Hydrologic Data for the Oak Ridge Area Tennessee

GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1839-N

Prepared in cooperation with the U.S. Atomic Energy Commission

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By WILLIAM M. McMASTER

CONTRIBUTIONS TO THE HYDROLOGY OF THE UNITED STATES

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CONTENTS

ILLUSTRATIONS

TABLES

CONTRIBUTIONS TO THE HYDROLOGY OF THE UNITED STATES

HYDROLOGIC DATA FOR THE OAK RIDGE AREA, TENNESSEE

By William M. McMaster

ABSTRACT

The Oak Ridge, Tenn., area is abundantly supplied with water. Annual rainfall ranges from 46 inches in the northeastern part of the area to more than 58 inches in the northwestern part; areal mean rainfall is 51.2 inches.

The results of streamflow measurements at 6 continuous-record stations and at 19 partial-record sites on small streams in the area demonstrate the variability of flow with geologic characteristics of the basins. Flows equaled or exceeded 90 percent of the time range from 0.04 cfsm (cubic feet per second per square mile) for streams draining areas underlain entirely by sandstone and shale to 0.58 cfsm for streams draining areas underlain mostly by dolomite and limestone.

Low-flow discharges also generally reflect geologic conditions. Lowest mean annual discharges of 1-day duration and a recurrence interval of 2 years ranged from 0.01 cfsm for a basin underlain mostly by shale and sandstone to 0.54 cfsm for a basin underlain mostly by dolomite.

The Knox Dolomite is the principal aquifer of the area; several large springs flow from the Knox, the largest of which is Bacon Spring, which has a mean discharge of about 3.8 cubic feet per second.

Ground water is not adequate as a source of large supply. It is estimated that the average well in the area would yield not more than 10 gpm (gallons per minute) and that very few wells would yield more than 50 gpm.

In general, the water in streams in the Oak Ridge area is moderately hard to very hard and has a low content of sodium, potassium, and chloride. Four streams receive industrial or municipal wastes which alter their chemical quality.

Several of the small streams in the Oak Ridge area are used for waste disposal, and one is used as a part of an arboretum. Ground-water development is small: at present, several springs are used for community or utility district supplies.

Very large supplies of surface water from the Clinch River are presently developed in the area. Most of this supply is used by U.S. Atomic Energy Commission and Tennessee Valley Authority facilities.

INTRODUCTION

PURPOSE AND SCOPE

Between 1956 and 1965 the U.S. Geological Survey cooperated with the U.S. Atomic Energy Commission (USAEC) in hydrologic and geologic studies in and near the Oak Ridge reservation in Tennessee. During the period of cooperation and especially between June 1960 and July 1964, when studies were being made of the distribution and movement of radionuclides in the Clinch River and Whiteoak Creek, a considerable amount of hydrologic data was collected in many of the small basins in the reservation and adjacent areas.

During the period of cooperation many requests for hydrologic and geologic information were received from other groups and agencies in the area as well as from USAEC installations. This report is meant to provide a reference of available hydrologic data for the Oak Ridge area. Most of such data consist of precipitation records, continuous and partial records of steamflow, and analyses of surface-water quality. Data obtained on ground water were almost entirely limited to Whiteoak Creek and Bear Creek basins.

As a complement to the hydrologic information, a geologic map of the Oak Ridge area (McMaster, 1964) was published by the Commission.

GENERAL DESCRIPTION OF THE AREA

The area of this report, herein referred to as the Oak Ridge area, includes small drainage basins in and near the Oak Ridge reservation in which the Geological Survey has collected data. The area and the streams within it for which data were obtained are shown in figure 1. For ease of reference to figures and tables in this report, gaging stations are numbered from 1 to 6 and partial-record sites are numbered from 7 to 25, in downstream order.

Most of the area is in the Valley and Ridge province, but about 75 square miles of the western part is in the Cumberland Mountains section of the Appalachian Plateaus province.

The Oak Ridge reservation was established in 1942 by the U.S. Army's Manhattan Engineering District and the Stone and Webster Engineering Corp. It includes 58,800 acres in the west-central part of eastern Tennessee; it is bounded on the northeast, southeast, and southwest by the Clinch River, and on the northwest by Blackoak Ridge. Facilities in the area include the Oak Ridge National Laboratory (ORNL), a research and development center; Y–12, a research, development, and production center; the K–25 Gaseous Diffusion

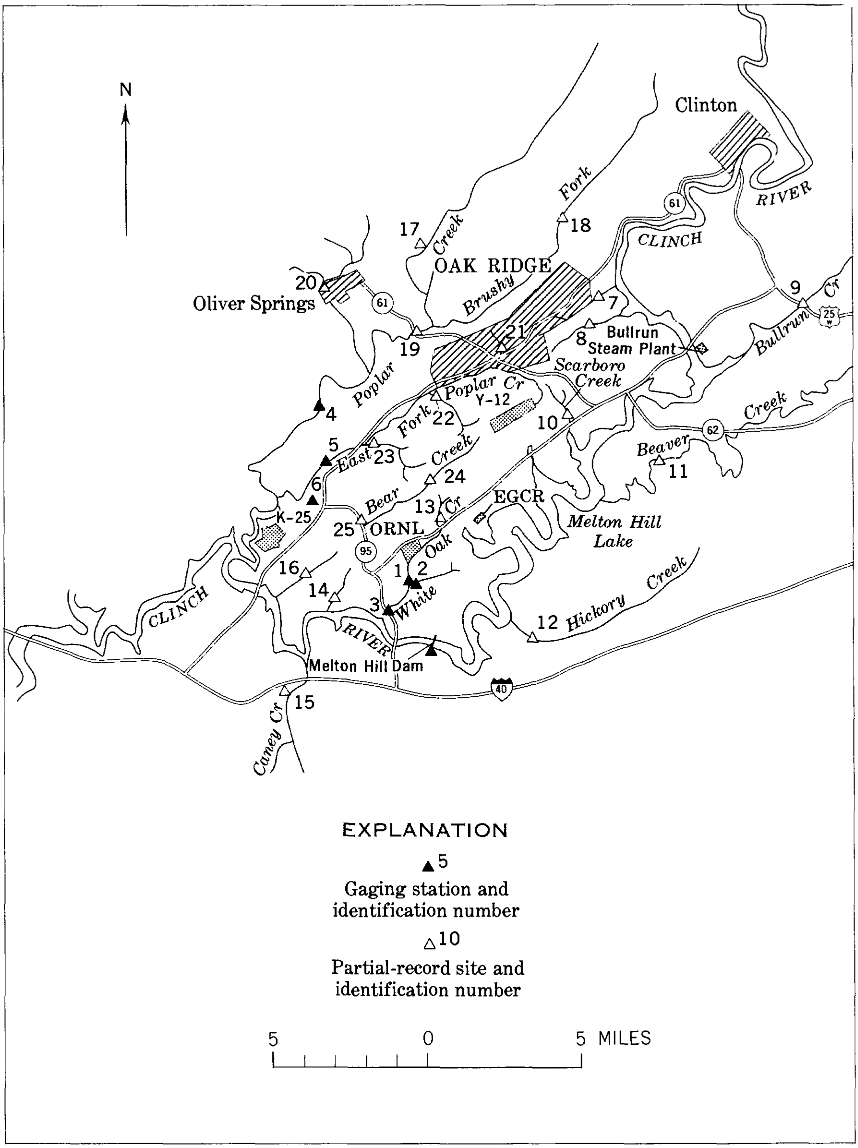

FIGURE 1.—Continuous records of streamflow were obtained at 6 sites and partial records of flow at 19 sites during 1961–64.

Plant, a production facility; the Oak Ridge Institute of Nuclear Studies; the Experimental Gas-Cooled Reactor (EGCR); Melton Hill Dam; and Bullrun Steam Plant.

In the Valley and Ridge part of the area the ridge crests are generally at altitudes of 1,000–1,200 feet, and the valley floors at altitudes of 750–850 feet. Most of the ridges are underlain by sandstone and shale of the Rome Formation or by the Knox Dolomite. The valleys are mostly underlain by the Conasauga Shale or by the Chickamauga Limestone.

Altitudes in the Cumberlain Mountains in the area rise to more than 3,200 feet. These mountains are underlain by sandstone, shale, and coal of Pottsville age.

Drainage of the area is to the Clinch River, which is tributary to the Tennessee River.

METHODS OF ANALYSIS, SURFACE-WATER DATA

Streamflow data for small streams in the Oak Ridge area (see fig. 1) consist basically of 4 years of concurrent record at 6 continuous-record stations and at 19 partial-record sites. At most of the partial-record sites, 7–12 discharge measurements were made.

In order to make the streamflow data more representative of the probable long-term flow characteristics at the gaging sites, the period of water years 1936–60 was adopted as a reference period to which the data would be adjusted for comparability. Techniques of adjustment are described in the following sections and numbered tables follow the text.

CONTINUOUS-RECORD SITES

Adjustment of the 1961–64 flow-duration curves to the reference period was made by use of adjustment factors obtained from records of Sewee Creek near Decatur, Tenn. The factors were ratios of discharges for the 1961–64 and the 1936–60 curves at several duration-percentage points.

In this report, estimates of low-flow frequency are given in table 8 (p. N47), for 2- and 10-year recurrence intervals and for durations of 1–90 days. The estimates were computed through regression analysis. Concurrent flows at the short-term station (Y) and a nearby long-term station (X) and the regression equation of the form $\log Y = a + b (\log X)$ were used for the conversion of short-term to long-term estimates. It was found that randomly selected concurrent days of low flow could not be used in the analyses, but that selection of days on the basis of at least 10 preceding days of continous recession at each station resulted in good relationship; these computations resulted in coefficients of correlation of 0.90 or better.

The 1961–64 quarterly runoff values at the short-term stations were compared to concurrent values at a nearby long-term station through the regression equation of the form $\log Y = a + b (\log X)$. The long-term station's quarterly runoff values during the years 1936–60 were then converted by the equation, and averaged by quarter for estimates of mean runoff at the short-term station. These data are given in table 9.

PARTIAL-RECORD SITES

Results of several base-flow discharge measurements at each partial-record site and concurrent mean daily discharge at Sewee Creek near Decatur were used to establish a relationship by the regression equation of the form $\log Y = a + b (\log X)$. The resulting relationship was used to convert the 1936–60 flow duration values at the long-term station to estimates of corresponding values at the short-term station for discharges equaled or exceeded 40–90 percent of the time. Results are listed in table 7.

Low-flow frequency at each partial-record site was estimated by use of the equation in the preceding paragraph relating concurrent-day discharges at the site to a long-term site. Values for recurrence intervals of 2 and 10 years and for durations of 1 and 7 days at the long-term site were converted by the equation to estimates for the partial-record site. Results are contained in table 8.

Mean annual rainfall on the partial-record basins and average quarterly values of the quarterly runoff to annual rainfall ratio at the continuous-record sites were used to obtain estimates of quarterly runoff, as listed in table 9.

STREAMS RECEIVING WASTE-WATER EFFLUENTS

Industrial and municipal wastes constitute a substantial part of flow in two of the local streams. East Fork Poplar Creek receives 12–24 cfs (cubic feet per second) of waste water from the Y–12 plant, and 3–10 cfs from the west sewage-disposal plant for the city of Oak Ridge. The daily mean discharges of East Fork Poplar Creek during the 1961–64 water years were adjusted to remove the effects of waste water released from these facilities. Whiteoak Creek receives an average of about 3.5 cfs from Oak Ridge National Laboratory, but because of uncertainty of quantity of waste water released, discharge records of this basin were not adjusted for waste-water discharges nor to the reference period.

ACKNOWLEDGMENTS

The author expresses his appreciation for the cooperation of officials of Management Services, Inc., operators of the Oak Ridge pumping station, who made their records available; to personnel of the city of Oak Ridge Department of Public Works, who provided daily records of discharge from the west end sewage-treatment plant; and to the

staff of the U.S. Weather Bureau Research station at Oak Ridge, who made available their records for the Oak Ridge area.

THE AREAL HYDROLOGY

PRECIPITATION

AVERAGE ANNUAL PRECIPITATION

An isohyetal map of the Oak Ridge area (fig. 2), was prepared on the basis of precipation data for 11 stations in and near the area (Tennessee Valley Authority, 1964; see also table 1, p. N42). Contour areas were measured on the map to determine mean annual precipitation on the area for the water years 1936–60. As determined by this method the Oak Ridge area had a mean annual precipitation of 51.2 inches, ranging from 46 inches in the northeast to more than 58 inches in the northwest.

SEASONAL AND MONTHLY PRECIPITATION

Normal monthly values for the 11 stations in and near the Oak Ridge area were used in preparing mean quarterly isohyetal maps of the area for the water years 1936–60. Measurement of the contour areas gave the following values, in inches: January–March, 16.5; April–June, 11.4; July–September, 11.8; and October–December, 11.5.

Although precipitation is fairly well distributed throughout the year, well-defined seasonal and areal variations exist. At 7 of the 11 stations used in the analysis, January was the month of greatest precipitation; at the remainder of the stations, February, March, and July were the months of greatest precipitation (see table 1). Monthly precipitation may vary greatly from year to year. At the U.S. Weather Bureau's Oak Ridge station during the 1948–64 period, precipitation in October has ranged from a trace to 6.11 inches, and in January has ranged from 1.86 to 10.47 inches.

MAXIMUM VOLUME AND INTENSITY

The greatest rainstorm to occur during the period of record in the town of Oak Ridge was that of the afternoon of August 10, 1960, when, in a period of 3.3 hours 7.43 inches of rain fell at the Weather Bureau gage site (Tennessee Valley Authority, 1960). At the storm center, about 0.75 mile north of this recording gage, as much as 9 inches fell, according to measurements of supplemental catches by TVA personnel. At the recording gage the maximum intensity was 3.43 in. per hr. (inches per hour). The cloudburst had a very limited areal extent; rainfall of 4 inches or more fell in an area of about 3.5 by 7 miles.

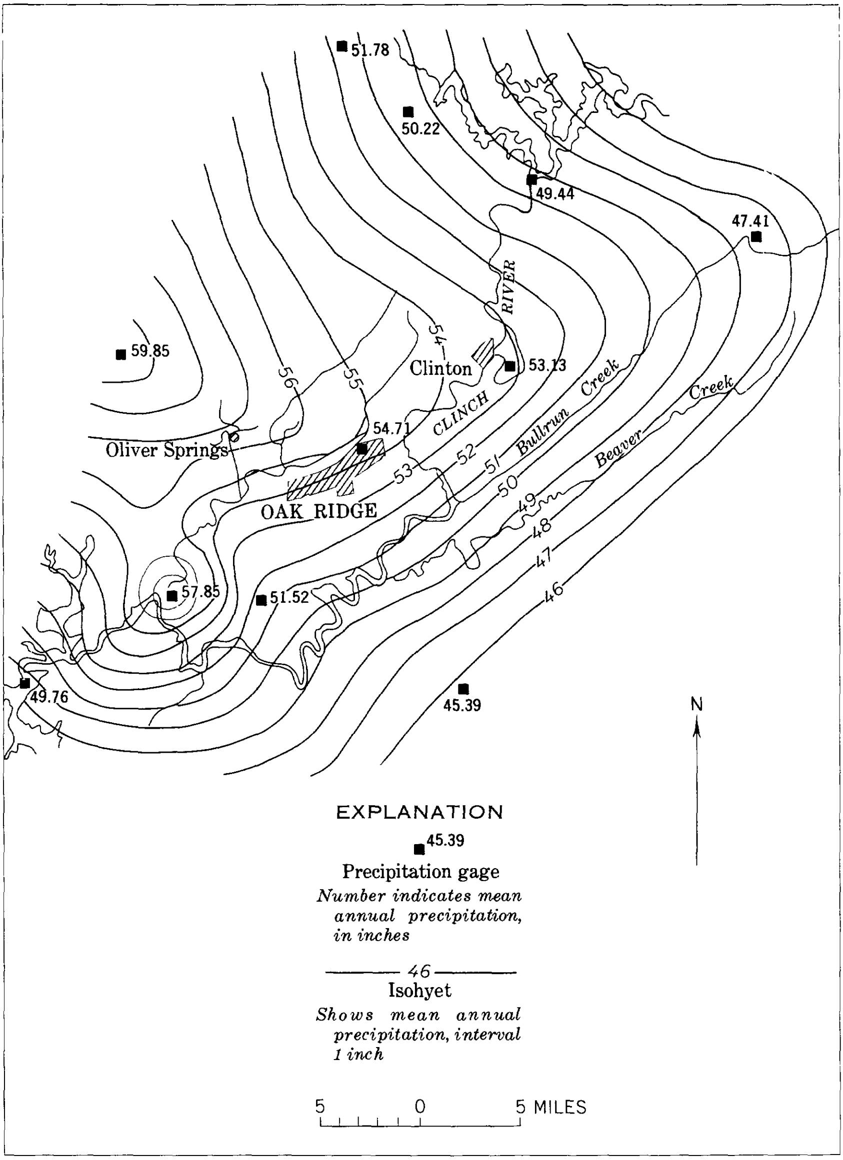

FIGURE 2.—Mean annual precipitation for the 1936–60 period ranges from more than 58 inches in the northwest to about 46 inches in the northeast.

At the recording gage at the Gaseous Diffusion Plant, 12 miles away, only 0.03 inch was recorded. According to the U.S. Weather Bureau (1961) the recurrence interval of a rainfall of the magnitude of

3.4 in. per hr. is greater than 100 years. A very similar storm occurred at the ORNL weather station on September 29, 1944, when a total of 7.75 inches fell in less than 6 hours.

Frequencies of maximum rainfalls of durations from 0.5 to 24 hours for the Oak Ridge area, as interpolated from U.S. Weather Bureau data (1961), are shown in figure 3.

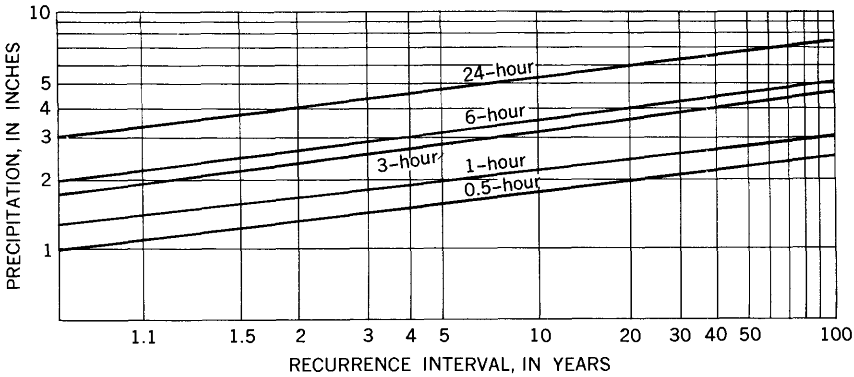

FIGURE 3.—Frequency of maximum precipitation of selected durations (adapted from U.S. Weather Bureau, 1961).

MINIMUM PRECIPITATION

The lowest annual precipitation to occur at the Oak Ridge USWB station since record began in 1948 was 37.43 inches, in 1958. Lowest monthly precipitation of record was in October 1963, when only a trace was recorded. At this station, June, August, September, and October are the only months to have had precipitation of less than 1 inch.

Mean frequencies of three volumes of 24-hour precipitation at the Oak Ridge Weather Bureau station for the period 1948–1964 are shown in figure 4, to illustrate the similarity of seasonal distribution of different volumes of precipitation.

The average annual number of occurrences of consecutive rainless days for periods of as much as 30 days for 12 years of record at the Oak Ridge station was computed by Hilsmeier (1963). Hilsmeier's data were used to formulate a relative duration curve of rainless periods, as shown in figure 5 (see table 3). The analysis indicates that half the dry periods exceeded 3 days, 10 percent exceeded 8 days, and 1 percent exceeded 17 days.

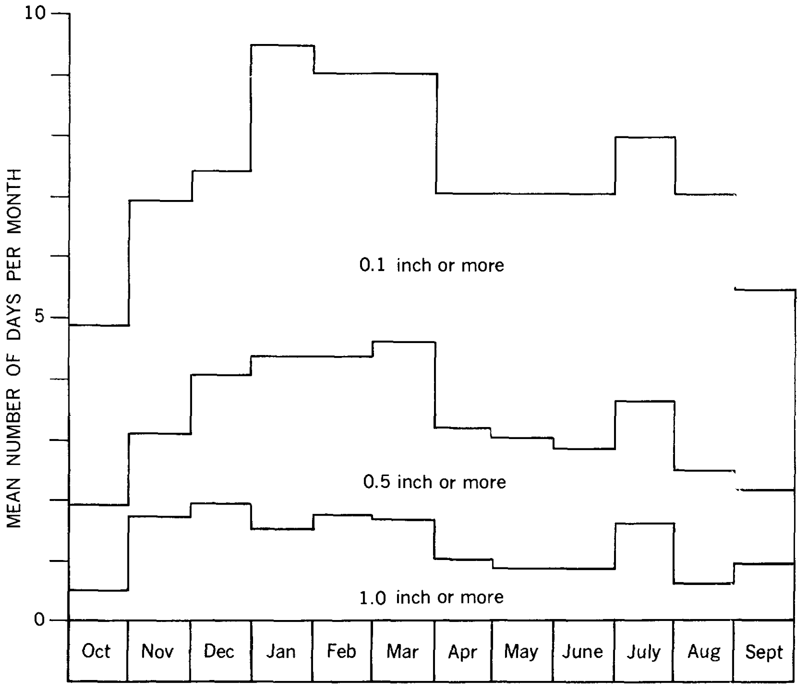

FIGURE 4.—Frequencies of occurrence of different volumes of 24-hour rainfall at the Oak Ridge station tend to follow similar seasonal patterns of distribution.

RUNOFF FROM THE AREA

AVERAGE ANNUAL RUNOFF

Results of analyses in which runoff values were adjusted to the water years 1936–60 indicate that the average annual runoff, exclusive of the Clinch River, is about 22.3 inches. Depending on areal distribution of mean annual rainfall, computed annual runoff ranged from 19.7 inches for Bullrun Creek, in the northeastern part of the area, to 25.2 inches for Poplar Creek, in the western part of the area.

SEASONAL AND MONTHLY VARIATIONS

Variations in annual runoff occur as the result of variations in rainfall and rates of water loss. In the Oak Ridge area the quarter of greatest runoff is that of January through March; the quarter of least runoff is that of July through September. The average quarterly

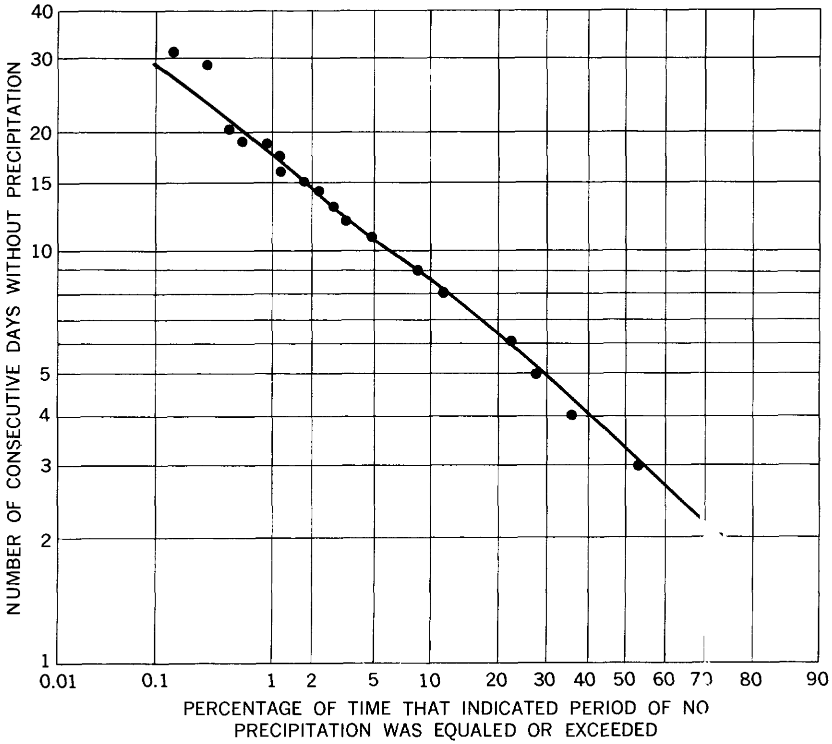

FIGURE 5.—Less than 20 percent of the periods of no precipitation exceed 1 week (modified from Hilsmeier, 1963).

runoff from the area, as a percentage of annual runoff based on records obtained during the 1961–64 water years at the continuous-record stations and adjusted to the 1936–60 water years, is shown in the following table.

Quarter	*Percentage of annual runoff*	*Quarter*	*Percentage of annual runoff*
October–December	17	April–June	23
January–March	49	July–September	11

Estimates of mean quarterly runoff during the years 1936–60 at each gaging site in the area are listed in table 9.

Maximum monthly runoff is likely to occur in January, February, or March, when rainfall is normally high and soil moisture and ground-water storage are at a maximum. Minimum runoff is likely to occur in September or October when rainfall is normally low and soil moisture and ground-water storage are at a minimum. Estimated mean seasonal distribution of rainfall and runoff for the area are shown in figure 6.

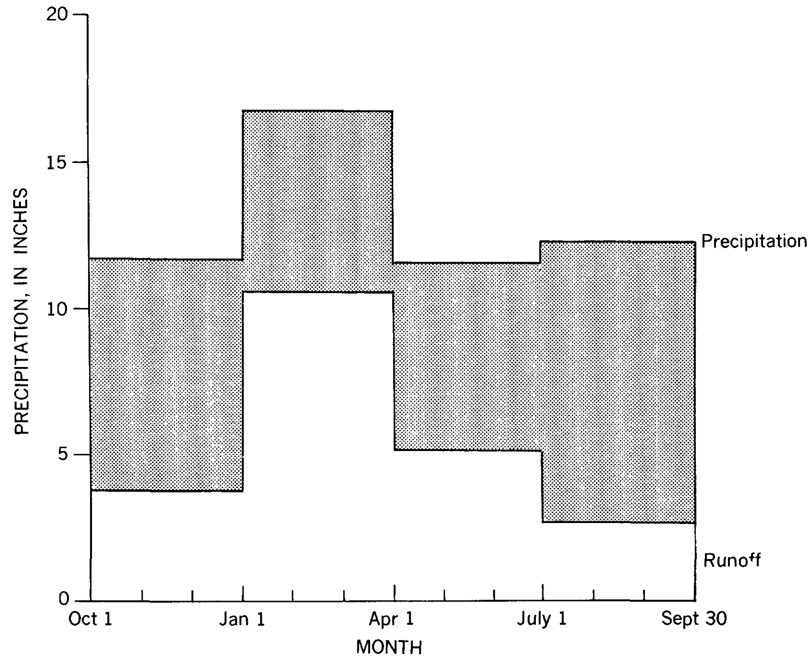

FIGURE 6.—The quarter year beginning January 1 averages a high rainfall and runoff; that beginning July 1 is second highest in rainfall but lowest in runoff (adjusted to the 1936–60 period).

A large part of runoff is derived from discharge of stored ground water. The variations in quantity of ground water stored are reflected by changes in level of the water table. Ground-water levels generally begin to rise in November and continue to rise until a peak is reached, most frequently in March. Following the peak, water levels decline as discharge exceeds recharge. The annual cycle of water levels in the area is illustrated by figure 7, which shows changes in water level in two wells in the Knox Dolomite in Whiteoak Creek basin during the period June 1962–June 1963. Surface altitudes of the wells are about 835 feet and 950 feet. The greater variation in water level in the higher well is the result of movement of ground water from areas of higher altitude toward points of discharge at lower altitude.

FLOW-DURATION CHARACTERISTICS

The shape and slope of a flow-duration curve is an indication of the variability of the flow in the stream for which it is drawn and of the dependability of supply. The flow-duration curve is a cumulative frequency curve showing the percentage of time that a given discharge

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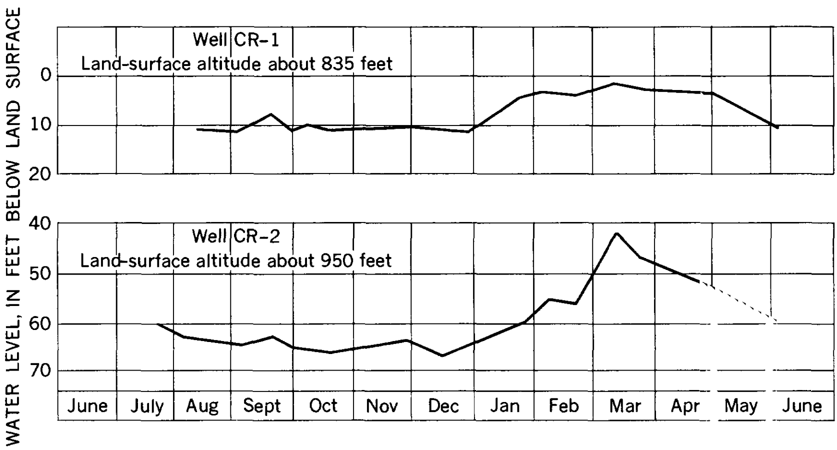


FIGURE 7.—Water levels in wells at higher altitudes commonly are farther below land surface and have a wider range of seasonal variation than those in wells at lower altitudes. (Wells in Knox Dolomite of Whiteoak Creek basin, 1962–63.)

was equaled or exceeded as represented by the history of measurement of flow at a gaging site. It implies nothing as to sequence or chronology of flows.

A comparison of flow-duration curves computed for several of the Oak Ridge area streams (fig. 8) shows the variation in yield on a per-square-mile basis for durations of as much as 30 percent of the time. As the figure illustrates, the differences in yield are greatest in the lower discharge range. Many factors affect the shape and slope of a flow-duration curve. The basic factors are climate and basin characteristics, such as size, shape, and geology. In the Oak Ridge area, for example, basins underlain predominantly by carbonate rocks tend to have a smaller range in flow than those underlain predominantly by sandstone and shale.

GROUND WATER

AQUIFERS AND GROUND-WATER CHARACTERISTICS

The volume of ground-water storage and discharge varies widely from aquifer to aquifer, according to rock type. In the Oak Ridge area the Knox Dolomite is the major aquifer (water-bearing formation) and the shale and sandstone rocks of Pottsville age and the Rome Formation are the poorest aquifers.

The occurrence of water in the Knox Dolomite and in the Chickamauga Limestone is similar, although solution openings in the Chicka-

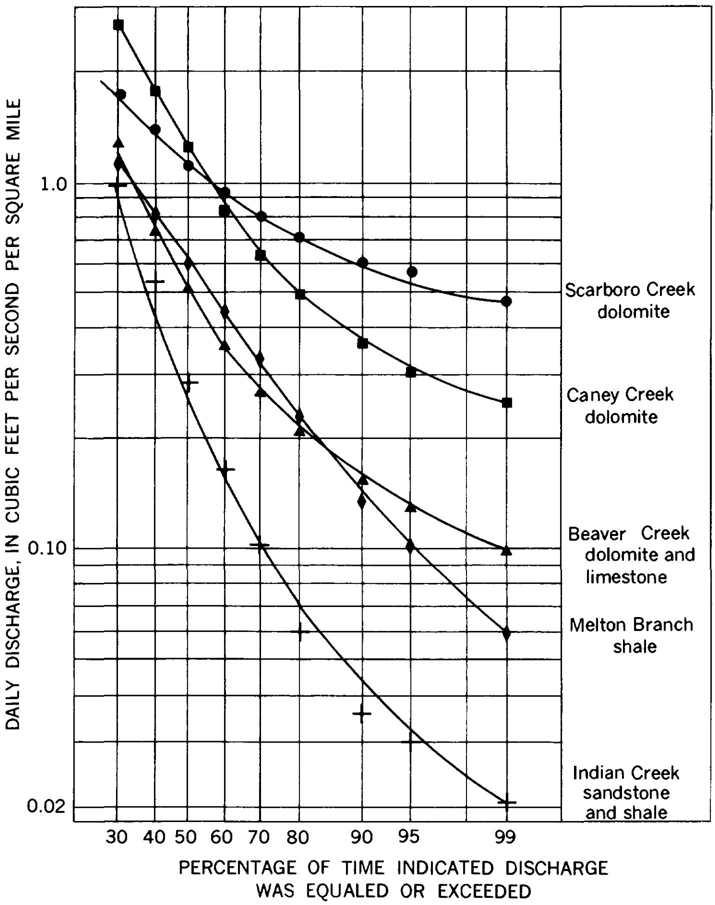


FIGURE 8.—Streamflows from basins underlain mostly by carbonate rocks tend to have higher base flow and less variation in range of flows than those from basins underlain mostly by sandstone and shale (curves are adjusted to 1936–60 period).

mauga are generally smaller than those in the Knox. The difference in the character of solution openings of the Chickamauga and the Knox is largely due to the thin-bedded shaly nature of the Chickamauga compared to the thicker bedded less shaly dolomite and limestone of the Knox.

In the sandstone and shale rocks of the area, that is, primarily those of the Rome Formation, of the Conasauga Group, and of Pottsville age, water occurs in small openings along joints and bedding planes. Because the rocks are nearly insoluble, the openings are not substantially enlarged, and the storage and transmissibility of these rocks are low.

The thickness and characteristics of residual material overlying bedrock affect the occurrence of ground water in the area. The Knox Dolomite is overlain by a mantle of cherty clay ranging in thickness, in most places, from about 25 feet to more than 100 feet. This material functions as a reservoir of ground water, feeding the underlying solution cavities. The residual material overlying the Conasauga is very similar in appearance to the unweathered bedrock, but is less compact and the water-bearing openings are larger; consequently, the residuum bears most of the ground water in Conasauga outcrop belt. Because the thickness of residuum in these belts is in most places less than 30 feet, the volume of ground-water storage is small and is virtually depleted by September or October. Residuum in the Chickamauga Limestone outcrop belts is generally heavy yellow or orange clay less than 10 feet thick; its low infiltration capacity limits recharge.

It is estimated that the average well in the Oak Ridge area would yield less than 10 gpm (gallons per minute). Even in the Knox Dolomite, it is unlikely that a well will penetrate a solution opening capable of yielding more than 50 gpm, except in certain locations. For example, wells have been developed in eastern Tennessee in the Knox Dolomite in locations adjacent to streams, but most of the pumped water moves laterally underground from the stream. The yield of a well adjacent to a spring, probably will not exceed that of the spring.

RELATION OF GROUND-WATER CHARACTERISTICS TO STREAMFLOW

Flow characteristics of a stream are affected to a large extent by water-bearing properties of the rocks of the stream basin. The effects of geology and ground water are particularly evident in low-flow characteristics of a stream. To illustrate this feature, the following table lists low-flow concurrent-day discharges in cubic feet per second per square mile for three gaging sites in Poplar Creek basin. Drainage basins of two of these sites, Indian Creek and Poplar Creek at Batley Road, are underlain by shale and sandstone; the other, Brushy Fork, is partly underlain by Knox Dolomite. The presence of the Knox Dolomite in the basin is reflected in its consistently greater low-flow discharge. More complete information on geologic compositions of basins in the area is given in table 10.

WATER LOSS

Annual water loss by evaporation and transpiration amounts to about 30 inches, or about 55 percent, of the annual rainfall. Water loss is most pronounced during the July–September quarter, when at least 80 percent of the quarter's rainfall is returned to the atmosphere.

Date	Discharge, in cubic feet per second per square mile		
	Brushy Fork	Indian Creek	Poplar Creek at Batley Road
9-18-61	0.20	0.05	0.04
9-10-63	.16	.07	.03
10-13-63	.14	.02	.01
6-23-64	.21	.05	.03

During this quarter, rainfall averages 11.5 inches and runoff (partly originating from ground-water storage) averages only 2.3 inches.

THE CLINCH RIVER

The Clinch River, which has a drainage area of 4,413 square miles at its mouth, is the source of most water used in the Oak Ridge area. From it are drawn supplies for Clinton, Oak Ridge, and USAEC facilities. Water pumped by the Oak Ridge pumping station is delivered to ORNL, Y-12, and the city of Oak Ridge. Waste water from ORNL is returned to the Clinch River via Whiteoak Creek, from Y-12 via East Fork Poplar Creek, and from the city of Oak Ridge via East Fork Poplar Creek and via a tributary to the Clinch River at river mile 51.1. The Gaseous Diffusion Plant has its own pumping station at river mile 14.5. Waste water from this plant is returned directly to the Clinch River.

A gaging station, Clinch River at Melton Hill Dam, (previously published as Clinch River near Scarboro, and Clinch River near Wheat) was operated between September 1936 and September 1964. Average flow during this 28-year period was 4,561 cfs. Maximum recorded discharge was 42,900 cfs in February 1937. No flow occurred on many days.

Records of flow in the Clinch River above the Oak Ridge area have been obtained since 1903 at a gaging station first published as Clinch River at Clinton, then as Clinch River near Coal Creek, and since 1936, as Clinch River below Norris Dam.

Flow in the Clinch River is regulated at Norris Dam and at Melton Hill Dam. Stages below Melton Hill Dam are further affected by operation of Watts Bar Lake. Power generation at Melton Hill Dam began in the summer of 1964. Estimated typical daily power release patterns for summer and winter operating conditions (Morton, 1965, p. 114; 1966, p. 44) are shown in figure 9. These release patterns generally will prevail each day except Saturday and Sunday when no releases are scheduled.

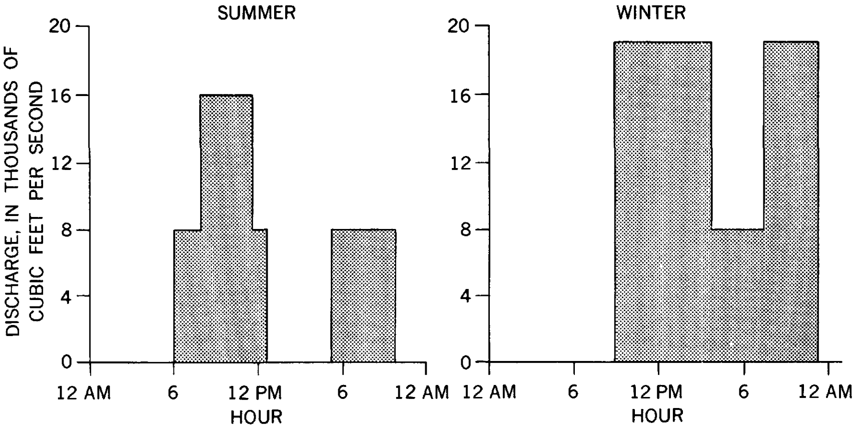


FIGURE 9.—Estimated daily releases from Melton Hill Dam for summer and winter operating conditions (Morton, 1965, 1966).

HYDROLOGY OF THE TRIBUTARY DRAINAGE BASINS

CONTINUOUSLY GAGED TRIBUTARY BASINS

In the following sections brief descriptions are given of the physical characteristics and ground-water conditions in the four basins in which continuous records of stream discharge were obtained. Discharge measurements at partial-record sites in these basins are listed in table 5. For stations other than those in Whiteoak Creek basin, estimates of magnitude and frequency of minimum flow are listed in table 8, and estimates of quarterly runoff are listed in table 9. Because data for Whiteoak Creek basin stations were not adjusted for waste-water discharges or to the reference period, low-flow data are contained in a table in the section on Whiteoak Creek basin.

Results of chemical analyses of water from all gaged streams in the area are listed in table 11; results of spectrographic analyses are listed in table 12. Water temperatures at three of the continuous-record stations during the 1964 water year are shown in table 13.

WHITEOAK CREEK BASIN

Whiteoak Creek basin (fig. 10) has an area of 6.53 square miles at its mouth, at Clinch River mile 22.8. Altitudes in the basin range from 741 feet at the mouth to 1,356 feet at the crest of Copper Ridge on the southeastern drainage divide.

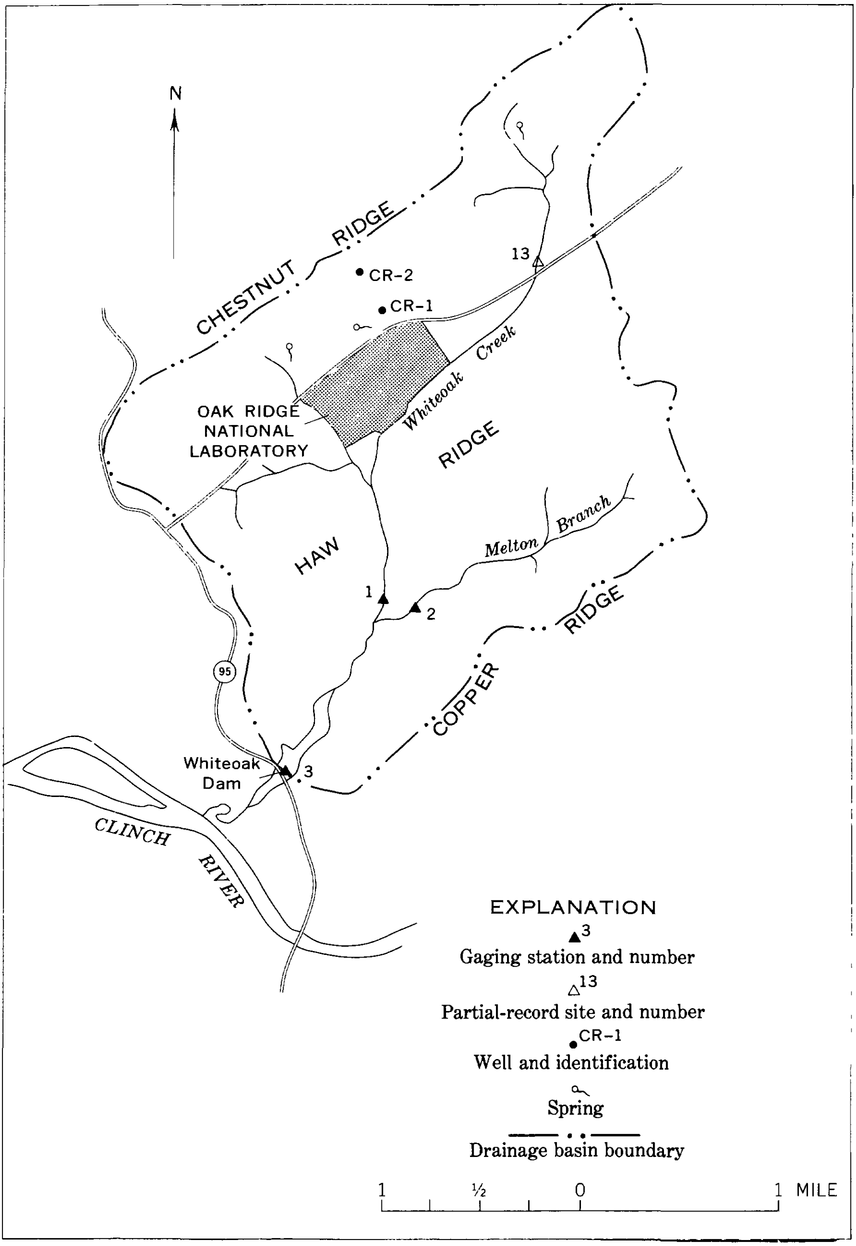


FIGURE 10.—Location of data-collection sites in Whiteoak Creek basin.

Oak Ridge National Laboratory is in Whiteoak Creek basin; the principal part of the laboratory is in the northwestern valley (Bethel Valley) but some facilities, including the laboratory's solid and liquid radioactive waste-disposal areas, are in the southeastern valley (Melton Valley).

A substantial part of the flow in Whiteoak Creek is waste water from the laboratory, which contains low-level concentrations of radionuclides and chemical wastes. No attempt was made to adjust the Whiteoak Creek records to the reference period because of uncertainty as to quantities of waste water released to the stream. Four continuous record stations have been operated in the basin: Whiteoak Creek at ORNL (not shown in fig. 10) from 1950 to 1955; Whiteoak Creek below ORNL (site 1, fig. 10) during 1950–52 and 1955–64; Melton Branch near Oak Ridge (site 2, fig. 10) during 1955–64; and Whiteoak Creek at Whiteoak Dam (site 3, fig. 10), during 1953–55 and 1960–64.

Whiteoak Creek is impounded by Whiteoak Dam, a small highway-fill dam 0.6 mile above the stream mouth. The impoundment, known as Whiteoak Lake, presently covers about 20 acres.

The flow-duration curve for the gaging station Whiteoak Creek at Whiteoak Dam, unadjusted, is shown in figure 11.

Lowest mean discharges for periods of as much as 60 consecutive days for the three gaging stations in Whiteoak Creek basin are shown in the table below.

Melton branch (see fig. 10) drains 1.48 square miles of Whiteoak Creek basin. Some of the Oak Ridge National Laboratory facilities, including a solid-waste burial ground, are located in the basin.

Magnitude of annual minimum flows at three stream-gaging sites in Whiteoak Creek basin

Station No. (fig. 1)	Station Name	Year	Lowest mean discharge (in cfs) for the number of consecutive days shown, in year beginning April 1: 1	3	7	14	30	60
1	Whiteoak Creek below ORNL near Oak Ridge.	1962	3.2	3.5	3.7	4.1	4.4	4.5
		1963	4.0	4.1	4.4	4.5	5.0	5.1
		1964	4.0	4.1	4.3	4.5	4.7	5.0
2	Melton Branch near Oak Ridge	1956	.1	.1	.1	.1	.1	.1
		1957	.1	.1	.1	.1	.2	.2
		1958	.4	.4	.4	.4	.5	.5
		1959	.3	.4	.4	.4	.5	.5
		1960	.2	.2	.2	.2	.3	.4
		1961	.1	.1	.1	.1	.3	.3
		1962	.0	.0	.0	.1	.1	.3
3	Whiteoak Creek at Whiteoak Dam near Oak Ridge.[a]	1962	4.7	4.8	5.0	5.2	5.7	5.8
		1963	4.1	5.2	5.4	5.5	5.9	6.5
		1964	4.8	4.8	5.0	5.1	5.2	5.5

[a] Days when gates were closed or being reset (April 7–9, May 2–3, 1963) not considered.

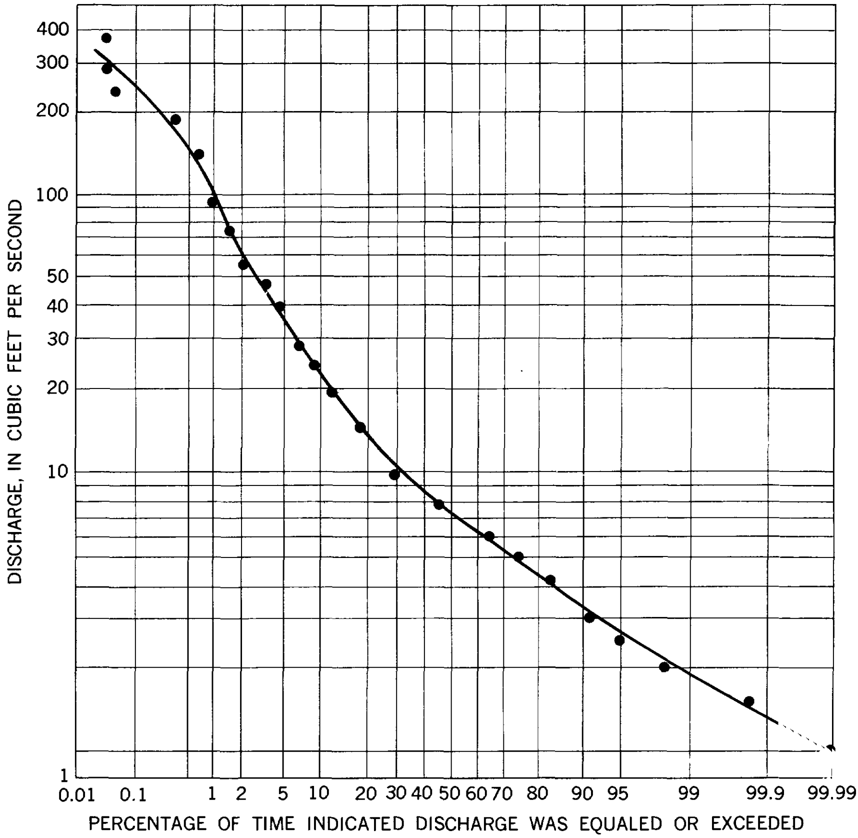


FIGURE 11.—Duration curve of daily flow for Whiteoak Creek at Whiteoak Dam, 1953–55 and 1960–63 (unadjusted).

Because most of the basin is underlain by the Rome Formation and the Conasauga Group, the base-flow discharge of the stream is low, and at times in the late fall periods of no flow have occurred. The 1956–63 flow duration curve, shown in figure 12, indicates that for 90 percent of the time discharge was 0.21 cfs or more; for 50 percent of the time, 0.90 cfs or more, and for 10 percent of the time, 5 cfs or more.

The belt of Knox Dolomite underlying Chestnut Ridge, which forms the northwestern drainage divide of the basin, is the principal water-bearing formation. Several springs along the base or in the reentrant valleys of the ridge are tributary to Whiteoak Creek. Low-flow measurements show that about 90 percent of Whiteoak Creek dry-weather discharge originates as ground-water discharge from the Knox Dolomite of Chestnut Ridge, the Chickamauga Limestone of Bethel Valley and from ORNL plant effluent.

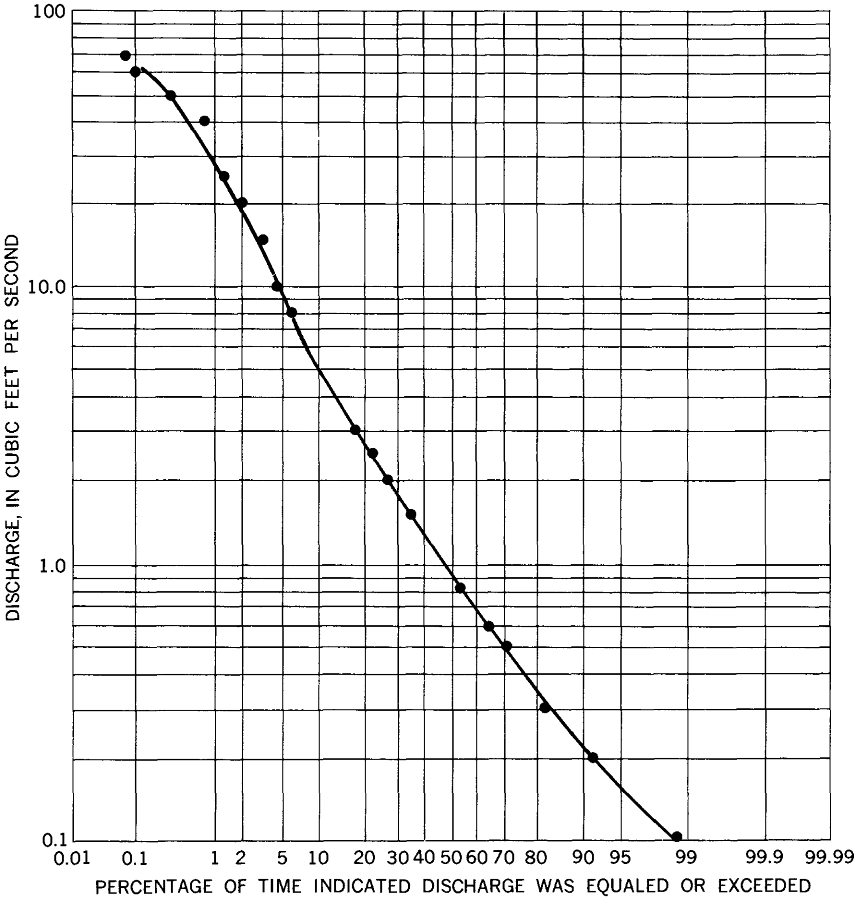


FIGURE 12.—Duration curve of daily flow for Melton Branch, 1956—63 (unadjusted).

Detailed reports on Whiteoak Creek basin hydrology, geology, soils, and their effects on radioactive waste disposal are given by McMaster and Waller (1965) and McMaster (1964).

POPLAR CREEK BASIN

Poplar Creek basin (fig. 13), on the northwestern side of the Oak Ridge area, has a drainage area of 136 square miles at its mouth at Clinch River mile 12.0. The western half of the basin is in the Cumberland Mountain section of the Appalachian Plateau province; the eastern half is in the Valley and Ridge province. Topographic relief is by far the greatest of all basins in the Oak Ridge area; altitudes

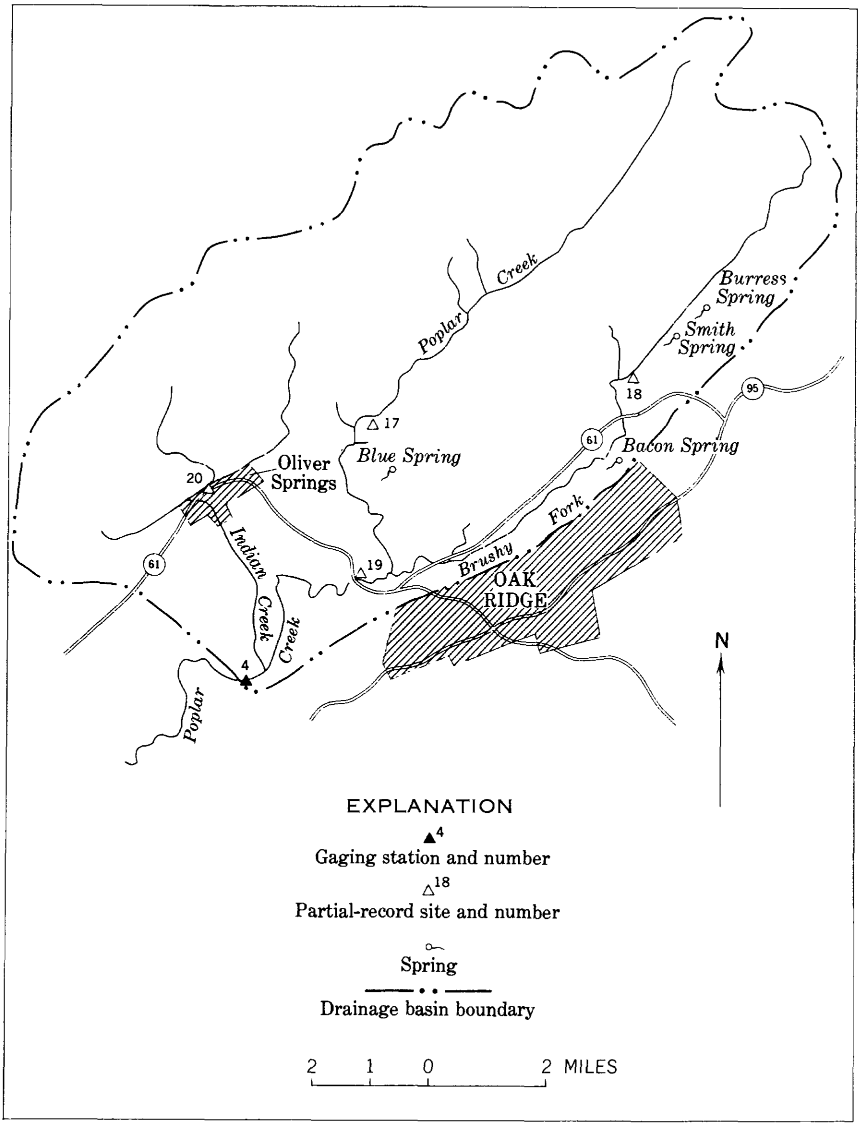


FIGURE 13.—Location of data-collection sites in Poplar Creek basin.

range from 735 feet at the mouth of Poplar Creek to more than 3,200 feet along the western drainage divide.

About 65 percent of the basin is wooded, and the remainder is largely farmland. Coal mining, generally by the stripping method, is extensive in the Cumberland Mountains part of the basin. The largest of the several small communities in the basin is Oliver Springs, population about 1,200.

A continuous-record station has been maintained on Poplar Creek about 13.3 miles above the mouth (site 4, fig. 13) since August 1960. From August 1960 until September 1964, partial-record sites were operated on Indian Creek at State Highway 61 bridge (site 20, fig. 13), on Poplar Creek at State Highway 61 bridge (site 19, fig. 13), on Poplar Creek at Batley Road (site 17, fig. 13), and on Brushy Fork (site 18, fig. 13).

Records of stream flow and of discharge measurements made in Poplar Creek basin are listed in table 5; estimated mean quarterly runoff, adjusted to the reference period, is given in table 9. Magnitude and frequency of minimum flows for all gaging sites are given in table 8, and flow-duration values for the partial-record stations are given in table 7. The flow-duration curve for Poplar Creek at the continuous-record site is shown in figure 14.

Most of Poplar Creek basin is underlain by shale and sandstone of low water-bearing capacity. The Knox Dolomite, which crops out mostly in the southeastern part of the basin, occupies only about five percent of the basin surface area, but is the source of all large springs in the basin. Three of these springs, Bacon Spring, Smith Spring, and Burress Spring, are tributary to Brushy Fork (fig. 13). Another large spring, Blue Spring, flows from a thin fault block of Knox in the central part of the basin. These four springs were measured on a monthly basis for at least 1 year beginning in June 1950. Bacon Spring was measured monthly from July 1951 to June 1954 (Sun and others, 1963, p. 26). For this series of measurements Bacon Spring, the largest spring in the Oak Ridge area, had a mean discharge of 3.83 cfs; Smith Spring, a mean discharge of 1.85 cfs; Burress Spring, a mean discharge of 2.22 cfs; and Blue Spring, a mean discharge of 1.18 cfs.

EAST FORK POPLAR CREEK BASIN

East Fork Poplar Creek has a drainage area of 29.8 square miles at its mouth at Poplar Creek mile 4.8; the basin is shown in figure 15. Altitudes in the basin range from 741 feet at the mouth of the basin to about 1,280 feet on Pine Ridge, on the southeastern drainage divide. About 40 percent of the basin area is woodland.

The Y–12 plant is at the headwaters of East Fork Poplar Creek. The stream also drains a large part of the residential and commercial area of Oak Ridge; it receives a large amount of waste water from the Y–12 plant and a smaller amount from the west sewage-disposal plant for the city of Oak Ridge.

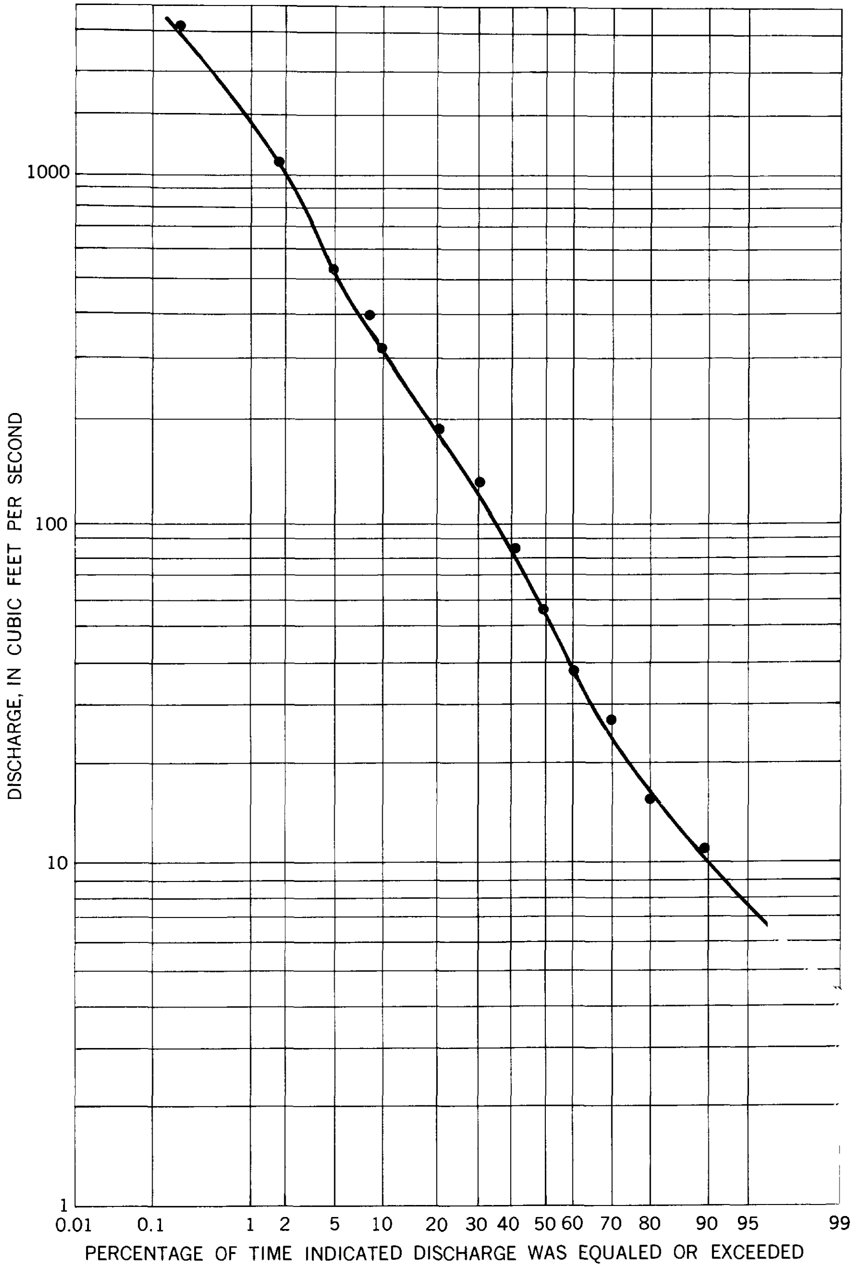


FIGURE 14.—Duration curve of daily flow for Poplar Creek (adjusted to 1936–60).

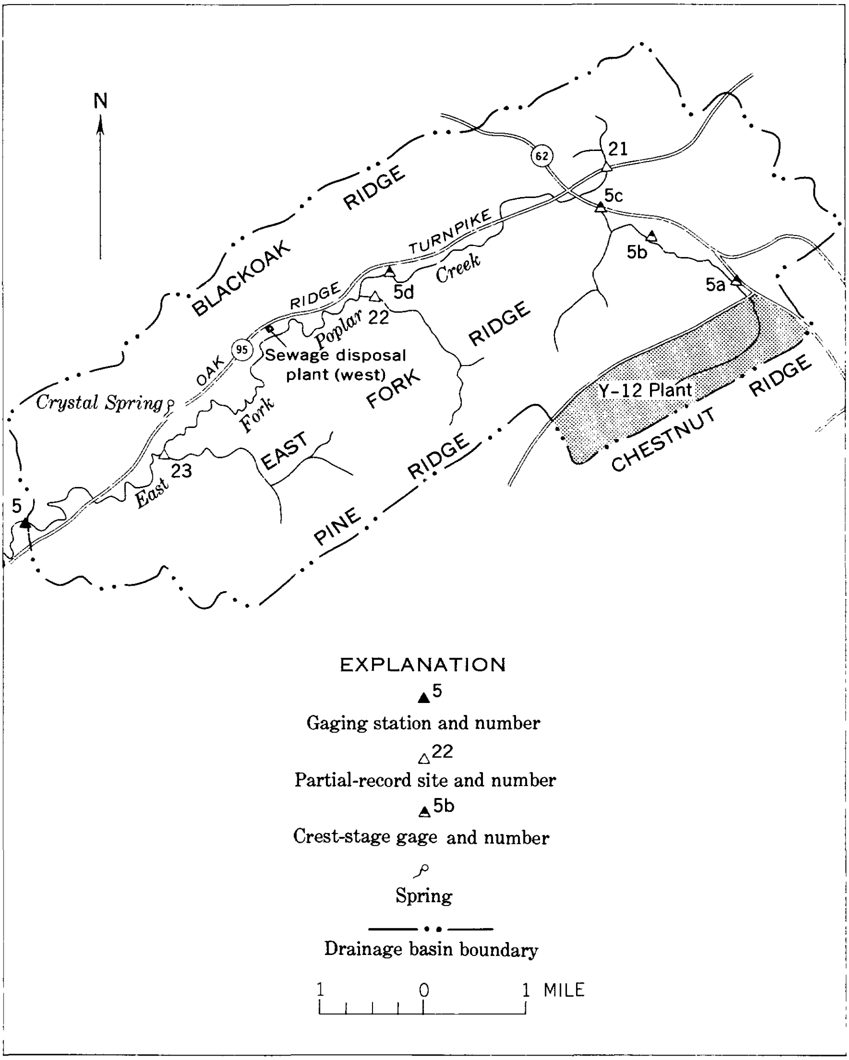


FIGURE 15.—Location of data-collection sites in East Fork Poplar Creek basin.

A continuous-record gaging station (site 5, fig. 15) has been operated on East Fork Poplar Creek about 3.1 miles above the mouth since August 1960, and four partial-record sites were maintained from August 1960 until September 1964 (see fig. 15); in addition, partial-record sites were operated on Gum Hollow Branch (site 23), Mill Branch (site 22), and an unnamed tributary to East Fork Poplar Creek (site 21; see table 5).

East Fork Poplar Creek receives 12–24 cfs of waste water from the Y–12 plant and 3–10 cfs from the west sewage-treatment plant for the city of Oak Ridge. Records of the Oak Ridge pumping station's daily water delivery to Y–12 during the 1961–64 water years and records of daily discharge from the sewage-treatment plant were used to adjust discharge records. The resulting daily discharge figures were used in constructing the flow-duration curve (fig. 16) and in computing minimum-flow frequency (table 8) and quarterly runoff at the gaging station (table 9).

The outcrop belt of the Knox Dolomite occupies about 25 percent of the East Fork Poplar Creek basin surface area, and is, as elsewhere in the Oak Ridge area, the major ground-water-bearing belt. One of the largest springs in the area, Crystal Spring (see fig. 5), is at the contact between the Knox and the Chickamauga Limestone. The spring discharge was measured monthly from July 1951 to June 1953. During that period, measured minimum discharge was 1.0 cfs, mean discharge was 1.7 cfs, and maximum discharge was 3.2 cfs. Several smaller springs occur along the Knox-Chickamauga contact in the basin.

Most ground-water discharge in Gum Hollow basin and Mill Branch basin probably is from the Fort Payne Chert, a formation of Early Mississippian age composed mostly of siliceous dolomite somewhat similar to that of the Knox Dolomite.

BEAR CREEK BASIN

Bear Creek basin (fig. 17), in the southwestern part of the Oak Ridge reservation, has a drainage area of 7.4 square miles at its mouth on East Fork Poplar Creek. Altitudes range from about 755 feet at the mouth to 1,220 feet on the crest of Chestnut Ridge. About 65 percent of Bear Creek basin is wooded; the open land is mostly old fields. Part of the upper basin is used by the Y–12 plant for waste disposal and refuse burning; otherwise, the area is unused.

A continuous-record gaging station was operated on Bear Creek 0.9 mile above the mouth (site 6, fig. 17) from August 1960 through September 1964. During this period, partial-record sites were maintained at the State Highway 95 bridge on Bear Creek (site 25) and at the Roane-Anderson County line (site 24; see table 5).

The adjusted flow-duration curve is shown in figure 18.

Several small perennial springs flow from the limestone beds in the upper part of the Conasauga and from the Knox Dolomite in Bear Creek Valley. Large solution cavities are known to exist in the limestone beds in the upper part of the Conasauga in Bear Creek Valley,

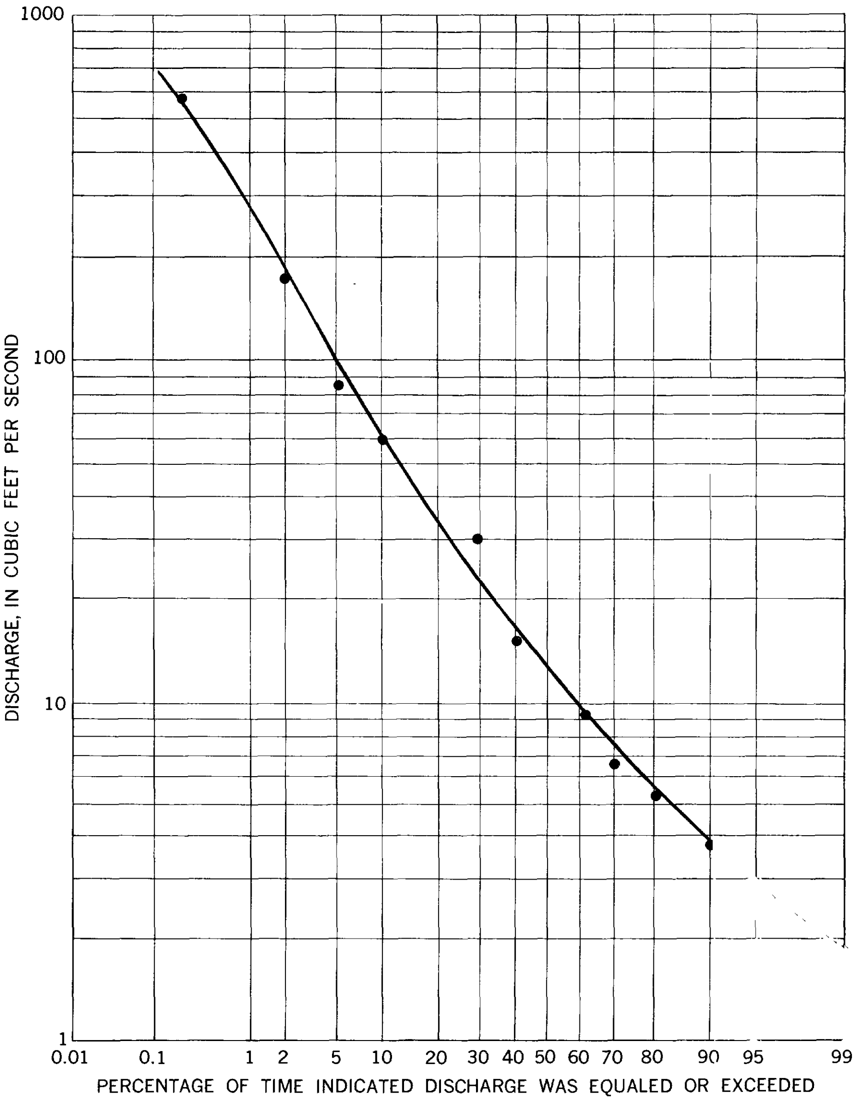


FIGURE 16.—Duration curve of daily flow for East Fork Poplar Creek (adjusted to 1936–60 period and for waste-water discharges).

from records of foundation drilling for the Y–12 plant, and from records of a series of exploratory wells drilled in Bear Creek Basin. Most of these openings are at depths of less than 50 feet and are partially or entirely mud filled. The absence of sustained high discharge from these cavities is probably due to the lack of storage capacity in

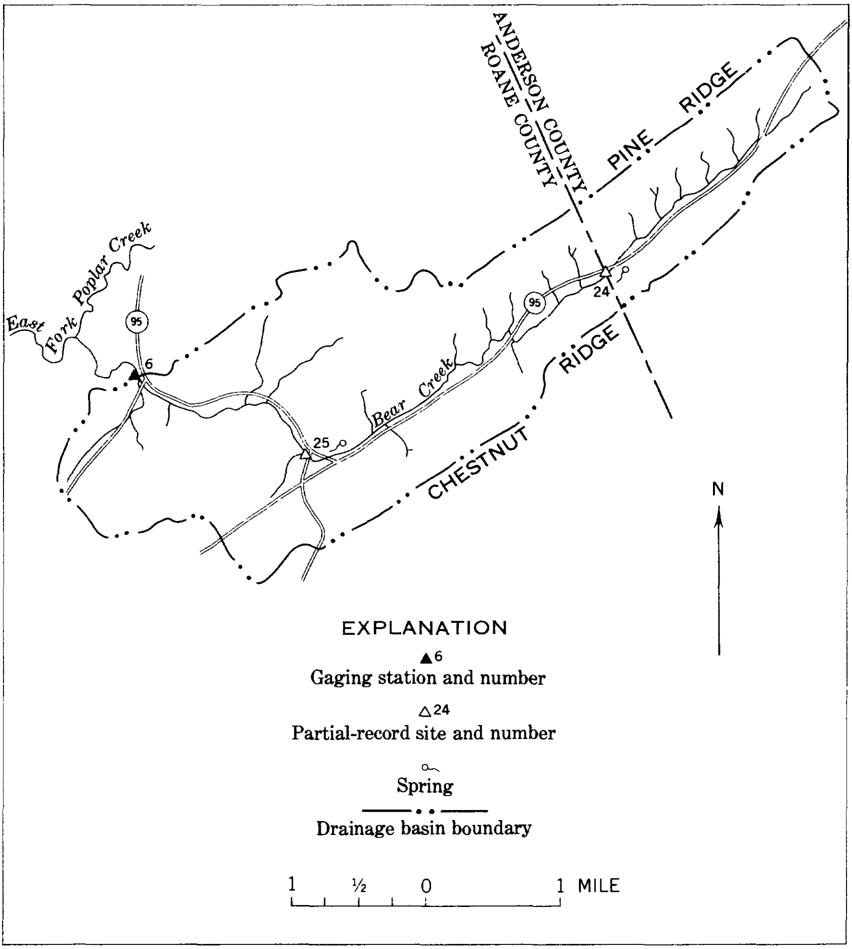


FIGURE 17.—Location of data-collection sites in Bear Creek basin.

the overlying material. The occurrence of ground water in the Rome and Conasauga in the basin is similar to that elsewhere in the area.

PARTIALLY GAGED TRIBUTARY BASINS

The following paragraphs describe very briefly the nine basins in which only partial records of discharge were obtained. Locations of streams and gaging sites are shown in figure 1. Records of discharge measurements made at these sites are contained in table 5, and a list of peak stages recorded at partial-record and crest-stage gage sites is given in table 6. Estimates of duration of daily flow are given in table 7, and estimates of magnitude and frequency of minimum flows

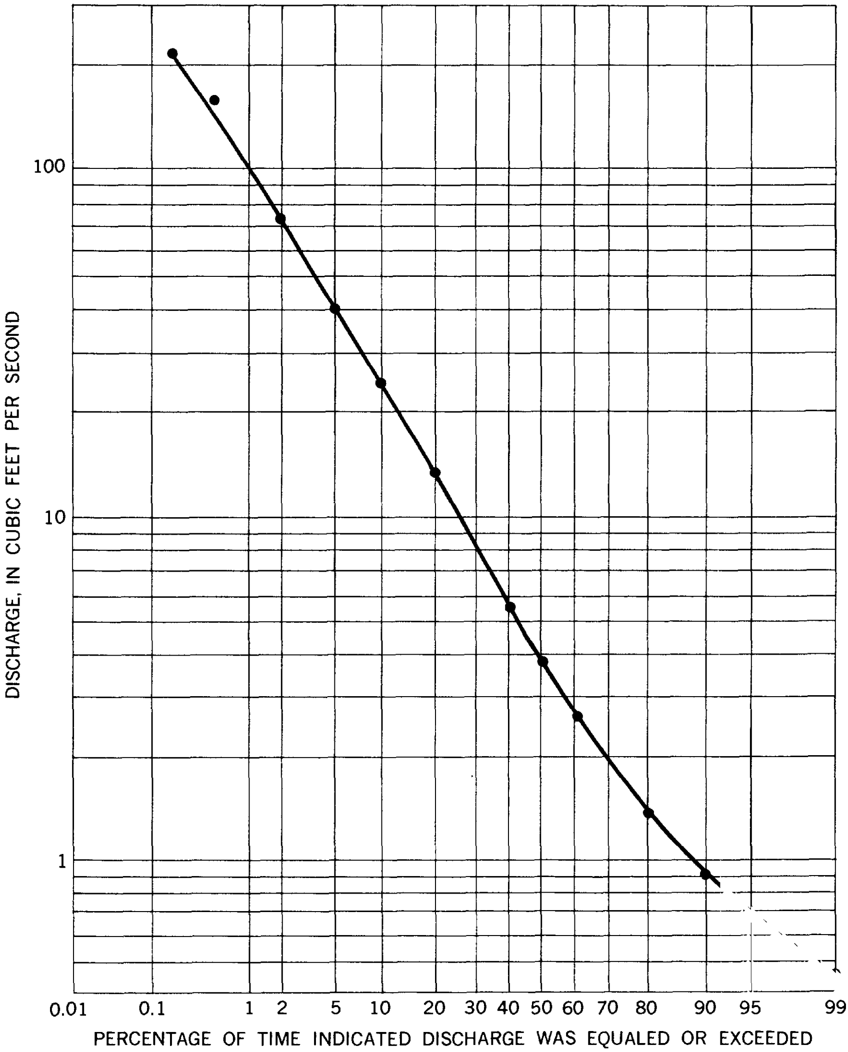


FIGURE 18.—Duration curve of daily flow for Bear Creek (adjusted to 1936–60).

for 1- and 7-day duration and 2- and 10-year recurrence interval are given in table 8. Estimated mean quarterly runoff is listed for each station in table 9.

The station Clinch River tributary at CRM (Clinch River mile) 51.1 (site 7, fig. 1) has a drainage area of 2.53 square miles, part of which is in the residential section of Oak Ridge. The sewage effluent for the east part of the city of Oak Ridge is discharged at a point just below the station.

Emory Valley Creek has a drainage area of 0.85 square mile at the gaging site (site 8). The basin drains part of a growing residential area.

A partial-record site (site 9) was maintained on Bullrun Creek at the U.S. Highway 25-W bridge, a short distance above Melton Hill backwater, where the stream has a drainage area of 93.3 square miles. A gaging station has been operated on Bullrun Creek about 8 miles upstream since 1957.

Scarboro Creek Basin is the site of Tennessee's first arboretum, presently being developed by the University of Tennessee's Forestry Department. A series of dams has been constructed to provide pooled water for certain species of trees. At the partial-record site (site 10), operated before establishment of the arboretum, the stream has a drainage area of 1.13 square miles.

Beaver Creek at the partial-record site (site 11) has an area of 86.8 square miles. The basin contains several small communities, the largest of which is Powell.

Hickory Creek has a drainage area of 4.36 square miles at the gaging site (site 12); its basin is mostly used for agriculture.

Clinch River tributary No. 2 (site 14) lies within the Oak Ridge reservation, has a drainage area of 0.94 square mile, and is presently unused. The basin is mostly former farmland reverting to woodland.

Caney Creek has a drainage area of 3.32 square miles at the partial-record site (site 15). The basin is mixed woodland and farmland.

Grassy Creek Basin, which has a drainage area of 1.00 square mile at the partial-record site (site 16), is unused and is mixed woodland and former farmland.

QUALITY OF SURFACE WATER AND GEOCHEMICAL RELATIONSHIPS

By R. J. Pickering

QUALITY OF WATER

Samples for determination of base-flow water quality were taken from 29 streams in the Oak Ridge area during the period September 1961 to June 1964. Sampling dates selected included periods of high, medium, and low base flow. Occasional samples were collected at three additional sites. Two of the streams sampled regularly drain areas in the Cumberland Mountains in which coal has been mined by stripping.

Results of chemical analyses of the samples for major and minor constituents are reported in table 11. Results of spectrographic analyses of the trace-element content of samples collected September 18–19, 1961, are shown in table 12.

In general, water in small streams in the Oak Ridge area is of the calcium-magnesium-bicarbonate type, except for water in Indian and Poplar Creeks, which drain the Cumberland Mountains area. These latter two streams contain substantial amounts of sulfate ion, probably as a result of oxidation and dissolution of iron sulfide minerals exposed through strip-mining of coal. They also contain a somewhat higher content of sodium and chloride than do the streams with water of the calcium-magnesium-bicarbonate type. The water in uncontaminated natural streams in the Oak Ridge area is moderately hard to very hard and has a low content of sodium, potassium, and chloride.

Generally, a content of more than 0.2 ppm of lithium, fluoride, phosphate, or detergents in streams in the Oak Ridge area is indicative of contamination. Analyses of water from East Fork Poplar Creek, Bear Creek, Whiteoak Creek, Melton Branch, and Indian Creek (tables 11 and 12) show that the content of one or more of the constituents listed above is higher than normal, and thus these streams may be considered contaminated. Occasional increases in sodium, chloride, and nitrate content of the tributary to East Fork Poplar Creek indicate some contamination of that stream also. Intermittent increases in nitrate content of Beaver Creek resulted from use of fertilizer on farmland drained by the creek.

The water in East Fork Poplar Creek has a higher content of nitrate, sodium, and chloride than other streams in the area, owing to industrial effluent from the Y–12 plant. Since 1963, increased control over effluent from Y–12 has been achieved through construction of a lagoon settling basin, which has reduced suspended solid load and fluctuation in pH.

GEOCHEMISTRY

The chemical constituents of surface water in a natural stream reflect the mineral composition of the soil and bedrock of the stream basin because base flow of the stream originates as ground water. During periods of low base flow, ground water moves rather slowly through the soil and bedrock, and the dissolved-solids content of stream water will most strongly reflect the influence of soil and bedrock in these periods. The limiting condition for dissolution of minerals by ground water is saturation of the water with the minerals being disolved.

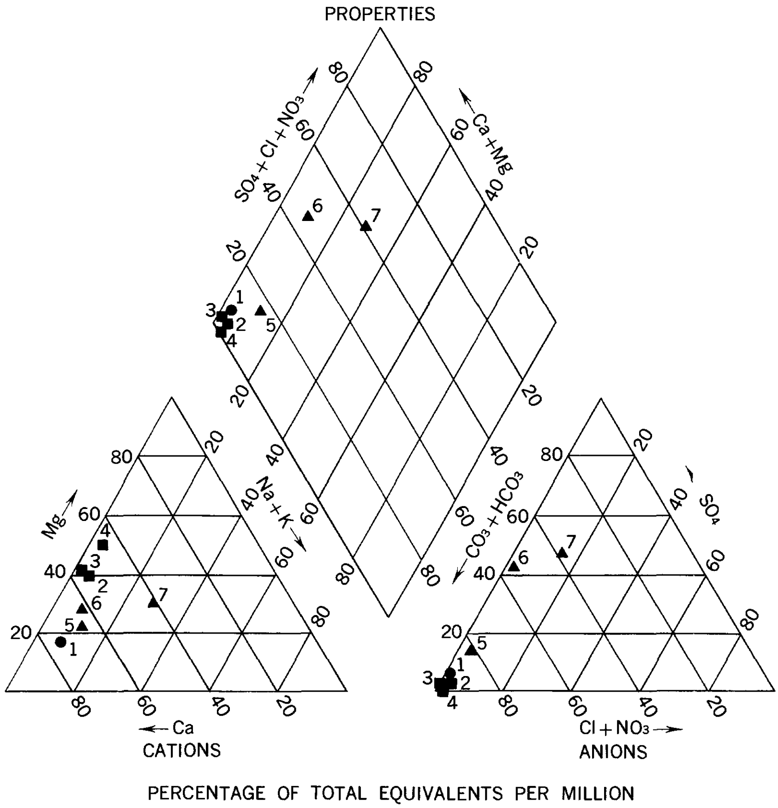
Streams which derive their base flow primarily from limestone, $CaCO_3$, will contain calcium and bicarbonate as the most abundant ions. Streams whose base flow is derived from dolomite, $CaMg(CO_3)_2$, will contain the same two primary ions and substantial amounts of magnesium.

Streams whose base flow is derived from shale, siltstone, and sandstone usually contain lesser concentrations of dissolved solids than do streams from carbonate rocks. The low dissolved-solids contents are a result of the lesser solubility of silica and silicate minerals which comprise shale, siltstone, and sandstone, in comparison to carbonate minerals. Differences in dissolved-solids content between the two stream types are greatest during periods of high base flow when the water is in contact with soil and rock for a relatively short period of time. On the other hand, water from shale, siltstone, and sandstone commonly contains higher concentrations of sodium, sulfate, and chloride than does water from carbonate rocks, because many carbonate rocks do not contain these constituents in significant amounts.

In general, the chemical composition of the natural streams in the Oak Ridge area strongly reflects the mineralogical composition of the bedrock underlying their individual drainage basins. This relationship is shown by the grouping of chemical constituents shown in figure 19. Constituents plotted on the diagrams represent averages of the two or three lowest base-flow samplings of streams having more than 75 percent of their drainage basin underlain by a single rock type, or group of rock types. They represent one stream in a limestone environment, three streams in dolomite environments, and three streams in shale-siltstone-sandstone environments (see table 10). Values plotted on the diagrams represent percentages, not absolute values, and are independent of differences between samples in concentration of individual constituents.

Points in the cation triangle, lower left of figure 19, show a distinct difference between the composition of the stream flowing in a limestone environment and the streams flowing in dolomite environments. The calcium: magnesium ratios in the latter streams are close to the expected ratios calculated on the basis of mineral composition and distribution of rock types. Both environments contribute very little sodium and potassium to the water. The streams flowing in shale-siltstone-sandstone environments are much more variable in calcium: magnesium ratios, and also contain more sodium and potassium than the streams flowing over carbonate rocks.

In the anion triangle, plots of the streams flowing in the two carbonate environments (limestone and dolomite) are grouped in the carbonate-bicarbonate corner. As in the cation triangle, the streams from shale-siltstone-sandstone environments are more variable in composition than are the streams draining carbonate rocks. In Poplar Creek and Indian Creek, which receives coal-mine drainage from Pennsyl-



EXPLANATION

ROCK TYPE

● Limestone

■ Dolomite

▲ Shale, siltstone, sandstone

STREAM

1. Emory Valley Creek
2. Caney Creek
3. Clinch River tributary 2
4. Whiteoak Creek above Oak Ridge National Laboratory
5. Melton Branch
6. Poplar Creek at Batley Ro?d
7. Indian Creek

FIGURE 19.—Dissolved chemical constituents in water from basins underlain by a single rock type.

vanian rocks of the Cumberland Mountains, sulfate is a much more important constituent than in Melton Branch, which receives no coal-mine drainage.

In the total-composition diamond, plots for streams flowing in exclusively carbonate environments are clustered in the Ca–Mg–CO_3–HCO_3 corner. Plots for the streams from shale-siltstone-sandstone environments are distributed over a much larger area of the diamond as a result of rather large variations in contributions of sodium and sulfate to the dissolved-solids content of the streams.

The influence of bedrock composition on the chemical compoꟻition of streams during base flow is further illustrated in figure 20. During

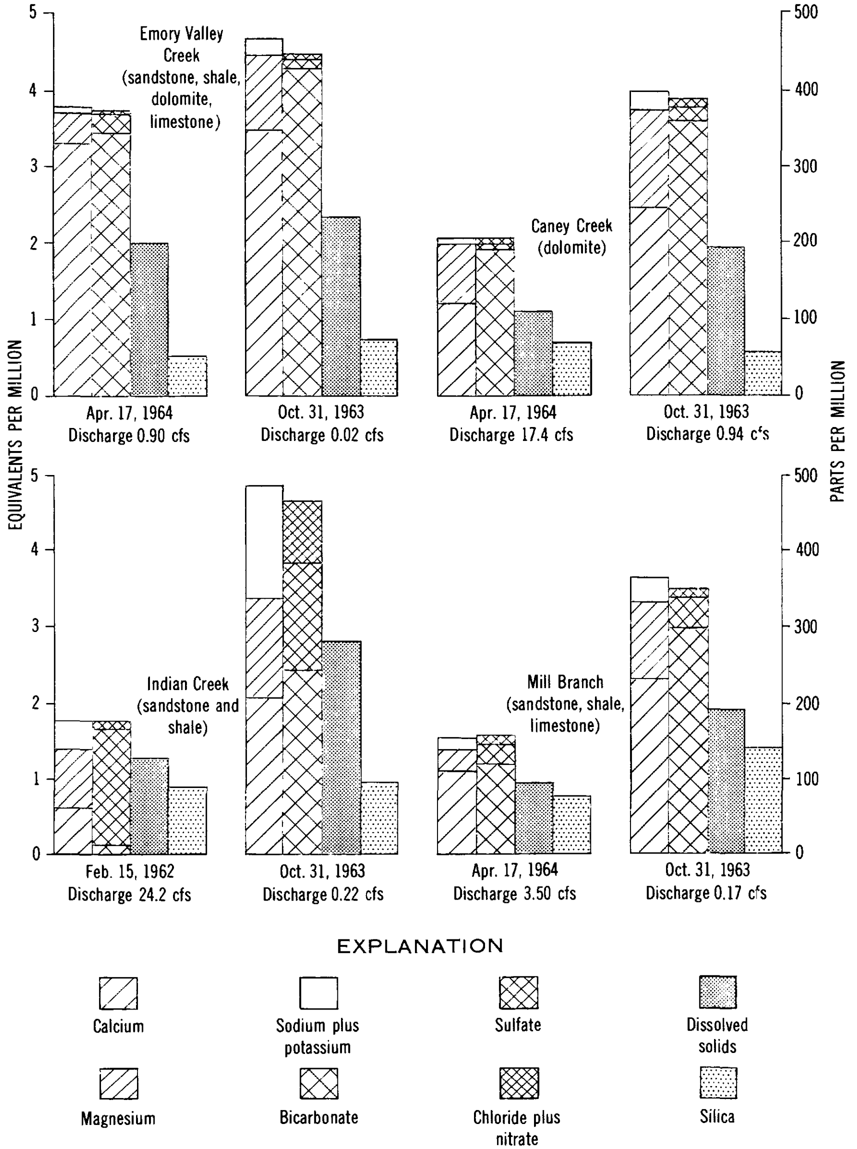


FIGURE 20.—The geologic composition of a basin as well as flow conditions affect chemical quality of water.

high base flow, Mill Branch, whose drainage basin is underlain predominantly by shale, had the lowest content of dissolved solids of the four streams graphed. During low base flow, Indian Creek had the highest content of dissolved solids. Its high content of dissolved solids, and of sulfate in particular, was derived from acid solutions draining from coal-mining areas in the Cumberland Mountains. The high contents of iron, manganese, aluminum, cobalt, and nickel in Indian Creek water probably were derived from the same source (table 12).

The stream in the Oak Ridge area that had the lowest average content of silica in base-flow samples was Clinch River tributary at CRM 51.1, which is underlain almost exclusively by Chickamauga Limestone and Knox Dolomite, both essentially carbonate rocks. The next lowest in silica content was Emory Valley Creek, which above the sampling site is underlain entirely by Chickamauga Limestone. A low silica content is characteristic of streams draining areas underlain by carbonate rocks.

In the Oak Ridge area, the highest silica contents are in streams whose drainage basins are largely underlain by shale, siltstone, and sandstone—Mill Branch, Indian Creek, Grassy Creek, and Gum Hollow Branch. Thus it appears that a high silica content is characteristic of streams draining areas underlain by these three rock types. The high silica content is probably due to dissolution of fine-grained silicate minerals which occur abundantly in the shale and siltstone. The Fort Payne Chert may have contributed to the silica content of Mill and Gum Hollow Branches. The high silica content of Indian Creek is largely the result of rapid dissolution of quartz and silicate minerals by acid water draining from coal mines.

The two streams having the highest hardness contents were Emory Valley Creek and Clinch River tributary at CRM 51.1. Drainage basins of both streams are underlain by carbonate rocks only. In general, streams draining basins underlain predominantly by shale, siltstone, or sandstone, had the lowest hardness contents.

The relationship between volume of base flow and content of dissolved solids is shown in figure 21 for several streams in the Oak Ridge area. In general, water in a stream at low base flow can be assumed to have been in contact with soil and bedrock for a longer period of time than water in the stream during periods of high base flow, and can therefore be expected to have a higher content of dissolved solids. Four of the five streams illustrated in figure 21 show this relationship. Emory Valley Creek does not. The absence of a well-defined relationship between the discharge and the dissolved solids content of Emory Valley Creek and also the high calcium and bicarbonate con-

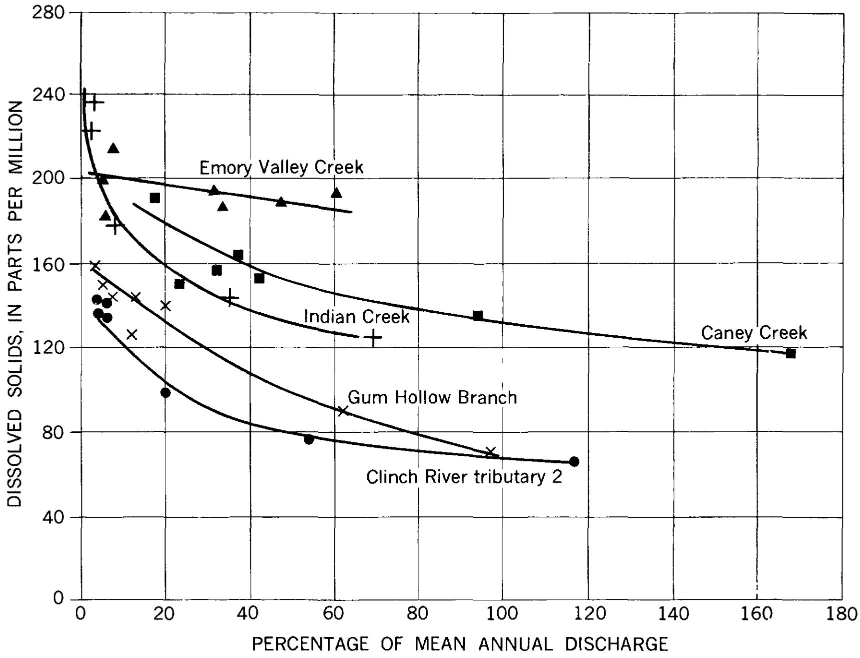


FIGURE 21.—Dissolved-solids content tend to decrease as flow increases.

tents of the stream suggest that Emory Valley Creek may be saturated with respect to calcium carbonate during some periods of the year. The base flow of a stream during periods of saturation is composed of ground water which has reached the limit of its capacity to dissolve limestone, and the calcium and bicarbonate content of the stream would not be expected to vary with discharge during such periods.

WATER USES IN THE OAK RIDGE AREA

IN PLACE USES

Recreation.—Since the filling of Melton Hill Lake the recreational use of water in the Oak Ridge area has greatly increased. The lake now has three commercial docks and a marina; several access areas and parks have been built and more are planned. Sport fishing is popular both in the reservoir and in Melton Hill Dam tailwater.

Waste disposal.—Wastes in the Oak Ridge area released to streams include organic wastes, chemical wastes, drainage from coal mines, gravel-washing wastes, and radioactive wastes. The largest volumes of waste water, which contain chemical, organic, and radioactive wastes in very dilute quantities, are discharged by the AEC plants.

The combined estimated mean effluent from the three plant installations is 470 cfs, about 450 cfs of which is cooling water from the Gaseous Diffusion Plant that is returned directly to the Clinch River.

The city of Oak Ridge discharges waste water from a secondary treatment plant at the east end of the city, which serves an estimated 14,000 people, to a small Clinch River tributary at river mile 51.1, and to East Fork Poplar Creek from a primary treatment plant at the west end of town, which serves an estimated 16,500 people. Clinton has a primary sewage-treatment plant serving 4,800 people, and releases waste water to the Clinch River. Oliver Springs and Powell have no sewage-treatment facilities. Two industries in Clinton discharge their waste water through the municipal waste-treatment system. A meat-packing firm near Powell releases untreated wastes to Beaver Creek (Tennessee Valley Authority, 1963a).

Navigation and hydropower generation.—Navigability of Clinch River has been extended by creation of Melton Hill Lake to a total of 60 miles from the mouth of the river upstream to Clinton. Most of the Clinch River flow will be used for power generation at Melton Hill Dam. At Norris Dam, 80–100 percent of the streamflow is used for power generation, water being spilled only to maintain flood-storage reservation (Tennessee Valley Authority, 1963a).

WITHDRAWAL USES

Municipal supply.—The Oak Ridge city pumping station on Melton Hill Lake serves ORNL, the Y–12 facility, and the city of Oak Ridge. The 1962 Oak Ridge report of pumpage for the State of Tennessee showed an average of 2.7 cfs delivered for domestic use and 1.3 cfs for commercial use. An estimated 80 percent of this is returned to Clinch River via the previously mentioned tributaries.

Clinton obtains its supply from Clinch River, pumping about 0.6 cfs. Oliver Springs pumps 0.3 cfs from Bacon Spring. The West Knox Utility District serves about 8,000 people and listed its average 1962 pumpage at about 0.6 cfs, obtained from Melton Hill Lake and a large spring. The First Utility District of Anderson County, serving 4,000 people, pumps water from two springs, and listed its 1962 average pumpage rate at about 0.3 cfs.

Industrial uses.—Other than water used by the Federal Government installations, industrial use of water in the area is small. The totally or partially self-supplied industries listed in the Clinch-Powell Valley Report (Tennessee Valley Authority, 1963a) used a total of only 0.3 cfs in 1962, obtained from wells and springs, in addition to 0.3 cfs from municipal sources.

Steampower generation.—The operation of Bullrun Steam Plant will require an estimated 928 cfs from Melton Hill Lake. The discharge water, having been used for condenser cooling, a nonconsumptive use, will have been raised in temperature by about 18°F (Carrigan and others, 1967).

Rural domestic use.—According to the Tennessee Valley Authority (1963a), the estimated total rural domestic water use in Anderson, Knox, and Roane Counties in the Clinch-Powell Valley was about 3.3 cfs in 1962, based on an estimated per-capita daily use of 60 gallons in homes with piped water and 10 gallons in homes without piped water.

Irrigation.—Agricultural use of water for irrigation in the area was estimated to be about 207 acre-feet per year in 1962, of which an estimated 187 acre-feet was consumptive use (Tennessee Valley Authority, 1963a). Water used for irrigation for other purposes includes that of the Oak Ridge Golf and Country Club, which is installing a dam and pumping system on Crystal Spring; expected use will be about 0.7 acre-feet per day in dry weather. The Melton Hill Golf and Country Club uses supplemental irrigation, pumping from Melton Hill Lake. The University of Tennessee Agricultural Experiment Station also pumps supplemental water from Melton Hill Reservoir.

SUMMARY

Annual precipitation in the Oak Ridge area ranges from more than 58 inches in the northwestern part of the area to about 46 inches in the northeastern part. Analysis of storm rainfall by the U.S. Weather Bureau indicates that the 100-year 24-hour rainfall is about 7.5 inches. The most intense measured rainfall at Oak Ridge occurred on August 10, 1960, when 7.43 inches fell in a period of 3.3 hours. Analysis of duration of periods of no rainfall indicates that half the dry periods are of 3 days or more duration. Annual water loss amounts to about 55 percent of annual rainfall; the quarter of greatest loss is that of July–September, when an average of 80 percent of the season's rainfall is returned to the atmosphere.

Flow characteristics of streams in the Oak Ridge area vary considerably from stream to stream. The variations are primarily caused by differences in areal distribution of rainfall and the geologic characteristics of the basins. Those basins underlain by a greater percentage of limestone and dolomite generally have higher unit-area low-flow discharges than those underlain by greater percentages of sandstone and shale. Basins underlain by greater proportions of sandstone and shale tend to have a wider range of discharge than those underlain mostly by dolomite and limestone.

The Knox Dolomite is the principal aquifer in the area and all the large springs, of which Bacon Spring is largest, issue from this formation. The sandstone and shale, of the Rome Formation, the Conasauga Group, and Pottsville Age, are the poorest aquifers. It is estimated that the yield of the average well in the area would not exceed 10 gpm.

Water in small streams in the Oak Ridge area is of the calcium-magnesium-bicarbonate type, except water in streams whose drainage is derived from the Cumberland Mountains area. These latter streams contain substantial amounts of sulfate ions, probably as a result of oxidation and dissolution of iron sulfide minerals exposed through strip mining coal; they also contain a somewhat higher content of sodium and chloride than do the streams with water of the calcium-magnesium-bicarbonate type. In general, the water in natural streams in the Oak Ridge area is moderately hard to very hard and has a low content of sodium, potassium, and chloride. Three streams—East Fork Poplar Creek, Whiteoak Creek, and Bear Creek—receive some industrial effluent.

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TABLES 1–13

TABLE 1.—*Monthly and annual precipitation, in inches, for the period of record at the Oak Ridge station*

[Maximum and minimum values are in italic. Based on data collected by the U.S. Weather Bur.]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1948	3.70	10.04	6.82	2.26	2.97	2.23	6.34	2.17	1.14	1.36	*12.22*	6.89	58.14
1949	8.60	2.52	4.33	4.39	3.10	2.76	*8.51*	4.96	1.40	*6.11*	*1.37*	4.49	52.54
1950	13.10	6.33	4.98	*1.39*	*7.05*	3.21	7.52	5.94	3.12	1.41	3.67	3.83	61.55
1951	7.10	6.35	8.09	4.86	*1.23*	4.83	3.74	1.38	4.95	2.96	6.70	8.01	60.20
1952	4.90	*1.90*	7.09	1.65	3.43	1.18	4.13	4.48	1.46	.94	4.48	3.77	39.41
1953	4.45	7.18	4.94	3.35	5.83	2.91	4.25	*.54*	4.03	.58	1.62	6.66	46.34
1954	*13.27*	4.64	6.24	1.80	3.09	2.29	5.06	2.73	3.73	1.97	2.49	9.39	56.70
1955	2.44	7.38	7.92	4.45	4.58	4.42	3.53	4.54	4.60	2.07	4.67	5.49	56.09
1956	4.57	*10.47*	6.44	*9.71*	4.44	2.28	7.90	2.08	2.91	3.80	2.23	*10.31*	67.14
1957	10.08	8.60	*2.13*	4.55	2.45	4.80	*2.72*	1.82	*9.10*	4.16	10.07	7.40	67.88
1958	2.52	2.57	3.66	6.62	3.17	1.91	4.46	3.46	3.00	.41	3.22	*2.43*	37.43
1959	5.81	4.39	4.28	4.35	3.24	3.85	3.23	5.63	.56	4.05	5.78	5.37	50.54
1960	3.75	3.59	5.23	2.09	1.97	7.00	3.76	*10.46*	4.64	4.55	2.72	4.56	54.32
1961	*1.86*	7.88	7.33	3.61	4.39	7.16	7.06	4.02	*.41*	2.91	4.41	9.86	60.90
1962	5.93	9.01	5.88	3.94	2.64	*8.09*	4.28	2.87	6.42	3.28	5.44	3.31	61.09
1963	2.83	2.86	*9.06*	3.70	3.24	3.62	7.51	3.17	1.43	Trace	4.30	2.99	44.70
1964	4.81	4.33	6.32	7.13	2.84	*.86*	3.41	5.05	3.14	2.61	3.82	5.62	49.94
Record mean	5.87	5.88	5.93	4.15	3.51	3.73	5.14	3.84	3.30	2.54	4.66	5.90	54.45

TABLE 2.—*Monthly and annual normal precipitation at 11 stations in or near the Oak Ridge area*

[Precipitation at TVA stations is adjusted to the period 1935–59: precipitation at USWB stations is adjusted to the period 1931–60]

Station owner and station name	Mean monthly precipitation, in inches, for the 1931–60 or 1935–59 period												Annual normal
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
USWB, Kingston	5.27	5.35	5.21	4.12	3.58	3.45	4.49	4.03	2.88	2.59	3.84	4.95	49.76
TVA, Petros	6.74	6.09	5.86	4.71	4.46	4.45	5.31	4.59	3.58	3.06	4.88	6.12	59.85
TVA, near Concord	5.02	4.98	4.75	3.87	3.31	2.94	4.63	2.70	2.82	2.27	3.77	4.33	45.39
TVA, Paulette	5.20	5.08	4.94	3.89	3.83	3.74	3.97	3.17	3.08	2.27	3.88	4.36	47.41
UCNC,[1] Wheat (K-25)	6.08	6.39	6.52	4.77	4.48	4.20	5.62	4.05	3.01	3.18	3.97	5.58	57.85
UCNC,[1] near Oak Ridge (ORNL)	5.24	5.39	5.44	4.14	3.48	3.38	5.31	4.02	3.59	2.82	3.49	5.22	51.52
USWB, Oak Ridge	5.94	5.80	5.59	4.20	3.73	3.24	5.95	4.62	3.30	2.67	3.77	5.90	54.71
TVA, Clinton TVA nursery	5.82	5.57	5.41	4.38	4.21	3.56	5.12	3.41	3.43	2.66	4.40	5.16	53.13
TVA, Vasper	5.53	5.30	5.22	3.98	3.70	3.69	4.65	3.38	3.15	2.21	4.32	5.09	50.22
TVA, Norris Dam	5.51	5.15	5.31	3.82	4.01	3.53	4.13	3.69	3.13	2.36	4.03	4.77	49.44
TVA, Turley	5.58	5.05	4.91	3.57	4.76	4.92	4.52	4.34	3.21	2.45	3.93	4.54	51.78

[1] Owned by Union Carbide Nuclear Corp., operated by USWB.

TABLE 3.—*Maximum 24-hour rainfalls, in inches, by months for the years 1951–64 at the Oak Ridge station*

[Based on data collected by the U.S. Weather Bur.]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1951	2.26	2.11	2.22	1.01	0.30	0.77	1.92	0.42	1.80	1.23	1.95	2.75
1952	1.05	.31	2.80	.90	1.22	.40	2.50	1.33	.63	.65	1.38	1.05
1953	1.10	2.45	1.27	1.23	2.20	.72	1.67	.14	1.77	.53	1.04	2.65
1954	4.25	2.94	1.77	.72	1.11	1.83	3.48	.92	1.92	.89	.65	4.73
1955	.72	2.38	1.62	1.57	2.04	1.44	1.11	2.20	2.36	1.46	1.35	3.45
1956	2.77	2.71	1.59	3.74	1.68	1.11	1.63	.75	1.59	1.25	1.10	3.42
1957	2.35	1.68	.99	1.89	1.13	2.01	1.42	.94	2.61	2.04	2 97	3.20
1958	.90	.73	.78	1.00	.78	.65	1.02	1.49	1.82	.29	1.33	1.59
1959	3.21	1.25	1.90	1.06	1.19	1.48	1.02	2.77	.22	1.13	2.29	1.69
1960	.75	.84	1.60	.57	.82	1.86	2.92	7.48	2.26	1.45	1.05	1.80
1961	.61	2.55	3.02	1.33	1.44	2.42	1.57	.95	.16	1.59	1.85	2.36
1962	1.16	2.51	1.78	1.68	1.33	2.02	1.26	1.26	3.43	1.22	1.93	.94
1963	.67	1.22	3.89	2.32	1.15	.67	2.37	.79	.58	Trace	1.62	1.29
1964	1.26	1.53	2.51	1.84	.74	1.03	1.18	2.38	2.03	1.24	1.48	1.96

TABLE 4.—*Maximum duration, in days, of periods of no precipitation at the Oak Ridge station, 1949–64*

[Based on data collected by the U.S. Weather Bur.]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Beginning date
1949	11	7	6	4	5	9	10	8	11	5	10	6	11	Jan. 6; Sept. 7.
1950	2	5	6	7	3	8	4	7	8	10	6	15	15	Sept. 23; Dec. 13.
1951	4	5	3	3	11	3	6	6	7	13	7	3	13	Oct. 8.
1952	5	7	6	9	8	9	6	5	11	21	8	9	29	Oct. 11.
1953	5	4	7	6	12	5	8	13	13	26	19	6	31	Sept. 26.
1954	4	12	9	5	8	13	9	5	9	10	11	7	14	June 18; Aug. 27.
1955	10	4	6	6	9	5	5	7	12	9	5	10	14	Apr. 26.
1956	9	3	5	6	7	11	2	7	10	12	9	10	19	Nov. 22.
1957	4	6	5	8	8	4	8	9	4	9	4	6	10	June 29.
1958	12	7	6	4	7	7	4	7	9	14	6	8	14	Oct. 4.
1959	5	4	4	6	10	10	6	7	18	8	7	8	18	Sept. 11.
1960	9	4	8	12	12	7	10	8	9	7	5	5	18	Aug. 24.
1961	12	9	4	5	6	4	3	5	6	15	5	4	15	Oct. 4.
1962	4	6	7	19	12	6	15	9	7	13	5	9	19	Apr. 15.
1963	4	7	5	11	12	5	4	7	14	31	11	7	32	Sept. 30.
1964	6	4	3	9	9	11	6	4	18	10	6	5	21	Aug. 29.

TABLE 5.—*Discharge measurements made at partial-record stations in the Oak Ridge area, 1961–64*

Station No. (fig. 1)	Station Name	Location	Drainage area (sq mi)	Measurements Date	Measurements Discharge (cfs)
7	Clinch River tributary at CRM 51.1 at Oak Ridge.	Lat 36°02′21″, long 84°12′34″, at sewage-treatment plant, 3.9 miles east of intersection of State Highways 62 and 95 in Oak Ridge.	2.53	9-18-61	0.03
				2-15-62	.99
				5-29-62	.24
				12- 4-62	.28
				9-12-63	.02
				10-28-63	.06
				4-16-64	2.52
				6-23-64	.14
8	Emory Valley Creek at Oak Ridge.	Lat 36°01′27″, long 84°13′00″, at tree on left bank, 20 ft below gravel road, 250 ft southwest of intersection of Emory Valley Road and Carnegie Drive in Oak Ridge.	.85	9-18-61	.08
				12-17-61	21.3
				2-15-62	.71
				5-29-62	.10
				12- 3-62	.49
				9-12-63	.07
				10-28-63	.02
				4-17-64	.90
				6-23-64	.50
9	Bullrun Creek near Powell.	Lat 36°01′56″, long 84°05′50″, at U.S. Highway 25W bridge, 1.5 miles below Big Spring Branch, 3.8 miles west of Powell.	93.3	9-18-61	16.4
				2-16-62	142
				5-29-62	34.5
				12- 3-62	35.1
10	Scarboro Creek near Oak Ridge.	Lat 35°57′13″, long 84°12′58″, at 3-barrel pipe culvert on Bethel Valley Road, 75 ft west of intersection of State Highway 62 and Bethel Valley Road, 3.4 miles southeast of intersection of State Highways 95 and 62 in Oak Ridge.	1.13	9-18-61	0.73
				12-12-61	1.72
				12-17-61	2.78
				2-15-62	2.39
				2-23-62	46.0
				2-29-62	26.6
				5-29-62	1.31
				12- 3-62	1.19
				9-12-63	.71
				10-28-63	.56
				4-17-64	4.09
				6-24-64	.78
11	Beaver Creek at Solway.	Lat 35°57′51″, long 84°10′41″, at bridge on Solway Road, 1.1 miles southwest of Solway, 5.9 miles southeast of the intersection of State Highways 95 and 62 in Oak Ridge.	86.8	9-18-61	19.4
				2-15-62	123
				2-23-62	1,670
				4-12-62	901
				5-29-62	35.9
				12- 4-62	35.0
				3-12-63	2,300
				7-10-63	28.0
				9-12-63	14.2
				10-28-63	9.43
				4-17-64	208
				6-23-64	21.8
12	Hickory Creek near Farragut.	Lat 35°53′28″, long 84°12′23″, at wooden bridge on Yarnell Road, 1.3 miles above Grable Branch, 4 miles west of Farragut.	4.36	9-18-61	1.26
				2-15-62	6.99
				5-29-62	2.04
				12- 4-62	2.08
				9-12-63	1.45
				10-28-63	1.05
				4-17-64	10.4
				6-23-64	1.78
13	Whiteoak Creek above ORNL near Oak Ridge.	Lat 35°56′28″, long 84°18′05″, along patrol road 0.3 mile north of Bethel Valley Road, 5 miles southwest of intersection of State Highways 95 and 62 in Oak Ridge.	.80	8- 2-61	.40
				9-18-61	.24
				12-12-61	10.5
				2-15-62	1.10
				2-23-62	49.9
				2-28-62	19.5
				12- 4-62	.28
				9-12-63	.18
				10-28-63	.20
				4-17-64	2.04
14	Clinch River tributary No. 2 at CRM 19.1 near Oak Ridge.	Lat 35°54′16″, long 84°21′29″, on gravel AEC patrol road, 1.3 miles southeast of State Highway 95 and Bethel Valley Road, 0.35 mile above mouth.	.94	9-18-61	.10
				2-15-62	.92
				12- 4-62	.34
				9-12-63	.06
				10-28-63	.09
				4-17-64	1.98
				6-23-64	.07

TABLE 5.—*Discharge measurements made at partial-record stations in the Oak Ridge area, 1961–64*—Continued

Station		Location	Drainage area (sq mi)	Measurements	
No. (fig. 1)	Name			Date	Discharge (cfs)
15	Caney Creek near Kingston.	Lat 35°51′53″, long 84°23′07″, on left bank at county road, 1.5 miles above mouth, 2.4 miles northeast from intersection on U.S. Highway 70 and Buttermilk Road, 7.5 miles east of Kingston.	3.32	9-18-61	1.96
				12-17-61	119
				2-15-62	9.23
				5-29-62	2.31
				12- 4-62	5.11
				3-12-63	326
				9-12-63	1.25
				10-28-63	.94
				4-17-64	17.4
				6-23-64	1.73
16	Grassy Creek near Oak Ridge.	Lat 35°55′00″, long 84°22′13″, at AEC Patrol rifle range on gravel road 0.2 mile southwest of Bear Creek Valley Road, 1.2 miles above mouth and 2 miles west of intersection of State Highway 95 and Bear Creek Valley Road.	1.00	9-18-61	.05
				2-15-61	.45
				5-29-62	.04
				12- 4-62	.08
				9-12-63	.02
				10-28-63	[1].01
				4-17-64	.98
				6-23-64	.16
17	Poplar Creek at Batley Road near Oliver Springs.	Lat 36°01′57″, long 84°18′16″, at bridge on Batley Road, 0.8 mile east of intersection of Batley Road and State Highway 61, 2.2 miles east of Oliver Springs.	30.3	9-18-61	1.57
				2-16-62	58.8
				5-21-62	3.56
				5-29-62	4.28
				12- 3-62	19.5
				9-10-63	1.99
				10-28-63	.68
				4-17-64	80.0
				6-23-64	1.44
18	Brushy Fork at Dossett.	Lat 36°04′11″, long 84°13′40″, at bridge on county road, 1.7 miles northwest of intersection of State Highways 61 and 95, 0.5 mile northeast of Dossett.	10.2	9-18-61	2.03
				2-15-62	14.7
				2-23-62	649
				5-29-62	2.88
				12- 3-62	6.61
				9-10-63	1.66
				10-28-63	1.39
				6-23-64	2.30
20	Indian Creek at Oliver Springs.	Lat 36°02′45″, long 84°20′48″, at bridge on State Highway 61, 200 ft west of intersection of State Highways 61 and 62 at Oliver Springs.	18.4	9-18-61	.81
				2-15-62	24.2
				2-23-62	1,110
				5-29-62	2.50
				12- 3-62	12.4
				9-10-63	.56
				10-28-63	.22
				6-23-64	.58
21	East Fork Poplar Creek Tributary at Oak Ridge.	Lat 36°00′47″, long 84°15′50″, at bridge 150 ft above State Highway 95 at Oak Ridge High School and 0.4 mile east of intersection of State Highways 62 and 95.	1.14	9-18-61	.32
				2-15-62	1.50
				2-23-62	34.7
				5-29-62	.61
				12- 3-62	.53
				9-12-63	.34
				10-28-63	.32
				4-17-64	1.86
				6-23-64	1.11
				9-17-64	.29
22	Mill Branch at Oak Ridge.	Lat 35°59′46″, long 84°18′10″, at mouth at East Fork of Poplar Creek, 2.1 miles west of intersection of State Highways 62 and 95, at extension of Bermuda Road at Oak Ridge.	1.78	9-18-61	0.32
				2-15-62	2.08
				6- 1-62	.38
				12- 3-62	.64
				9-12-63	.34
				10-28-63	.17
				4-17-64	3.50
				6-23-64	.32
				9-17-64	.16
23	Gum Hollow Branch at Oak Ridge.	Lat 35°58′31″, long 84°20′08″, at pipe culvert at 11th hole of Oak Ridge Golf Course, 4.4 miles west of intersection of State Highways 62 and 95 in Oak Ridge.	2.40	9-18-61	.33
				2-15-62	2.61
				6- 1-62	.48
				12- 3-62	.82
				9-12-63	.21
				10-28-63	.15
				4-17-64	4.06
				6-23-64	.56
				9-17-64	.13

See footnote at end of table.

TABLE 5.—*Discharge measurements made at partial-record stations in the Oak Ridge area, 1961–64*—Continued

Station		Location	Drainage area (sq mi)	Measurements	
No. (fig. 1)	Name			Date	Discharge (cfs)
24	Bear Creek at county line near Oak Ridge.	Lat 35°57′26″, long 84°18′03″, at double box culvert on Bear Creek Valley Road, at the Anderson County line, 4 miles southwest of intersection of State Highways 62 and 95 in Oak Ridge.	1.57	9-18-61	.13
				12-21-61	17.9
				2-15-62	1.08
				5-29-62	.09
				12- 3-62	.34
				3-12-63	85.8
				9-12-63	.11
				10-28-63	.04
				4-17-64	2.57
				6-24-64	.20
25	Bear Creek at Highway 95 near Oak Ridge.	Lat 35°56′17″, long 84°20′29″, at bridge on State Highway 95, in triangle formed by intersection of Highway 95 and Bear Creek Valley Road near Oak Ridge.	4.26	9-18-61	.96
				2-15-62	5.58
				4-11-62	162
				5-29-62	1.17
				12- 3-62	1.83
				3-12-63	233
				9-12-63	.62
				10-28-63	.53
				4-17-64	9.51
				6-24-64	1.12

[1] Est.

TABLE 6.—*Peak stages at partial-record sites equipped with crest-stage gages in the Oak Ridge area, 1961–64*

[Elevation of zero of gage is 0.00 ft arbitrary datum]

Station		Peak stage (feet)	Probable date
No. (fig. 1)	Name		
5b	East Fork Poplar Creek at Tuskeegee Drive (upstream gage)	9.46	8-23-61
5c	East Fork Poplar Creek at Vanderbilt Drive	8.15	3-12-63
5d	East Fork Poplar Creek at Wiltshire Drive	6.99	3-12-63
8	Emory Valley Creek	3.94	6-12-62
10	Scarboro Creek	4.99	3-12-63
11	Beaver Creek	12.78	3-12-63
13	Whiteoak Creek above ORNL	4.06	6-27-62
15	Caney Creek	6.56	3-12-63
18	Brushy Fork	11.68	3-12-63
19	Poplar Creek near Oliver Springs	16.31	3-12-63
20	Indian Creek	13.06	3-12-63
21	East Fork Poplar Creek tributary	3.64	3-12-63
24	Bear Creek at county line	5.29	3-12-63
25	Bear Creek at State Highway 95	4.88	3-12-63

TABLE 7.—*Duration of daily flow at partial-record sites, adjusted to reference period*

Station		Daily flow (in cfs) for indicated duration, in percentage of time					
No. (fig. 1)	Name	90	80	70	60	50	40
17	Poplar Creek at Batley Road near Oliver Springs.	1.10	1.70	2.50	4.10	8.10	12.0
18	Brushy Fork at Dossett	1.60	2.00	2.80	3.90	5.60	8.40
20	Indian Creek at Oliver Springs	.64	1.05	1.80	3.00	5.20	9.00
21	Tributary to East Fork Poplar Creek	.37	.44	.52	.64	.78	.96
22	Mill Branch	.27	.34	.45	.60	.84	1.20
23	Gum Hollow Branch	.23	.29	.40	.55	.79	1.15
24	Bear Creek at county line near Oak Ridge.	.07	.09	.14	.21	.33	.54
25	Bear Creek at State Highway 95 near Oak Ridge.	.45	.70	1.10	1.65	2.50	3.75
7	Clinch River tributary at CRM 51.1 at Oak Ridge	.06	.09	.14	.22	.35	.58
8	Emory Valley Creek at Oak Ridge	.04	.06	.09	.14	.22	.36
10	Scarboro Creek near Oak Ridge	.68	.78	.92	1.10	1.30	1.55
11	Beaver Creek at Solway	13.0	17.0	23.0	32.0	45.0	66.0
12	Hickory Creek near Farragut	1.20	1.50	1.90	2.35	3.10	4.10
14	Clinch River tributary No. 2 at CRM 19.1 near Oak Ridge	.06	.10	.16	.25	.39	.60
15	Caney Creek near Kingston	1.20	1.60	2.10	2.80	4.00	5.60
16	Grassy Creek near Oak Ridge	.03	.05	.08	.12	.17	.26

TABLE 8.—*Magnitude and frequency of annual minimum flow at stream-gaging sites (exclusive of Whiteoak Creek basin), adjusted to the reference period*

Station		Recurrence interval, in years	Lowest mean discharge (in cfs) for consecutive days indicated, in year beginning April 1						
No. (fig. 1)	Name		1	3	7	14	30	60	90
4	Poplar Creek near Oak Ridge	2	9.0	9.0	10.0	10.0	13.0	15.0	18.0
		10	7.0	7.0	7.0	8.0	9.0	10.0	12.0
17	Poplar Creek at Batley Road near Oliver Springs.	2	.75	------	.75	------	------	------	------
		10	.30	------	.40	------	------	------	------
18	Brushy Fork at Dossett	2	1.25	------	1.25	------	------	------	------
		10	.80	------	.88	------	------	------	------
20	Indian Creek at Oliver Springs	2	.42	------	.42	------	------	------	------
		10	.17	------	.21	------	------	------	------
5 [a]	East Fork Poplar Creek	2	2.3	2.3	2.3	2.4	2.6	3.0	3.4
		10	1.6	1.6	1.7	1.8	1.8	3.2	3.4
21	Tributary to East Fork Poplar Creek at Oak Ridge.	2	.33	------	.33	------	------	------	------
		10	.25	------	.26	------	------	------	------
22	Mill Branch at Oak Ridge	2	.23	------	.23	------	------	------	------
		10	.15	------	.16	------	------	------	------
23	Gum Hollow Branch at Oak Ridge.	2	.18	------	.18	------	------	------	------
		10	.12	------	.13	------	------	------	------
6	Bear Creek near Oak Ridge	2	0.7	0.7	0.7	0.7	0.7	0.8	0.9
		10	.6	.6	.6	.6	.6	.7	.7
24	Bear Creek at county line near Oak Ridge.	2	.05	------	.05	------	------	------	------
		10	.02	------	.03	------	------	------	------
25	Bear Creek at State Highway 95 near Oak Ridge.	2	.3	------	.3	------	------	------	------
		10	.05	------	.10	------	------	------	------
7	Clinch River tributary at CRM 51.1 at Oak Ridge.	2	.14	------	.04	------	------	------	------
		10	.01	------	.02	------	------	------	------
8	Emory Valley Creek at Oak Ridge.	2	.02	------	.01	------	------	------	------
		10	.0	------	.01	------	------	------	------
10	Scarboro Creek near Oak Ridge	2	.61	------	.61	------	------	------	------
		10	.49	------	.51	------	------	------	------
11	Beaver Creek at Solway	2	11.0	------	11.0	------	------	------	------
		10	7.0	------	7.6	------	------	------	------
12	Hickory Creek near Farragut	2	1.0	------	1.0	------	------	------	------
		10	.68	------	.74	------	------	------	------
14	Clinch River tributary No. 2 at CRM 19.1 Oak Ridge.	2	.15	------	.15	------	------	------	------
		10	.0	------	.0	------	------	------	------
15	Caney Creek near Kingston	2	1.0	------	1.0	------	------	------	------
		10	.68	------	.73	------	------	------	------
16	Grassy Creek near Oak Ridge	2	.01	------	.01	------	------	------	------
		10	.0	------	.05	------	------	------	------

[a] Adjusted for waste-water discharges.

TABLE 9.—*Estimated quarterly runoff and mean annual runoff at gaging sites during the reference period*

Station		Estimated quarterly runoff during the water years 1936-60								Mean annual discharge, in cubic feet per second	
		Oct.-Dec.		Jan.-Mar.		Apr.-June		July-Sept.			
No. (fig. 1)	Name	Inches	Cubic feet per second	Inches	Cubic feet per second	Inches	Cubic feet per second	Inches	Cubic feet per second	1961-64	Estimated 1936-60
7	Clinch River tributary at CRM 51.1 at Oak Ridge	4.1	3.1	11.9	9.0	5.6	4.2	2.7	2.0		4.6
8	Emory Valley Creek at Oak Ridge	4.1	1.0	11.8	3.0	5.5	1.4	2.6	.6		1.5
10	Scarboro Creek near Oak Ridge	4.0	1.3	11.6	3.9	5.4	1.8	2.6	.9		2.0
11	Beaver Creek near Solway	3.7	95	10.6	276	5.0	128	2.4	62		140
12	Hickory Creek near Farragut	3.7	4.8	10.6	14	5.0	6.5	2.4	2.1		71
14	Clinch River tributary No. 2 at CRM 19.1 near Oak Ridge.	4.1	1.1	11.7	3.3	5.5	1.5	2.6	.7		1.7
15	Caney Creek near Kingston	3.9	3.8	11.1	11	5.2	5.1	2.5	2.5		5.6
16	Grassy Creek near Oak Ridge	4.2	1.2	12.2	3.7	5.7	1.7	2.7	.8		1.9
17	Poplar Creek at Batley Road near Oliver Springs	4.2	38	12.2	111	5.7	52	2.7	24		57
18	Brushy Fork at Dossett	4.2	13	12.0	37	5.6	17	2.7	8.0		19
20	Indian Creek at Oliver Springs	4.4	24	12.7	70	6.0	33	2.8	15		35
4	Poplar Creek near Oak Ridge	3.7	90	12.9	319	6.0	147	2.6	64	167	153
21	Tributary to East Fork Poplar Creek at Oak Ridge	4.2	1.4	12.0	4.1	5.6	1.9	2.7	0.9		2.1
22	Mill Branch near Oak Ridge	4.1	2.2	11.8	6.3	5.5	2.9	2.6	1.4		3.2
23	Gum Hollow Branch near Oak Ridge	4.0	2.8	11.6	8.4	5.5	3.9	2.6	1.8		4.2
5	East Fork Poplar Creek near Oak Ridge	4.0	23	10.0	59	5.1	29	2.6	15	31.0	31
24	Bear Creek at county line near Oak Ridge	4.0	1.9	10.6	5.0	5.3	2.5	2.7	1.2		2.7
25	Bear Creek at State Highway 95 near Oak Ridge	4.0	5.0	10.6	14	5.3	6.7	2.7	3.4		7.3
6	Bear Creek near Oak Ridge	3.5	7.4	10.4	22	4.4	9.4	2.1	4.4	12.2	10.7

TABLE 10.—*Geologic composition, as percentage of surface area, of small basins in Oak Ridge area*

Basin	Rome Formation and Conasauga Group	Knox Dolomite	Chickamauga Limestone	Late Ordovician to Mississippian age	Pottsville age
Clinch River tributary at CRM 51.1		50	50		
Emory Valley Creek			100		
Bullrun Creek	44	25	31		
Scarboro Creek	38	62			
Beaver Creek	21	41	38		
Hickory Creek	60	15	25		
Whiteoak Creek	44	30	26		
Melton Branch	95	5			
Whiteoak Creek above ORNL		100			
Clinch River tributary No. 2		94	6		
Caney Creek		100			
Grassy Creek	76	24			
Poplar Creek	35	5	5		55
Poplar Creek at Batley Road	7				93
Brushy Fork	49	18	31		
Indian Creek					100
East Fork Poplar Creek	26	25	32	16	
Tributary to East Fork Poplar Creek		78	22		
Mill Branch	41		9	50	
Gum Hollow Branch	44		20	36	
Bear Creek	74	26			
Bear Creek at county line	78	22			
Bear Creek at Highway 95	66	34			

TABLE 11.—*Chemical composition of small streams*

[Concentrations in parts per million; specific conductance in micromhos at 25° C. Leaders indicate constituent not sought. Fe and Mn in solution when analyzed.]

Date of collection	Discharge	SiO_2	Al	Fe	Mn	Ca	Mg	Na	K	Li	HCO_3	CO_3	SO_4	Cl	F	NO_3	PO_4	Dissolved solids residue	Ca-Mg hardness		Specific conductance	pH	Detergent
																			Total	Noncarbonate			
9. Bullrun Creek near Powell																							
9-18-61	16.4	7.4	------	0.21	0.04	45	16	1.1	1.4	------	207	0	4.8	1.7	0.1	0.8	0.0	178	178	8	320	7.7	0.1
2-16-62	142	6.6	0.1	.01	.00	41	9.4	1.3	1.3	0.1	157	0	7.0	1.4	.2	1.7	.0	147	141	12	279	7.7	.0
5-29-62	34.5	7.2	.1	.00	.00	44	12	1.5	1.8	.1	188	0	5.8	1.7	.1	2.0	.0	167	162	8	292	7.4	.1
12- 3-62	35.1	6.1	.1	.01	.01	45	14	1.3	1.3	.2	196	0	8.4	2.6	.1	1.2	.0	182	172	11	312	7.9	.1
11. Beaver Creek at Solway																							
9-18-61	19.4	6.8	------	0.07	0.02	43	13	5.0	2.1	------	170	0	14	8.0	0.1	4.3	0.0	182	162	23	327	7.4	0.1
2-15-62	123	6.8	0.1	.00	.00	36	8.2	2.2	1.3	0.0	134	0	8.4	3.6	.2	4.2	.0	140	124	14	254	7.3	.1
5-29-62	35.9	7.0	.1	.00	.00	39	11	2.4	2.1	.0	152	0	12	3.2	.1	6.6	.0	161	142	18	277	7.1	.1
12- 3-62	35.0	5.8	.1	.00	.00	44	10	2.6	1.3	.1	175	0	8.4	5.2	.0	4.7	.1	170	154	11	296	8.1	.1
9-12-63	14.2	7.0	.0	.01	.01	34	18	5.5	2.2	.0	185	0	3.6	6.2	.4	2.3	.1	166	156	4	310	7.8	.1
10-31-63	9.43	5.0	.1	.03	.00	41	15	3.7	2.2	.0	193	0	6.0	4.1	.0	.1	.0	172	165	7	298	7.7	.2
4-17-64	208	5.7	.0	.00	.00	31	7.0	2.0	1.2	.0	121	0	7.4	2.5	.0	3.1	.0	120	106	8	210	7.3	--------
6-23-64	21.8	6.7	.1	.00	.00	34	15	2.8	1.5	.0	176	0	5.0	2.4	.0	1.5	.1	159	148	4	302	8.2	--------
12. Hickory Creek near Farragut																							
9-18-61	1.26	8.1	------	0.04	0.02	46	14	1.7	1.7	------	198	0	9.2	2.8	0.1	0.8	0.0	184	174	12	325	7.4	0.1
2-15-62	6.09	7.2	0.0	.01	.00	33	12	1.3	1.3	0.2	147	0	7.3	3.7	.1	.6	.0	139	132	12	253	7.3	.0
5-29-62	2.04	7.1	.1	.08	.01	37	17	1.4	1.3	.1	181	0	7.2	5.6	.1	.3	.0	166	162	14	290	7.4	.0
12- 4-62	2.08	6.5	.1	.01	.01	48	11	1.5	1.4	.1	184	0	13	2.9	.1	.9	.0	179	162	16	309	8.1	.0
9-12-63	1.45	7.8	.0	.00	.00	30	24	1.6	1.8	.0	196	0	8.6	1.0	.1	.1	.0	170	172	12	310	8.1	.0
10-31-63	1.05	8.1	.0	.02	.00	45	15	1.7	1.7	.0	198	0	11	1.5	.1	.2	.0	179	176	14	310	7.8	.2
4-17-64	10.4	6.8	.0	.01	.00	34	9.0	1.4	1.4	.0	140	0	7.8	1.1	.0	1.1	.0	132	121	6	232	7.8	--------
6-23-64	1.78	8.3	.1	.00	.00	35	17	1.2	1.5	.0	186	0	7.8	1.4	.0	.0	.0	170	159	6	318	8.2	--------

15. Caney Creek near Kingston

9-18-61	2.0	7.5	...	0.04	0.02	37	17	1.0	1.0	...	189	0	1.8	2.8	0.1	3.2	0.0	164	162	8	299	8.0	0.1
2-15-62	9.23	7.3	0.0	.00	.00	28	11	1.0	.9	0.1	128	0	3.6	1.7	.0	.8	.1	117	112	7	221	7.8	.0
5-29-62	2.31	7.6	.1	.00	.00	35	16	1.4	1.0	.0	181	0	2.2	1.0	.1	.8	.0	151	154	6	271	7.7	.1
12- 4-62	5.11	6.2	.1	.00	.01	30	14	1.0	.7	.1	150	0	7.8	2.4	.1	1.5	.0	135	131	8	239	7.9	.0
9-12-63	1.25	7.7	.0	.00	.00	37	19	0.9	.9	.0	196	0	2.2	0.8	.0	.6	.0	151	168	8	295	8.1	.0
10-31-63	0.94	5.3	.1	.01	.00	48	16	3.6	3.3	.0	218	0	6.8	4.3	.1	.1	.0	191	187	8	338	7.5	.1
4-17-64	17.4	6.5	.0	.01	.00	23	9.7	1.1	.8	.0	114	0	4.6	.5	.0	1.3	.0	104	96	3	185	7.3	...
6-23-64	1.73	7.7	.1	.00	.00	31	19	0.8	1.1	.0	182	0	2.8	1.0	.1	.8	.0	157	155	6	301	8.2	...

7. Cliuch River tributary at CRM 51.1

9-18-61	0.03	3.3	...	0.02	0.05	81	6.2	7.9	1.6	...	242	0	25	13	0.2	0.3	0.2	268	227	28	440	7.7	0.7
2-15-62	1.00	3.5	0.0	.01	.00	81	8.0	3.6	.8	.2	247	0	24	6.4	.2	.8	.2	252	236	33	442	7.3	.1
5-29-62	.240	4.6	.1	.01	.00	70	6.3	4.7	2.0	.1	217	0	28	6.0	.1	.5	.0	241	200	22	400	7.3	.2
12- 4-62	.285	3.1	.1	.00	.01	90	9.2	5.0	.8	.1	284	0	30	7.4	.1	.0	.0	246	262	30	493	7.9	.1
9-12-63	.02	2.8	.0	.01	.00	62	17	7.6	2.3	.0	248	0	24	6.6	.1	.1	.1	252	226	22	435	8.0	.2
4-17-64	2.52	3.6	.1	.02	.00	65	5.5	2.8	1.0	.0	204	0	18	3.2	.2	.5	.0	203	186	19	350	7.6	...
6-23-64	.142	3.0	.1	.00	.00	65	5.3	7.2	1.4	.0	200	0	23	7.4	4.3	.0	.0	217	184	20	380	7.8	...

8. Emory Valley Creek at Oak Ridge

9-18-61	0.1	5.4	...	0.03	0.02	64	6.7	2.6	0.7	...	221	0	10	3.0	0.3	0.3	0.0	183	188	8	357	7.9	0.1
2-15-62	.71	5.8	0.1	.01	.00	68	3.2	1.0	.6	0.1	213	0	12	2.2	.1	.1	.0	188	182	8	367	7.8	.1
5-29-62	.104	5.8	.1	.02	.00	66	7.5	4.8	1.3	.0	218	0	14	4.2	.2	.3	.4	214	197	18	370	7.1	.2
12- 3-62	.486	5.2	.1	.00	.01	42	27	1.2	.7	.2	248	0	14	3.1	.1	1.6	.0	195	219	16	367	7.9	.1
9-12-63	.07	5.8	.0	.01	.00	58	9.6	2.1	1.2	.0	228	0	8.4	2.2	.1	.2	.0	200	185	0	360	7.9	.0
10-31-63	.02	6.9	.1	.03	.00	69	12	2.9	1.5	.0	252	0	10	3.2	.1	.1	.0	...	220	14	380	8.2	...
4-17-64	.90	5.1	.0	.00	.00	65	5.2	1.4	.8	.0	207	0	12	2.0	.1	.6	.0	194	184	14	335	7.9	...
6-23-64	[1].5	6.3	.1	.00	.00	46	9.9	1.5	.9	.0	187	0	5.4	1.6	.1	.2	.0	186	155	2	348	8.1	...

10. Scarboro Creek near Oak Ridge

9-18-61	0.729	8.2	...	0.02	0.04	38	17	0.5	0.7	...	193	0	2.8	1.1	0.1	1.2	0.0	166	166	8	302	7.9	0.0
2-15-62	2.39	8.0	0.1	.00	.00	33	13	.6	.9	0.1	158	0	4.0	.9	.0	.1	.0	137	137	8	262	7.7	.1
5-29-62	1.31	6.7	.0	.03	.00	34	17	1.2	.9	.1	186	0	1.2	2.5	.1	.0	.0	153	156	4	287	7.5	.0
12- 3-62	1.19	7.1	.1	.00	.00	36	20	.4	.7	.1	200	0	4.2	2.9	.0	1.3	.0	171	173	9	310	8.1	.0
9-12-63	.70	8.2	.0	.00	.00	42	18	.9	.9	.0	208	0	2.6	.8	.1	.3	.0	166	178	8	312	8.0	.0
10-31-63	.56	8.1	.0	.01	.00	39	20	1.2	.8	.0	205	0	5.6	1.3	.0	.5	.0	170	178	10	301	7.9	.1
4-17-64	4.39	7.0	.1	.01	.00	28	12	.9	.8	.0	140	0	4.0	1.4	.0	1.1	.0	124	119	4	222	7.6	...

See footnotes at end of table.

TABLE 11.—*Chemical composition of small streams*—Continued

Date of collection	Discharge	SiO_2	Al	Fe	Mn	Ca	Mg	Na	K	Li	HCO_3	CO_3	SO_4	Cl	F	NO_3	PO_4	Dissolved solids residue	Ca-Mg hardness: Total	Ca-Mg hardness: Noncarbonate	Specific conductance	pH	Detergent
14. Clinch River tributary No. 2 near Oak Ridge																							
9-18-61	0.1	7.8	------	0.04	0.02	31	14	0.5	0.5	------	158	0	3.4	0.7	0.1	0.2	0.0	135	136	6	240	7.8	0.2
2-15-62	.92	6.6	0.1	.02	.00	17	6.3	.4	.4	0.2	78	0	2.6	1.3	.1	.1	.0	76	68	4	150	7.7	.0
12-4-62	.340	6.6	.1	.01	.01	21	9.5	.4	.2	.0	105	0	2.6	1.1	.0	.1	.0	98	92	6	168	7.9	.1
9-12-63	.06	7.3	.0	.00	.00	36	14	.9	.6	.0	172	0	1.8	.4	.0	.0	.0	136	146	6	260	8.0	.0
10-31-63	.09	7.3	.0	.01	.00	32	15	1.2	.7	.0	168	0	4.4	.9	.0	.1	.0	141	144	7	249	7.9	.1
4-17-64	1.98	6.1	.0	.00	.00	15	4.9	.6	.4	.0	67	0	4.4	.7	.0	.5	.0	66	56	2	110	7.6	------
6-23-64	.07	7.8	.1	.00	.00	32	13	.8	.6	.0	163	0	2.2	.4	.0	.1	.0	142	135	2	268	8.0	------
16. Grassy Creek near Oak Ridge																							
9-18-61	0.05	12	------	0.06	0.02	33	7.7	4.8	1.6	------	139	0	5.0	1.2	0.1	0.7	0.0	131	112	0	230	7.5	0.0
2-15-62	.45	8.2	0.0	.04	.01	19	5.6	2.1	1.2	0.2	78	0	6.8	1.9	.0	.0	.0	85	70	6	142	7.6	.0
5-29-62	.04	13	.1	.00	.00	28	6.5	4.5	2.8	.0	126	0	4.6	1.1	.1	.0	.0	122	98	0	207	7.4	.1
12-4-62	.079	9.7	.1	.00	.00	29	6.4	4.0	1.3	.1	118	0	8.8	1.7	.1	.9	.0	120	100	3	202	7.7	.0
9-12-63	.02	9.5	.0	.01	.00	34	10	5.1	2.2	.0	159	0	4.6	0.4	.0	.1	.0	140	128	0	250	8.0	.1
4-17-64	.891	7.0	.0	.01	.00	17	3.6	1.7	1.2	.0	68	0	7.8	.7	.0	.4	.0	72	58	3	123	7.7	------
6-23-64	.16	10	.1	.00	.00	30	9.5	4.8	2.0	.0	147	0	4.2	.6	.2	.0	.0	138	114	0	242	8.0	------
5a. East Fork Poplar Creek at Bear Creek Valley Road																							
9-18-61	12.3	3.4	------	0.00	0.00	22	1.8	144	1.9	------	0	[2]88	22	78	1.0	124	0.2	524	62	0	809	10.7	0.4
2-15-62	14.1	7.2	0.1	.01	.01	34	7.8	50	2.2	0.7	109	25	25	37	1.3	20	1.1	267	118	0	463	9.0	.4
5-29-62	16.8	4.7	.5	.00	.01	32	8.8	40	3.5	.6	148	0	21	23	3.0	44	1.5	254	118	0	425	7.9	1.0
12-3-62	11.2	3.8	.3	.01	.01	38	12	35	1.7	.6	142	0	36	38	1.1	14	.3	260	143	26	434	8.0	.3
10-30-63	12.7	4.2	.1	.02	.00	35	8.9	10	1.7	.0	123	0	25	6.3	0.8	5	.4	158	124	23	265	7.2	.2
4-17-64	15.0	5.1	.0	.00	.00	36	9.0	25	3.5	.1	121	0	44	18	1.4	18	.1	223	127	28	368	7.3	------
6-23-64	13.2	4.5	.3	.06	.04	33	8.3	34	2.0	.2	134	0	27	27	.8	18	.3	222	118	8	403	8.0	------

5b. East Fork Poplar Creek at Tuskeegee Drive

9-18-61	16.0	5.2	------	0.04	0.00	31	9.1	80	1.6	------	95	41	25	73	1.3	18	0.5	350	114	36	574	9.5	0.2
2-15-61	18.2	5.3	0.2	.03	.02	92	21	47	3.4	0.7	116	0	263	25	.8	19	.0	535	319	224	828	7.3	.2
5-29-62	19.0	5.0	.2	.00	.2	31	8.5	31	2.4	.2	161	0	21	18	.8	0	.1	196	113	0	343	7.2	.2
12-3-62	16.1	5.1	.4	.02	.02	39	10	40	2.9	.8	138	10	38	42	5.0	8	.7	279	98	0	483	8.6	.3
9-12-63	14.8	6.6	.0	.00	.00	31	8.4	33	2.4	.0	135	0	26	29	.8	6	1.4	211	112	2	370	8.1	.1
6-23-64	15.5	3.9	.4	.03	.03	32	9.5	31	2.1	.2	132	0	30	24	.8	16	.1	220	120	12	396	8.1	--------

5c. East Fork Poplar Creek at East Vanderbilt Drive

9-18-61	14.4	6.4	------	0.01	0.00	32	8.6	87	1.6	------	89	52	33	72	1.0	13	0.5	358	116	44	608	9.7	0.3
2-15-62	18.2	6.1	0.6	.22	.04	97	26	44	3.3	0.6	96	0	300	25	.6	17	.1	572	350	272	838	7.1	.4
5-29-62	15.4	5.1	.2	.05	.03	35	9.0	41	2.7	.5	149	0	24	27	2.8	31	.4	259	126	4	429	7.0	.6
12-3-62	13.2	4.5	.3	.01	.00	43	12	30	2.0	.5	135	0	51	33	1.0	13	.3	256	158	46	449	7.8	.2
9-12-63	15.4	6.3	.0	.00	.00	33	8.3	33	2.4	.0	136	0	24	29	.8	5	1.1	207	115	4	370	7.9	.2
4-17-64	18.9	5.1	.0	.00	.00	37	9.5	20	3.3	.1	123	0	42	15	1.0	15	.0	211	132	31	352	7.3	--------
6-23-64	18.1	4.2	.3	.00	.00	33	9.4	31	2.2	.2	137	0	28	25	.7	17	.2	222	122	10	393	8.1	--------

21. East Fork Poplar Creek tributary at Oak Ridge

9-18-61	0.3	7.0	------	0.06	0.01	34	13	1.4	0.7	------	161	0	5.6	2.6	0.1	1.3	0.0	136	138	6	260	7.8	0.1
2-15-62	1.50	6.9	0.0	.00	.00	33	10	1.4	.6	0.1	140	0	5.0	3.1	.1	3.4	.0	134	126	12	246	7.7	.0
5-29-62	.61	7.1	.1	.01	.00	37	11	23	1.1	.0	174	0	6.4	25	.2	3.3	.0	203	140	0	356	7.3	.0
12-3-62	.532	7.5	.1	.00	.01	39	12	1.5	.7	.0	163	0	5.6	3.2	.0	3.3	.0	154	146	12	270	7.6	.1
9-12-63	.34	7.6	.0	.00	.00	38	13	32	1.1	.0	164	0	4.8	53	.0	2.1	.0	240	150	15	440	8.0	.1
4-17-64	1.86	7.6	.0	.00	.00	33	8.8	1.6	.7	.0	134	0	7.6	2.7	.1	2.9	.0	130	118	8	226	7.6	--------
6-23-64	1.11	7.4	.1	.00	.00	32	15	38	1.8	.0	159	0	7.0	55	.1	4.3	.1	241	142	12	464	8.2	--------

5d. East Fork Poplar Creek at Wiltshire Drive

9-18-61	14.7	3.6	------	0.01	0.01	47	14	83	1.9	------	136	5	26	71	4.6	126	0.1	463	176	64	727	8.5	0.2
12-3-62	15.8	4.6	0.2	.02	.01	36	15	29	1.6	0.6	154	0	30	33	.9	8.5	.3	239	150	24	422	7.9	.2
10-30-63	13.5	3.6	.1	.03	.00	36	9.8	10	1.5	.0	131	0	29	6.9	.6	1.5	.1	163	131	24	275	7.2	.2
4-17-64	26.4	5.3	.0	.00	.00	40	8.6	15	2.8	.1	128	0	36	11	1.0	17	.0	200	136	32	330	7.3	--------
6-23-64	15.6	4.2	.2	.00	.00	35	9.7	25	2.3	.2	134	0	27	23	.8	16	.1	222	128	18	398	8.0	--------

See footnotes at end of table.

TABLE 11.—*Chemical composition of small streams*—Continued

Date of collection	Discharge	SiO_2	Al	Fe	Mn	Ca	Mg	Na	K	Li	HCO_3	CO_3	SO_4	Cl	F	NO_3	PO_4	Dissolved solids residue	Ca-Mg hardness		Specific conductance	pH	Detergent
																			Total	Noncarbonate			
22. Mill Branch at Oak Ridge																							
9-18-61	0.3	13	------	0.04	0.02	48	9.9	4.4	2.5	------	176	0	18	5.0	0.1	0.1	0.0	186	162	18	309	7.8	0.2
2-15-62	2.08	8.4	0.1	.02	.01	25	4.8	2.2	1.8	0.1	87	0	13	2.5	.2	.1	.0	103	84	12	183	7.4	.0
6- 1-62	.385	11	.1	.05	.01	41	9.4	4.6	2.8	.2	162	0	9.2	6.5	.1	.0	.0	170	142	10	282	7.5	.0
12- 3-62	.637	9.1	.1	.01	.01	41	7.3	2.7	1.9	.1	144	0	17	3.7	.1	1.0	.0	152	134	16	261	7.7	.0
9-12-63	.34	13	.0	.01	.00	43	14	5.6	3.1	.0	184	0	18	5.0	.1	.2	.0	186	166	16	330	7.9	.0
10-31-63	.17	14	.0	.02	.00	46	12	5.4	2.8	.0	181	0	19	3.5	.1	.1	.0	190	163	14	306	7.7	.1
4-17-64	3.50	7.7	.0	.00	.00	22	3.5	2.2	1.8	.0	72	0	14	2.5	.1	1.2	.0	92	68	10	149	7.4	--------
6-23-64	.32	13	.1	.00	.00	50	11	6.1	4.0	.0	182	0	23	6.8	.0	3.8	.0	213	168	18	365	7.8	--------
23. Gum Hollow Branch at Oak Ridge																							
9-18-61	0.3	9.9	------	0.05	0.01	40	6.2	2.0	1.4	------	139	0	12	0.7	0.2	0.1	0.0	141	126	12	250	7.7	0.2
2-15-62	2.61	8.3	0.1	.03	.00	21	4.5	1.4	1.2	0.2	76	0	10	1.0	.1	.1	.0	88	72	9	150	7.4	.0
6- 1-62	.48	9.9	.1	.01	.00	33	6.3	1.6	1.4	.0	118	0	13	.7	.2	.1	.0	126	110	13	211	7.4	.0
12- 3-62	.821	8.5	.1	.01	.01	35	7.5	1.0	1.1	.2	131	0	12	1.0	.1	.4	.0	130	118	11	227	8.1	.1
9-12-63	.21	9.7	.1	.00	.00	43	7.2	2.7	1.1	.0	153	0	14	.4	.1	.0	.0	149	138	12	260	7.8	.0
10-31-63	.15	10	.1	.02	.00	42	8.5	2.5	1.5	.0	152	0	15	1.1	.0	.1	.0	158	140	15	258	7.8	--------
4-17-64	4.06	7.6	.0	.00	.00	16	3.0	1.3	1.2	.0	56	0	9.8	.8	.2	1.0	.0	69	52	6	110	7.4	--------
6-23-64	.56	9.5	.1	.01	.00	39	5.8	2.2	1.4	.0	134	0	14	1.4	.1	.1	.0	145	123	13	252	8.1	--------
5. East Fork Poplar Creek near Oak Ridge (at gage)																							
9-19-61	19.7	6.8	------	0.10	0.02	44	12	62	3.0	------	152	0	22	65	2.2	64	2.1	366	160	36	620	6.9	1.3
2-15-62	42.0	7.2	0.1	.02	.00	36	8.0	24	2.5	0.7	142	0	19	18	.7	14	1.8	206	124	8	360	7.0	.6
2-15-62	43.0	7.2	.1	.01	.00	44	8.6	21	2.0	.3	142	0	45	17	.4	4.9	.7	222	146	30	395	7.1	.4
12-3-62	22.5	6.0	.1	.00	.01	42	16	28	2.7	.5	145	0	28	44	.9	26	2.6	273	172	52	470	7.0	.5
9-12-63	21.3	7.7	.0	.01	.00	35	8.7	22	3.6	.0	129	0	26	16	.9	13	4.6	193	122	16	340	7.4	.5
4-17-64	56	5.7	.0	.01	.01	36	6.8	7.8	2.1	.1	113	0	22	6.6	.5	10	.6	158	117	24	216	7.2	--------
6-23-64	23	5.0	.1	.01	.00	38	9.6	17	2.7	.1	131	0	26	17	.6	12	3.7	203	134	26	351	7.3	--------

24. Bear Creek at County line near Oak Ridge

9-18-61	0.132	7.7	------	0.01	0.2	89	16	7.4	2.5	------	202	0	38	7.1	0.8	106	0.0	379	286	120	598	7.9	0.3
2-15-62	1.03	7.6	0.3	.00	.02	55	12	5.3	2.0	0.3	110	0	41	5.1	.5	68	.0	256	188	98	398	7.9	.2
5-29-62	.088	6.3	.1	.00	.00	92	20	10	3.2	.4	121	0	26	6.3	1.2	236	.0	526	312	212	682	7.0	.5
12-3-62	.335	6.6	.3	.00	.4	103	20	11	3.0	.7	161	0	66	11	.8	182	.0	516	341	209	736	7.7	.4
9-12-63	.11	6.0	.0	.01	.00	48	20	6.5	1.8	.0	172	0	24	4.0	.9	52	.0	234	204	63	410	7.8	.2
4-17-64	2.57	6.4	.1	.00	.00	41	9.3	6.9	4.4	1.0	92	0	31	11	.7	50	.1	231	142	67	341	8.0	--------
6-24-64	1.2	6.3	.1	.00	.00	50	20	6.8	2.0	.5	176	0	31	9.2	.6	39	.0	275	206	62	450	8.1	--------

25. Bear Creek at State Highway 95 near Oak Ridge

9-18-61	1.0	7.5	------	0.04	0.02	53	16	2.2	1.2	------	202	0	13	2.7	0.2	24	0.0	223	197	32	367	7.8	0.0
2-15-62	5.58	6.8	0.0	.00	.01	35	10	1.7	1.0	0.1	122	0	14	1.8	.2	18	.1	148	130	30	274	7.6	.0
5-29-62	1.17	6.7	.1	.01	.00	44	18	2.0	1.1	.0	177	0	10	2.2	.3	35	.0	210	184	38	346	7.5	.1
12-3-62	1.83	6.7	.1	.00	.02	56	12	3.4	1.2	.1	166	0	20	3.5	.3	46	.0	227	190	54	390	7.8	.1
9-12-63	.62	7.0	.0	.00	.00	41	23	2.5	1.3	.0	206	0	9.2	2.4	.1	21	.0	199	198	28	365	7.9	.1
4-17-64	9.51	6.5	.2	.00	.00	28	8.3	2.0	1.1	1.1	103	0	12	2.5	.2	18	.0	130	106	21	214	7.5	--------
6-24-64	1.12	6.7	.1	.00	.00	42	18	2.4	1.1	.0	188	0	11	2.8	.2	16	.0	202	178	24	360	8.0	--------

6. Bear Creek near Oak Ridge (at gage)

9-19-61	1.6	9.5	------	0.03	0.01	52	16	2.9	1.4	------	185	0	33	2.6	0.3	12	0.0	239	194	42	367	7.8	0.2
2-15-62	7.66	7.7	0.1	.01	.00	32	9.7	1.8	1.2	0.1	111	0	18	1.5	.2	12	.0	144	120	29	247	7.6	.1
5-29-62	--------	8.8	.1	.00	.00	47	16	2.2	1.5	.0	167	0	30	1.0	.2	20	.0	209	182	46	341	7.5	.1
12-3-62	2.77	8.0	.1	.00	.01	47	15	2.7	1.3	.1	157	0	31	2.9	.2	27	.0	206	180	51	352	7.8	.1
9-12-63	1.08	9.3	.0	.00	.01	31	29	3.0	1.7	.0	186	0	38	1.0	.1	7.5	.0	215	198	46	370	8.0	.0
4-17-64	7	6.7	.0	.00	.00	25	7.7	1.9	1.2	.1	92	0	14	1.9	.3	9.2	.0	117	95	20	193	8.0	--------
6-23-64	1.1	9.4	.1	.00	.00	43	20	2.8	1.5	.0	177	0	37	2.4	.2	10	.0	222	190	44	382	8.1	--------

17. Poplar Creek at Batley Road near Oliver Springs

9-18-61	1.6	7.1	------	0.43	0.00	29	9.1	4.1	1.9	------	76	0	48	3.0	0.1	0.5	0.0	149	111	48	254	7.3	0.1
2-16-62	58.8	5.9	0.0	.01	.23	11	4.5	2.6	1.0	0.2	10	0	40	2.6	.2	.4	.0	74	46	38	122	6.8	.1
5-29-62	4.28	5.9	.1	.00	.00	27	5.7	3.7	2.0	.0	46	0	58	.8	.0	.0	.0	129	92	55	209	7.0	.1
12-3-62	19.5	6.1	.1	.01	.3	15	5.8	3.1	.8	.0	11	0	59	1.7	.0	.6	.0	102	62	54	159	6.7	.1
9-10-63	1.99	7.3	.0	.00	.00	36	7.4	4.4	6.9	.0	68	0	66	1.8	.1	.2	.0	160	120	64	260	7.4	.0
10-31-63	.68	8.2	.0	.02	.00	33	9.5	3.5	2.1	.0	103	0	37	2.8	.1	.1	.0	148	122	38	240	7.5	--------
4-17-64	80.0	6.2	.0	.00	.00	11	3.5	2.8	.9	.0	12	0	36	1.3	.1	1.3	.0	73	42	32	109	6.6	--------
6-23-64	1.44	6.4	.1	.00	.00	25	7.6	4.0	1.4	.0	62	0	49	3.0	.1	.2	.0	135	94	44	230	7.7	--------

See footnotes at end of table.

TABLE 11.—*Chemical composition of small streams*—Continued

Date of collection	Discharge	SiO_2	Al	Fe	Mn	Ca	Mg	Na	K	Li	HCO_3	CO_3	SO_4	Cl	F	NO_3	PO_4	Dissolved solids residue	Ca-Mg hardness: Total	Ca-Mg hardness: Noncarbonate	Specific conductance	pH	Detergent
18. Brushy Fork at Dossett																							
9-18-61	2.03	7.1	------	0.04	0.02	43	11	1.0	0.9	------	176	0	5.6	1.0	0.1	0.9	0.0	154	154	10	285	7.6	0.1
2-15-62	14.7	6.8	0.1	.01	.00	30	6.7	1.1	.9	0.2	115	0	6.0	2.8	.2	.8	.1	113	103	9	206	7.5	.0
5-29-62	2.88	6.3	.1	.00	.00	38	9.3	1.2	1.2	.0	152	0	5.4	1.0	.1	.3	.0	142	134	9	241	7.3	.0
12-3-62	6.61	6.6	.1	.02	.00	38	9.0	.8	.8	.2	151	0	7.6	1.5	.1	2.0	.0	147	133	10	251	7.8	.1
9-10-63	1.68	7.0	.0	.00	.03	46	9.7	1.6	1.3	.0	182	0	5.8	.8	.1	.4	.0	157	156	7	285	8.0	.0
10-31-63	1.39	7.0	.0	.02	.00	45	13	2.0	1.0	.0	188	0	9.4	1.7	.1	.2	.0	180	166	12	294	7.7	.1
4-17-64	25.3	6.5	.0	.02	.00	27	5.2	1.3	.9	.0	102	0	7.6	1.3	.1	.9	.0	101	88	4	176	7.4	--------
6-23-64	2.30	7.2	.1	.00	.00	40	9.5	1.4	1.1	.0	164	0	7.0	1.8	.0	.7	.0	153	140	6	283	8.1	--------
19. Poplar Creek near Oliver Springs (Highway 61)																							
9-18-61	9.65	7.3	------	0.28	0.2	37	12	1.6	1.0	------	152	0	14	1.7	0.1	1.0	0.0	153	142	18	272	7.7	0.1
2-16-61	[1] 130	6.6	0.1	.02	.01	21	5.2	1.8	1.1	0.0	66	0	19	1.5	.0	.6	.0	93	74	20	164	7.1	.1
5-29-62	15.7	6.5	.0	.00	.00	32	9.7	1.6	1.2	.0	126	0	16	1.3	.1	.5	.1	132	121	18	229	7.3	.1
12-3-62	40.2	6.3	.2	.03	.01	26	7.1	2.0	.8	.0	78	0	31	2.9	.0	.6	.0	110	95	31	197	7.6	.0
4-17-64	165	6.4	.0	.00	.00	18	4.9	2.4	1.0	.0	56	0	22	2.0	.0	1.0	.0	92	65	19	141	7.1	--------
6-23-64	9.49	7.1	.1	.00	.00	32	13	1.6	1.0	.0	152	9	12	1.4	.1	.5	.0	146	134	10	269	8.0	--------
20. Indian Creek at Oliver Springs																							
9-18-61	0.8	11	------	1.2	2.1	28	14	22	2.5	------	51	0	112	12	0.2	1.1	0.3	237	130	88	368	6.9	0.4
2-15-62	24.2	8.7	0.2	.01	1.2	12	9.4	7.2	1.2	0.2	6	0	74	2.5	.2	.3	.0	125	32	27	199	6.1	.1
5-29-62	2.50	8.6	.0	.05	.00	20	11	17	2.5	.1	32	0	89	7.7	.1	.0	.0	180	94	68	271	6.3	.1
12-3-62	12.4	8.8	.1	.01	1.6	15	11	8.7	1.3	.1	10	0	90	3.3	.1	.6	.0	142	88	80	228	6.3	.4
9-10-63	.56	9.6	.0	.15	.02	29	11	20	2.6	.0	77	0	70	16	.0	.5	1.2	194	116	54	335	7.4	.4
10-31-63	.22	12	.1	.02	.00	41	16	30	4.9	.0	148	0	66	28	.2	.1	5.4	278	170	48	450	6.9	--------
6-23-64	.58	12	.1	.06	.00	26	14	20	2.6	.0	56	0	102	11	.1	.0	.4	224	122	77	369	7.6	--------

4. Poplar Creek near Oak Ridge (at gage)

9-18-61	12.5	7.4	------	0.23	0.04	37	11	3.1	1.3	------	143	0	19	1.8	0.1	0.6	0.0	156	137	20	270	7.3	0.1
2-16-62	144	7.0	0.1	.01	.00	20	5.9	3.1	1.1	0.0	54	0	30	1.5	.1	.6	.0	101	74	29	172	7.1	.1
5-29-62	---------	6.6	.1	.00	.00	32	8.8	3.2	1.5	.0	117	0	25	2.1	.2	1.0	.0	136	117	21	232	7.3	.0
12- 3-62	60.8	6.9	.1	.04	.05	24	7.7	4.0	.9	.1	68	0	41	2.5	.0	.7	.0	116	92	36	207	7.4	.1
9-10-63	14	7.0	.0	.00	.00	40	10	3.9	1.7	.0	145	0	23	2.0	.3	.2	.0	154	142	22	275	7.7	.0
4-17-64	210	7.1	.1	.07	.00	17	5.0	2.7	1.0	.0	45	0	30	.9	.0	.3	.0	92	63	26	141	7.1	--------
6-23-64	11.9	8.1	.1	.00	.00	31	13	2.8	1.3	.0	144	0	16	2.6	.0	.3	.0	148	132	14	270	8.1	--------

13. Whiteoak Creek above ORNL near Oak Ridge

9-18-61	0.239	7.6	------	0.03	0.02	29	16	0.5	0.6	------	159	0	2.0	1.3	0.1	0.5	0.1	135	136	6	249	7.8	0.1
2-15-62	1.10	7.0	0.1	.01	.00	17	8.4	.2	.5	0.0	90	0	4.2	.3	.2	.0	.0	82	78	4	153	7.5	.0
12- 4-62	.281	6.8	.1	.00	.01	26	13	.6	.5	.1	139	0	2.0	.6	.1	.3	.0	116	118	4	213	8.0	.1
9-12-63	.18	7.4	.0	.00	.01	33	17	.8	.7	.0	177	0	1.4	.2	.1	.1	.0	136	150	6	260	8.1	.0
4-17-64	2.04	5.7	.0	.01	.00	13	6.3	.5	.6	.0	71	0	2.8	1.1	.0	.6	.0	67	60	2	118	7.6	--------
6-23-64	[1] 0.2	6.7	.1	.00	.00	28	15	1.1	.9	.0	158	0	3.6	2.0	.2	.0	.0	138	132	3	262	8.1	--------

1. Whiteoak Creek below ORNL

9-19-61	3.6	6.3	------	0.03	0.04	35	9.2	25	1.4	------	159	0	29	6.3	1.0	5.1	0.5	197	125	0	340	7.9	0.1
2-15-62	7.22	6.6	0.0	.00	.00	35	7.5	14	1.5	0.0	137	0	18	5.2	.7	7.6	.5	165	120	8	298	7.2	.1
5-22-62	5.0	5.1	.1	.04	.00	20	3.9	88	2.2	.3	179	28	30	11	.9	12	1.8	289	66	0	457	9.2	.4
12-3-62	5.54	4.7	.1	.00	.00	34	9.1	23	1.8	.3	150	0	29	6.7	.8	7.0	1.7	190	123	0	322	7.4	.2
4-17-64	11.7	6.3	.1	.00	.00	32	6.6	16	1.9	.1	124	0	25	10	.6	4.0	.2	164	107	6	275	7.2	--------
6-24-64	5.0	5.0	.1	.00	.00	36	7.7	20	1.7	.1	138	0	34	7.0	.1	5.5	.3	195	121	8	339	7.6	--------

2. Melton Branch near Oak Ridge

9-19-61	0.3	5.2	0	0.01	0.02	38	7.4	4.7	1.2	------	132	0	18	4.6	0.8	1.0	0.3	142	126	18	256	7.6	0.1
2-15-62	1.50	6.7	.0	.01	.00	38	6.7	3.4	1.2	0.2	135	0	14	2.2	.2	.1	.1	141	122	12	258	7.6	.0
5-22-62	---------	4.1	.0	.00	.01	37	6.0	5.5	1.3	.1	125	0	16	6.8	.1	.5	.0	139	117	14	239	7.3	.1
12-3-62	.60	6.1	.1	.01	.01	45	14	1.3	1.3	.2	196	0	8.4	2.6	.1	1.2	.0	182	172	11	312	7.9	.1
9-12-63	.30	4.3	.0	.00	.00	34	7.9	7.2	1.4	.0	131	0	15	3.4	.7	.2	.0	139	117	10	245	7.9	.1
4-17-64	1.89	5.6	.0	.01	.00	41	5.1	3.3	1.4	.0	135	0	19	2.4	.1	.5	.0	144	123	12	246	7.9	--------
6-24-64	1.0	4.3	.1	.00	.00	37	9.9	10	1.7	.0	144	0	21	7.4	.6	5.1	.0	174	132	14	315	8.1	--------

See footnotes at end of table.

TABLE 11.—*Chemical composition of small streams*—Continued

Date of collection	Discharge	SiO_2	Al	Fe	Mn	Ca	Mg	Na	K	Li	HCO_3	CO_3	SO_4	Cl	F	NO_3	PO_4	Dissolved solids residue	Ca-Mg hardness		Specific conductance	pH	Detergent
																			Total	Noncarbonate			
3. Whiteoak Creek at Whiteoak Dam																							
9-19-61	4.9	6.4	------	0.20	0.04	37	8.9	23	1.8	------	150	0	32	8.1	1.0	6.0	0.5	198	128	5	342	7.2	0.1
2-15-62	10.4	5.7	0.1	.00	.01	39	8.2	14	1.6	0.2	137	0	26	4.6	.6	13	.4	180	131	18	320	7.1	.1
5-22-62	5.0	4.7	.1	.04	.00	37	7.5	21	1.8	.2	145	0	28	10	.8	4.6	.3	187	123	4	312	7.1	.1
12-3-62	8.75	4.1	.1	.01	.01	38	9.8	20	1.6	.4	160	0	35	8.2	.7	8.6	.2	200	136	6	358	7.5	.2
4-17-64	--------	4.9	.0	.01	.00	33	5.8	12	1.4	.0	121	0	21	4.5	.3	5.3	.1	148	106	6	250	7.2	-------
6-23-64	5.7	6.4	.1	.00	.00	31	10	29	2.2	.0	151	0	32	10	.8	7.9	.6	219	120	0	369	8.1	-------
Miscellaneous sampling sites — Beaver Creek near Powell																							
12-3-62	19.6	6.5	0.1	0.00	0.01	49	11	3.4	1.4	0.0	185	0	9.2	5.2	0.1	4.8	0.5	181	168	16	321	7.4	0.1
Clinch River tributary at CRM 37.4																							
9-18-61	0.17	5.2	------	0.06	0.03	42	11	3.8	1.5	------	140	0	36	2.2	0.3	0.5	0.0	168	151	36	300	7.8	0.1
Whiteoak Creek at ORNL																							
5-22-62	---------	3.6	0.1	0.03	0.00	29	11	5.0	1.4	0.1	115	0	26	6.5	0.7	1.0	0.0	143	120	26	246	7.0	0.1
6-24-64	4.1	4.9	.2	.00	.00	36	10	6.4	1.5	.0	118	0	35	2.2	.9	1.8	.0	169	134	38	300	8.1	-------

[1] Estimated.
[2] Also 5 ppm OH.

TABLE 12.—*Trace element content of small streams in Oak Ridge area*

[Samples collected Sept. 18-19, 1961; concentrations in parts per billion. The following elements were sought but not detected in any of the samples analyzed: Be, La, Sc, Sn. ND, sought but not detected]

Station		Al	B	Ba	Cr	Co	Cu	Fe	Pb	Li	Mn	Mo	Ni	P	Rb	Ag	Sr	Ti	V	Yb	Y	Zn	Zr
No. (fig. 1)	Name																						
9	Bullrun Creek near Powell	140	21	54	<0.32	ND	5.1	200	3.8	0.38	35	ND	5.1	ND	ND	<0.32	28	4.7	ND	ND	ND	<320	ND
11	Beaver Creek at Solway	78	23	29	<0.30	ND	5.4	220	4.5	<0.30	33	ND	5.4	ND	3.0	<0.30	63	3.0	ND	ND	ND	ND	ND
12	Hickory Creek near Farragut	91	26	71	<0.30	ND	2.1	100	3.0	0.59	16	ND	<3.0	ND	ND	<0.30	44	<3.0	ND	ND	ND	ND	ND
15	Caney Creek near Kingston	72	20	75	<0.28	ND	2.6	220	3.6	0.33	44	ND	3.6	ND	ND	<0.28	21	2.8	ND	ND	ND	ND	ND
7	Clinch River tributary at CRM 51.1.	55	72	36	0.76	ND	7.2	51	9.7	<0.42	110	ND	4.2	ND	ND	<0.42	93	<4.2	ND	ND	ND	ND	ND
8	Emory Valley Creek at Oak Ridge	130	22	31	0.39	ND	2.9	130	7.8	0.35	53	ND	3.5	ND	ND	ND	74	<3.5	ND	ND	ND	<350	ND
10	Scarboro Creek near Oak Ridge	82	26	63	0.44	<3.1	4.1	94	9.1	0.47	35	ND	3.5	ND	ND	<0.31	31	5.3	ND	ND	ND	<310	ND
—	Clinch River tributary at CRM 37.4.	110	280	72	0.41	ND	6.5	75	7.5	7.7	39	23	2.8	ND	ND	<0.26	160	2.6	<7.7	ND	ND	<260	ND
14	Clinch River tributary No. 2 near Oak Ridge.	50	14	110	<0.24	ND	2.9	83	7.1	0.24	50	ND	3.3	ND	ND	<0.24	36	<2.4	ND	ND	ND	<240	ND
16	Grassy Creek near Oak Ridge	45	21	75	0.34	ND	17	82	9.5	1.1	73	ND	14	ND	ND	<0.22	69	<2.2	ND	ND	ND	ND	ND
5a	East Fork Poplar Creek at Bear Creek Valley Road.	240	34	68	3.0	ND	5.4	68	<5.7	130	6.8	<1.7	<5.7	ND	5.7	1.8	97	<5.7	ND	ND	ND	ND	ND
5b	East Fork Poplar Creek at Tuskeegee Drive.	550	28	100	9.0	ND	13	170	8.5	150	13	2.0	<5.0	ND	<5.0	0.65	150	<5.0	ND	ND	ND	ND	ND
5c	East Fork Poplar at East Vanderbilt Drive.	600	31	120	9.9	ND	17	180	8.4	130	21	1.9	5.5	ND	<5.0	0.80	140	5.0	ND	ND	ND	ND	ND
21	East Fork Poplar Creek tributary at Oak Ridge.	100	15	56	0.73	ND	5.9	240	3.9	0.32	22	ND	2.7	ND	ND	<0.24	34	2.4	ND	ND	ND	<240	ND
5d	East Fork Poplar Creek at Wilshire Drive.	1,400	41	340	12	ND	29	200	11	240	17	7.5	7.5	ND	<6.3	3.6	170	<6.3	ND	ND	ND	ND	1-10
22	Mill Branch at Oak Ridge	43	49	59	<0.31	ND	7.1	190	3.4	2.4	31	ND	4.3	ND	3.1	<0.31	100	<3.1	ND	ND	ND	<310	ND
23	Gum Hollow Branch at Oak Ridge.	91	22	48	0.30	ND	9.3	120	6.7	1.3	56	ND	8.0	ND	ND	ND	61	2.6	ND	ND	ND	ND	ND
5	East Fork Poplar Creek near Oak Ridge.	330	110	140	2.4	ND	51	260	12	130	190	4.3	71	714	<5.1	<0.51	130	5.1	ND	ND	ND	ND	ND
24	Bear Creek at county line near Oak Ridge.	160	91	190	<0.51	5.1	6.6	56	<5.1	61	240	ND	9.7	ND	ND	<0.51	170	ND	ND	ND	ND	ND	ND
25	Bear Creek at State Highway 95 near Oak Ridge.	53	36	100	<0.36	ND	2.7	130	3.6	13	50	ND	<3.6	ND	ND	<0.36	46	<3.6	ND	ND	ND	ND	ND
6	Bear Creek near Oak Ridge	160	34	120	<0.34	ND	2.8	200	4.0	10	16	ND	6.1	ND	ND	ND	130	3.4	ND	ND	ND	ND	ND
17	Poplar Creek at Batley Road near Oliver Springs.	98	25	55	<0.19	1.9	7.9	550	4.0	0.96	150	ND	3.4	ND	2.3	<0.19	43	<1.9	ND	ND	ND	ND	ND
18	Brushy Fork at Dossett	66	22	82	0.32	ND	9.3	150	9.8	0.58	120	ND	3.4	ND	ND	<0.27	61	<2.7	ND	ND	ND	ND	ND
19	Poplar Creek near Oliver Springs	85	27	98	0.34	<2.4	9.5	340	9.3	0.39	130	ND	7.1	ND	ND	<0.24	54	<2.4	ND	ND	ND	ND	ND

TABLE 12.—*Trace element content of small streams in Oak Ridge area*—Continued

Station No. (fig. 1)	Station Name	Al	B	Ba	Cr	Co	Cu	Fe	Pb	Li	Mn	Mo	Ni	P	Rb	Ag	Sr	Ti	V	Yb	Y	Zn	Zr
20	Indian Creek at Oliver Springs	150	71	96	<0.27	9.3	10	1,100	4.9	5.2	1,900	ND	26	ND	3.0	0.30	120	2.7	ND	<1.0	<10	ND	ND
4	Poplar Creek near Oak Ridge	160	31	68	<0.21	<2.1	3.7	290	2.7	0.58	130	ND	6.4	ND	<2.1	<0.21	37	3.5	ND	ND	ND	ND	ND
13	Whiteoak Creek above ORNL near Oak Ridge.	39	8.0	120	<0.24	ND	2.4	100	3.4	0.24	12	ND	<2.4	ND	2.4	ND	21	<2.4	ND	ND	ND	ND	ND
1	Whiteoak Creek below ORNL	3001	70	72	210	ND	13	210	14	2.7	72	36	7.2	ND	ND	0.39	99	3.3	ND	ND	ND	ND	1-10
2	Melton Branch near Oak Ridge	170	27	100	1.0	ND	8.0	220	3.9	1.3	48	ND	6.0	ND	ND	<0.23	94	3.7	ND	ND	ND	<230	ND
3	Whiteoak Creek at Whiteoak Dam near Oak Ridge.	190	32	100	120	ND	17	130	6.8	2.7	53	24	22	ND	<3.0	<0.30	130	5.0	ND	ND	ND	ND	ND

TABLE 13.—*Maximum, minimum, and mean water temperatures, by months, in degrees Fahrenheit, for East Fork Poplar Creek, Poplar Creek, and Bear Creek, 1964*

Station No. (fig. 1)	Station Name		Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
4	Poplar Creek near Oak Ridge	Max	[1] 64	56	43	45	45	58	67	71	78	78	79	75
		Min	[1] 54	41	33	33	39	44	49	57	62	69	67	61
		Mean	------	50	36	39	42	52	59	66	72	74	72	68
5	East Fork Poplar Creek near Oak Ridge	Max	66	60	50	48	48	57	67	70	76	75	76	75
		Min	54	48	38	40	40	46	50	59	64	67	66	62
		Mean	62	54	44	45	46	52	60	65	70	72	72	70
6	Bear Creek near Oak Ridge	Max	63	56	46	44	[2] 46	56	64	66	70	70	71	[3] 66
		Min	49	43	34	35	[2] 39	44	47	53	58	62	62	[3] 61
		Mean	58	50	38	40	------	50	55	62	65	66	66	------

[1] No record Oct. 1–8.
[2] No record Feb. 4–Mar. 1.
[3] No record Sept. 13–30.