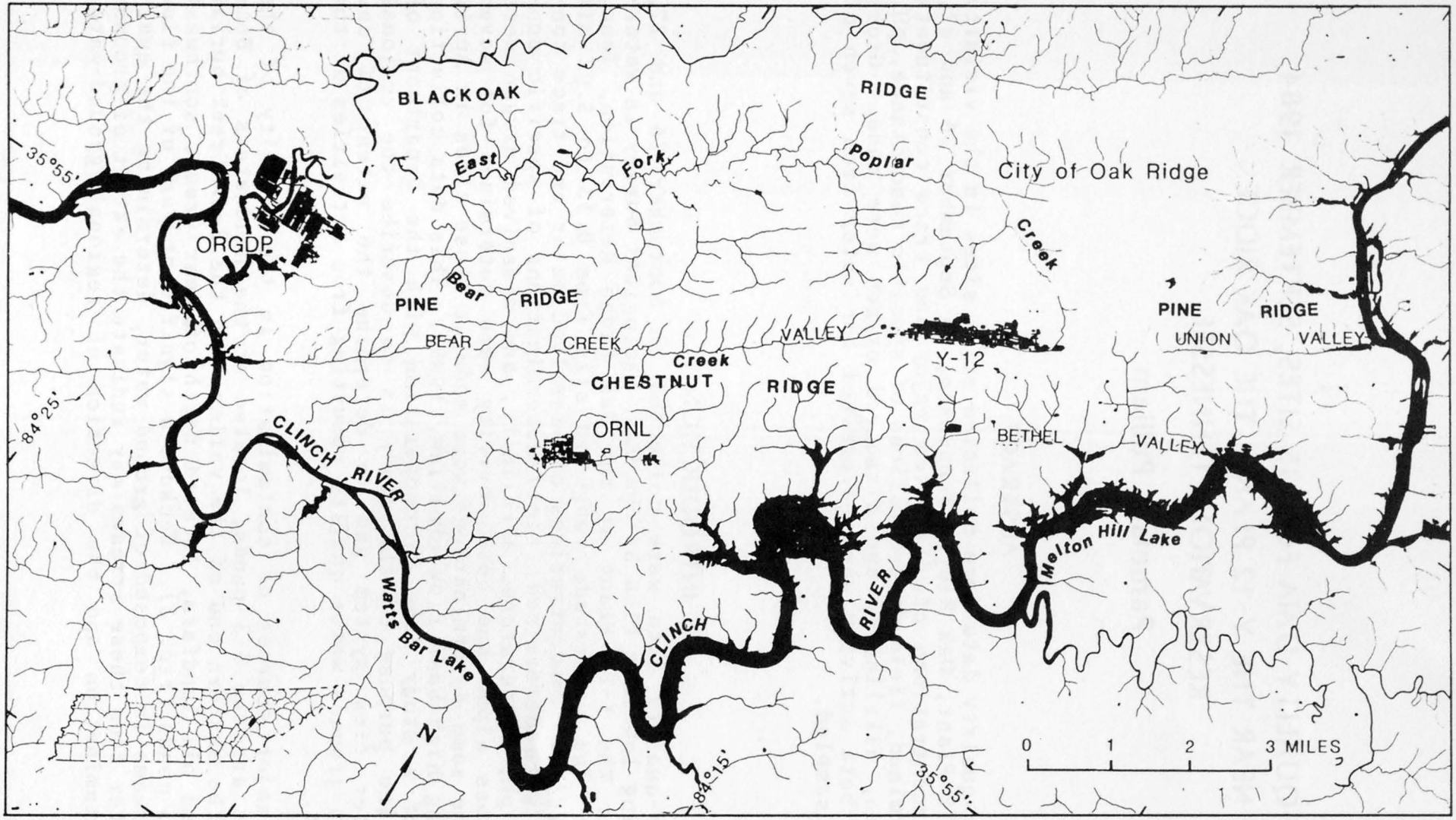
ABSTRACT

Water-quality data were collected at 35 sites in the vicinity of the Y-12 Plant, Oak Ridge, Tennessee, on September 26 and 27, 1984. Concentrations of dissolved major and trace constituents were determined; field determinations of specific conductance, pH, temperature, alkalinity, and dissolved oxygen were made. Gross alpha and beta activity were determined for water from seven of the sites sampled.

INTRODUCTION

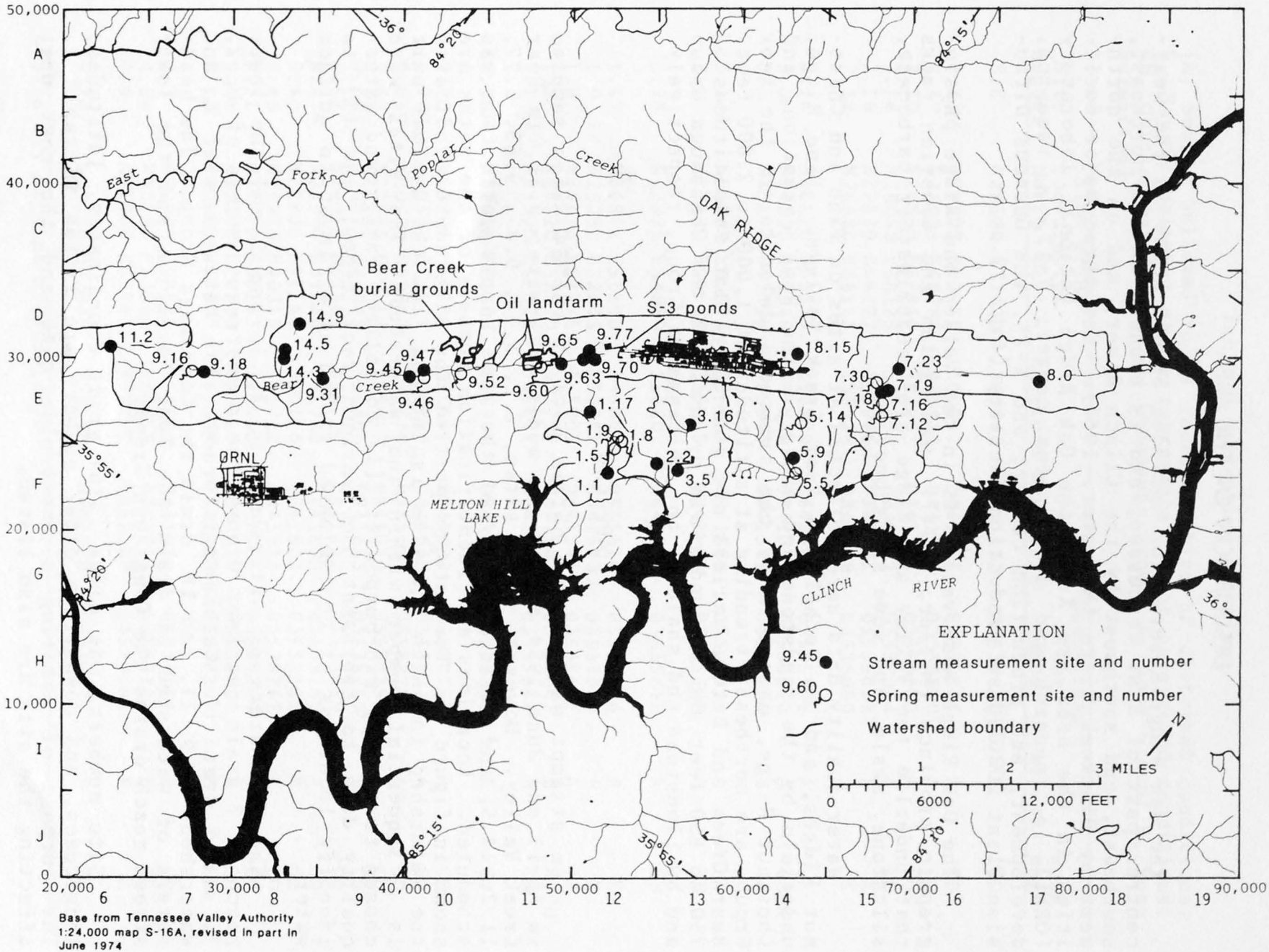
Water-quality data were collected on September 26 and 27, 1984, during low base flow by the U.S. Geological Survey in watersheds near the Y-12 Plant at the Oak Ridge Reservation, Tenn. (fig. 1). The watersheds range in size from 0.33 to 5.92 mi^2 (Evaldi, 1984). Concentrations of dissolved major and trace constituents were determined; field determinations of specific conductance, pH, temperature, alkalinity, and dissolved oxygen were made. Gross alpha and beta activity were determined for seven sites. The same determinations were made at these sites in April 1984 during high base flow (Pulliam, 1985). This data collection is part of a study done in cooperation with the Department of Energy. The purpose of the study is to describe the regional ground-water flow system and to determine the extent of any effects on ground- water quality resulting from activities at the Y-12 Plant.

The major sources of contamination in the vicinity of the Y-12 Plant are the S-3 ponds, located at the headwaters of Bear Creek at the eastern end of the valley, and the Bear Creek burial grounds and oil landfarm, located north of Bear Creek, southwest of the S-3 ponds (fig. 2). Because a significant part of the flow in the streams is composed of ground water, determining the quality of water from these streams may indicate the extent of ground-water contamination and the direction of regional ground-water flow.



Base from Tennessee Valley Authority
1:24,000 map S-16A, revised in part June 1974

Figure 1.--Study area (from Pulliam, 1985).



Base from Tennessee Valley Authority 1:24,000 map S-16A, revised in part in June 1974

Figure 2.--Sampling sites (modified from Pulliam, 1985).

DESCRIPTION OF THE AREA

The Oak Ridge Reservation includes 58,000 acres in the west-central part of East Tennessee, and is bounded on the northeast, southeast, and southwest by the Clinch River, and on the northwest by Blackoak Ridge (McMaster, 1967). The three major facilities in the area are X-10, the Oak Ridge National Laboratory (ORNL), a research and development center; Y-12, a research, development, and production center; and K-25, the Gaseous Diffusion Plant (ORGDP), a production facility (fig. 1).

The Oak Ridge Reservation is in the Valley and Ridge physiographic province (Miller, 1974). Ordovician and Cambrian rocks that underlie the Valley and Ridge are predominately carbonate, siltstone, shale, and some sandstone.

Water-quality data were collected at sites on Pine and Chestnut Ridges, and in Bethel and Bear Creek Valleys. Pine Ridge, underlain by the sandstone and shale of the Rome Formation, and Chestnut Ridge, underlain by the siliceous dolomite of the Knox Group, are northeast-trending at altitudes of 1,000 to 2,000 feet. Bear Creek and Bethel Valleys are generally flat at altitudes of 750 to 850 feet and are underlain by shale of the Conasauga Group and by limestone and shale of the Chickamauga Group, respectively.

APPROACH

An attempt was made to obtain data at the 34 sites sampled in April and June 1984 and at one additional site, 9.31, in Bear Creek Valley. However, eight sites, 2.2, 3.16, 9.47, 9.65, 9.77, 11.2, 14.5, and 18.15 were dry at the time sample collection was scheduled. Locations and identification numbers of the sites are shown in figure 2. The integer part of the site number indicates the watershed in which the site is located, and the decimal part is a sequential number within the watershed. The sites were chosen to satisfy two purposes: (1) to collect background water-quality data to represent the various rock types, and (2) to identify locations of contaminated ground-water input to surface water.

The headwaters of watersheds 1, 2, 3, and 5 and the lower reach of 7 drain the Knox Group; the downstream reaches of 1, 2, 3, and 5 drain the Chickamauga Group. The headwaters of 7, and watersheds 8, 9, 11, and 18 drain the Conasauga Group. The headwaters of watershed 14 drain the Rome Formation and the lower stream reach drains the Conasauga Group.

Site numbers, Oak Ridge (S16A grid) coordinates, latitudes, longitudes, and downstream order numbers are listed in table 1. The purpose of sampling a particular site and the rock unit affecting the site are also listed.

Table 1.--Sampling locations

[A, Sample believed to be representative of disturbed conditions; B, Sample believed to be representative of background conditions; CH, Chickamauga Group; CO, Conasauga Group; K, Knox Group; R, Rome Formation]

Site number	SI6A grid coordinates North	East	Latitude	Longitude	Downstream order number	Purpose	Rock unit
8.0	N28580	E77420	360046	0841157	03534880	A	CO
7.23	N29405	E69175	360007	0841325	03535076	B	CO
7.19	N28055	E68285	355950	0841326	03535080	A	CO
7.30	N28550	E67850	355953	0841333	03535082	A	CO
7.18	N28050	E68125	355950	0841327	03535084	A	CO
7.16	N27320	E68177	355944	0841322	03535087	B	K
7.12	N26580	E68153	355938	0841316	03535090	B	K
5.14	N26175	E63375	355909	0841402	03535105	A	K
5.9	N24205	E62940	355850	0841353	03535110	A	CH,K
5.5	N23310	E63095	355843	0841345	03535120	B	CH
3.16[a]	N26065	E56875	355853	0841508	03535590	A	K
3.5	N23420	E56180	355805	0841455	03535598	A	CH
2.2[a]	N23925	E54880	355802	0841512	03535615	A	CH
1.17	N26845	E51100	355805	0841610	03535636	B	K
1.9	N25280	E52645	355802	0841543	03535639	B	K
1.8	N25170	E52775	355801	0841541	03535641	A	K
1.5	N24720	E52370	355756	0841541	03535643	B	K,CH
1.1	N23300	E52025	355741	0841537	03535648	B	CH
18.15[a]	N30218	E63200	355941	0841431	03538233	A	CO
9.70	N29906	E51238	355831	0841629	03538253	A	CO
9.77[a]	N30450	E50918	355836	0841635	03538254	A	CO
9.65[a]	N29920	E50560	355828	0841637	03538255	A	CO
9.63	N29583	E49117	355817	0841649	03538256	A	CO
9.60	N29425	E48085	355808	0841653	03538257	B	CO
9.52	N29038	E43342	355739	0841742	03538259	A	CO
9.47[a]	N28940	E41240	355728	0841803	03538260	A	CO
9.46	N28805	E41168	355726	0841803	03538261	B	CO
9.45	N28925	E40315	355722	0841813	03538262	A	CO
9.31	N28779	E36163	355653	0841903	03538264	A	CO
9.18	N29175	E28167	355616	0842017	03538268	A	CO
9.16	N29180	E27550	355614	0842022	03538269	B	CO
14.3	N29920	E33043	355649	0841932	03538266	B	CO
14.5[a]	N30250	E33060	355652	0841934	03538267	B	CO
14.9	N31906	E33943	355711	0841937	03538265	B	R
11.2[a]	N30650	E22846	355558	0842120	03538271	B	CO

[a]Site dry at time of sampling.

EXPLANATION OF DATA

The water-quality parameters determined for samples collected in the vicinity of the Y-12 facility are shown in table 2.

Table 2.--Water-quality parameters determined

Field:

- Water temperature
- Specific conductance
- pH
- Alkalinity
- Dissolved oxygen

Laboratory:

Major constituents (dissolved) or properties:

- Calcium
- Magnesium
- Sodium
- Potassium
- Alkalinity
- Chloride
- Sulfate
- Nitrogen
- Phosphorus
- Residue on evaporation

Trace constituents (total recoverable) and compounds:

Arsenic	Cobalt	Lithium	Selenium
Barium	Copper	Manganese	Strontium
Beryllium	Cyanide	Mercury	Uranium
Cadmium	Iron	Molybdenum	Vanadium
Chromium	Lead	Nickel	Zinc

Other parameters:

- Gross alpha (dissolved and suspended)
- Gross beta (dissolved, total, and suspended)
- Dissolved, total, and suspended organic carbon

Field Analyses: Measurements of temperature, specific conductance, pH, dissolved oxygen, alkalinity, and streamflow were made at each site at the time of sample collection (table 3). In some cases insufficient flow prevented measurement of discharge and (or) dissolved oxygen.

Laboratory Analyses: The concentrations of major constituents and properties are listed in table 4. Samples were filtered through a 0.45 micrometer membrane filter at the time of collection. All trace constituent concentrations were determined from unfiltered samples with the exception of uranium, vanadium, dissolved organic carbon, and suspended organic carbon (table 5). These analyses

Table 3.--Field analyses

Site number	Date of sample	Discharge (ft^3/s)	Temperature (°C)	Specific conductance (µS/cm)	pH	Alkalinity (mg/L as $CaCO_3$)	Oxygen, dissolved (mg/L)
8.0	9/27/84	--	14.0	600	7.7	150	--
7.23	9/26/84	<0.01	18.0	128	7.2	60	8.6
7.19	9/26/84	.02	17.0	825	7.2	372	5.2
7.30	9/26/84	.05	15.5	445	7.0	232	3.7
7.18	9/26/84	.07	16.5	405	7.6	212	10.0
7.16	9/26/84	.07	16.0	290	7.1	166	9.4
7.12	9/26/84	.09	15.5	310	7.2	174	9.4
5.14	9/27/84	.08	13.5	275	7.2	140	6.2
5.9	9/27/84	.25	18.0	275	7.5	140	7.2
5.5	9/27/84	.01	14.0	460	6.9	246	16.9
3.5	9/27/84	1.8	19.0	250	8.8	78	9.5
1.17	9/27/84	.05	17.0	228	7.4	124	8.2
1.9	9/27/84	.17	16.5	230	7.1	122	8.2
1.8	9/27/84	.02	14.5	270	6.9	130	5.4
1.5	9/27/84	.04	15.5	265	7.2	148	9.4
1.1	9/27/84	.14	18.0	233	7.9	134	9.4
9.70	9/26/84	.04	17.0	7300	7.0	156[a]	5.0
9.63	9/26/84	<.01	17.0	4500	7.2	137[a]	7.2
9.60	9/26/84	.03	13.5	320	7.3	170	8.4
9.52	9/26/84	.05	13.0	800	6.9	230	4.2
9.46	9/26/84	.12	13.5	675	7.8	201	12.4
9.45	9/26/84	.09	14.0	700	7.8	198	8.8
9.31	9/26/84	.08	16.0	650	8.1	216	12.2
9.18	9/26/84	<.01	16.0	460	8.4	182	16.8
9.16	9/26/84	.14	13.0	315	7.6	162	9.3
14.9	9/27/84	.01	15.0	300	7.1	154	13.2
14.3	9/27/84	.01	14.5	215	7.9	104	12.2

[a]Alkalinity determined in laboratory.

Table 4.--Major constituents

Site number	Date of sample	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)
8.0	9/27/84	73	24	11	3.5	5.5
7.23	9/26/84	16	6.4	4.8	2.3	1.1
7.19	9/26/84	72	37	30	16	49
7.30	9/26/84	76	10	3.7	1.9	6.1
7.18	9/26/84	62	13	4.1	1.6	8.0
7.16	9/26/84	34	19	.60	.70	1.5
7.12	9/26/84	35	19	.60	.90	1.5
5.14	9/27/84	31	15	.60	1.0	1.2
5.9	9/27/84	31	14	4.0	1.1	1.9
5.5	9/27/84	83	9.5	3.1	.80	5.4
3.5	9/27/84	32	7.0	3.3	3.2	3.6
1.17	9/27/84	27	13	.50	.90	1.2
1.9	9/27/84	32	11	1.7	1.0	3.2
1.8	9/27/84	35	12	1.7	.90	3.3
1.5	9/27/84	36	15	.60	.80	1.2
1.1	9/27/84	34	12	1.6	1.0	2.8
9.70	9/26/84	820	150	170	20	120
9.63	9/26/84	470	67	66	7.6	64
9.60	9/26/84	37	20	.50	.70	1.5
9.52	9/26/84	120	23	14	3.1	23
9.46	9/26/84	94	22	10	2.0	19
9.45	9/26/84	93	22	9.5	2.0	18
9.31	9/26/84	87	20	9.4	2.7	18
9.18	9/26/84	61	18	5.0	2.1	11
9.16	9/26/84	39	16	1.1	.90	1.9
14.9	9/27/84	34	14	7.0	2.4	1.4
14.3	9/27/84	25	8.6	6.9	2.8	3.4

and properties

Sulfate dissolved (mg/L as SO_4)	Nitrogen, NO_2+NO_3 dissolved (mg/L as N)	Nitrogen, ammonia dissolved (mg/L as N)	Nitrogen, ammonia + organic total (mg/L as N)	Phosphorus, ortho, dissolved (mg/L as P)	Phosphorus, dissolved (mg/L as P)	Phosphorus, total (mg/L as P)	Solids, residue at 180°C dissolved (mg/L)
150	3.7	0.030	0.10	<0.010	<0.010	<0.010	398
5.4	<.10	.030	<.10	.020	<.010	<.010	90
14	.43	8.20	10	<.010	<.010	<.010	438
14	1.1	.030	.20	<.010	<.010	<.010	270
10	.70	<.010	.20	<.010	<.010	<.010	224
3.3	.28	<.010	.10	<.010	<.010	<.010	164
3.2	.23	<.010	<.10	<.010	<.010	<.010	173
2.2	.37	<.010	.60	<.010	<.010	<.010	147
3.7	.19	.050	<.10	.010	<.010	<.010	153
11	.90	<.010	.20	.010	<.010	.010	--
50	3.2	<.010	.50	.020	<.010	.040	166
2.3	<.10	<.010	.10	<.010	<.010	<.010	129
7.5	.13	<.010	.10	.020	<.010	<.010	136
7.2	<.10	<.010	.20	.020	<.010	<.010	144
5.2	<.10	.010	.10	.010	<.010	<.010	160
7.0	<.10	.040	.20	.010	.020	--	150
250	610	.520	.20	<.010	<.010	<.010	--
88	380	.100	.10	<.010	<.010	<.010	--
3.5	1.9	<.010	.10	<.010	<.010	<.010	176
34	35	.280	.40	<.010	<.010	<.010	--
24	27	.010	<.10	<.010	<.010	<.010	--
23	27	.030	<.10	.010	<.010	<.010	--
23	24	<.010	.10	<.010	<.010	<.010	585
14	14	<.010	.10	<.010	<.010	<.010	266
2.2	.27	<.010	.20	<.010	<.010	<.010	--
9.1	<.10	<.010	.20	.050	.050	.050	171
8.7	<.10	<.010	.20	.020	.020	--	130

Table 5.--Trace consti

Site number	Date of sample	Arsenic total (µg/L as As)	Barium, total recoverable (µg/L as Ba)	Beryllium, total recoverable (µg/L as Be)	Cadmium total recoverable (µg/L as Cd)	Chromium, total recoverable (µg/L as Cr)	Cobalt, total recoverable (µg/L as Co)	Copper, total recoverable (µg/L as Cu)	Cyanide total (mg/L as CN)	Iron, total recoverable (µg/L as Fe)	Lead, total recoverable (µg/L as Pb)	Lithium total recoverable (µg/L as Li)
8.0	9/27/84	<1	100	<10	<1	<1	<1	1	<0.01	80	3	20
7.23	9/26/84	1	100	<10	<1	<1	4	2	<.01	1400	5	<10
7.19	9/26/84	2	400	<10	<1	<1	3	1	<.01	1600	4	<10
7.30	9/26/84	<1	100	<10	<1	<1	2	1	<.01	1100	3	10
7.18	9/26/84	1	100	<10	<1	<1	<1	1	<.01	230	4	10
7.16	9/26/84	1	100	<10	<1	<1	<1	<1	<.01	100	3	10
7.12	9/26/84	<1	<100	<10	<1	<1	1	<1	<.01	200	4	10
5.14	9/27/84	1	100	<10	<1	<1	<1	<1	<.01	100	1	10
5.9	9/27/84	2	100	<10	<1	<1	1	1	<.01	470	2	10
5.5	9/27/84	1	100	<10	<1	<1	<1	1	<.01	890	6	10
3.5	9/27/84	110	100	<10	<1	<1	<1	1	<.01	390	3	70
1.17	9/27/84	1	<100	<10	<1	<1	<1	1	<.01	290	3	10
1.9	9/27/84	1	100	<10	<1	<1	2	1	<.01	80	3	<10
1.8	9/27/84	1	100	<10	<1	<1	1	1	<.01	170	5	10
1.5	9/27/84	1	100	<10	<1	<1	3	1	<.01	80	2	<10
1.1	9/27/84	1	100	<10	<1	<1	1	1	<.01	300	4	<10
9.70	9/26/84	1	400	<10	33	<1	10	4	.07	210	2	30
9.63	9/26/84	1	900	<10	1	<1	2	1	.06	260	4	10
9.60	9/25/84	1	200	<10	<1	<1	<1	<1	<.01	340	1	10
9.52	9/26/84	1	200	<10	<1	<1	<1	1	.01	350	6	30
9.46	9/26/84	<1	200	<10	<1	10	<1	2	.01	160	4	60
9.45	9/26/84	<1	200	<10	<1	<1	<1	1	<.01	530	2	100
9.31	9/26/84	1	200	<10	<1	<1	<1	1	.01	520	3	170
9.18	9/26/84	1	100	<10	<1	<1	1	1	<.01	100	5	110
9.16	9/26/84	1	100	<10	<1	<1	1	2	<.01	310	4	10
14.9	9/27/84	1	200	<10	<1	<1	<1	1	<.01	390	3	10
14.3	9/27/84	<1	100	<10	<1	<1	<1	1	<.01	260	3	10

tuents and compounds

Manganese, total recoverable (µg/L as Mn)	Mercury total recoverable (µg/L as Hg)	Molybdenum, total recoverable (µg/L as Mo)	Nickel, total recoverable (µg/L as Ni)	Selenium, total (µg/L as Se)	Strontium, total recoverable (µg/L as Sr)	Uranium dissolved, extraction (µg/L as U)	Uranium natural dissolved (µg/L as U)	Vanadium, dissolved (µg/L as V)	Zinc, total recoverable (µg/L as Zn)	Carbon, organic total (mg/L as C)	Carbon, organic dissolved (mg/L as C)	Carbon, organic suspended total (mg/L as C)
20	0.2	4	5	<1	900	--	3.0	<1	20	1.0	0.70	0.30
80	<.1	1	3	<1	60	0.08	--	<1	10	--	--	.20
730	.4	1	1	<1	220	--	1.0	<1	<10	8.3	8.2	.10
120	<.1	1	2	<1	120	--	1.2	<1	10	.80	.80	.10
120	.1	1	2	<1	110	--	1.0	<1	40	2.4	.70	.10
30	<.1	1	3	<1	40	--	1.1	1	<10	--	5.5	.10
20	<.1	1	3	<1	50	.28	--	<1	10	--	.30	--
20	<.1	1	<1	<1	40	--	.9	1	<10	--	1.1	.40
30	<.1	1	1	<1	50	--	1.5	<1	10	--	.80	--
120	<.1	1	3	<1	160	.30	--	<1	10	.90	.70	.10
20	<.1	35	1	8	250	--	2.2	23	10	--	2.7	--
110	<.1	1	1	<1	30	--	.9	<1	10	--	3.0	.10
20	<.1	1	<1	<1	40	--	1.0	<1	<10	--	1.5	.10
30	<.1	1	<1	<1	50	--	1.0	<1	<10	--	.90	.10
30	<.1	1	<1	<1	80	.41	--	<1	<10	--	3.4	--
10	<.1	1	<1	<1	70	--	1.1	<1	<10	--	3.2	.10
9200	.4	1	95	<1	1900	--	870	2	20	--	8.6	.40
50	.2	1	7	<1	1300	--	890	1	10	--	6.9	.60
50	<.1	1	<1	<1	50	--	1.1	1	<10	--	1.2	.10
200	.4	1	8	<1	250	--	250	<1	<10	--	2.0	.60
10	<.1	<1	3	<1	200	--	160	<1	20	--	21	.20
50	<.1	1	4	<1	210	--	150	<1	10	--	6.4	.30
60	<.1	1	7	<1	200	--	150	<1	30	--	3.0	.20
70	<.1	1	6	<1	110	--	100	<1	<10	--	4.8	.10
20	<.1	1	4	<1	50	--	5.4	<1	20	--	.50	.10
160	<.1	1	4	<1	<10	.29	--	<1	40	--	4.0	.10
10	<.1	1	4	<1	100	.16	--	<1	<10	--	5.7	.10

were done by the U.S. Geological Survey Central Laboratory, Doraville, Georgia, using methods described in Skougstad and others (1979) and Goerlitz and Brown (1972). The radionuclides (table 6) were determined at the Geological Survey Central Laboratory in Arvada, Colorado, using methods described in Thacker and others (1977).

Table 6.--Radiochemicals

Site number	Date of sample	Gross alpha, dissolved (µg/L as U-Nat)	Gross alpha, susp. total (µg/L as U-Nat)	Gross beta, dissolved (pCi/L as Cs-137)	Gross beta, dissolved (pCi/L as Sr-90/ Y-90)	Gross beta, susp. total (pCi/L as Cs-137)	Gross beta, susp. total (pCi/L as Sr-90/ Y-90)
7.30	9/26/84	<4.2	<0.9	2.5	2.1	0.5	0.5
3.5	9/27/84	<4.3	.8	2.6	2.2	.7	.6
9.70	9/26/84	1300	8.4	1200	1100	130	120
9.63	9/26/84	66	37	49	42	280	240
9.60	9/26/84	<6.1	<.4	<2.6	<2.2	<.4	<.4
9.46	9/26/84	110	2.6	63	54	31	29
14.3	9/27/84	<2.3	<.4	3.6	3.1	.5	.4

REFERENCES

Evaldi, R. D., 1984, Streamflow and specific conductance data for selected sites, February 15 through April 9, 1984, near the Y-12 Plant, the Oak Ridge Reservation, Tennessee: U.S. Geological Survey Open-File Report 84-625, 5 p.

Goerlitz, D. F., and Brown, Eugene, 1972, Methods for analysis of organic substances in water: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 5, Chap. A3, 40 p.

McMaster, W. M., 1967, Hydrologic data for the Oak Ridge area Tennessee: U.S. Geological Survey Water-Supply Paper 1839-N, 60 p.

Miller, R. A., 1974, The geologic history of Tennessee: Tennessee Division of Geology Bulletin 74, 63 p.

Pulliam, P. J., 1985, Water-quality data for 34 sites, April and June 1984, near the Y-12 Plant, the Oak Ridge Reservation, Tennessee: U.S. Geological Survey Open-File Report 85-165, 13 p.

Skougstad, M. W., Fishman, M. J., Friedman, L. C., Erdmann, D. E., and Duncan, S. S., eds., 1979, Methods for determination of inorganic substances in water and fluvial sediments: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 5, Chap. A1, 626 p.

Thacker, L. L., Janzer, V. J., and Edwards, K. W., 1977, Methods for determination of radioactive substances in water and fluvial sediments: U.S. Geological Survey Techniques of Water-Resources Investigatons, Book 5, Chap. A5, 95 p.

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