GEORGIA

STATE DIVISION OF CONSERVATION

DEPARTMENT OF MINES, MINING AND GEOLOGY

GARLAND PEYTON, Director

19 Hunter Street, Atlanta, Georgia

THE GEOLOGICAL SURVEY

Bulletin No. 69

CHEMICAL QUALITY OF WATER OF GEORGIA STREAMS, 1957 - 58

(A Reconnaissance Study)

by

Rodney N. Cherry

Prepared by the

United States Geological Survey

in cooperation with

Georgia Department of Mines, Mining and Geology

ATLANTA

1961

CONTENTS

ILLUSTRATIONS

Page

CHEMICAL QUALITY OF WATER OF GEORGIA STREAMS, 1957 - 58

(A Reconnaissance Study)

By Rodney N. Cherry

SUMMARY

A statewide reconnaissance of the quality of the surface waters of Georgia, a part of the continuing inventory of the water resources of the State, was carried out in 1957 and 1958. The purpose of this reconnaissance was to give knowledge of the present chemical quality and to identify the influences controlling the quality.

Water of most of the streams in the State is soft and is low in mineral content—hardness is usually less than 60 ppm and mineral content is usually less than 100 ppm. Figure 1 shows concentration of dissolved solids (sum of determined constituents as defined in Appendix A) for several locations. Only two areas of the State, in the northwestern and southwestern corners, have waters that, at times, are hard. Although some constituents need to be removed from some particular uses, with few exceptions the surface waters of the State are suitable for municipal, industrial, and agricultural purposes.

Usually the surface waters of the State are either siliceous, carbonate, or chloride in type. Most of the waters are siliceous in type. Carbonate waters are present in the extreme northwestern and southwestern corners of the State and in the Buckhead Creek basin. Chloride waters are present in the southern part of the State, principally in the swampy and coastal areas of the lower Coastal Plain. Waters of lowest mineral content are present in the mountainous areas of the northeastern part of the State. Generally, these waters are very clear and the mineral content is almost as low as that in rainwater.

The most objectionable features of the water quality of the streams in the State are those contributing to the appearance. Suspended sediments are carried by streams in the Valley and Ridge province and in the Piedmont province,

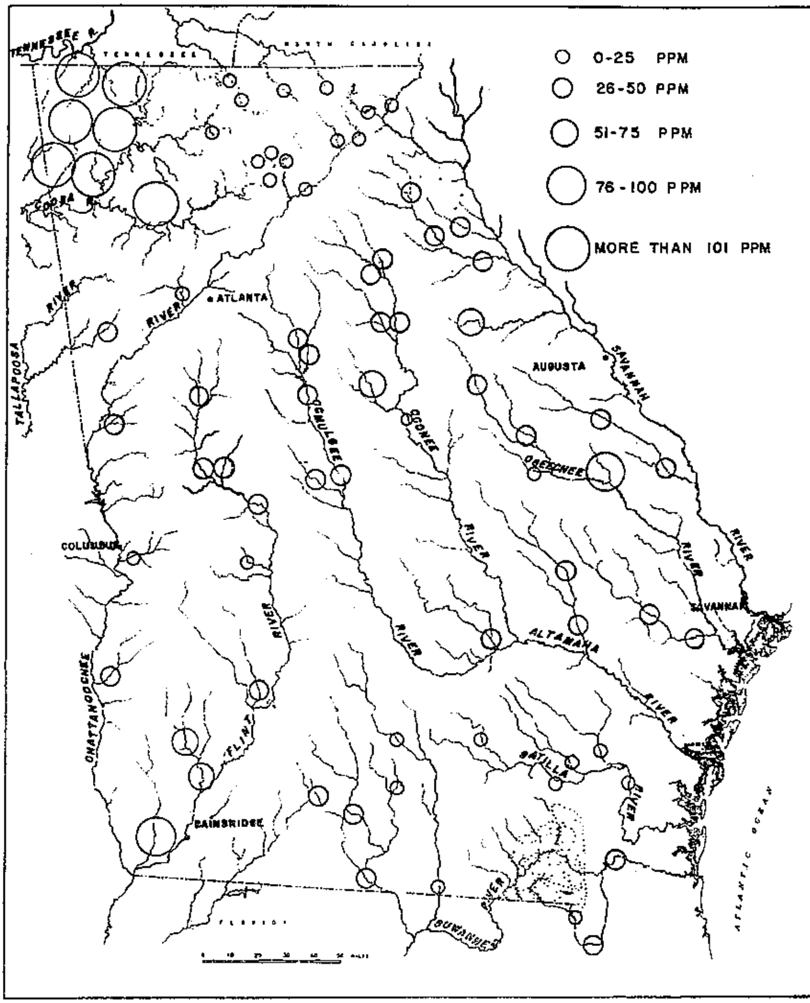

Figure 1. Dissolved-solids concentration in Georgia stream, 1957-58.

particularly during periods of high flow. Color is present in the waters of the southern part of the State, presumably as a result of the biologic conditions.

For the most part the chemical characteristics of the waters in the State seem to be determined by the natural environment; the waters are still relatively free of chemical contamination by man's activities. Because the gross effect of the natural influences in Georgia seems to produce a water low in mineral content and soft, continuation of the present status of quality of water is expected until the cultural influences become more pronounced.

Generally geology and precipitation are the most influential factors in determining the characteristics of the water quality, although biologic influences in the southern part of the State play a predominant role. Differences in quality characteristics between areas in the State are related chiefly to differences in geology, whereas differences in quality within small areas of the State are related principally to rainfall.

INTRODUCTION

A reconnaissance of the chemical quality of water in the streams of Georgia was conducted during the period July 1957 to June 1958. The purpose was to obtain current information and to determine environmental factors influencing the quality of the waters. The results provide a basis for determining the need for and nature of future programs of study. A reconnaissance gives knowledge of general conditions; detailed studies give information that more adequately defines the quality of the waters.

This report presents the findings of a reconnaissance and includes comparison with past records collected in the State.

Acknowledgments

The General Assembly of Georgia in February 1957 enacted the Georgia Water Resources Commission Act to become effective July 1, 1957. The Act created a Water Resources Commission that has as one of its functions an inventory of the water resources of the State. The Georgia Department of Mines, Mining and Geology, Capt. Garland Peyton, Director, has been carrying on a water resources inventory since 1937 in cooperation with the U. S. Geological Survey. Since 1947 cooperative flood and bridge site investigations have been carried on under cooperative programs between the State Highway Department and the U. S. Geological Survey. In addition other Federal, State, and local agencies have made water investigations that add to the knowledge of the State's water resources.

This report was prepared under the supervision of J. W. Geurin, district chemist, with assistance by V. C. Kennedy and B. F. Joyner, Ocala, Fla. Other offices in the U. S. Geological Survey provided special help; the Surface Water Branch, Atlanta, Mr. M. T. Thomson, district engineer, furnished streamflow records and collected samples from streams in the State, and the Ground Water Branch, Atlanta, Mr. J. T. Callahan, district geologist, furnished information on geology of the State. Climatological data were obtained from publications of the U. S. Weather Bureau.

Program Description

The reconnaissance in Georgia was designed to give a general knowledge of the chemical quality of the surface waters of the State and to determine the factors that influence the quality of the waters.

Data were collected at 125 locations on streams in Georgia. (See map, fig. 2.) At 52 of these locations samples were

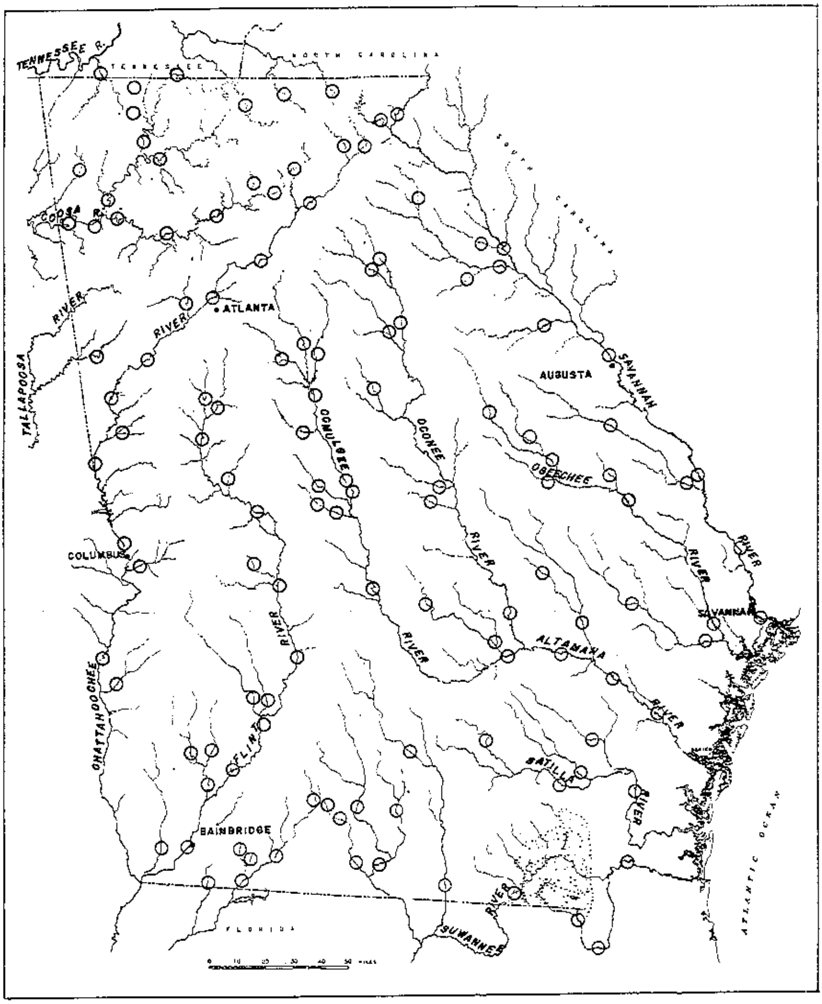

Figure 2. Location of sampling points on streams in Georgia, 1957-58.

collected for analysis at approximately 6-week or 3-month intervals. Samples were collected twice during the year coincident with periods of high and relatively low flow from the remaining locations. Analyses of these samples give information and an indication of chemical characteristics of the stream waters during the period of study and suggest the extremes in concentration that may be expected.

Indications of any long-term changes in quality were sought by comparison of information from this study with that from previous studies.

The determination of the areal relationships, that is, the comparison of quality of water at one location with that at other locations, was based on information and samples collected during field investigations. Specific conductance (p. 81) and temperature measurements were made at a number of locations on the rivers and their tributaries, including the points shown on figure 2. In addition, at a number of these stream locations observations were made of topography, weather, approximate discharge, channel characteristics, geologic features, and appearance of the water. These surveys were made from the headwaters downstream to the mouth in as short a time as possible—one to three days—in order to minimize the effect of changes caused by rainfall during the survey.

The samples collected during this study were analyzed according to methods regularly used by the Geological Survey. These methods are the same as, or are modifications of, methods described in recognized authoritative publications for the mineral analysis of water samples (Rainwater, 1959).

The number of observations made during this study is small in relation to the number needed to give a complete picture of water quality. This, however, is the intent of any reconnaissance—to provide information about variations in composition or quality over an area. The quality-of-water data presented in this report, in addition to being limited in number of observations, were obtained during a period when streamflow was generally higher than normal and may well indicate better water quality than normally prevails.

The report is divided into three major sections. The first section deals with some of the individual characteristics and shows where water with a certain characteristic may be found. The second section presents some of the characteristics of chemical quality within rather large areas. The emphasis in this section is on characteristics that are similar due to similar environment. The third section discusses characteristics of the chemical quality of the major rivers of the

State and the discussion in this section is restricted to the similarities and changes in water quality within each river basin.

Description of Georgia

Georgia has an area of 58,518 square miles. From north to south its length is 320 miles and from east to west its greatest width is about 250 miles. Altitudes range from sea level in the southeastern part to almost 5,000 feet above sea level in the northern part.

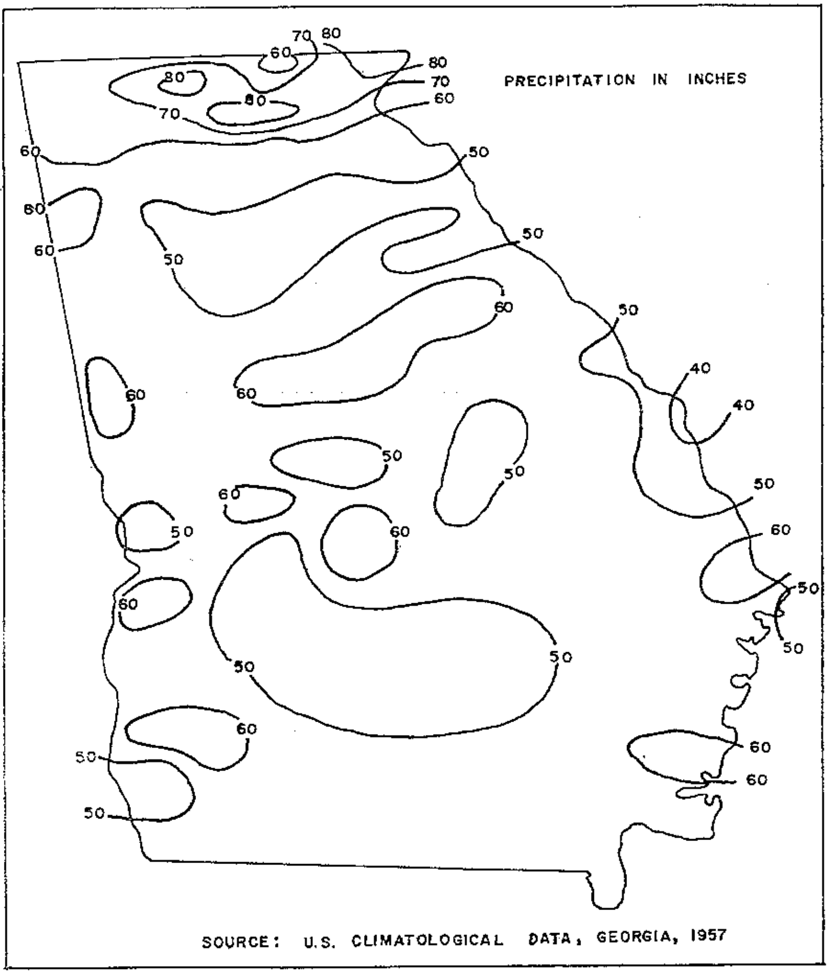

Figure 3. Average precipitation, 1957.

Georgia is a humid State. In an average year, precipitation is equivalent to a volume of water 50 inches deep spread over the entire State. The average precipitation in the mountainous region is considerably higher than in other parts of the State. The average is lowest in the central region of the State. Figure 3 shows average precipitation in the State in 1957.

Georgia lies in five physiographic provinces: The Blue Ridge, the Cumberland Plateau, the Valley and Ridge, the Piedmont, and the Coastal Plain (Fenneman, 1938). Because of differences in runoff characteristics in the Coastal Plain,

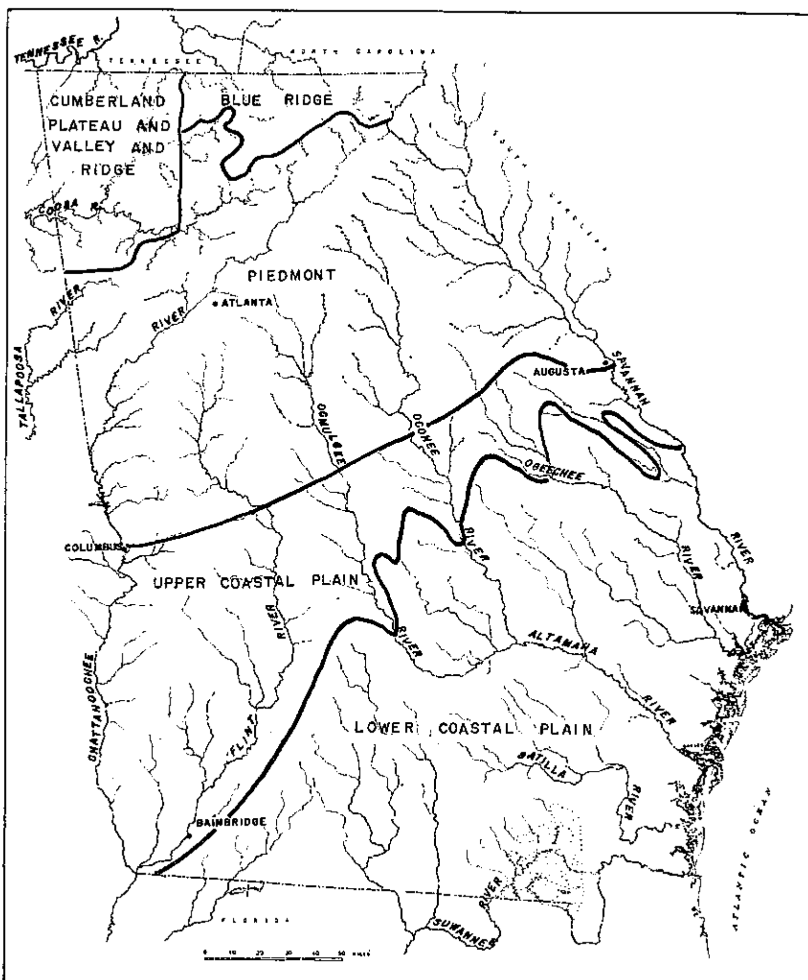

Figure 4. The physiographic provinces in Georgia.

this province has been subdivided into the upper and lower Coastal Plain. A portion of northwest Georgia lies in the Cumberland Plateau. As this portion is small when compared to the major provinces of Georgia, it is grouped with the Valley and Ridge province. The locations of these provinces are shown in figure 4.

Blue Ridge province.—The Blue Ridge province includes the mountainous region of northeastern Georgia where some of the mountains reach altitudes of almost 5,000 feet above mean sea level. Very high water yields are characteristic of the area—in many places the runoff is almost 2 mgd per square mile of drainage area. The average annual precipitation ranges from 53 to about 70 inches, and the average annual runoff ranges from 27 to 37 inches.

The Cumberland Plateau and the Valley and Ridge provinces.—The Valley and Ridge province, in northwestern Georgia, is characterized by wide cultivated valleys separated by narrow, steep, and wooded ridges. The altitudes of the valleys range from 550 to 800 feet above sea level and those of the ridges from 1,600 to 2,000 feet above sea level. The average annual precipitation in this province ranges from 49 to 58 inches, and the average runoff ranges from 18 to 24 inches.

The Cumberland Plateau and the Valley and Ridge provinces grade one into the other, the rocks of the Cumberland Plateau being flat lying whereas those of the Valley and Ridge province are folded. The latter gets its name from the well developed, long valleys and ridges.

Piedmont province.—The Piedmont province extends diagonally across the State, bounded on the north by the Blue Ridge and the Valley and Ridge provinces and on the south by the Coastal Plain. The Fall Line marks the boundary with the Coastal Plain and is so-named because of the falls and rapids in the rivers as they cross this zone. The Piedmont province has an average annual precipitation ranging from 44 to 59 inches and an average annual runoff of 10 to 39 inches.

The region is characterized by both broad and narrow ridges separated by relatively narrow valleys. The altitude ranges from 300 to 1,500 feet above sea level.

The Coastal Plain province.—The Coastal Plain province includes all of Georgia south of the Fall Line and covers approximately three-fifths of the total area of the State.

The average annual precipitation in the upper Coastal Plain ranges from 43 to 55 inches, and the average annual runoff ranges from 12 to 28 inches. In the lower Coastal Plain the average annual precipitation ranges from 45 to 53 inches, and the average annual runoff ranges from 9 to 14 inches.

The streams in the Coastal Plain are usually sluggish and flow in meandering channels. The streams generally have wide, swampy flood plains bounded by broad low ridges. Because much of the soil is permeable, rainfall is absorbed rapidly and runoff is low. In the Coastal Plain, particularly in the upper part and along the Flint River, ground-water inflow helps to sustain flow in the streams.

Factors affecting quality of water in Georgia

The quality of water in Georgia is determined by the environment through which it has passed. Among the factors that influence the quality of surface waters are rainfall, geology, topography, and cultural influences. These factors are not constant with respect to time and location, and a change in any one usually causes a change in the quality of the water.

Rainfall.—The source of nearly all surface waters in Georgia is precipitation entering the stream either as direct runoff or as ground-water inflow that has percolated through the soils and rocks to the water table. Rainfall reaches the earth in a relatively pure state; however, some substances such as dissolved gases, mineral matter, and dust particles may be dissolved or entrapped in the rain. In coastal areas dissolved mineral matter of several parts per million may be carried inland from the ocean by prevailing winds; the amount decreases with greater distances from the coast. Also rain may become polluted by smoke and gases in industrialized areas. Consequently, part of the dissolved mineral matter in surface waters is carried in directly by rainfall.

As soon as the water reaches the earth's surface it begins to react with the soils and rocks to dissolve mineral matter and, at times, to transport materials as sediment. Carbon dioxide dissolved in rainwater aids in the solution of materials from the earth's crust. Even though dissolved mineral matter is added to the stream systems by rainfall and overland flow, the net effect of runoff from rainfall is usually a dilution of the surface waters. Where intense rainfall occurs, the runoff may be so rapid that very little material is dissolved and carried into the stream systems.

Geology.—The characteristics of a water in areas where the cultural influences are small are determined, for the most part, by the geology of the area.

The quantity of mineral matter dissolved by water from rocks and soils depends primarily on the type of materials present, their solubility, the length of time of contact, and the chemical composition of the water itself.

Streamflow is maintained during low rainfall periods by inflow from ground-water reservoirs, and some ground water enters the streams even during high rainfall periods either from springs or through seepage. Usually these ground waters are more mineralized than the surface waters and, therefore, tend to increase the mineral content of the surface waters.

Waters draining areas of crystalline rocks are usually low in mineral content and are soft. Silica may constitute as much as 50 percent or more of the dissolved minerals in the water. Calcium, magnesium, and sodium dissolved from these rocks are usually present in about equivalent amounts and their concentrations are low. Waters draining limestone, dolomite, sandstone, and shale contain higher concentrations of mineral matter, principally the carbonates of calcium and magnesium.

Time of contact.—The time of contact of water with soluble materials is one of the factors that determine how much of the materials will go into solution. The rainfall is an area of steep mountain slopes or rugged topography runs off into the stream channels rapidly. This rapid runoff has the effect of adding to the stream system waters low in dissolved material, because the direct runoff has only a short contact time with soluble materials, and these waters have the effect of reducing the concentrations of mineral matter in the stream.

Biologic conditions.—The total effect of biologic conditions on the quality of water has not been determined, in fact, the effect of many of the processes involved has been determined only to a small extent. The influence may be considerable, although not readily apparent, in many areas. A noticeable effect is found in the southern part of the State in the Okefenokee Swamp. Plant growth in the spring and summer is rapid. The dead and decaying plants form a thick blanket of vegetable matter in the water in the winter. Oxidation of this material tends to deplete the oxygen content of the soil and water and increases the carbon dioxide content. Carbon dioxide dissolved in water forms carbonic acid, which increases the solvent action of the water on minerals with which it comes in contact. In this area the soil and rocks exposed at the surface are, for the most part, only slightly soluble and the increase in mineral content of the water is slight. However, the decomposition of the vegetable matter releases organic compounds that impart color to the water. High color is characteristic of the water in this area.

Cultural influences.—In addition to the natural influences of rainfall, topography, and geology, cultural influences also have an effect on the water quality. Materials introduced into the stream as municipal or industrial wastes and as a result of agricultural practices may have a considerable effect on the quality. Inorganic wastes introduced into the streams in small amounts may be below the limit of detection during periods of high flow, but during periods of low flow they might be of sufficient concentration to change the quality of the water appreciably. Organic wastes in streams may produce color, odors or tastes, reduce the dissolved oxygen content, or may, in themselves, be toxic to aquatic life. In this study mineral constituents principally were considered, and only a few instances of contamination by municipal or industrial wastes were noted. However, flow of the streams during this study was above normal. During periods of lower flow the effect of these wastes on the quality of the water would be more pronounced.

Reservoirs may exert opposing influences on the quality of water. The chemical quality of the water in the reservoir may be improved by dilution with waters of low mineral content during periods of high runoff. Concentrations of minerals may be increased by the process of evaporation and by solution of materials from the sides and bottom of the reservoir during storage. Generally, the storage of water in reservoirs in Georgia resulted in a slight increase in mineral content.

WATER QUALITY OF GEORGIA STREAMS

The overall chemical characteristics of water of Georgia streams are closely related to their natural environment and vary with respect to geographical location and with respect to time. As the effects of the cultural influences on the quality of water within the State seem to be subordinate to those of the natural influences, it is possible to define general characteristics for large areas of the State.

Characteristics of water quality throughout the State are shown in figures 5 to 11. They are based on data collected during the period May 19 to June 4, 1958. Streamflow was below average in all regions except the mountainous area and the lower Coastal Plain. In these regions the flow was above average.

Mineral content of water

The areal variations in mineral content of water are shown in figure 5. It should be noted that the areas of highest concentration occur in the northwestern and southwestern sections of the State. This results from the fact that the limestone and dolomite in the northwest and the limestone in the southwest are more soluble than the rocks predominating over the rest of the State. In addition, much of the water in these streams is from ground-water sources, particularly during periods of low flow. Generally the waters of the northwest are more mineralized than those in the southwest and, too, those in the northwest have a calcium-to-magnesium equivalent ratio of about 3 to 1, and those in the southwest about 12 to 1.

In the northeastern section of the State the mineral content of the water is very low and nearly always is less than 25 ppm. This area is mountainous and is underlain by crystalline-type rocks. Also, it is the area of highest precipitation. As a result of these factors—the large quantity of water falling on relatively insoluble materials and the time of contact being short due to the rugged terrain—the waters are very low in dissolved mineral matter.

The southeastern section is underlain by coastal sediments consisting of sand, gravel, and clay in various stages of consolidation (Cooke, 1943, p. 47-117). These are relatively insoluble and as a result the waters are low in mineral content although usually not as low as those in the northeastern part of the State.

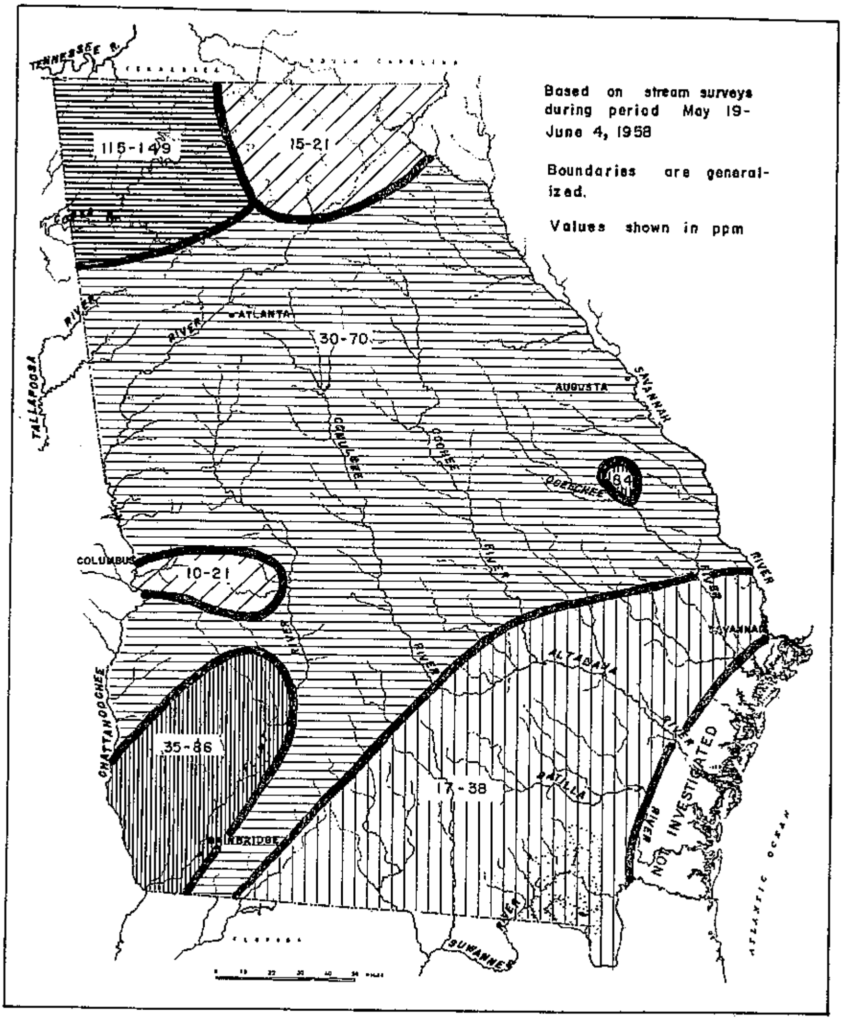

Figure 5. Variations in mineral content of water, 1957-58.

Insoluble sand and gravel (Cretaceous age) are found in and around Marion County (West Central Georgia). This area yields water that has the lowest mineral content of any observed in the State. The mineral concentrations are less than 21 ppm.

Calcareous deposits are present in a belt running northeastward from near Fort Gaines to Augusta. Generally these deposits contain some limestone (Cooke, 1943, p. 39-117). As a consequence, streams in this belt have higher mineral content than those in and around the Marion County area.

Other than the northwestern and southwestern parts of the State, the only area in which the water has a relatively high mineral content is in the Buckhead Creek basin near Millen. This area is unusual in that it appears isolated with respect to mineral content of the water. The water of this creek has concentrations similar to those found in the northwestern and southwestern parts of the State. These concentrations are probably related to the marl formations found in the

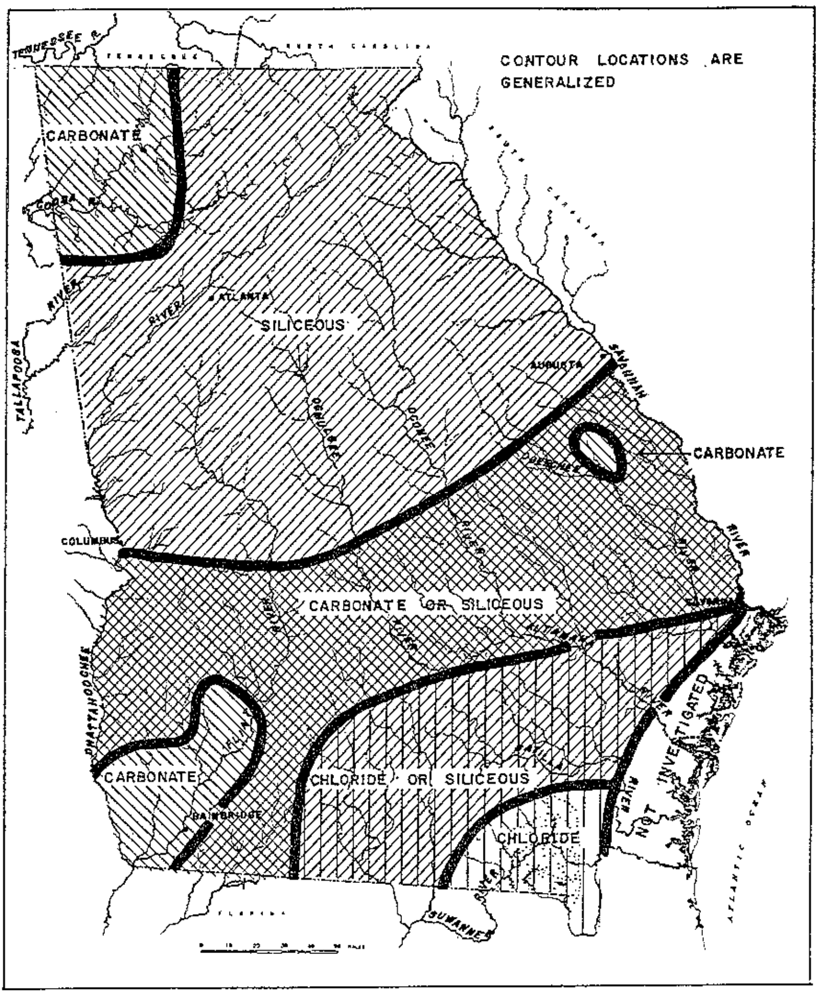

Figure 6. Water types.

drainage basin (Geologic Map of Georgia, 1939). The water of this creek is similar to the waters of the southwest in other characteristics; that is, small quantities of magnesium and similar color values.

Water type

The areal variation in water types is shown in figure 6. The water is typed mainly on the basis of concentration of the negative ions. The higher concentration in parts per million (ppm) determines the type. This scheme provides a way by which silica can be included equally with other constituents. The typing is a modification of the method used by Clarke (1924, p. 182-195).

Siliceous-type waters occur in streams in the central and northeastern parts of the State. The concentration of silica usually does not exceed 15 ppm, although in a few waters 20 ppm or more is present. Silica in the water draining this area is derived from weathering of the rocks.

In a belt from the southwest to the southeast central part of the State, with the exception of the areas in and around Marion County, the waters are sometimes siliceous and sometimes carbonate in type. Usually in periods of higher than average flow the waters are siliceous in type, whereas in periods of lower than average flow they tend to be carbonate in type. In the periods of lower flow, higher percentages of water in the streams are from ground-water sources. Carbonate-type waters occur in the northwestern and southwestern parts of the State. Limestone and dolomites underlie these areas.

Chloride-type waters are in the Okefenokee Swamp. Surrounding this area the waters usually are chloride in type but are sometimes siliceous. The mineral content is usually less than 35 ppm; of this, about 4 to 10 ppm is chloride. This quantity could be transported by rains and winds from the ocean. Too, some chloride may be present in the soil as a result of incomplete leaching of deposits laid down by ancient seas.

Hardness

The distribution of hardness of water for the State is shown in figure 7. Hardness is the property of water attributable to the presence of alkaline earths such as calcium and mag-

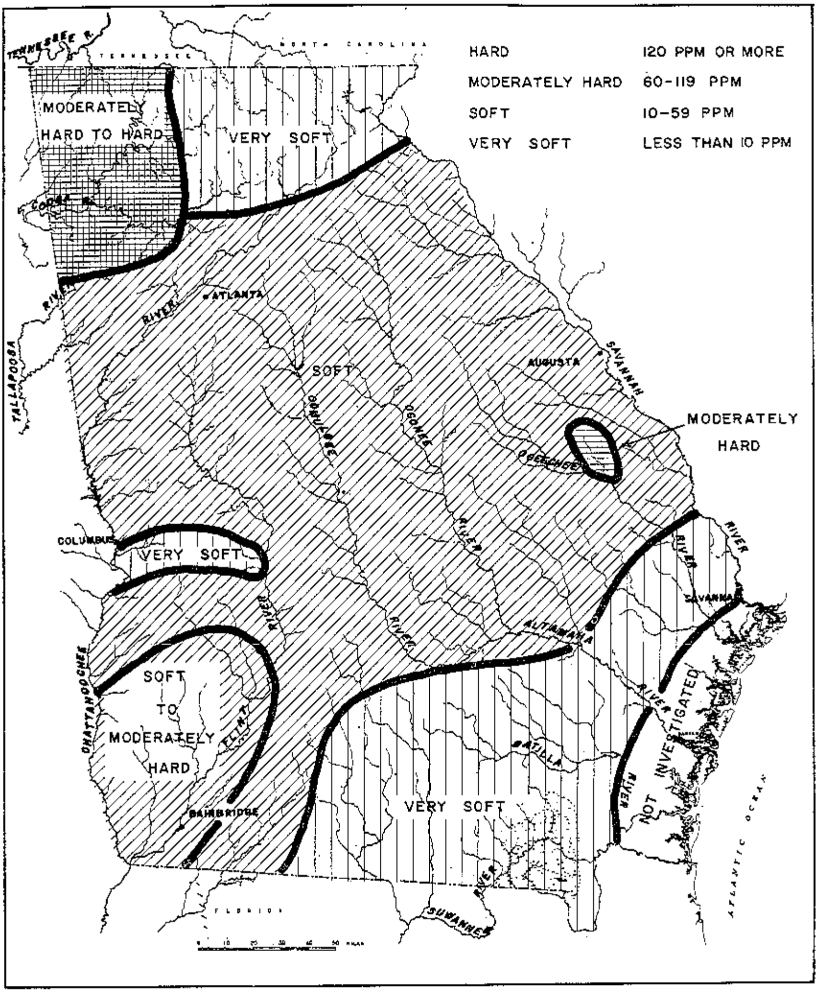

Figure 7. Distribution of hardness of water.

nesium. Hardness represents the soap-consuming power of water (Hem, U. S. Geol. Survey Water-Supply Paper 1473, p. 145), as soap will not cleanse or lather until the constituents contributing to hardness have been either precipitated or neutralized.

The harder waters occur in the northwestern and southwestern parts of the State and in the area of Buckhead Creek. During periods of low flow, waters in these areas may have hardness greater than 120 ppm and would, therefore, be considered hard. These harder waters are due to solution of calcareous material in their drainage areas. In the northeastern and southeastern parts and in a small area in the southwest central part of the State, the hardness is usually less than 10 ppm.

pH

The ranges in pH values that may be expected in surface waters in Georgia are shown in figure 8. The lower pH values are found in the southeastern part of the State, the lowest

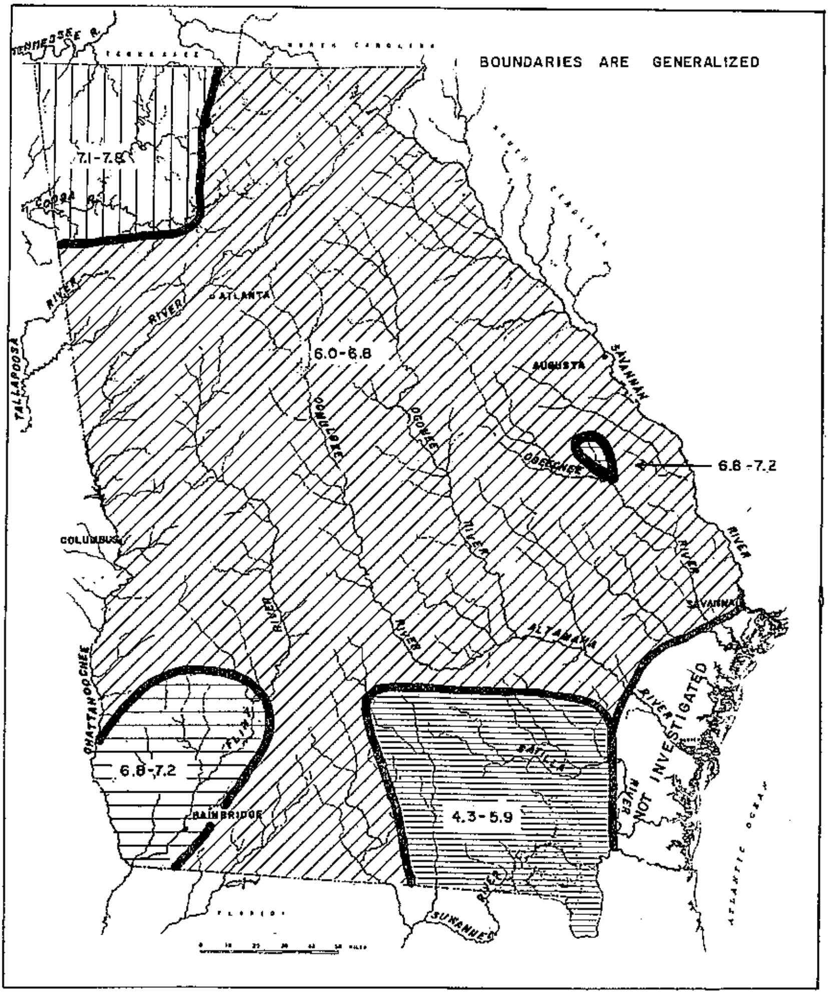

Figure 8. Ranges in pH of water.

values occurring in the area of the Okefenokee Swamp. The lower values are probably due to decomposition of organic material and the subsequent release of carbon dioxide into the water, or they may be due to organic acids derived from vegetation in the streams.

The higher pH in the northwestern and in the southwestern part of the State reflects the predominance of limestone and dolomitic rocks. High pH in the Buckhead Creek basin is due to the calcareous formations found in this basin.

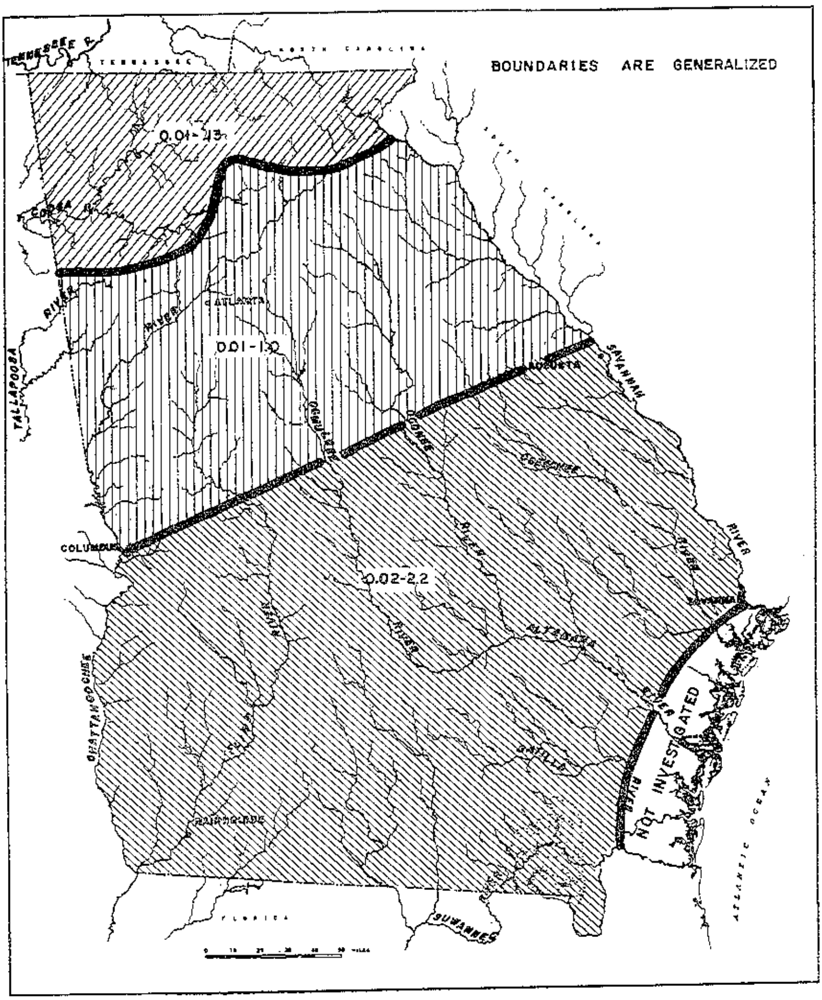

Figure 9. Ranges in iron concentrations.

Iron

The ranges in iron concentrations over the State are shown in figure 9. More than a few tenths of a part per million of iron may stain laundry and utensils reddish brown (Lamar, p. 140-141). It may give a metallic or astringent taste to drinking water.

Iron concentrations greater than 1.0 ppm were not uncommon in the southern part of the State. These high values may occur as a result of the activity of microorganisms or may be associated with color which may be in a colloidal state.

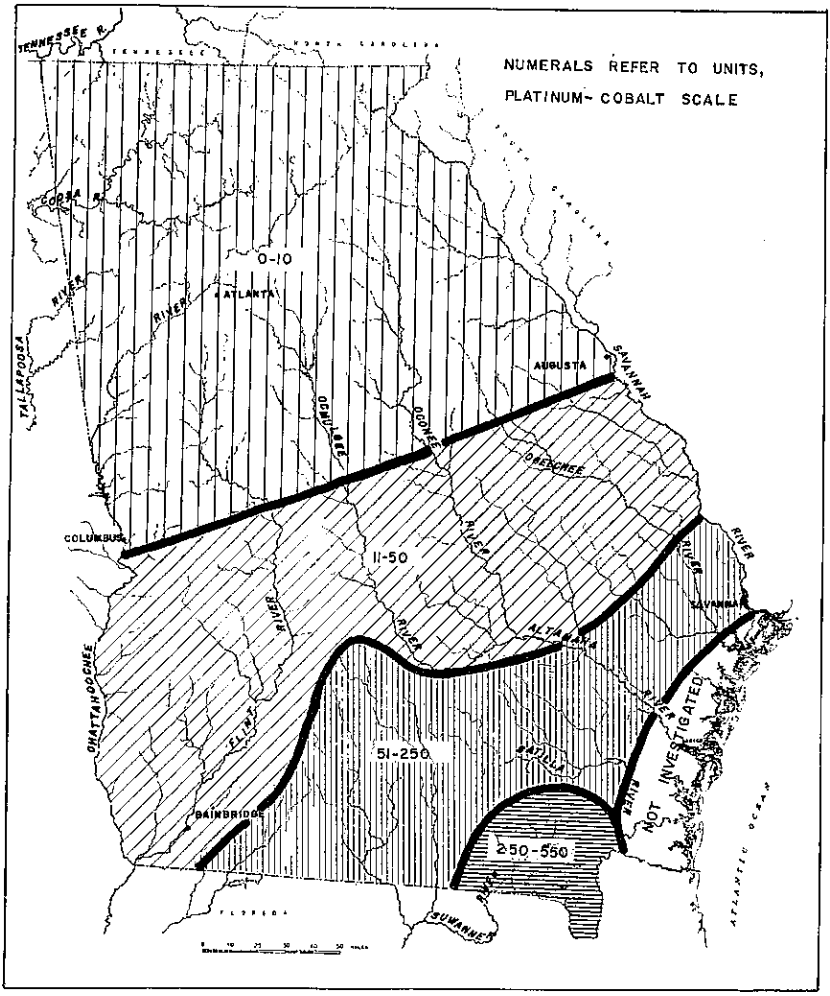

Figure 10. Color of surface waters.

All samples for the determination of iron were filtered into polyethylene bottles at the time of collection. In some samples the high values of iron may be attributed to fine clay particles passing through the filter, but in the southern part of the State the fine particles do not appear to be present. A more intensive investigation will be necessary to explain these observations.

Color

The variation in the color of water is shown by figure 10. Color in water may affect dyeing, textiles and food process-

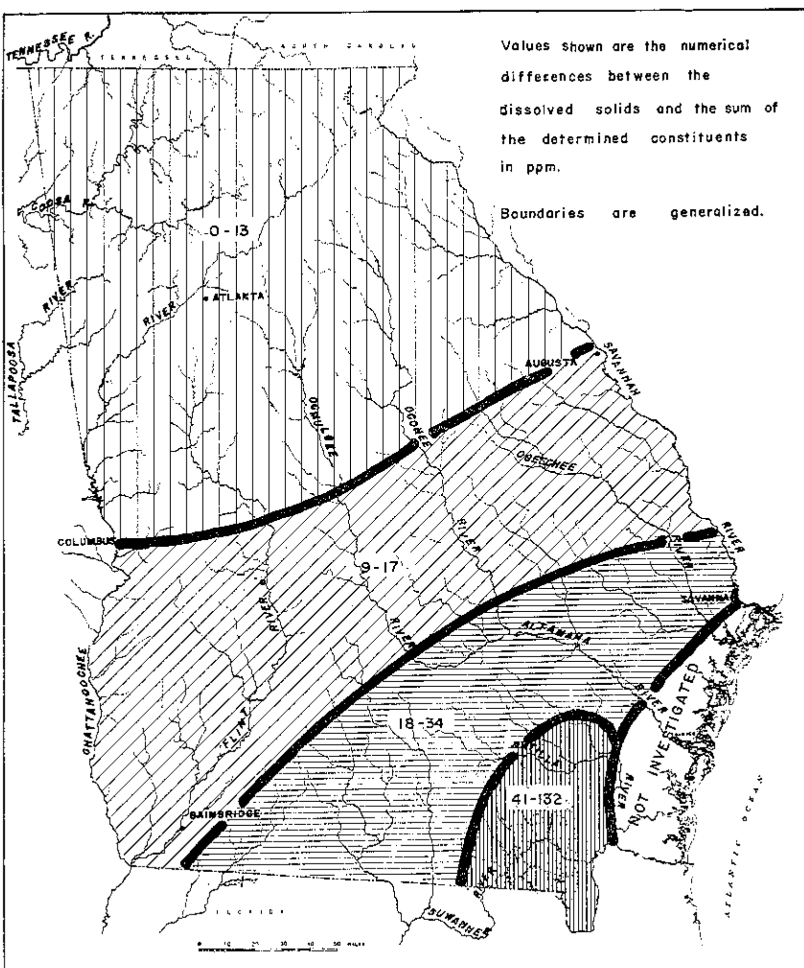

Figure 11. Concentrations of undetermined organic and mineral constituents.

ing, and other uses of water. Color in surface waters is usually most intense in swampy areas. The color is derived from decaying vegetation and may exist in a colloidal state. However, its exact nature is not known. Appreciable color is found in the waters throughout the southern part of the State. Very high color is found in and around the Okefenokee Swamp. Almost no color is observed in streams north of the Fall Line. However, these streams are often turbid because of finely divided clay particles and frequently give the impression of high color.

The numerical differences between values for dissolved solids and the sum of the determined constituents shown in figure 11 gives an indication of the amount of organic materials present in the waters. The higher values are in the area in and around the Okefenokee Swamp. Because the water of this area also has high color, the direct relation suggests that most of the color is due to organic matter.

WATER QUALITY BY AREAS

Collectively, the preceding maps (figs. 5-11) show the areas where water with certain characteristics may be found. For the most part, delineations of the areas have coincided with geologic or topographic features. These areas are shown in figure 12. For convenience in discussion, these areas have been given a numerical designation. The following discussion summarizes the relationship of some of the characteristics of the water within these areas and relates these characteristics to their environmental factors.

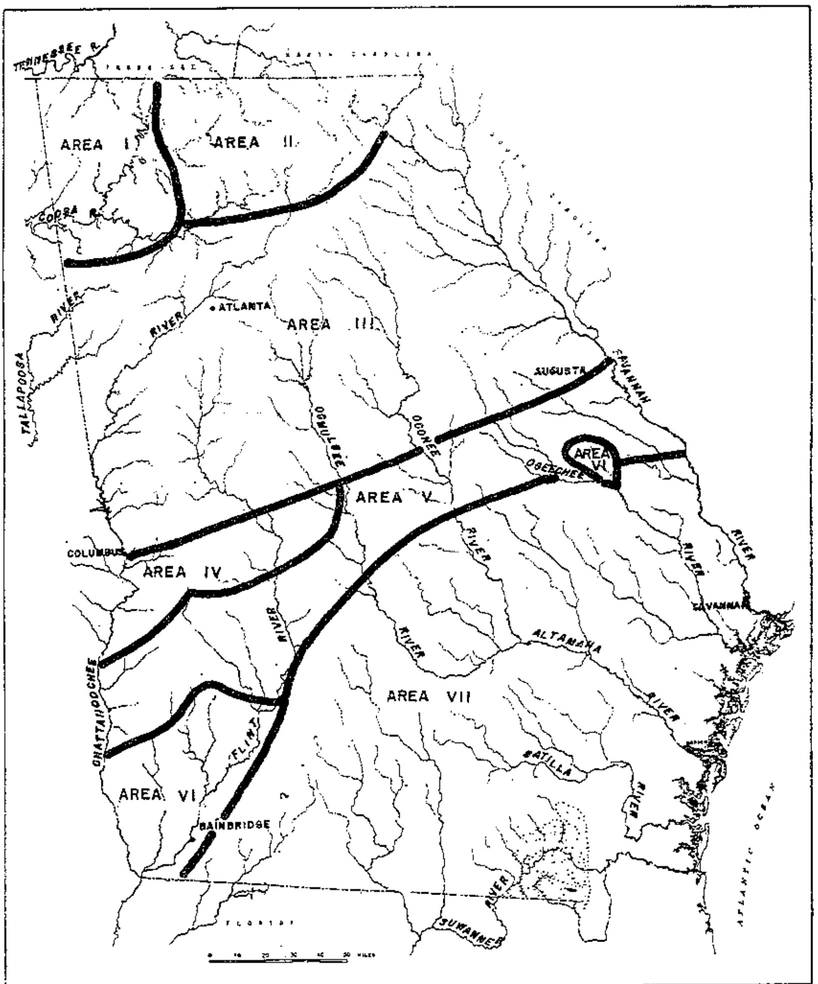

Figure 12. Generalized map showing areas of similar quality of water.

Area I

Area I is located in the extreme northwestern corner of the State (fig. 12). Its boundary to the south and east is considered to be the same as the boundary of the Valley and Ridge province.

The rocks of this area consist of folded shale, dolomite, limestone, and sandstone (Butts, 1948, p. 3-63). Of these rocks, the limestone and dolomite are the more soluble and therefore exert more influence on water quality.

The rivers rise rapidly during storms because of the steep slope of the stream channels. Thousands of springs flow from the caves and solution channels in the limestone that underlies much of the area and, owing to the inflow from these springs, the streams have good sustained flows even during periods of low rainfall.

South Chickamauga Creek and Chattanooga Creek, in the northwestern section of the area, drain northward into the Tennessee River basin. The remainder of the streams drain southwestward into the Mobile River basin.

The rivers and springs are the principal source of municipal water supply in the area (Thomson, Carter, 1955, p. 8) and, in general, are suitable for most purposes although treatment may be necessary for specific purposes. Contact with the limestone and dolomite causes water of the springs to be moderately hard to hard.

Generally the streams in the area have the highest mineral content of any streams in the State. The principal mineral constituents are calcium, magnesium, and bicarbonate. Relatively high sulfate (32 ppm) was found in samples from Tiger Creek near Ringgold.

Streams such as the Conasauga, Coosawattee, and Etowah Rivers originate in the mountainous areas to the east of Area I. Water of these streams is very low in mineral content. As streams enter this area, tributary inflow, ground-water inflow, and contact with soluble rock materials cause a rapid increase in mineral content and a change from a siliceous to a carbonate type of water.

The color of water in this area is usually less than 5 units. During periods of high rainfall the streams are noticeably turbid. The pH of these streams is relatively high as compared to most streams in the State, values ranging from about 7.2 to 8.1.

On the basis of equivalents per million, bicarbonate is the principal ion; it makes up about 80 to 95 per cent of the anions. About 80 to 95 percent of the cations are calcium plus magnesium, with the calcium-to-magnesium ratio being about 3 to 1.

Analysis of water typical of Area I

Constituent or property	Units	ppm	Equivalents per million
Specific conductance (micromhos)	205		
pH	7.6		
Color	2		
Sum		115	
Dissolved solids		113	
Silica		8.3	
Iron		.01	
Calcium		30	1.50
Magnesium		7.3	.60
Sodium		1.5	.07
Potassium		.7	.02
Bicarbonate		HCO_3 (130)	2.13
as carbonate		64	
Sulfate		1.5	.03
Chloride		1.2	.03
Fluoride		.2	.01
Nitrate		.4	.01

Area II

Area II is located in the northeastern corner of the State (fig. 12). It includes all of the Blue Ridge province and a portion of the Piedmont province. The southern boundary may be defined roughly as a line running from Tugaloo to Canton.

The area contains many steep, forest-covered mountains; the valleys are nearly V-shaped. The soil is derived from the weathering of the crystalline rocks which underlie the area. These rocks include granite, gneiss, schist, phylitte and quartzite (Geologic map of Georgia, 1939).

The many streams in this area usually have rock or gravel beds and, because of the high relief, are rapid flowing. Many dams are located in this area and the reservoirs formed are in popular recreation areas. There are no large cities and only a few industrial plants. Only minor quantities of water are used by the few towns and small textile industries, but large quantities are stored in the reservoirs for power generation.

This area receives more precipitation than any other area in the State. The average is estimated to be 60 inches. Several of the larger streams of the State originate within this area.

The water quality is characterized by a low mineral content—usually less than 25 ppm. Silica makes up approximately 50 percent of the mineral matter. Usually none of the individual mineral constituents exceed 6 ppm. The low mineral content may occur as a result of the intense rainfall and the short time of contact of the water with the relatively insoluble rocks of the area.

On the basis of equivalents per million, bicarbonate is the predominant anion (70-90 percent of the total anions).

The color is usually less than 4 units. The pH values ranged from about 6.4 to 6.8.

The following analysis is considered to be typical of waters of this area.

Analysis of water typical of Area II

Constituent or property	Units	ppm	Equivalents per million
Specific conductance (micromhos)	17.3		
pH	6.6		
Color	4		
Sum		20	
Dissolved solids		22	
Silica		9.9	
Iron		.09	
Calcium		1.2	.06
Magnesium		.4	.03
Sodium		1.5	.07
Potassium		.7	.02
Bicarbonate		HCO_3 (10)	.16
as carbonate		4.9	
Sulfate		.5	.01
Chloride		1.0	.03
Fluoride		.1	.01
Nitrate		.0	.00

Area III

Area III is located north of the Fall Line and includes all of the Piedmont province except that portion found in Area II (fig. 12).

Most of the population of the State is in this area and during recent years many industries have been established. The area, however, is still farmed extensively.

Larger streams of the State either originate or flow through this area. Some of the cities and industries use these streams as a source of their water supply. The Chattahoochee River alone supplies a population of more than 900,000 and the Savannah, Ocmulgee, Oconee, and Flint Rivers supply additional thousands.

Metamorphic and igneous rocks underlie the area. The metamorphic rocks include biotite gneiss and schist, quartzite, slate, and marble. The igneous rocks are granite, hornblende and diorite gneiss, gabbro, basalt, and small amounts of pyroxenite and peridotite (Geologic Map of Georgia, 1939). The soil is derived largely from weathering of the underlying rocks.

The water is siliceous in type and soft. Generally the mineral content is within the range of 25 to 50 ppm, of which about 20 to 35 percent is silica. The water quality of this area is similar to that of Area II except that in this area the water generally has a higher concentration of dissolved minerals and is often turbid.

Of the anion equivalents per million, bicarbonate is predominant (65-85 percent of the total anions). Of the cations, calcium and sodium are found in near equal equivalents per million; magnesium is slightly less than calcium.

Little, if any, color is present in the water of streams of this area—usually less than 10 units—but the streams are often turbid during periods of high rainfall. This turbidity is caused by the suspension of finely divided clay particles.

Comparatively high concentrations of silica (26 ppm) are found in the Little River (near Washington) and in the headwaters of the Ogeechee River.

The following analysis is considered to be typical of waters of this area.

Analysis of water typical of Area III

Constituent or property	Units	ppm	Equivalents per million
Specific conductance (micromhos)	45.5		
pH	6.9		
Color	8		
Sum		40	
Dissolved solids		43	
Silica		15	
Iron		.66	
Calcium		3.2	.16
Magnesium		1.2	.10
Sodium		3.7	.16
Potassium		1.6	.04
Bicarbonate		HCO_3 (22)	.36
as carbonate		11	
Sulfate		.8	.02
Chloride		2.5	.07
Fluoride		.0	.00
Nitrate		.9	.01

Area IV

Area IV includes that part of the upper Coastal Plain west of the Ocmulgee River in which the deposits of Late Cretaceous Age are exposed (fig. 12). The deposits consist mainly of sand and gravel (Cooke, p. 16-38) in various stages of consolidation and are relatively insoluble.

The mineral content of the water of the streams does not exceed 21 ppm and about 50 percent of this is silica. None of the other mineral constituents exceeds 4 ppm.

In equivalents per million, bicarbonate is usually the predominant anion; however, at times chloride is the predominant anion. The bicarbonate makes up about 35 to 60 percent of the anions. Calcium, magnesium, and sodium are found in nearly equal percentages of equivalents and together constitute about 85 to almost 100 percent of the total cations.

The color is usually less than 10 units. The pH ranges from about 5.2 to 6.4.

The following is an analysis considered to be typical of the waters of this area.

Analysis of water typical of Area IV

Constituent or property	Units	ppm	Equivalents per million
Specific conductance (micromhos)	9.3		
pH	5.6		
Color	3		
Sum		10	
Dissolved solids		11	
Silica		5.8	
Iron		.35	
Calcium		.4	.02
Magnesium		.4	.03
Sodium		.6	.03
Potassium		.1	.00
Bicarbonate		HCO_3 (2)	.03
as carbonate		1	
Sulfate		.0	.00
Chloride		1.5	.04
Fluoride		.2	.01
Nitrate		.4	.01

Area V

This area includes that part of the upper Coastal Plain in which the deposits of Paleocene and some of Eocene Age are exposed (fig. 12). The deposits of Paleocene Age include those of the Clayton formation. Those deposited during Eocene Age include the Wilcox group, McBean formation, Barnwell sand, and Flint River formation (Cooke, 1943, p. 39-67, 77-84).

These formations are composed of sand and clay in various stages of consolidation. Within some of the formations, such as the McBean, beds of limestones are found. Generally, the exposed formations to the west of the Ocmulgee River are more calcareous than those to the east. Consequently the water in streams west of the Ocmulgee River tend to be a carbonate type, particularly during the periods of lower than average flow. Water in streams to the east of the Ocmulgee River is more of a siliceous type although occasionally carbonate.

The mineral content of streams of this area usually falls within the range of 25 to 45 ppm. The silica usually makes up about 25 to 40 percent of the mineral matter.

Bicarbonate is the predominant anion, constituting about 55 to 80 percent of the anionic equivalents per million. Calcium usually is more than 50 percent of the cations. The higher percentages of calcium are found in the Muckalee and Kinchafoonee Creeks.

Color of water in streams of this area is usually less than 40 units. The pH usually is within the range 6.4 to 7.0.

The following is an analysis considered to be typical of the waters of this area.

Analysis of water typical of Area V

Constituent or property	Units	ppm	Equivalents per million
Specific conductance (micromhos)	45.2		
pH	6.6		
Color	22		
Sum		28	
Dissolved solids		42	
Silica		9.9	
Iron		1.2	
Calcium		3.0	.15
Magnesium		.9	.06
Sodium		2.2	.10
Potassium		.6	.02
Bicarbonate		HCO_3 (15)	.25
as carbonate		7.4	
Sulfate		1.0	.02
Chloride		3.0	.08
Fluoride		.0	.00
Nitrate		.4	.01

Area VI

Area VI is in the southwestern corner of the State and is characterized by limesinks and caves formed by the solvent action of water on limestone (fig. 12). It includes that part of the Coastal Plain in which the Ocala limestone is exposed. A small area in east central Georgia, principally the area drained by Buckhead Creek, has streams with the same characteristics and is considered a part of Area VI. In this small area the water quality is influenced by calcareous rocks mapped as the Cooper Marl (Geologic Map of Georgia, 1939).

A relatively high mineral content is characteristic of water in streams of Area VI, with concentrations as high as 112 ppm being present during periods of lower than average flow. Because the water has been in contact with soluble limestone, most of the mineral matter is calcium and bicarbonate. About 85 to 95 percent of the anionic equivalents per million is bicarbonate. Calcium makes up about 85 to 95 percent of the cations. Less than 2 ppm of magnesium is present in the water.

Color exceeding 50 units is common in Area VI. The pH of the water is relatively high—usually about 7.0.

The following analysis is considered to be typical of the waters of this area.

Analysis of water typical of Area VI

Constituent or property	Units	ppm	Equivalents per million
Specific conductance (micromhos)	147		
pH	7.2		
Color	45		
Sum		86	
Dissolved solids		97	
Silica		5.7	
Iron		.06	
Calcium		28	1.40
Magnesium		.5	.04
Sodium		1.9	.08
Potassium		.4	.01
Bicarbonate		HCO_3 (87)	1.43
as carbonate		43	
Sulfate		3.0	.06
Chloride		3.0	.08
Fluoride		.1	.01
Nitrate		.2	.00

Area VII

Area VII includes most of the lower Coastal Plain (fig. 12). It is underlain by Suwannee limestones of Oligocene age, Tampa limestones, and Hawthorn formation of Miocene age, and other deposits of the Pleistocene and Recent ages. The exposed formation for the most part is the Hawthorn (Geologic map of Georgia, 1939).

The water of the streams in this area moves slowly. As a result, the time of contact with the rock material is longer than in most parts of the State, but these materials are relatively insoluble.

The banks of the streams often have heavy growth of plants and it is common to see channels of streams cluttered with logs and branches. Many swamps are in this area.

One of the more apparent water-quality characteristics is the high color of the water. Often color exceeds 300 units. The higher color is present in water in the southeastern part of the area, particularly in or near the Okefenokee Swamp. Another characteristic of waters of this area is a low pH. Usually the pH is less than 6.0 and in many streams is less than 5.0. The lower pH values are found in the more highly colored streams. The quantity of organic material carried by these streams is often greater than the inorganic materials. (See fig. 11.) An interrelationship of the low pH, high color, and amount of organic material is suggested. The iron content of water is higher in this area than in other parts of the State and is believed to be associated with the color-producing compounds.

The concentration of chloride in streams of this area is generally higher than in the rest of the State, and the water is often chloride in type. The reason for this higher chloride content is not fully understood. Significant quantities of salt may be added by rain from over the ocean. This conclusion is suggested by some of the following observed conditions: The equivalents per million of chloride and sodium are either equal or nearly equal in most of these streams. Generally the equivalents per million of chloride are greater than the equivalents of bicarbonate. This condition is generally confined to this area. Sodium is generally the predominant cation. The magnesium often exceeds the calcium in equivalents per million.

The Suwannee River, North Prong St. Marys River, and the lower part of the Satilla River have lower pH and higher color than the other streams in the area. The streams in the Canoochee and Little Ocmulgee River basins are similar in character with respect to calcium and bicarbonate to streams to their north but are similar in color and chloride to streams to their south. The Little Tired Creek and Attapulgus Creeks are similar with respect to calcium and bicarbonate to those of streams to their northwest, yet have color and chloride characteristic of streams to their east.

The following analysis is considered to be typical of the waters of the area.

Analysis of water typical of Area VII

Constituent or property	Units	ppm	Equivalents per million
Specific conductance (micromhos)	31.7		
pH	5.4		
Color	55		
Sum		23	
Dissolved solids		67	
Silica		7.4	
Iron		1.7	
Calcium		2.0	.10
Magnesium		.2	.02
Sodium		3.4	.15
Potassium		1.0	.03
Bicarbonate		HCO_3 (5)	.08
as carbonate		2.5	
Sulfate		2.0	.04
Chloride		4.2	.12
Fluoride		.2	.01
Nitrate		.5	.01

WATER QUALITY BY RIVER BASIN

Water from hundreds of springs and small tributaries feeds into seven major rivers and several smaller rivers that drain the more than 58,000 square miles of Georgia. From the headwaters to the mouth, these streams are exposed to a multitude of natural and cultural influences that result in constantly changing features of water quality.

In this section the chemical quality of water of each major stream system and the factors to which the quality appears to be related are discussed. Characteristics of the headwaters are discussed first, and succeeding changes to the mouth of the stream are noted along with the reasons for the changes in characteristics. Diagrams showing specific conductance and the percentage equivalents (defined p. 80) of calcium plus magnesium to total cations and percentage equivalents of bicarbonate to total anions are shown under the discussions of individual rivers. The percentage equivalents of sodium plus potassium may be obtained from these diagrams by subtracting the percentage equivalents of calcium plus magnesium from 50 percent; likewise, the percentage equivalents of sulfite, chloride, fluoride, and nitrate may be obtained by subtracting percentage equivalents of bicarbonate from 50 percent.

The diagram showing the specific conductance may be used to estimate the dissolved mineral concentrations by applying factors of 1.05 to the specific conductance for streams in the Blue Ridge province; 0.60 for streams in the Cumberland Plateau and Valley and Ridge province; 0.75 in the Piedmont; and 0.65 in the Coastal Plain. The larger factor to be applied for the streams in the Blue Ridge province is due to the presence of larger percentages of silica in the waters.

Mineral content is presented throughout this section by use of a number followed by a parenthesis, which may contain one or two numbers, that is, 4 (25-45) ; the 4 indicates the number of comprehensive analyses for this sampling point, or points, and 25-45 designates the range in parts per million of the mineral content of the samples.

Instantaneous loads of dissolved minerals were calculated by using the concentrations of dissolved minerals and the instantaneous discharges of the streams. The loads are given in tabular form (Appendix B) for each river basin so that they may be compared for different sampling points on the streams and for the same point at different discharges. Stream discharges were not available for all points sampled; therefore, instantaneous loads to show pickup of dissolved minerals could not be computed. From the few that were computed, it appears that the pickup of dissolved material per square mile of drainage area is greater above the Fall Line than below. The differences in loads appear to be related more to the availability of water than to any other factor.

Dissolved loads were calculated for several of the larger streams by using water analyses from previous studies. These loads are based on the average yearly discharge and the mineral content (sum) of the samples for the period of collection. A tabulation of the loads is given in Appendix C.

For purposes of comparison, past and present analyses were selected in the following manner: From the past records, usually a year's record of composited daily samples, analyses were selected which were considered to be representative of low and high flows (Lamar, 1944, p. 352-377; U. S. Geol. Surv. Water-Supply Papers, 1943-49, Nos. 942, 950, 970, 1022, 1030, 1050, 1102). Then analyses were selected of samples collected during the present study under approximately similar flow conditions. Tabulations of analyses from past records and of analyses of samples collected during the present study are contained in Appendices D and E.

The chemical characteristics of water during the two periods are shown graphically for several streams in figure 13. The graph indicates that no significant changes in the overall chemical characteristics of the streams of Georgia occurred in the interval between the two studies.

Savannah River Basin

The headwaters of the Savannah River rise in the Appalachian Mountains in an area of crystalline rocks. The Chattooga and Tallulah Rivers join to form the Tugaloo River, which in turn joins the Seneca River near Anderson, S. C., to form the Savannah River. The Savannah River flows southeastward through the Piedmont and Coastal Plain, forming the Georgia-South Carolina boundary, and enters the Atlantic Ocean about 12 miles southeast of the city of Savannah. At the gaging station near Clyo, approximately 50 miles upstream from Savannah, the drainage area is 9,850 square miles and the average discharge for 19 years of record (1937-56) was 10,830 cfs.

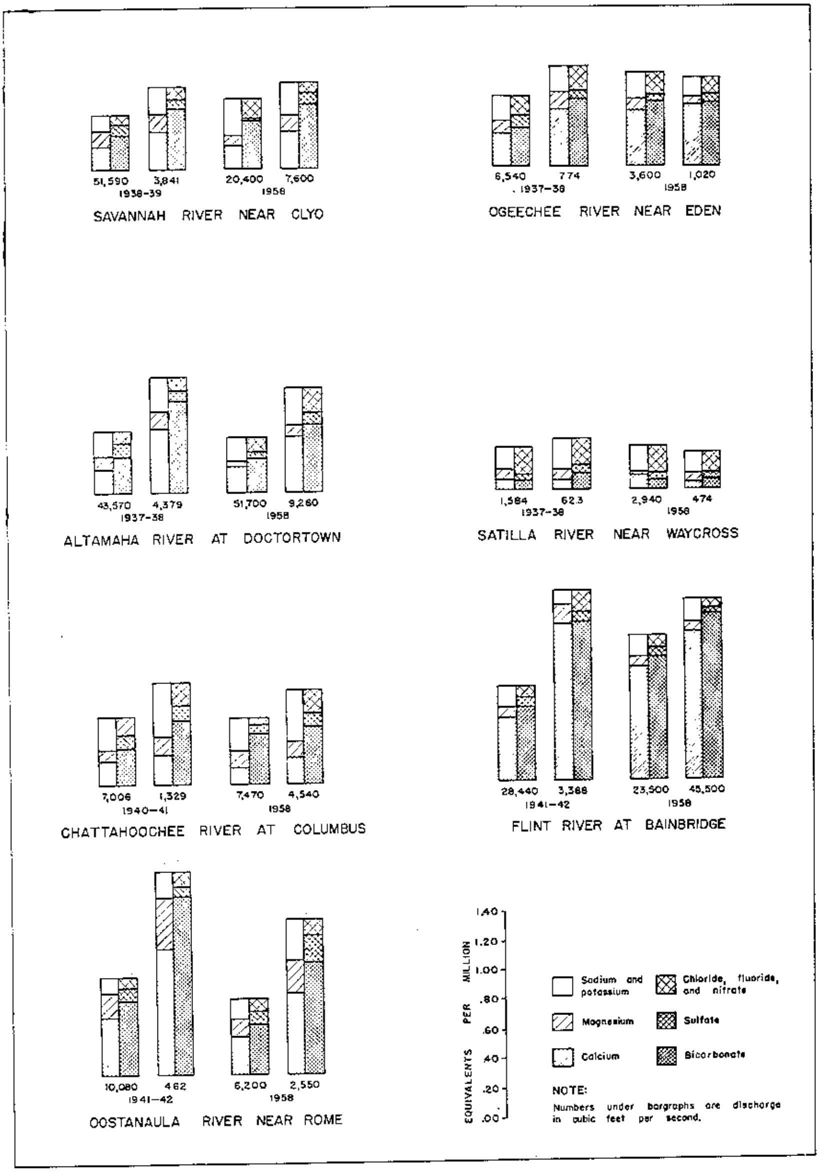

Figure 13. Chemical composition of water of selected streams during past and present studies.

This stream has considerable regulation by Clark Hill reservoir and Stevens Creek dam (U. S. Geol. Survey Water-Supply Paper 1433, 1958, p. 295).

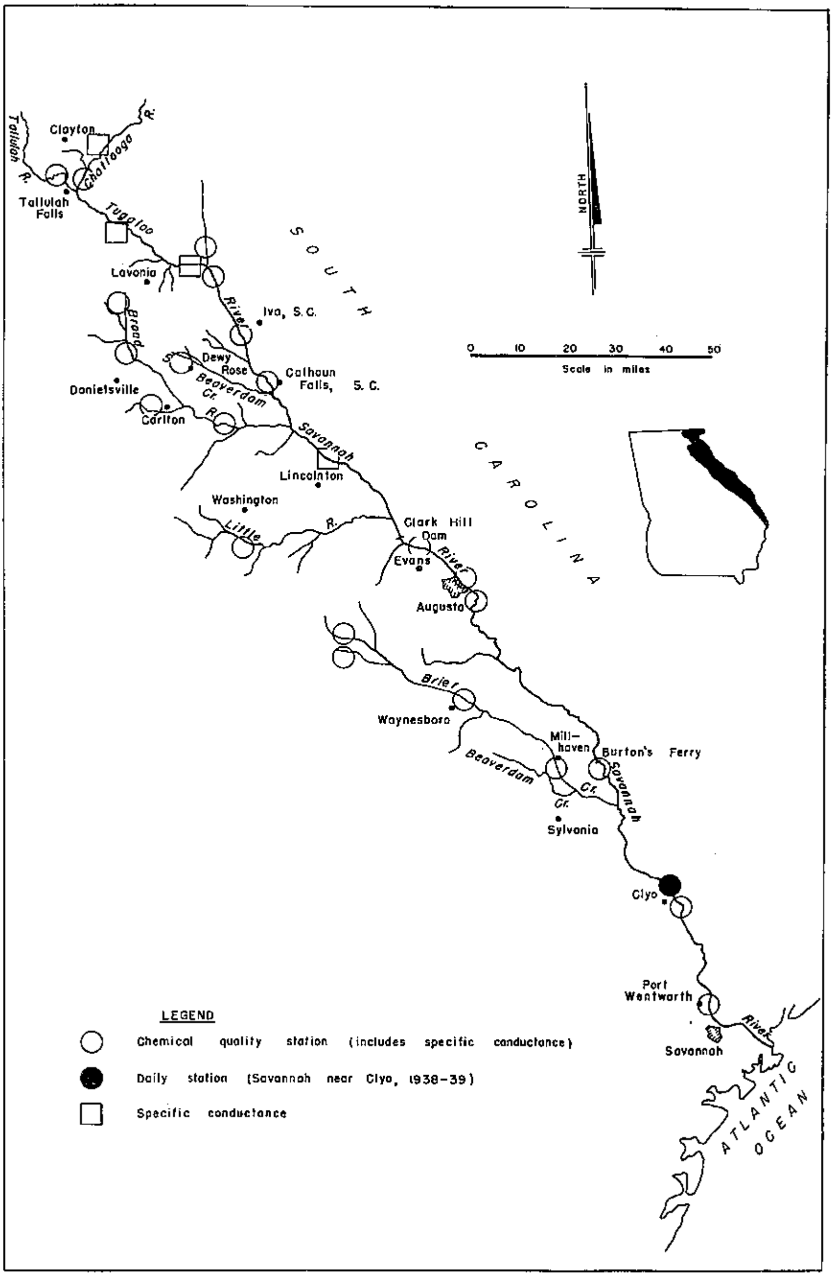

Figure 14. Approximate location of sampling points in the Savannah River basin.

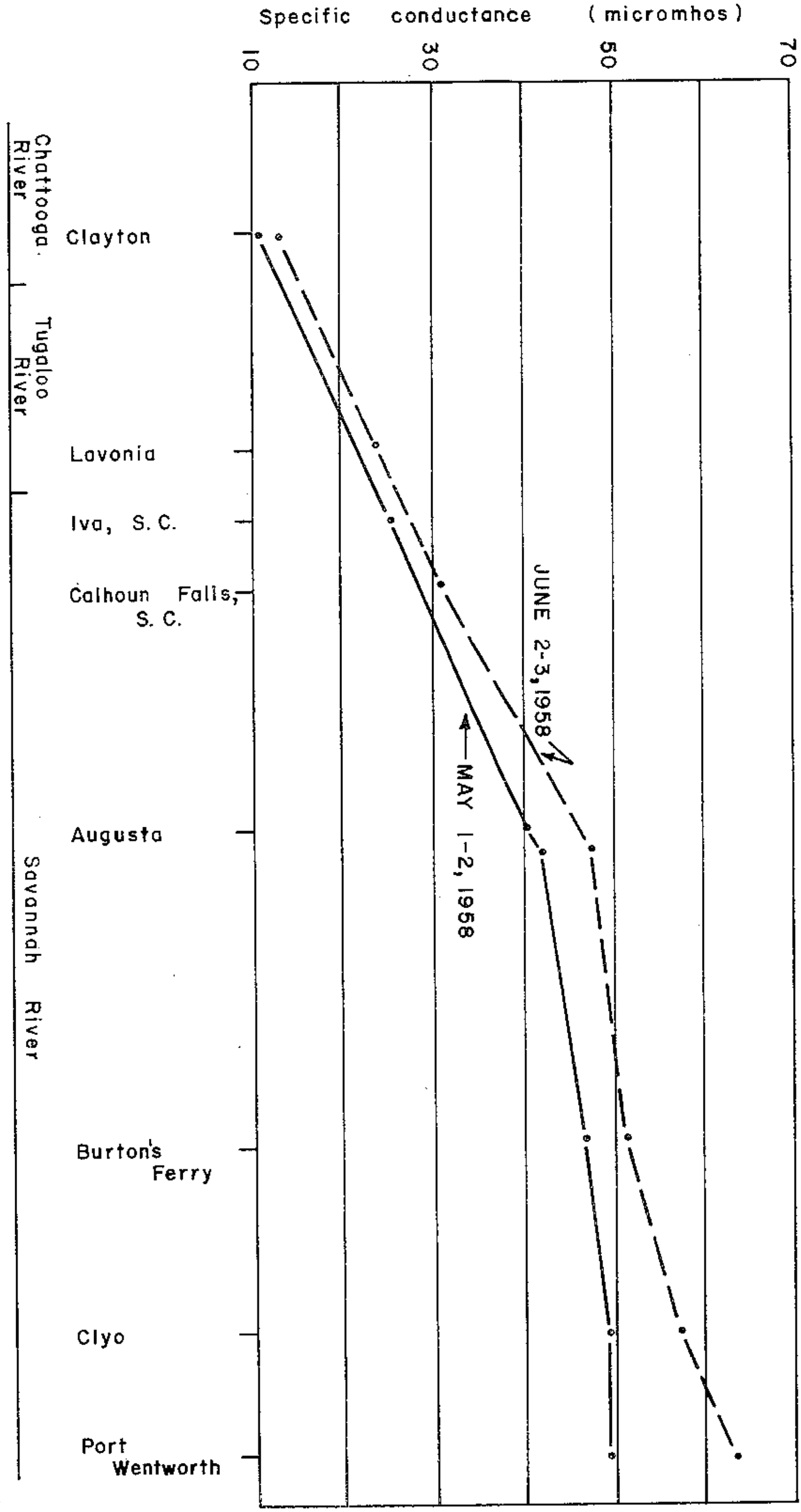

Figure 15. Specific conductance of water of Savannah River during stream surveys on May 1-2 and June 2-3, 1958.

Locations at which data on quality of water were obtained in the Savannah River basin are shown in figure 14.

Specific conductance at various locations on the Savannah River during the stream surveys of May 1-2 and June 2-3, 1958,

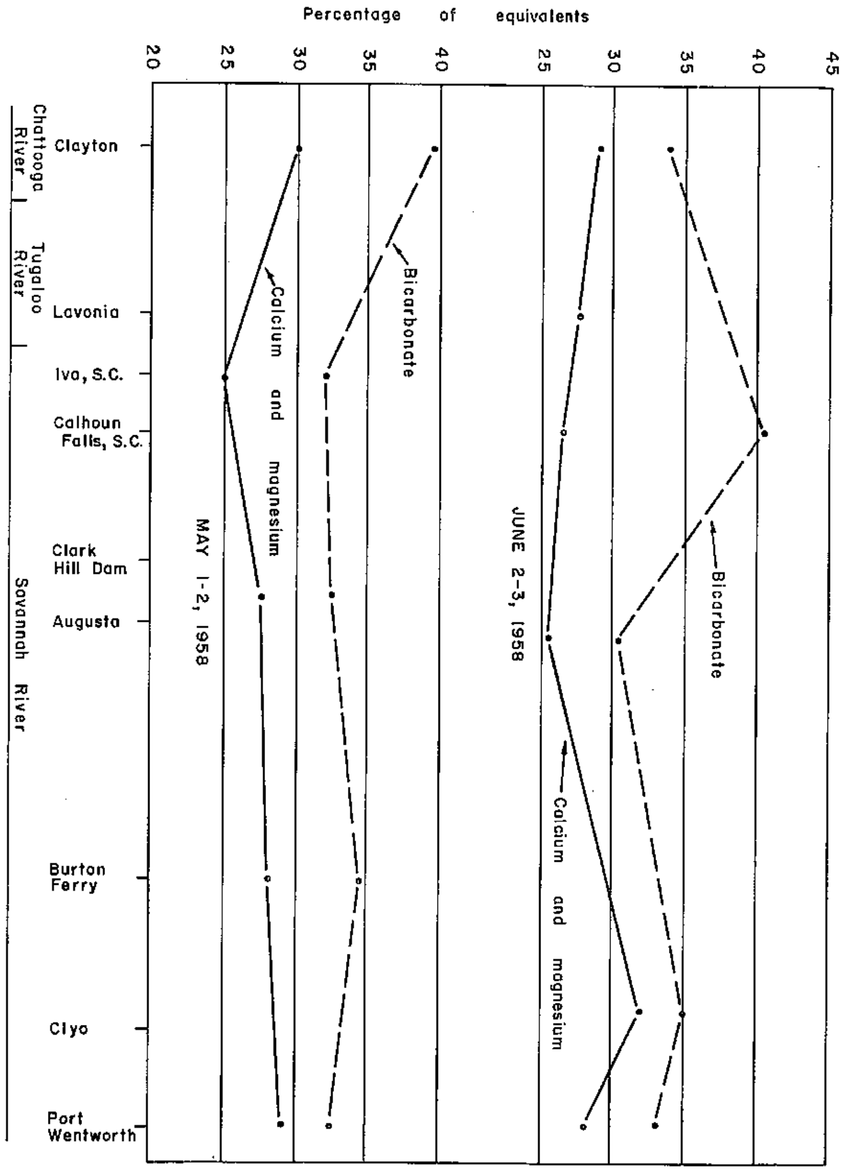

Figure 16. Chemical characteristics of water at various locations on the Savannah River during the May 1-2 and June 2-3, 1958 stream surveys.

are shown in figure 15. Specific conductance indicates the approximate mineral content of the water. The figure shows a trend of gradual increase in mineral content from the headwaters to the mouth of the Savannah River.

The chemical characteristics of the waters of the Savannah River main stem at various locations are shown graphically in figure 16.

The waters of the Savannah River basin are of excellent chemical quality. The mineral content in the headwater streams, such as the Chattooga, Tallulah, and Seneca Rivers, does not exceed 30 ppm. The concentrations gradually increase with increasing distance downstream. The greatest percentage increase occurs in the upper two-thirds of the stream; in the lower section, impoundment of waters in large reservoirs tends to smooth out the fluctuations in chemical concentrations. In the lower reaches of the Savannah River, salt-water intrusion affects the chemical quality of the water.

The waters of the Savannah River are soft, low in mineral content, and siliceous in type. In the headwater streams, silica comprises about 50 percent of the dissolved mineral matter. Below the Fall Line, proportionate increases of other minerals are greater so that silica concentrations are reduced to about 25 to 35 percent of the total. Bicarbonate is the predominant anion in samples collected from this stream, with the higher percentage in water from the mountainous areas.

Several cities dispose of their wastes in either the Savannah River or its tributaries, but these disposals had little effect on the mineral concentrations at the time of this study. This was due to the large quantity of water of low mineral content in the Savannah River in relation to the smaller quantities of more concentrated effluent from disposal plants. The effect of these disposals on the chemical quality of the river water during low flow conditions was not investigated.

The Chattooga 7 (12-17) and Tallulah 2 (16) Rivers drain areas of crystalline rocks. The waters from these streams are low in mineral content and siliceous in type. The highest content of dissolved minerals found in the streams was 17 ppm and about 50 percent of this was silica. Bicarbonate was the predominant anion in the samples analyzed.

South Beaverdam Creek at Dewey Rose carries a siliceous-type water of low mineral content 2 (26-30). Silica constitutes about 30 percent of the mineral matter. This stream drains areas of crystalline rocks.

Broad River 9 (31-50) and its tributaries and the Little River 2 (58-70) drain areas of crystalline rocks. The waters are siliceous in type, low in mineral content, and soft. Silica constitutes about 35 percent of the mineral matter. The cations, calcium and sodium, are present in nearly equivalent quantities; bicarbonate is the principal anion present. These streams are often turbid from finely divided clay particles carried as colloidal or suspended material.

Brier Creek 7 (24-40) usually is carbonate in type. Silica usually is less than 30 percent of the mineral matter. Calcium and bicarbonate are present in nearly equivalent quantities. The calcium and bicarbonate are derived from the beds of limestone found in the basin, and their presence as the predominant ions occurs usually during lower flow periods.

Ogeechee River

The Ogeechee River rises in the Piedmont province, near Crawfordville, in an area of crystalline rocks, flows southeastward through the upper and lower Coastal Plains, and enters the Atlantic Ocean near Savannah. At the gaging station near Eden, the Ogeechee River has a drainage area of 2,650 square miles and the average discharge for 19 years of

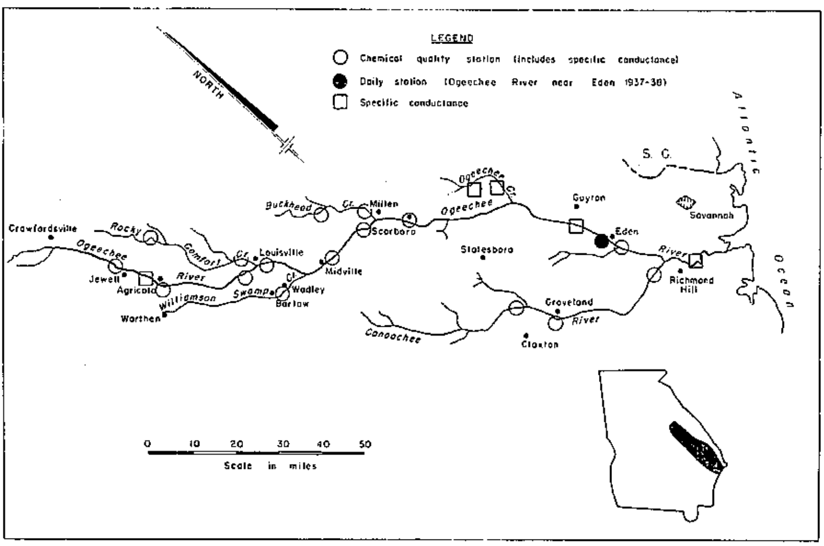

Figure 17. Approximate location of sampling points in the Ogeechee River basin.

record (1937-56) was 2,077 cfs (U. S. Geol. Survey Water-Supply Paper 1434, 1958, p. 15).

The Canoochee River, the principal tributary, joins the Ogeechee River approximately 30 miles below Eden. At the gaging station nearest its mouth, the drainage area is 555 square miles and the average discharge for 19 years of record (1937-56) was 400 cfs (U. S. Geol. Survey Water-Supply Paper 1434, 1958, p. 16).

The points on the Ogeechee River at which data on quality of water were obtained during this study and the point at which a daily station had been operated previously (Ogeechee River near Eden, 1937-38) are shown in figure 17.

The highest mineral content noted in water in this basin, 85 ppm, was in Buckhead Creek near Millen on May 30, 1958, and the lowest, 17 ppm, was in the Canoochee River near Claxton on February 28, 1958. The highest concentration on the main stem of the Ogeechee River was 68 ppm, at Jewell, May 30, 1958. The lowest was 24 ppm near Louisville on March 6, 1958.

One downstream reconnaissance was conducted during January 1958 and one during May 1958. The specific conductance of the water during these investigations is shown in figure 18. The chemical characteristics of the water of the Ogeechee River at various points during the two stream surveys are shown in figure 19.

Above the Fall Line, water from the Ogeechee River is siliceous in type and has little or no color. On May 30, 1958 the silica concentration was 26 ppm. Silica constitutes as much as 40 percent of the mineral matter. Comparatively high concentrations of silica are found in samples from the Little River, a tributary of the Savannah River, which drains similar geologic formations. The percentage equivalents of bicarbonate in the Ogeechee River are nearly constant above and below the Fall Line. These characteristics of the water are believed to be imparted by the geologic formations in the basin (crystalline rocks), as the industrial and municipal influences on this stream are considered insignificant.

The Ogeechee River above and below the confluence with Rocky Comfort Creek has a lower mineral content than above the Fall Line. This is probably caused by inflow of the ground and surface waters of lower concentration that result from contact of the waters with insoluble sands and gravels. An

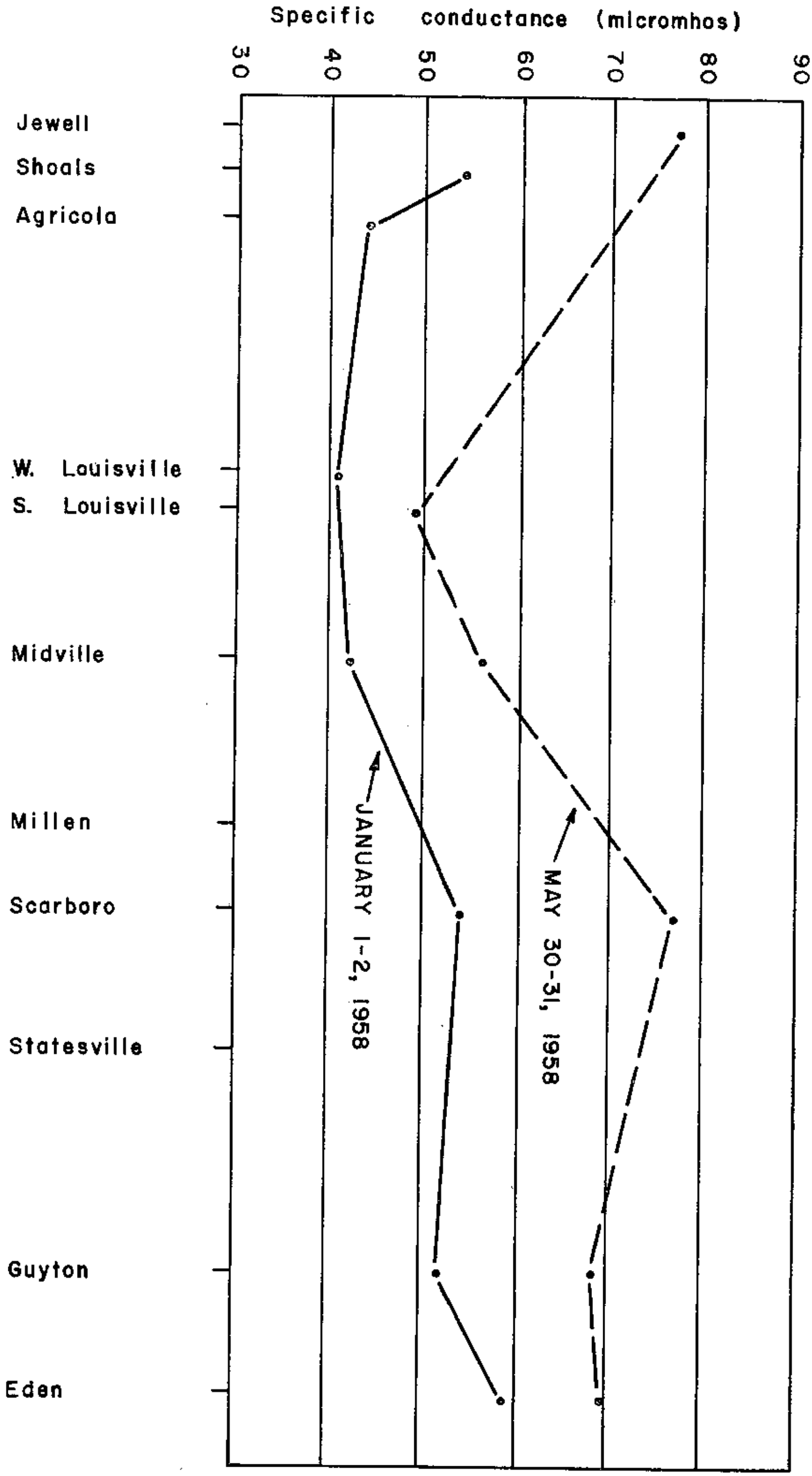

Figure 18. Specific conductance of water of Ogeechee River during stream surveys on Jan. 1-2, 1958 and May 30-31, 1958.

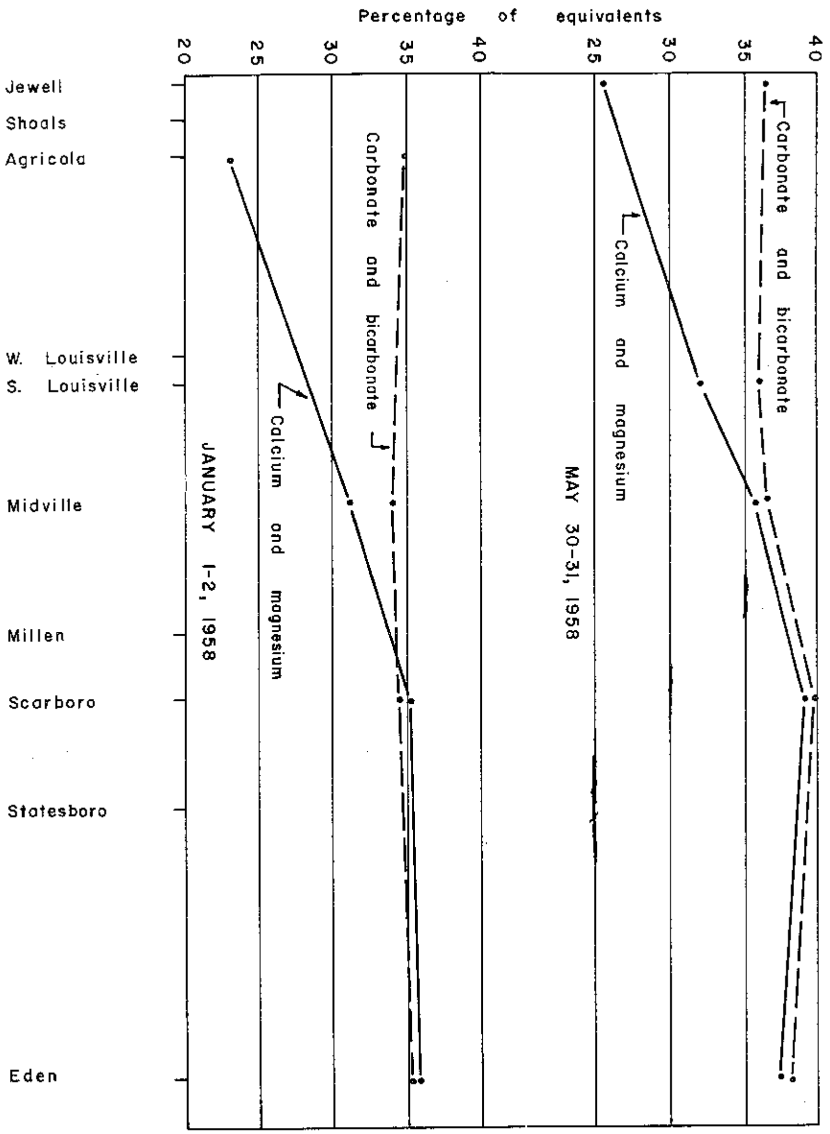

Figure 19. Chemical characteristics of water at various locations on Ogeechee River during stream surveys on Jan. 1-2, 1958 and May 30-31, 1958.

increase in concentration occurs from just below Louisville down to Scarboro, with the increase due principally to increases in calcium, magnesium, and bicarbonate. The calcium and magnesium (in equivalents per million) increase from about

50 to 75 percent of the total cations, and the sodium and potassium decrease proportionally. These increased concentrations are believed to be due to inflow of ground water of a carbonate type. Similar increases in concentration occur in the Oconee and Ocmulgee Rivers at about the same distance below the Fall Line.

Rocky Comfort Creek, a tributary of the Ogeechee, drains an area underlain by the sands and gravel of the Tuscaloosa and the sands and limestones of the Barnwell formations. Water from this stream generally is a siliceous, although sometimes a carbonate type, and frequently has appreciable color. For the most part, it possesses the characteristics of water from streams above the Fall Line but is less mineralized 4 (28-37). The color is characteristic of or similar to that of streams in the lower Coastal Plain.

Buckhead Creek near Millen has the highest mineral content 3 (45-84) of any stream sampled in the Ogeechee River basin. The water is a carbonate type and is soft to moderately hard. The characteristics are believed to be due to contact of the water with the marls found in the drainage basin.

Williamson Swamp Creek drains portions of the upper and lower Coastal Plains. The water is a soft, carbonate type, similar in characteristics to that of Buckhead Creek but less mineralized 2 (24-46).

The Canoochee River, the largest tributary of the Ogeechee River, differs in characteristics from other streams in the basin. The water is a siliceous type and generally has a high color, is soft, and of low mineral content 8 (17-29). It is similar to the Ohoopee and Little Ocmulgee Rivers in ratios of chloride to bicarbonate equivalents per million, mineral content, and color; these three stream basins are in the Coastal Plain and have about the same factors influencing the composition of the water.

Ocmulgee-Altamaha River Basins

The Ocmulgee River is formed in the Piedmont by the confluence of the South, Alcovy, and Yellow Rivers near Jackson. From Jackson it flows southeastward to the Hill-Telfair County line where it turns east, then southeast, and joins the Oconee River near Hazlehurst to form the Altamaha River. The Altamaha River flows southeastward and into the Atlantic Ocean near Darien. At the gaging station at Lumber City, 12 miles above the confluence with the Oconee River, the drainage area of the Ocmulgee River is 5,180 square miles and the average discharge was 5,264 cfs for 20 years of record, 1936-56 (U. S. Geol. Surv. Water-Supply Paper 1434, 1958, p. 25). The Altamaha at Doctortown, 59 miles above its mouth, has a drainage area of 13,600 square miles and the average discharge was 12,480 cfs for 25 years of record, 1931-56 (U. S. Geol. Surv. Water-Supply Paper 1434, 1958, p. 35).

Data were obtained in the Ocmulgee-Altamaha River basins at the locations shown on figure 20.

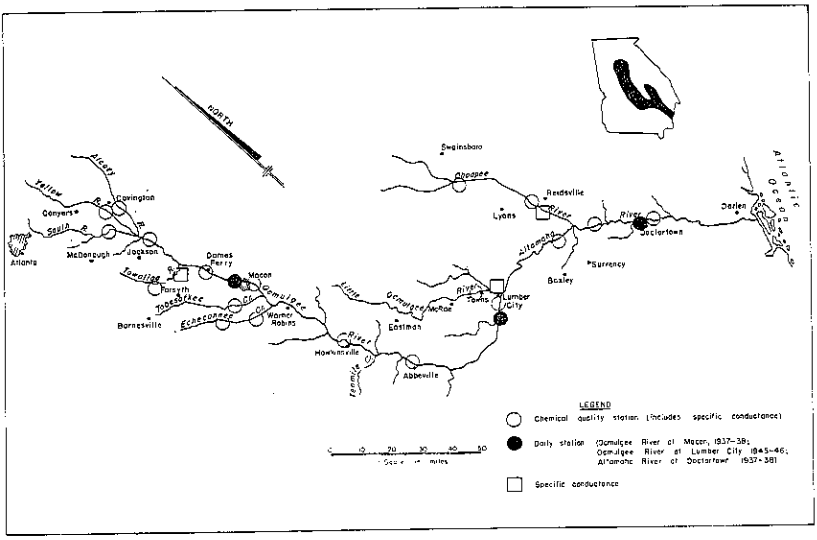

Figure 20. Approximate location of sampling points in the Ocmulgee-Altamaha River basin.

Stream surveys were made in December 1957 and May 1958 to give information on change in characteristics of water from the headwaters of the Ocmulgee River to the lower reaches of the Altamaha River. The specific conductance and chemical characteristics of water at various locations are shown in figures 21 and 22.

Above the Fall Line the water of the Ocmulgee River is siliceous in type, of low mineral content 12 (32-44), and soft. Approximately one-fourth of the mineral content is silica. About equal amounts (equivalents per million) of calcium, magnesium, and sodium are found in the Ocmulgee River. The color is less than 10.

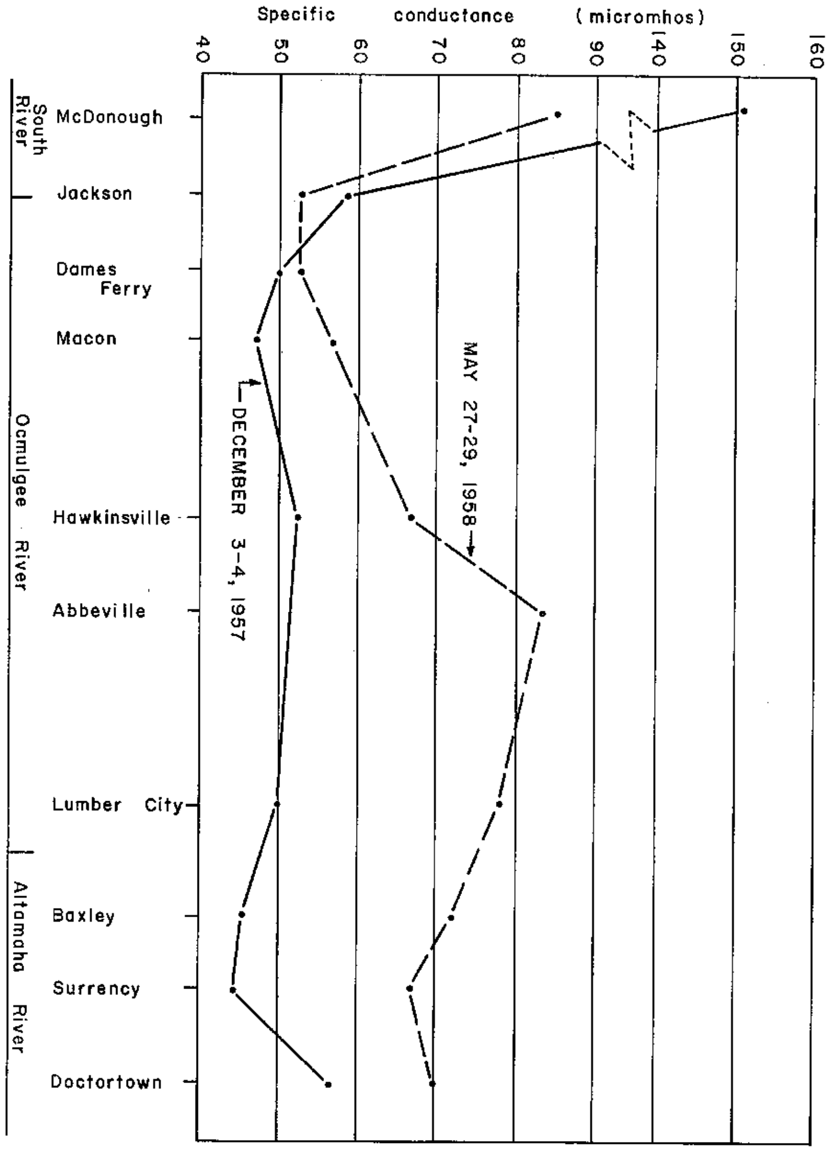

Figure 21. Specific conductance of water of the Ocmulgee and Altamaha Rivers during the stream surveys on Dec. 3-6, 1957, and May 27-29, 1958.

Below the Fall Line, during periods of higher flow, the composition of the water is similar to that above the Fall Line; during periods of lower flow, however, the water changes to

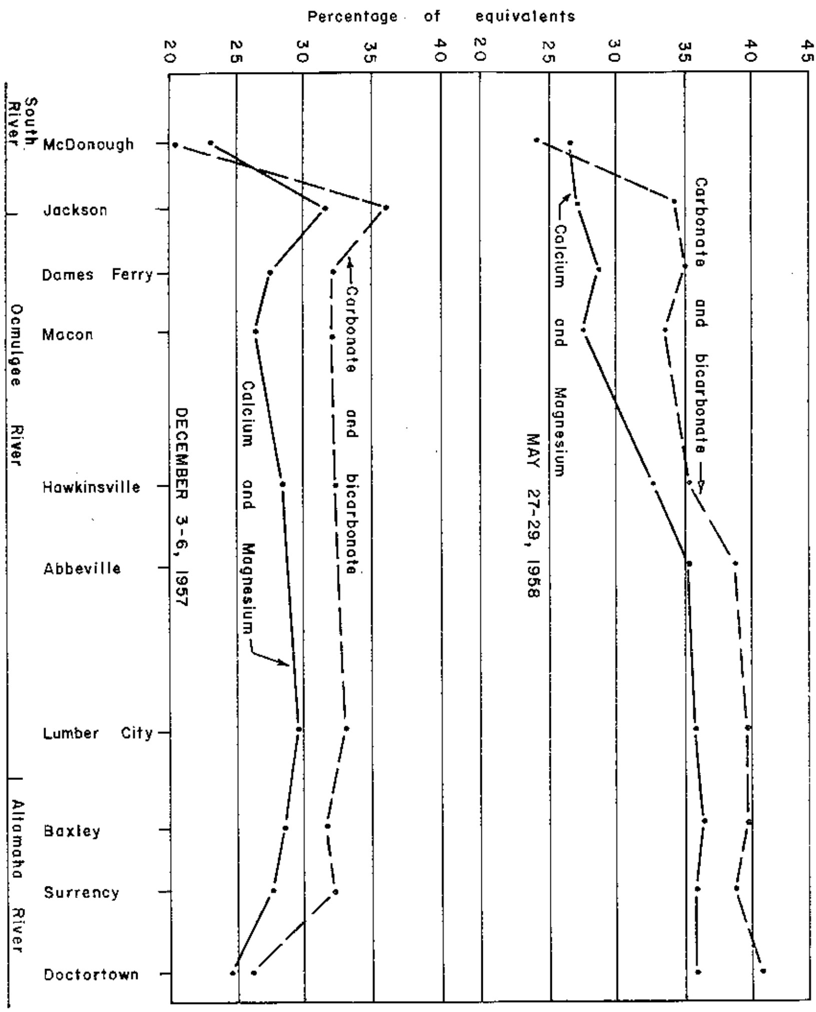

Figure 22. Chemical characteristics of water at various locations on the Ocmulgee and Altamaha Rivers during stream surveys on Dec. 3-6, 1957, and May 27-29, 1958.

a carbonate type, with the percentage of carbonates increasing downstream to about Abbeville and remaining almost constant for the remaining reaches of the stream. This change in composition is believed to be due to inflow of ground water of a carbonate type.

The highest mineral content (61 ppm) of the samples collected from the Ocmulgee-Altamaha Rivers was at Lumber

City, August 8, 1957. The lowest was 29 ppm at Doctortown, March 14, 1958. The highest concentration observed for the tributaries in the basin was 95 ppm in samples from the South River near McDonough, December 3, 1957; the lowest was 21 ppm from the Little Ocmulgee River at Towns, March 19, 1958, and from the Ohoopee River near Reidsville, March 12, 1958.

Correlation of mineral content with discharge above the Fall Line is not likely, as this stream is regulated by dams and some of the flow is diversion from the Chattahoochee and Flint River basins. Below Macon it is believed that some correlation of discharge with the mineral content would be possible.

The South River has the highest observed mineral content (95 ppm) of any stream in the Ocmulgee-Altamaha River basin. South River receives much of its flow as discharge from the DeKalb County Water System; the supply for the System is the Chattahoochee River. Comparatively high concentrations of sodium, chloride, sulfate, and nitrate are observed in this stream. These higher concentrations are due to disposals of industrial and municipal effluents into the stream in and near Atlanta.

Towaliga Creek receives much of its water from the Griffin Water System (supply—Flint River). The water quality of this stream near Forsyth is similar to that of other streams in the area although the water is slightly higher in concentration. It is suspected that during periods of lower flow, this stream would have characteristics considerably different from those observed this year.

Tobesofkee Creek, near Macon, drains an area of crystalline-type rocks. About one-fourth of the mineral content of the water is silica. The water is soft and is low in mineral content 2 (36-44); bicarbonate is the principal anion. The stream generally has little or no color but is noticeably turbid during periods of high flow.

Echeconnee Creek rises in the Piedmont and flows southeastward through the upper Coastal Plain to join the Ocmulgee River near Robins Air Force Base. Near Roberta and at Robins Air Force Base the water from this stream is low in mineral content 7 (22-46) and is soft. Silica constitutes about 30 percent of the dissolved material; bicarbonate is the predominant anion.

Most of the Little Ocmulgee River basin lies in the lower

Coastal Plain. Water from this stream is siliceous in type, soft, and low in mineral content 6 (21-35). The concentration is lower than that of water from streams in the Piedmont or upper Coastal Plain. A relatively high percentage of chloride-to-bicarbonate in equivalents per million is observed. This relatively high chloride is not readily explainable. The chloride-to-bicarbonate ratios in samples collected from this stream is characteristic of most streams in the lower Coastal Plain. The high color observed in the water probably is due to the decomposition of the organic matter and is a characteristic of streams of the lower Coastal Plain.

The Ohoopee River lies in the lower Coastal Plain. Water from this stream is colored, low in mineral content 8 (21-44), and soft. About one-fourth of the dissolved mineral matter is silica. The water is similar in character to that of the Little Ocmulgee River in that the chloride often is equivalent to or greater than the bicarbonate. Even though this stream lies in the lower Coastal Plain, the water sometimes has characteristics similar to those of streams in the Piedmont province.

Oconee River Basin

The Oconee River rises in the Piedmont province near Athens, flows southward past Milledgeville into the Coastal Plain, and joins the Ocmulgee River near Hazlehurst to form the Altamaha River. The principal tributaries of the Oconee River are: Middle Oconee River, Apalachee River, Richland Creek, Commissioners Creek, Little River, and Big Sandy Creek. The Oconee River near Mount Vernon, 29 miles above the mouth, has a drainage area of 5,110 square miles and for the period 1937-55 the average discharge was 4,977 cfs (U. S. Geol. Surv. Water-Supply Paper 1384, 1957, p. 36). There is some regulation of the flow by Barnett Shoals Dam and almost total regulation by Sinclair Dam at Milledgeville. During low flow periods, regulation by Sinclair Dam affects the flow downstream to the mouth. At Sinclair Dam 83 percent of the annual runoff is used for hydroelectric power generation.

The approximate location of points at which data on quality of water were obtained during the present study are shown in figure 23.

In the upper basin, igneous and metamorphic rocks which include granite gneiss and biotite gneiss predominate; in the

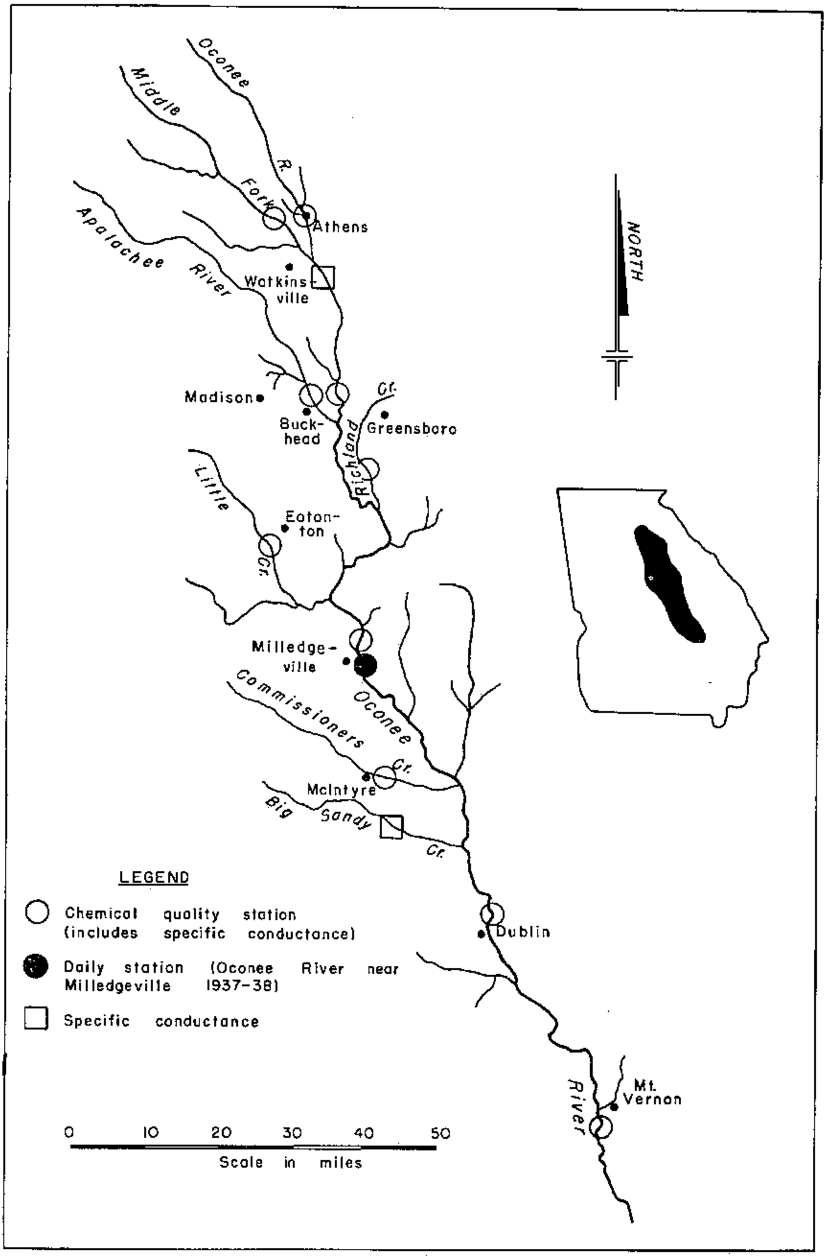

Figure 23. Approximate location of sampling points in the Oconee River basin.

lower basin sandstone, conglomerates and shale predominate. This, combined with the fact that the cultural influences are minor, causes the water to be low in mineral content and soft.

There is a slight decrease in specific conductance of the water from Athens downstream to Milledgeville, then an increase downstream to the mouth, as shown in figure 24. The increase from Dublin to Mount Vernon is greater during the period of lower flow, probably because of ground-water in-

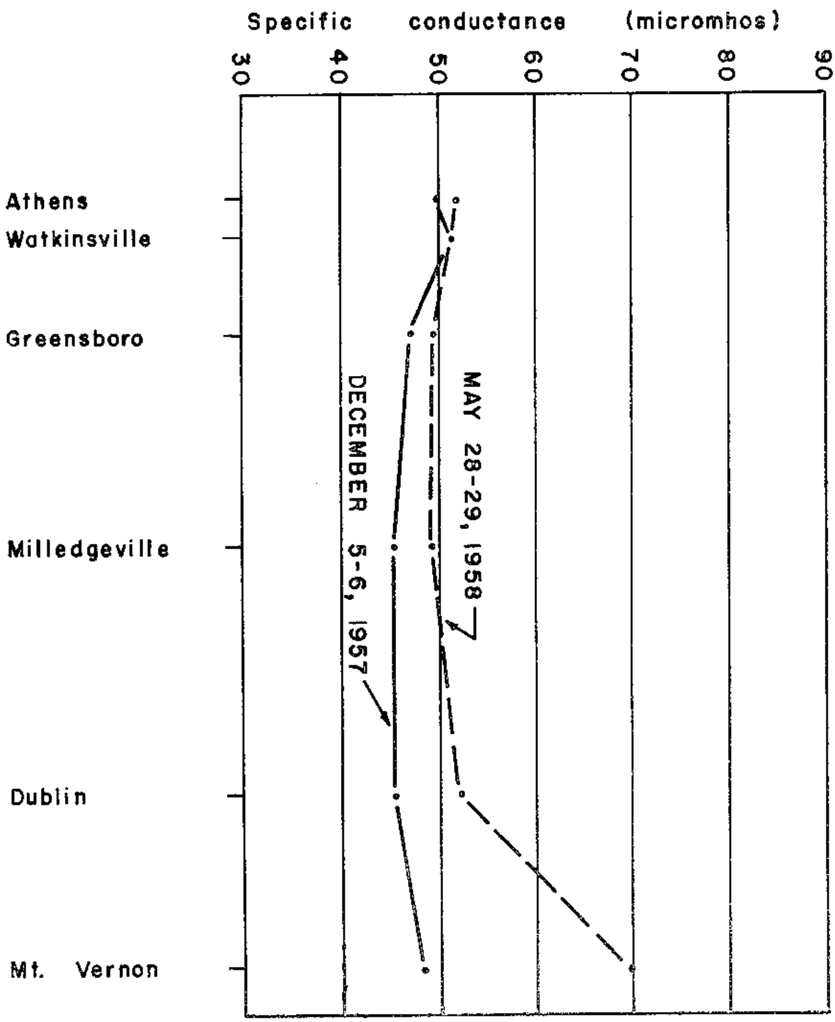

Figure 24. Specific conductance of water of Oconee River during stream surveys on Dec. 5-6, 1957, and May 28-29, 1958.

flow. The highest mineral content, 87 ppm, in any stream in the basin was in a sample from Richland Creek near Greensboro on May 28, 1958. The lowest was 30 ppm from the Apalachee River near Buckhead on May 3, 1958.

The Oconee River water is siliceous in type except during periods of lower flow when a carbonate-type water is found below Dublin. This is probably due to ground-water inflow between Dublin and Mount Vernon. Of the dissolved constituents, bicarbonate is the principal anion, usually constituting from 65 to 80 percent of the total anion equivalents per million, with the higher percentage occurring below Milledgeville. Except for periods of lower flow, when calcium predominates

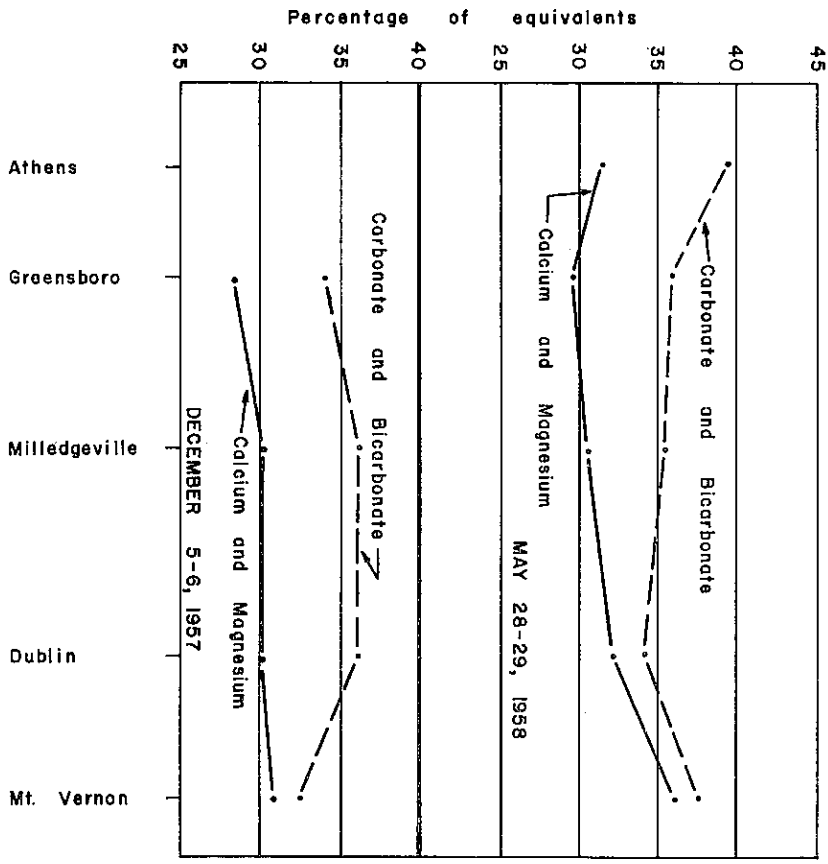

Figure 25. Chemical characteristics of water at various locations on Oconee River during stream surveys on Dec. 5-6, 1957, and May 28-29, 1958.

below the Fall Line, the cations of calcium, magnesium, and sodium occur in nearly equivalent quantities.

The characteristics of the water of the Oconee River from the headwaters to the mouth during stream surveys in December 1957 and May 1958 are shown in figure 25.

Several cities dispose of their waste in the Oconee River, but analyses of samples collected during this reconnaissance indicated that the mineral characteristics of the water were not greatly altered. This period of study was during one of higher than normal flows and some increase in concentration and change in composition of the water may be expected during extreme low flow periods.

Waters from the Middle Oconee River, Oconee River above Athens, Apalachee River, and Little River are siliceous in type, of low mineral content 13 (30-53), and soft. The silica constitutes better than 30 percent of the dissolved mineral matter. The color is low but the streams are often turbid during periods of high flow. This turbidity appears to be caused by finely divided clay particles. The cations, calcium and sodium, are found in nearly equal amounts; the principal anion is bicarbonate. All of these streams drain areas of crystalline-type rocks.

Richland Creek near Greensboro has the highest mineral content (87 ppm) of any stream sampled in this basin. The water is carbonate in type, comparatively high in silica, and of low color. Calcium and sodium are the principal cations. This stream drains areas of crystalline rocks but the character of the water is affected by waste disposals at Greensboro.

Commissioners Creek near McIntyre drains an area of conglomerates, sandstone and shale. As a result of mining operations in the basin, the water of this stream is somewhat higher in mineral content 2 (43, 61) and dissimilar in character to that of other streams in the State draining similar geologic formations. In one sample collected, sulfate was the predominant mineral constituent (24 ppm); in another, sulfate was comparatively high (11 ppm) in relation to the other dissolved ions present but was smaller in quantity than silica.

The Middle Oconee River and the Oconee River above Athens, and the Alcovy and Yellow Rivers, headwater streams of the Ocmulgee River, drain areas similar in geology and are relatively free of cultural influences. Data collected during the stream surveys show similar concentrations of individual constituents in these streams.

Lower Coastal Plain River Basins

The Satilla River, part of the St. Marys River basin, and the headwater streams of the Suwannee and Ochlockonee Rivers lie within the lower Coastal Plain of Georgia. Figure 26 shows

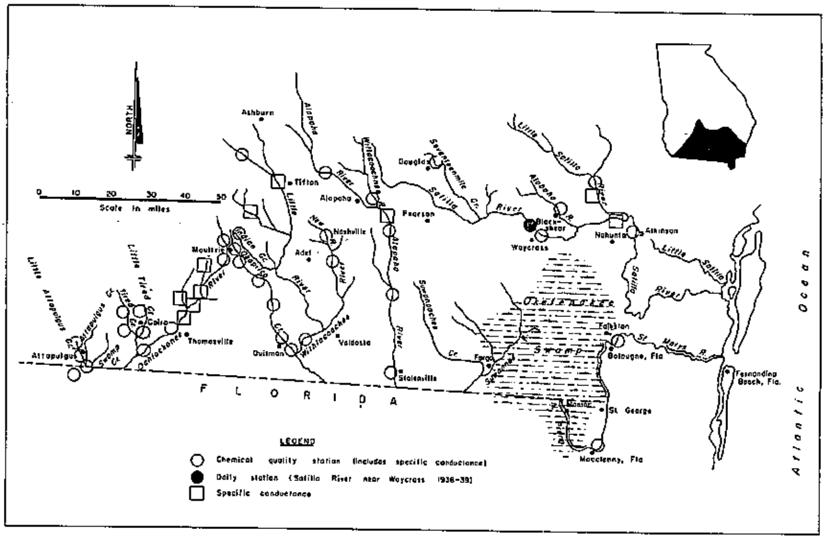

Figure 26. Approximate location of sampling points in the basins of the lower Coastal Plain rivers.

the location of the points in these basins where data on quality of water were obtained during the current study.

Generally, the waters of the Coastal Plain rivers are low in mineral content and soft. For these streams, other than the points where cultural influences were significant, the lowest concentration of dissolved minerals was 17 ppm and the highest was 60 ppm. Sodium and chloride usually are the predominant ions; however, the concentration of silica is often greater than any other constituent. Streams in the Coastal Plain are the only ones in the State in which chloride normally exceeds bicarbonate in equivalents per million. Salts transported by winds from over the ocean and deposited with rain could account for a part of the chloride. The waters often have pH values lower than 5.5 and in several instances lower than 4.5.

The color frequently is higher than 200 units and occasionally exceeds 500 units. The ratios of the sum of the determined constituents-to-the dissolved solids were usually less than 0.5, indicating that a large part of the dissolved solids is organic material. As the lower pH values and higher color of the water were usually accompanied by lower ratios of sums of determined constituents-to-the dissolved solids, an interrelation of these factors is suggested. More information is required before any conclusion can be drawn concerning the possible relationships.

The Satilla River at Atkinson, approximately 50 miles above the mouth, has a drainage area of 2,880 square miles and an average discharge for 25 years of record (1931-56) of 1,941 cfs (U. S. Geol. Survey Water-Supply Paper 1434, p. 39). The water of the Satilla River basin is soft, siliceous in type, and low in mineral content 17 (19-32). Silica constitutes about 25 percent of the mineral content. The color of the water is often high; one sample had a color of 250 units. The pH ranges from 4.5 to 5.9. Sodium and chloride are the predominant ions and are present in nearly equivalent quantities.

The North Prong St. Marys River flows from the Okefenokee Swamp and joins the South Prong near Macclenny, Florida, to form the St. Marys River. The St. Marys River flows north and then eastward to enter the Atlantic Ocean near Fernandina, Florida, forming the Georgia-Florida State boundary downstream from near Moniac, Georgia. Near Macclenny, Florida, the drainage area of the St. Marys River is approximately 720 square miles (includes part of watershed in Okefenokee Swamp which is indeterminate) and the average discharge for 30 years of record (1926-56) was 634 cfs (U. S. Geol. Surv. Water-Supply Paper 1434, p. 42). North Prong St. Marys River was sampled once near Moniac, Georgia, and the St. Marys River was sampled twice near Macclenny and Boulogne, Florida. During the May 1958 reconnaissance, at the edge of the Okefenokee Swamp at Moniac, the water of the North Prong was a chloride type; however, on the basis of the chemical equivalents per million, the hydrogen ion was greater than either the sodium or chloride. The pH of the water was 4.3 and the color was 550 units. Near Macclenny the water of the St. Marys River was a chloride type, the pH was 4.8, and the color was 380 units. At Boulogne the water was a chloride type, the pH was 6.0, and the color was 350 units.

The Suwannee River flows southwestward from the Okefénokee Swamp and enters Florida from southeastern Echols County. The drainage area at Fargo is about 1,260 square miles (includes part of watershed in Okefenokee Swamp which is indeterminate) and the average discharge for 23 years of record (1927-31, 1937-56) was 1,040 cfs (U. S. Geol. Surv. Water-Supply Paper 1434, 1958, p. 131). The principal tributaries of the Suwannee River originating in Georgia are: Alapaha River and the New River-Withlacoochee River system. The Suwannee River at Fargo receives its flow from the Okefenokee Swamp. At this point the water is chloride in type, of low mineral content 5 (17-25), and soft. The water is highly colored—color sometimes exceeding 400 units. Of the seven samples collected, the pH ranged from 4.2 to 4.4.

The Alapaha River has its headwaters near Ocilla and flows southward to join the Suwannee River in Florida. At Statenville, which is about five miles north of the Florida State line, the drainage area is approximately 1,400 square miles and the average discharge was 910 cfs for 24 years of record (1932-56) (U. S. Geol. Surv. Water-Supply Paper 1434, 1958, p. 134). The waters are of low mineral content 9 (20-29) and are usually siliceous in type. Sodium and chloride are the principal ions in solution.

The Withlacoochee River is a tributary of the Suwannee River. Tributaries of the Withlacoochee River include New River, Little River, and Okapilco Creek. Near Pinetta, Fla., about 5 miles south of the Georgia-Florida State line, the drainage area of the Withlacoochee River is approximately 2,220 square miles and the average discharge for 25 years of record (1931-56) was 1,398 cfs (U. S. Geol. Survey Water-Supply Paper 1434, 1958, p. 136). The waters of the streams in this basin, which are not significantly influenced by cultural factors, are sometimes siliceous and sometimes chloride in type. They are low in mineral content 16 (20-56), and silica sometimes constitutes 25 to 30 percent of the total. Color as high as 150 units is noted in some of the streams. The pH values usually range from 5.6 to 6.3.

Okapilco Creek, a tributary of the Withlacoochee River, is influenced by waste disposals at Moultrie. On November 8, 1957, the stream above the town had a specific conductance of 63 micromhos; at the crossing at Highway 37 the conductance was 983 micromhos and the mineral content was 524 ppm. The mineral content at Highway 33 crossing at the city limits south of Moultrie during the December reconnaissance was 115 ppm. Of this content 45 ppm. was chloride and 31 ppm was sodium. About 6 miles downstream, the concentration had decreased to 62 ppm, of which 21 ppm was chloride and 13 ppm was sodium. This decrease in concentration was due to the inflow of the tributaries of lower concentration.

The Ochlockonee River, with headwaters near Moultrie, flows southwestward and enters Florida near Concord. At Thomasville, which is about 15 miles above the Georgia-Florida State line, the drainage area is approximately 550 square miles and the average discharge was 432 cfs for 19 years of record (1937-56) (U. S. Geol. Survey Water-Supply Paper 1434, 1958, p. 150). The water of the Ochlockonee River is usually of a chloride type, low in mineral content 10 (25-55), and soft. The pH of 13 samples ranged from 5.9 to 6.5.

Tired Creek near Cairo (tributary to the Ochlockonee River) is siliceous in type, of low mineral content 4 (27-36), and soft. The pH of the water usually is about 6.2.

Little Tired Creek, a tributary of Tired Creek, is influenced by waste disposals from Cairo. One sample collected from this stream had a mineral content of 996 ppm, of which 335 ppm and 575 ppm were sodium and chloride, respectively. Appreciable amounts of sulfate were also present. On November 8, 1957, the mineral content was 752 ppm, of which 272 ppm was sodium and 430 ppm was chloride. During a period of high flow (Jan. 1, 1958), specific conductance of the stream above the town was 37 micromhos and at Highway 93, south of the town, was 242 micromhos.

Little Attapugus Creek in Attapulgus, just below the plant processing fuller's earth, contained about 0.6 ppm of total acidity on December 29, 1958. The pH of the water was 3.6 and the mineral content was 69 ppm. Big Attapulgus Creek downstream from the confluence with Little Attapulgus Creek did not appear to be appreciably influenced by industrial wastes. The mineral content was 28 ppm and pH was 4.9 on December 29, 1958.

Chattahoochee River basin

The Chattahoochee River rises in the Blue Ridge Mountains near Cleveland, flows southwestward through the Piedmont to near West Point, then southward, forming the Georgia-

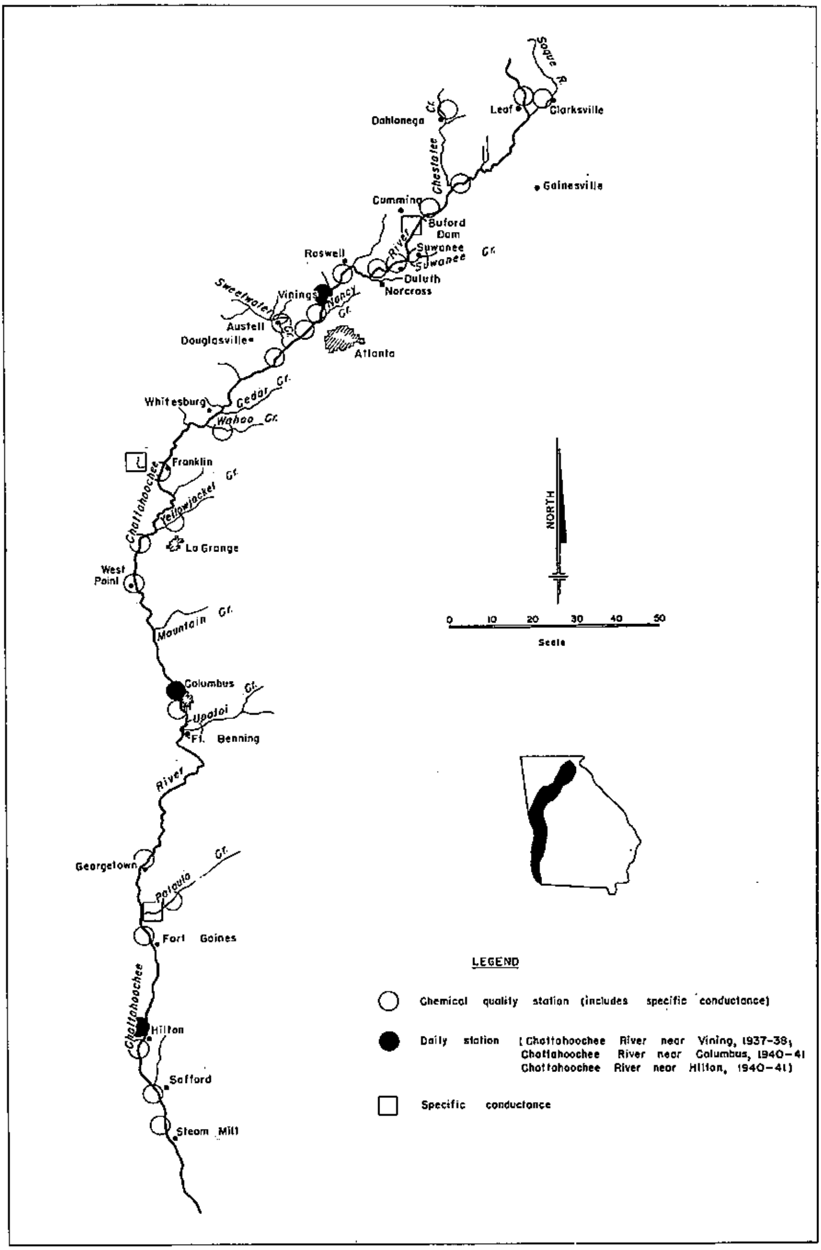

Figure 27. Approximate location of sampling points in the Chattahoochee River basin.

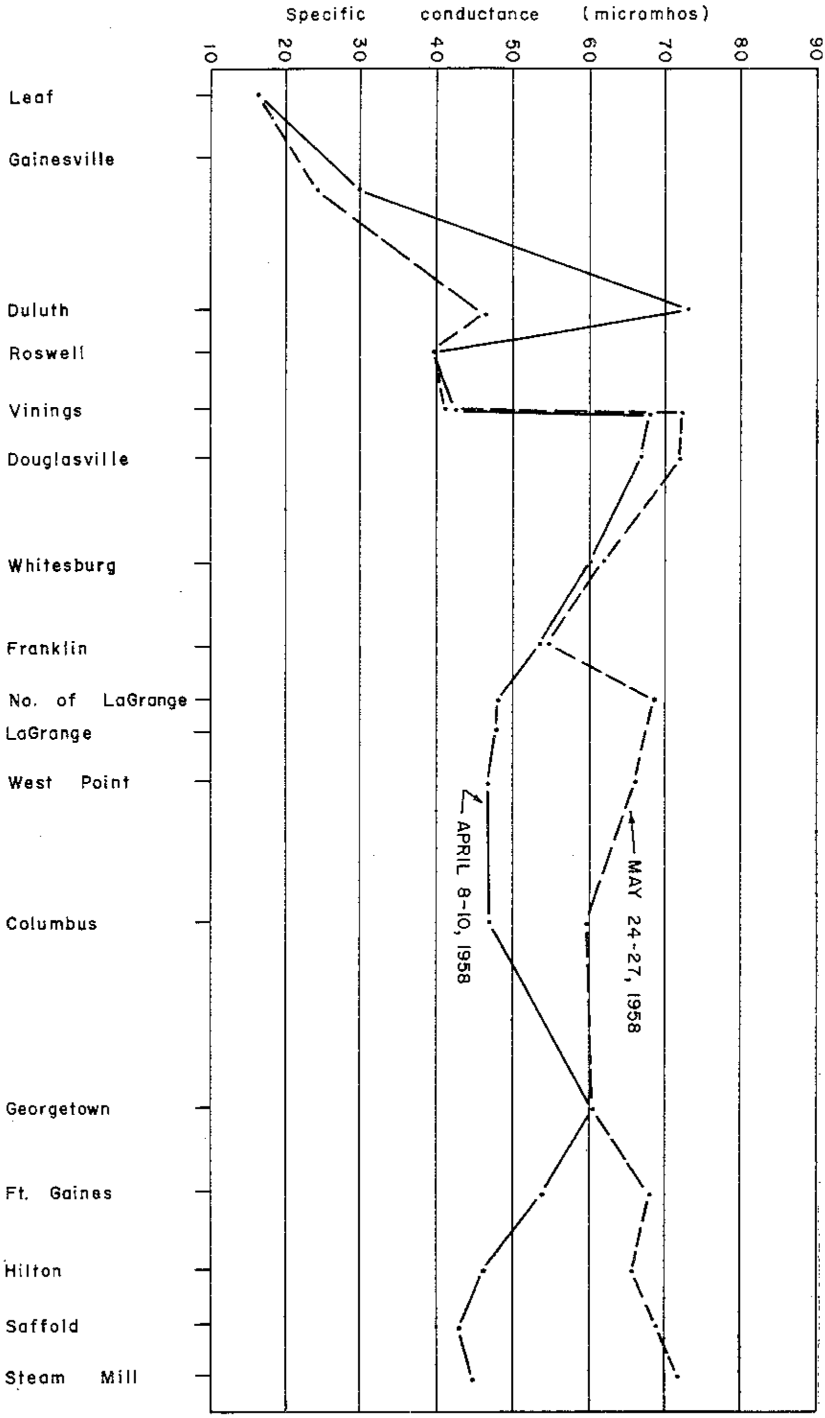

Figure 28. Specific conductance of water of Chattahoochee River during stream surveys on Apr. 8-10 and May 24-27, 1958.

Alabama State boundary, and joins the Flint River in the reservoir of the Jim Woodruff Dam to form the Apalachicola River. At Hilton, which is about 49 miles above the confluence with the Flint River, the Chattahoochee River has a drainage area of 8,040 square miles and the average discharge for 28 years of record, 1928-56, was 10,600 cfs (U. S. Geol. Survey Water Supply Paper 1434, 1958, p. 171). The flow of the Chattahoochee River is regulated by Buford Dam near Gainesville and a series of dams below West Point. The water from this stream supplies about 22 percent of the homes in Georgia, not including the several communities that utilize water from its tributaries.

The locations at which data on the quality of water were obtained during the present study are shown in figure 27.

The Chattahoochee River, from the headwaters to near Columbus, drains areas of crystalline rocks. Below Columbus to the confluence with the Flint River, the drainage area is composed of the sedimentary rocks of the Coastal Plains.

Specific conductances of water during the downstream reconnaissance of April and May 1958 are shown in figure 28.

The characteristics of water at various locations is shown in figure 29.

The water is low in mineral content (less than 25 ppm) and siliceous in type from the headwaters downstream to near Duluth. A sharp increase in concentration occurred just above Duluth at the confluence with Suwannee Creek. Suwannee Creek was noticeably turbid during the April reconnaissance and was relatively high in mineral content (70 ppm). Inflow of this creek caused an increase in mineral content and increase in color in the Chattahoochee River. The Chattahoochee River at Duluth was carbonate in type and the concentration of 48 ppm was the highest at any point from the headwaters downstream to Atlanta.

From near Duluth downstream to Whitesburg the water is carbonate in type, but the mineral content decreases downstream to the gaging station at West Paces Ferry Road at Atlanta. At Highway 3 Bridge, which is below the gaging station, an increase in concentration is observed (fig. 30). This increase is attributed to sewage effluent from the disposal plant on the south bank of the Chattahoochee River. At this point the water had a specific conductance of 135 micromhos at the south bank and 58 micromhos at the north bank. The

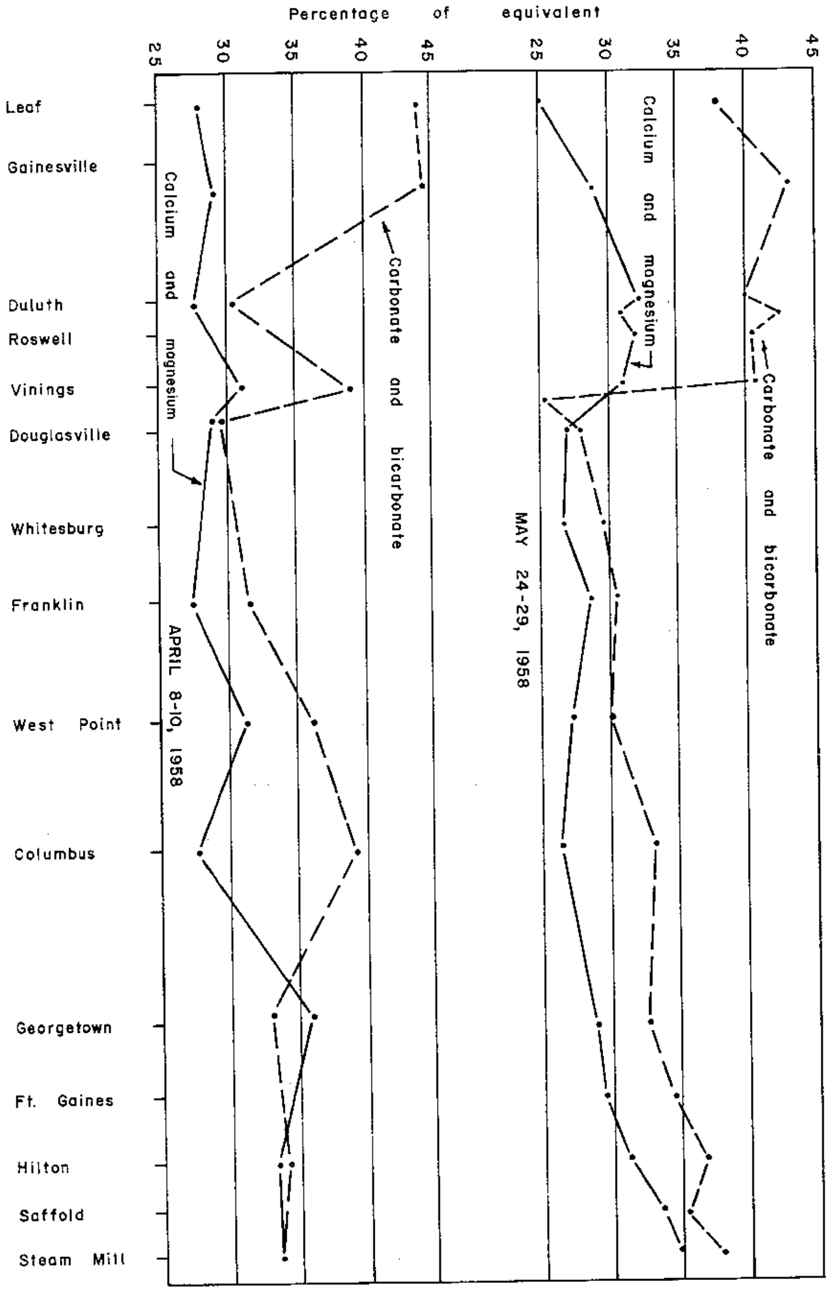

Figure 29. Chemical characteristics of water at various locations on the Chattahoochee River during stream surveys on Apr. 8-10 and May 24-27, 1958.

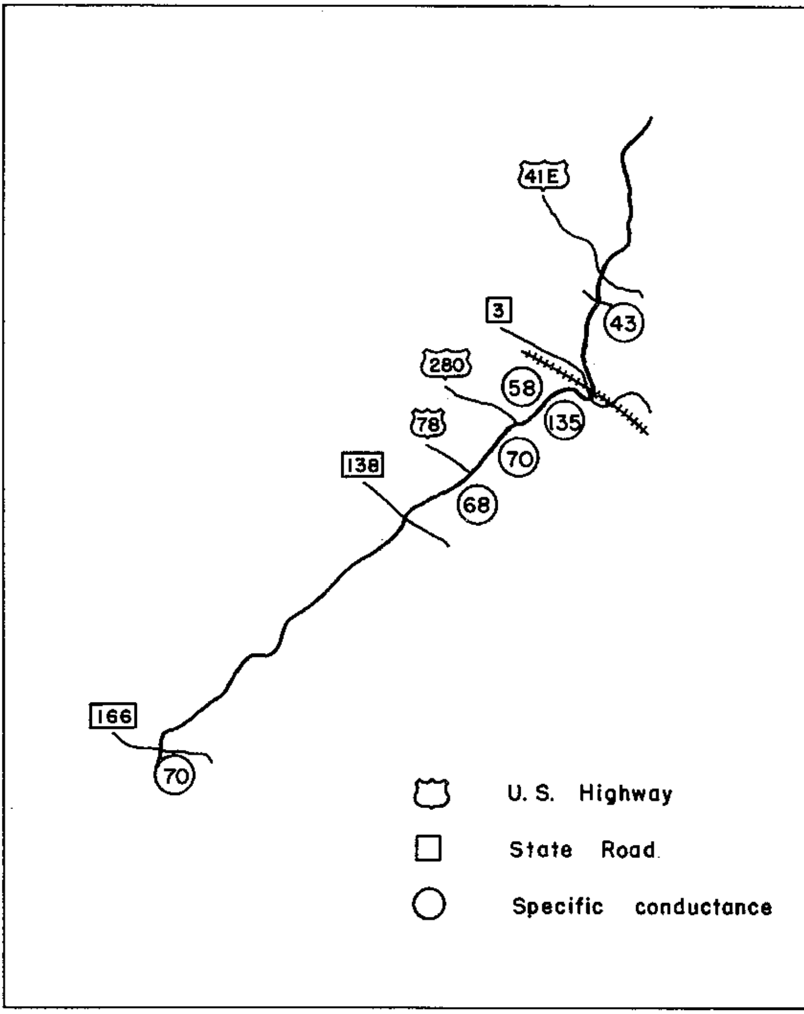

Figure 30. Specific conductance of water of Chattahoochee River in the Atlanta area.

water on the south side was noticeably turbid and on the north side it was relatively clear. About 2 miles downstream from the plant, at Highway 280 crossing, the specific conductance was 70 micromhos. The specific conductance remained near constant downstream to the Highway 166 crossing, near Douglasville. From this point to Whitesburg the concentration decreases and the water tends to become siliceous in type.

From Whitesburg to below Columbus the water is siliceous in type and continues to decrease in mineral content. This change in type and decrease in concentration is believed to be due to water from tributaries of low mineral content but with high percentage concentrations of silica.

During the May reconnaissance the water of the Chattahoochee River below Columbus to the confluence with the Flint River tended to become carbonate in type and to increase in concentration. However, during the April reconnaissance intense rainfall occurred and a decrease in concentration was observed from Georgetown downstream.

Tributaries such as the Chestatee River near Dahlonega and the Soque River near Clarksville drain areas of crystalline rocks. Their waters are siliceous in type, of low mineral content 8 (19-24), and soft.

Suwannee Creek near Duluth drains areas of crystalline rocks but is influenced by waste disposals. On April 8, 1958, this disposal caused the water to be relatively high in dissolved mineral matter (48 ppm) as compared to that of the Chattahoochee River above the confluence (25 ppm).

Nancy Creek at West Paces Ferry Road flows through Atlanta. One sample collected was siliceous in type and was relatively high in dissolved mineral matter (54 ppm). Bicarbonate was the principal ion. The influences controlling the composition of the water of this stream were not determined. As the water is of somewhat higher concentration than that from other streams draining areas of crystalline rocks, it appears that it may be influenced by cultural activities.

Sweetwater Creek near Austell drains areas of crystalline rocks. The water is siliceous in type and low in mineral content 2 (44-47).

Wahoo Creek near Arnco Mills drains areas of crystalline rocks and is influenced by disposals of wastes that cause the water to be noticeably turbid. The water is siliceous in type.

Yellowjacket Creek near LaGrange drains areas of crystalline rocks. The water does not appear to be significantly influenced by cultural activities; it is siliceous in type, of low mineral content 2 (36-47), and soft.

Upatoi Creek near Fort Benning drains areas of conglomerate in the sedimentary rocks and gneisses found in the crystallines. It does not appear to be significantly influenced by wastes. Consequently, the water is low in mineral content 3 (20-29) and siliceous in type.

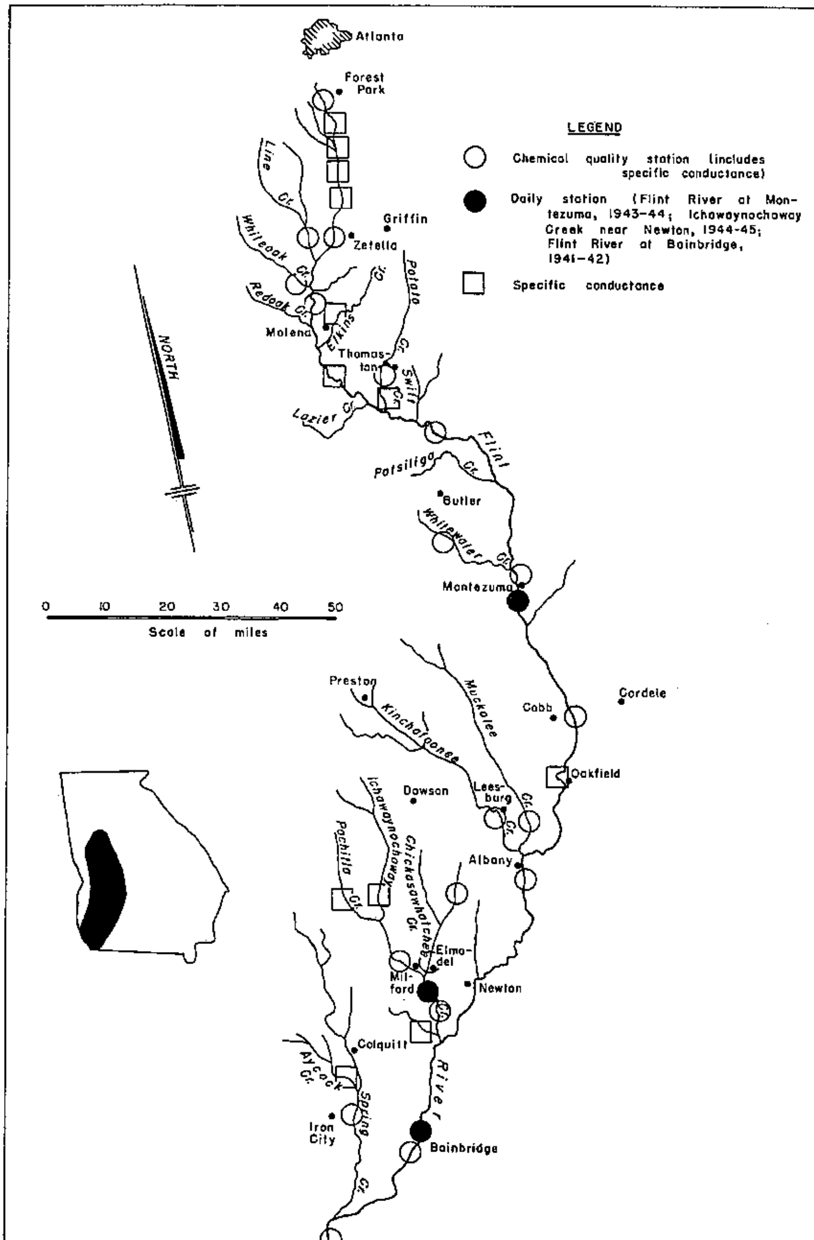

Figure 31. Approximate location of sampling points in the Flint River basin.

Pataula Creek near Hatcher drains an area of conglomerates, shales, and sandstones. The water of this stream is low in mineral content 2 (31-39) and siliceous in type.

Flint River basin

The Flint River rises in an area of crystalline rocks in the vicinity of Atlanta and flows southward through the Piedmont and the Coastal Plain, joining the Chattahoochee River in the reservoir of the Jim Woodruff Dam to form the Apalachicola River. At Bainbridge, 29 miles above the Jim Woodruff Dam, the Flint River has a drainage area of 7,350 square miles and an average discharge for the period 1908-13, 1929-56, of 8,284 cfs (U. S. Geol. Survey Water-Supply Paper 1434, 1958, p. 181). The flow of this stream is regulated by power plants near Cordele, Albany, and Recovery.

During the present study samples were collected at the 24 locations shown in figure 31. In addition stream surveys were made in October 1957 and May 1958.

The specific conductance of the water during the stream surveys is shown in figure 32.

The percentage of equivalents of calcium plus magnesium and of bicarbonate, as determined from analyses of samples collected at various locations during the surveys, is shown in figure 33.

Above Zetella during periods of high flow, the water is soft, siliceous in type, and low in mineral content (32 ppm). Bicarbonate is the principal ion. In periods of low flow the characteristics probably would depend on the composition of the industrial and municipal wastes entering the Flint River in and near Atlanta. At different times sodium, sulfate, or chloride ions predominate. From Zetella to the Fall Line the water of the Flint River is a siliceous type, of low mineral content 8 (28-51), and soft. These characteristics of the water appear to be related to the geologic formation of the area.

From Zetella southward through the Piedmont and upper Coastal Plain to the reservoir near Cobb, the water is diluted by the less concentrated streams such as Line Creek, Whiteoak Creek, Elkins Creek, and Whitewater Creek, reaching the point of least concentration just above the reservoir at Cobb. In the reservoir at Cobb, the mineral content increases and the water changes to a more pronounced carbonate type. This is probably due to increased ground-water inflows. Increases in

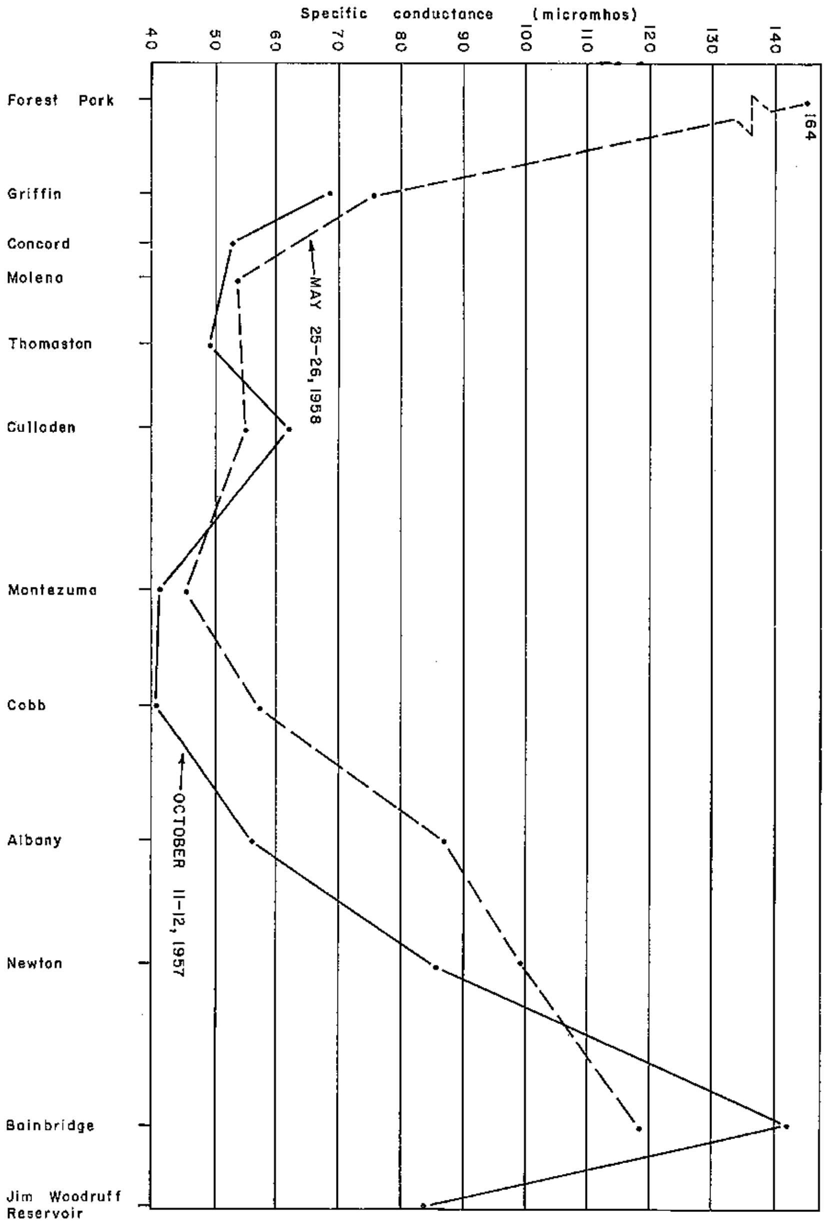

Figure 32. Specific conductance of water of Flint River during stream surveys on Oct. 11-12, 1957 and May 25-26, 1958.

Figure 33. Chemical characteristics of water at various locations on Flint River during stream surveys on Oct. 11-12, 1957, and May 25-26, 1958.

concentration from the reservoir outflow to the mouth were observed. The increase is more apparent during periods of lower flow when higher percentages of the water of the river is from ground-water sources.

The waters of the tributaries to the Flint River vary in characteristics as well as in mineral content. Generally, the waters of the tributaries entering the river above Cobb are siliceous in type, low in mineral content 12 (9-45), and soft. Below Cobb the waters of the tributaries are of a carbonate type, of higher concentrations 31 (20-112), and of higher color. Waters of the highest concentrations are in the southwestern corner of the basin. The surface formation in the area is limestone and the waters are a typical carbonate type. The color is a result of the decomposition of vegetation and contact with cypress trees in the swampy areas.

Line Creek, south of Atlanta, drains an area of crystalline-type rocks consisting chiefly of gneiss and schists. The drainage basin is similar to the Flint River above Zetella but the stream does not receive wastes as does the Flint River. The water from this stream is siliceous in type, low in mineral content 3 (29-45), and soft. Nearly equivalent quantities of calcium and sodium are found in water from this stream. Bicarbonate is the predominant anion, ranging from 70 to 80 percent of the total anions. The water has little color.

Whiteoak Creek and Potato Creek drain areas similar in geology and topography to that of Line Creek; consequently, the water is similar in composition.

In the drainage basin of Whitewater Creek the Clayton, Cussetta, and Tuscaloosa formations are exposed at the surface. These formations are composed of clays, sands, and gravels and are relatively insoluble in water. The water of Whitewater Creek is low in mineral content and soft; silica makes up from 26 to 58 percent of the dissolved mineral matter. The stream was sampled six times during this study and none of the samples had concentrations greater than 12 ppm.

The water from Muckalee Creek is a carbonate type, of low mineral content 2 (31-50), and soft. Concentrations of dissolved mineral matter are somewhat higher than those of streams above the Fall Line but are not as high as those of streams of the Flint River basin in the extreme southwestern part of the State. The water often has some color and, during periods of high flow, is noticeably turbid.

The water from Kinchafoonee Creek is a siliceous type, of low mineral content 7 (22-35), and soft. The geologic formations exposed at the surface in the drainage area of this stream are mostly sands and gravels; as a consequence the water has a lower mineral content than that of Muckalee and Chickasawhatchee Creeks.

Ichawaynochaway Creek rises in an area where sands and gravels are the surface formations and flows southward to join the Flint River about midway between Newton and Bainbridge.

From near Morgan to the confluence of Ichawaynochaway Creek with the Flint River, there are many limestone outcrops. Specific conductances were obtained within a few minutes of each other from streams in this area during the May reconnaissance. As indicated by these results (fig. 34), the water of the Ichawaynochaway has a low mineral content from the headwaters to near Morgan. The drainage area of the Ichawaynochaway Creek near Morgan is 600 square miles, and the conductance of the water was less than 40 micromhos. At Milford, the drainage area is 620 square miles and the conductance was 80 micromhos. In this additional 20 square miles of drainage area the conductance and mineral content of the water doubled. Pachitla Creek, which drains the same geologic formation as the headwaters of the Ichawaynochaway Creek, had a conductance of 40 micromhos (about the same as the Ichawaynochaway Creek near Morgan).

Chickasawhatchee Creek, a tributary of the Ichawaynochaway Creek, is of higher concentration 6 (20-90) than Ichawaynochaway Creek. This is expected since nearly all of the Chickasawhatchee Creek basin is in the limestone area. The water of this stream is soft to moderately hard and is a carbonate type. The water generally contains some color 6 (8-70).

Near Newton, which is below the confluence with the Chickasawhatchee Creek, water of the Ichawaynochaway Creek is a carbonate type and is representative of a mixture of the waters of the Chickasawhatchee and Ichawaynochaway Creeks. Generally, the water has color 3 (22-32).

Spring Creek near Iron City drains a limestone area similar to the area drained by Chickasawhatchee Creek, and samples collected from the streams on the same day were almost identical in chemical character. The water of Spring Creek is a

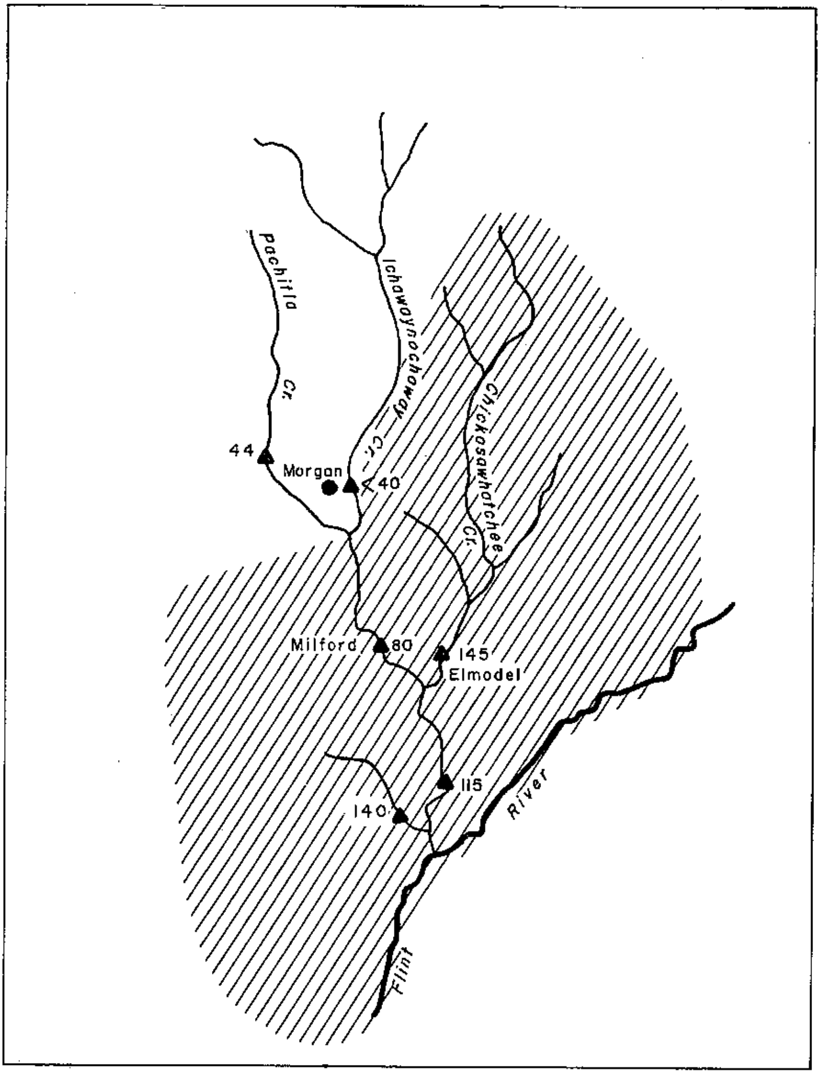

Figure 34. Change in specific conductance of water of streams flowing from areas of less soluble material to an area of more soluble material.

carbonate type, of moderate concentration 5 (64-112), and of moderate hardness.

Coosa River basin

The Coosa River is formed by the confluence of the Oostanaula and Etowah Rivers at Rome and flows westward to the

Alabama State line. At the gaging station near Rome, which is about 30 miles above the Alabama line, the drainage area is 4,040 square miles and the average discharge for 22 years of record (1928-31, 1937-56) was 6,124 cfs (unadjusted). The flow of this stream is regulated by Allatoona Reservoir (U. S. Geol. Survey Water-Supply Paper 1434, 1958, p. 224).

During the present study analyses were made of samples collected from 23 locations in the basin (fig. 35) and specific

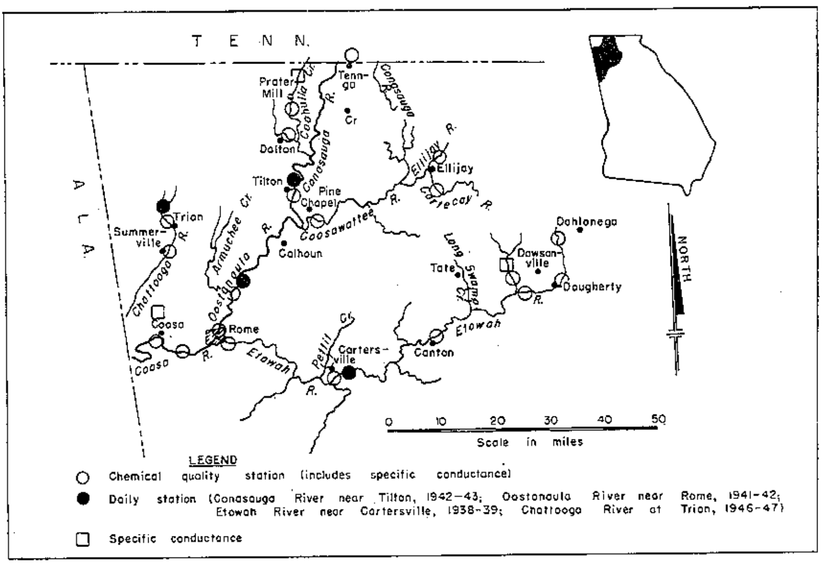

Figure 35. Approximate location of sampling points in the Coosa River basin.

conductance measurements were made at several other locations during stream surveys.

In the discussion of the quality of water as it occurred during the reconnaissance of May 1958, the Cartecay, Coosawattee, and Oostanaula Rivers are considered to be the headwater streams of the Coosa River, and the Conasauga, Etowah, and Chattooga Rivers are the principal tributaries. The Chattooga and Little Tallapoosa Rivers enter the Coosa River below the Alabama State line.

The results of the reconnaissances with respect to specific conductance of the water at various locations and the change in characteristics are shown in figures 36 and 37.

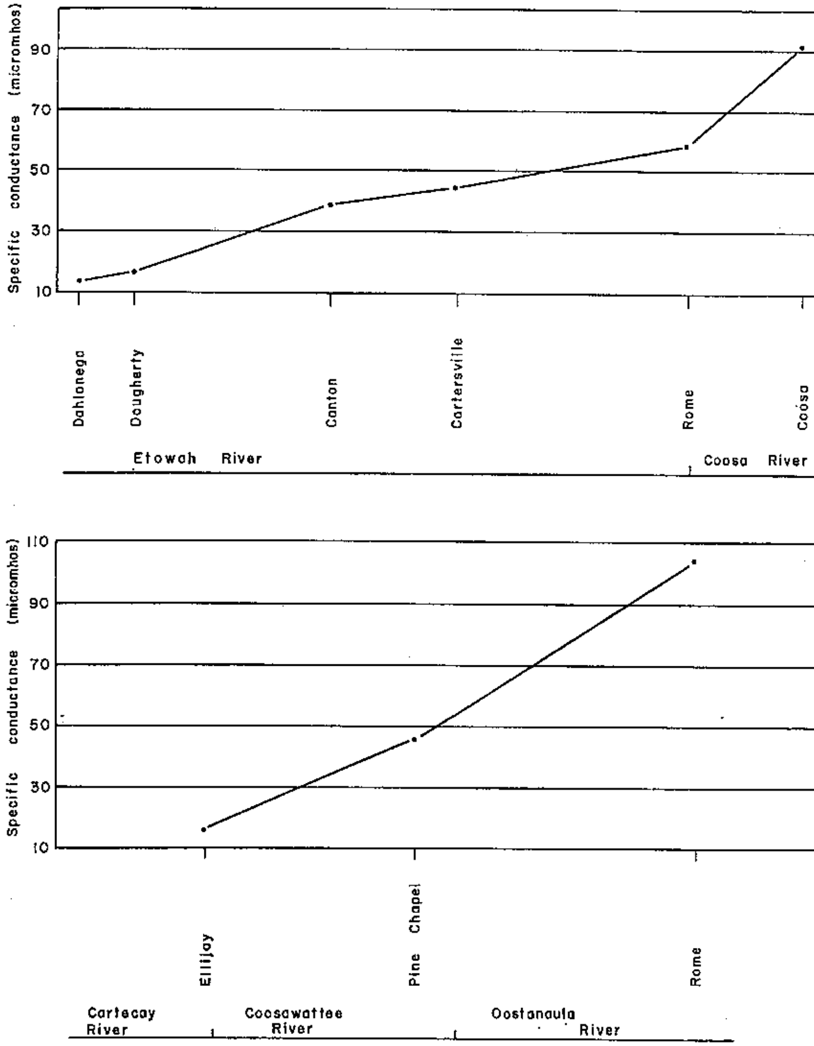

Figure 36. Specific conductance of water of Coosa River during stream survey on May 23-24, 1958.

During the downstream reconnaissance conducted in May 1958, the Cartecay River near Ellijay was clear, of low mineral content (18 ppm), and siliceous in type; bicarbonate was the principal anion. These characteristics result from contact of the water with the crystalline rocks that are exposed at the surface in this area.

The Cartecay River joins the Ellijay River to form the

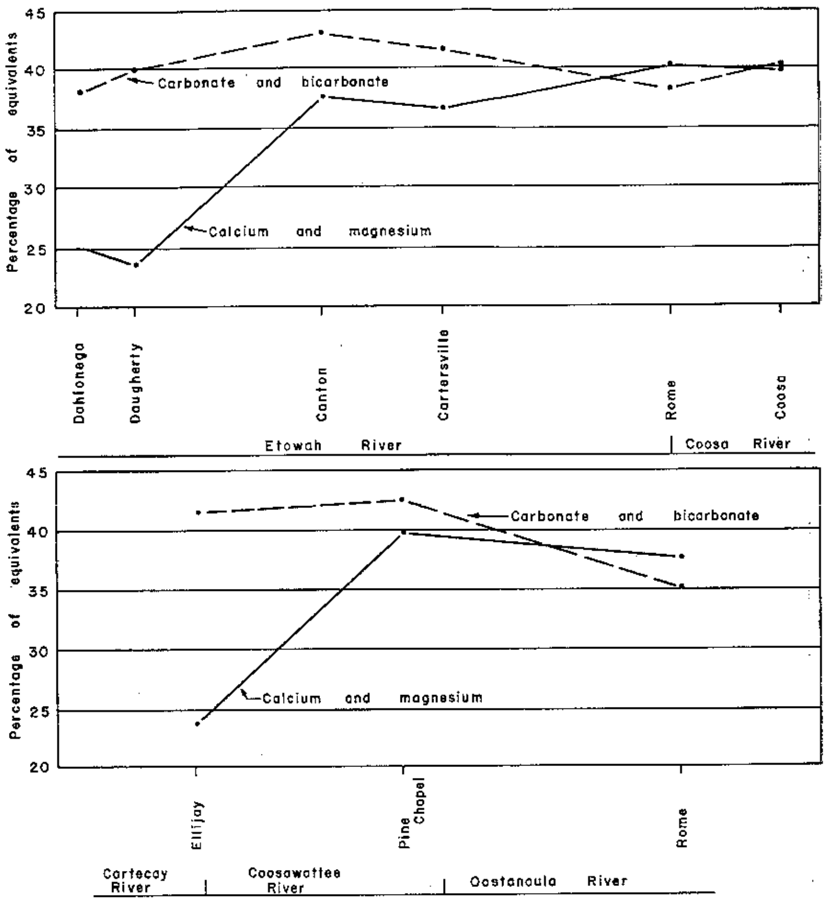

Figure 37. Chemical characteristics of water at various locations on Coosa River during stream survey on May 23-24, 1958.

Coosawattee River near the town of Ellijay. The Coosawattee River flows through areas of biotite gneiss, micaceous quartzite, phylitte and schist, limestone, dolomite, and shale. The mineral content of the water of the Coosawattee River increased from near Ellijay to Pine Chapel, at which point it was 32 ppm. At Pine Chapel the water of the Coosawattee River was carbonate in type, and significant increases in calcium and magnesium concentrations were found. The increase in concentration of the water and the change in character are believed to result from contact of the water with the more soluble limestone and dolomitic rocks found in this area, enhanced by tributary inflows of higher concentration that are carbonate in type.

The Coosawattee River joins the Conasauga River to form the Oostanaula River about 6 miles downstream from Pine Chapel. The Oostanaula River flows through an area of shale, limestone, and sandstone. At Rome the water of the Oostanaula River had a mineral content of 64 ppm. It was carbonate in type and soft. In equivalents per million, calcium was about twice that of magnesium.

The Oostanaula River joins the Etowah River at Rome to form the Coosa River. The Coosa River flows through areas of limestone and shale and enters Alabama near the town of Coosa. The mineral content of the water near Coosa was 58 ppm and the water was carbonate in type. The calcium content in equivalents per million was about twice the magnesium.

Tributaries such as Mill Creek, Chattooga River, and Coahulla Creek receive most of their water from the limestone and dolomitic area of the Valley and Ridge province. The water from the streams is usually higher in mineral content than that from streams draining the Blue Ridge province. Samples collected from streams in the Valley and Ridge province have high magnesium-to-calcium ratios, indicating contact with dolomitic rocks.

The Conasauga River rises in an area containing slate and quartzite. The water in this area is low in mineral content. Generally, the water is siliceous in type but occasionally it is carbonate. Of five samples from the Conasauga River near Tennga, Tenn., the mineral content ranged from 16 to 23 ppm. At Tilton the mineral content was about 78 ppm; the water is a carbonate type and is moderately hard. The magnesium-to-calcium ratio is high, which indicates that this stream also contacts dolomitic rocks.

Coahulla Creek enters the Conasauga River just above Tilton. The mineral content of two samples collected at Prater Mill was 119 and 102 ppm. The water is a carbonate type and is moderately hard. The magnesium-to-calcium ratio is high, indicating contact of the water with dolomitic rocks.

Mill Creek, a tributary of Coahulla Creek, was sampled twice at Dalton. The water of this stream is a carbonate type and is moderately hard. The mineral content of the two samples collected was 83 and 115 ppm. The magnesium-to-calcium ratio, 1 to 2, is similar to that of Coahulla Creek.

The Etowah River rises in areas of crystalline rocks in the Appalachian Mountains. At Dougherty and near Dahlonega and Dawsonville, the mineral content of samples collected does not exceed 20 ppm. The water is siliceous in type and soft. At Canton the mineral content increases to about twice that at Dahlonega. At times, the water is siliceous in type; at other times it is carbonate in type. Pollution of the water in the Canton area probably accounts for the somewhat higher concentration and the different characteristics. Near Cartersville the Etowah River enters the limestone and dolomite area of the Valley and Ridge province. From near Cartersville to Rome the water passes through areas in which formations of dolomite, limestone, shale, and sandstone are exposed. At Rome the water is carbonate type and at times it is moderately hard. The ratios of magnesium to calcium indicate contact with dolomitic rocks.

The Amicolola River drains an area of crystalline rocks and joins the Etowah River near Dawsonville. Samples collected from this stream are siliceous in type, of low mineral content 2 (15-17), and soft.

The analysis of one sample collected from Long Swamp Creek near Tate during the May reconnaissance showed a carbonate-type water low in mineral content (55 ppm).

Pettit Creek near Cartersville was sampled once during the May reconnaissance. The analysis of this sample showed a hard, carbonate water, indicating contact with limestone and dolomitic rocks.

The Chattooga River flows through rock formations composed of shale, limestone, and coal. The water generally is a carbonate type and moderately hard. One sample collected during low flow, September 19, 1957, was high in sodium content, probably due to waste disposals at Trion. On May 24, 1958, above Trion and at Summerville, the mineral content was 120 and 121 ppm, respectively.

Little Tallapoosa River drains an area of crystalline rocks. During the stream surveys in February and May the water was siliceous in type, of low mineral content 2 (28-38), and soft.

Walkers Creek drains an area of crystalline-type rocks. Analysis of one sample collected near Tallapoosa shows a soft, siliceous-type water, of low mineral content (21 ppm).

For the streams of the Coosa River basin, the quality of the water depends on the type of rock formation in the areas through which the streams flow. For instance, streams originating in the areas of crystalline rocks are low in mineral content, soft, and siliceous in type; whereas the streams that rise or flow through the areas of the more soluble rocks, such as the limestone and dolomite, are generally carbonate in type, have a relatively high mineral content, and are generally moderately hard.

Tennessee River basin

The small streams draining the extreme northern part of Georgia, the Hiwassee, Nottely, and Toccoa Rivers and South Chickamauga Creek, are tributaries to the Tennessee River. During the present study data on quality of water were obtained at 14 locations on the stream shown in figure 38.

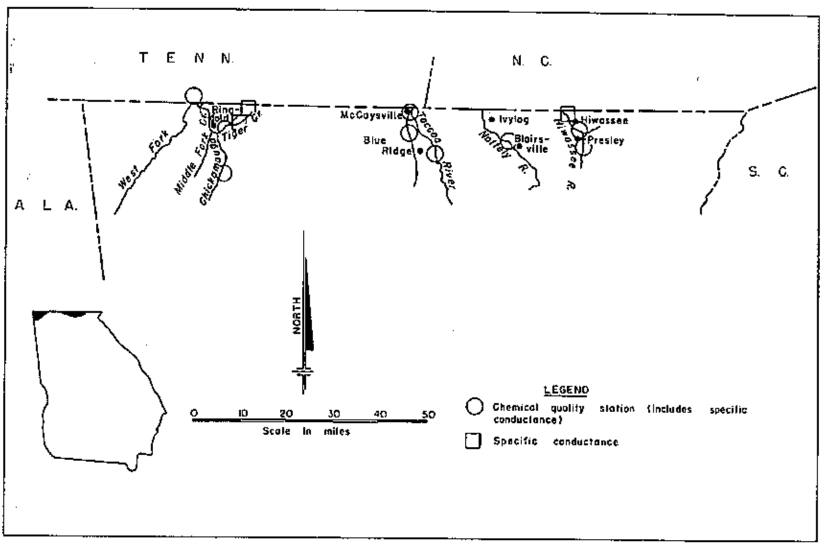

Figure 38. Approximate location of sampling points in the Tennessee River basin.

The Hiwassee River at Presley has a drainage area of 45.5 square miles and had an average discharge of 128 cfs for 14 years of record (1942-56). (See U. S. Geol. Surv. Water-Supply Paper 1436, 1958, p. 160.) The water of the Hiwassee River, which drains areas of crystalline rocks, is siliceous in type and low in mineral content 2 (15-17). The water has almost no color.

The Nottely River near Ivy Log has a drainage area of 215 square miles and a discharge of 400 cfs (adjusted for storage) for 14 years of record (1942-56). (See U. S. Geol. Survey Water-Supply Paper 1436, 1958, p. 165.) This stream drains areas of crystalline rocks; consequently, the water is a siliceous type and is low in mineral content 4 (18-28). Silica constituted about 40 percent of the mineral matter.

The Toccoa River drains an area of crystalline rocks; the water is siliceous in type and low in mineral content 4 (15-21). The drainage area near Blue Ridge, Ga., is 233 square miles and the average discharge for 43 years of record (1913-56) was 580 cfs (U. S. Geol. Survey Water-Supply Paper 1436, 1958, p. 169).

South Chickamauga Creek rises in the Cumberland Plateau and Valley and Ridge province near Tunnel Hill, Ga. Near Chickamauga, Tenn., the drainage area is 428 square miles and the average discharge for 28 years of record (1928-56) was 693 cfs (U. S. Geol. Survey Water-Supply Paper 1436, 1958, p. 169). Rock formations found in this basin include limestone, sandstone, dolomite, and shale. The water of this stream is carbonate in type, relatively high in mineral content 5 (96-129), and is moderately hard. The magnesium-to-calcium ratio (equivalents per million), about 1 to 2, indicates that the water of this stream comes in contact with dolomitic rocks. Industrial waste disposals near Ringgold do not appear to alter the character except to impart some color.

Tiger Creek near Ringgold was sampled during the May reconnaissance. This stream has one of the highest concentrations of dissolved minerals (149 ppm) of any stream in the State not subjected to disposals of wastes. From the headwaters to its confluence with South Chickamauga Creek, the specific conductance of the stream varied little. The water is a carbonate type but it contains appreciable quantities of sulfate (32 ppm). The magnesium-to-calcium ratio indicates that the water comes in contact with dolomitic rocks.

SELECTED REFERENCES

1. Butts, Charles, and Gildersleeve, Benjamin, 1948, Geology and Mineral Resources of the Paleozoic Area in Northwest Georgia: Georgia Geol. Survey Bull. No. 54.
2. Clarke, Frank Wigglesworth, 1924, Data of Geochemistry: U. S. Geol. Survey Bull. No. 770.
3. Clarke, James Wood, 1952, Geology and Mineral Resources of the Thomaston Quadrangle, Georgia: Georgia Geol. Survey Bull. No. 59.
4. Collins, W. D., Lohr, E. W., Williams, K. T., Haller, H. S., and Kenworthy, O. C., 1932, Chemical Character of Surface Waters of Virginia: Commonwealth of Virginia, State Commission on Conservation and Development, Division of Water Resources and Power, in cooperation with the U. S. Geol. Survey, Bull. No. 3.
5. Cooke, C. Wythe, 1943, Geology of the Coastal Plains of Georgia: U. S. Geol. Survey Bull. No. 941.
6. Crickmay, Geoffrey W., 1952, Geology of the Crystalline Rocks of Georgia: Georgia Geol. Survey Bull. No. 58.
7. Fenneman, N. M., 1938, Physical Divisions of the United States: McGraw-Hill Book Co., Inc.
8. Hem, John D., 1959, Study and Interpretation of the Chemical Characteristics of Natural Water: U. S. Geol. Survey Water-Supply Paper No. 1473.
9. Herrick, S. M., and LeGrand, H. E., 1949, Geology and Ground Water Resources of the Atlanta Area, Georgia: Georgia Geol. Survey Bull. No. 55.
10. Hurst, Vernon J., 1955, Stratigraphy, Structure and Mineral Resources of the Mineral Bluff Quadrangle, Georgia: Georgia Geol. Survey Bull. No. 63.
11. LaMoreaux, Philip E., 1946, Geology of the Coastal Plain of East Central Georgia: Georgia Geol. Survey Bull. No. 50—Part I.
12. ——————— 1946, Geology and Ground Water Resources of the Coastal Plain of East Central Georgia: Georgia Geol. Survey Bull. No. 52.
13. LeGrand, H. E., 1956, Geology and Ground Water Resources of Central-East Georgia: Georgia Geol. Survey Bull. No. 64.
14. Lamar, William L., 1942, Industrial Quality of Public Water Supplies in Georgia: U. S. Geol. Survey Water-Supply Paper 912.
15. ——————— 1944, Chemical Character of Surface Waters of Georgia: U. S. Geol. Survey Water-Supply Paper 889-E.
16. Meinzer, Oscar E., 1942, Hydrology: Dover Publications, Inc.
17. Munyan, Arthur C., 1951, Geology and Mineral Resources of the Dalton Quadrangle, Georgia-Tennessee: Georgia Geol. Survey Bull. No. 57.
18. Rainwater, F. H., and Thatcher, L. L., 1959, Methods for Collection and Analysis of Water Samples: U. S. Geol. Survey Water-Supply Paper 1454.
19. Stose, George W., Cooke, C. Wythe, Crickmay, Geoffrey W., and Butts, Charles, 1939, Geologic Map of Georgia.
20. Thomson, M. T., and Carter, R. F., 1955, Surface Water Resources of Georgia During the Drought of 1954: Information Circular No. 17.
21. Thomson, M. T., Herrick, S. M., Brown, Eugene, and others, 1956, Availability and Use of Water in Georgia: Georgia Geol. Survey Bull. No. 65.
22. Industrial Water Supplies of the Tennessee Valley Region: 1948, Tennessee Valley Authority.
23. Tennessee River Water Temperature and Quality: 1957, Tennessee Valley Authority.

24. U. S. Climatological Data, Georgia, Annual Summary 1957: U. S. Weather Bureau.

25. U. S. Geological Survey, 1943, Quality of Surface Waters of the United States, 1941; U. S. Geol. Survey Water-Supply Paper 942.

26. ———— 1944, Quality of Surface Water of the United States, 1942: U. S. Geol. Survey Water-Supply Paper 950.

27. ———— 1945, Quality of Surface Water of the United States, 1943: U. S. Geol. Survey Water-Supply Paper 970.

28. ———— 1947, Quality of Surface Water of the United States, 1944: U. S. Geol. Survey Water-Supply Paper 1022.

29. ———— 1949, Quality of Surface Water of the United States, 1945: U. S. Geol. Survey Water-Supply Paper 1030.

30. ———— 1950, Quality of Surface Water of the United States, 1946: U. S. Geol. Survey Water-Supply Paper 1050.

31. ———— 1952, Quality of Surface Water of the United States, 1947: U. S. Geol. Survey Water-Supply Paper 1102.

32. Warren, M. A., 1944, Artesian Water in Southeastern Georgia: Georgia Geol. Survey Bull. No. 49.

33. Water in Georgia, 1955, Prepared and Submitted by the Water Use and Conservation Committee to the General Assembly of Georgia.

APPENDIX A

Explanation of terms

Characteristics of water quality.—Distinguishing features of water imparted by the number, kind, and amount of organic or inorganic materials.

Color.—The color of water as considered in this report is that due to substances in solution. Color in water may be of mineral, animal, or vegetable origin. It may be caused by metallic substances, humus materials, peat, algae, weeds, or protozoa. Industrial wastes may also color water. The color of water is compared to that of glass-colored discs which have been calibrated to correspond to the platinum cobalt scale of Hazen.

Dissolved solids.—The reported quantity of dissolved solids—the residue on evaporation—consists primarily of the dissolved mineral constituents in the water. The residue on evaporation may also contain organic matter and water of crystallization. Water with less than 500 ppm of dissolved solids is usually satisfactory for domestic and most industrial uses.

Dissolved ions.—The positive or negative charged atoms or group of atoms formed when materials dissolve in water. Anions are those ions that carry the negative charge of electricity and deposit on the anode in an electrical cell. In water the anions are the nonmetallic ions. Those determined for this study include carbonate, bicarbonate, sulfate, chloride, fluoride, and nitrate. Cations are the positively charged ions that deposit on the cathode of an electrical cell. Those cations determined for this study include calcium, magnesium, sodium, and potassium.

Equivalent.—A term used in chemistry to denote equal combining power. It is the weight in grams of an element that will combine with one atomic weight of hydrogen. The equivalent weight of an element is the atomic weight divided by its valence in a particular reaction. Thus 23 grams of sodium, one equivalent weight, will combine with 35.5 grams, one equivalent weight, of chloride to form 58.5 grams of sodium chloride (common table salt).

Equivalents per million as reported in this report are numerical expressions of parts per million. The equivalents per million are computed by multiplying the reported concentration of the individual constituents in parts per million by the reciprocal of their combining weights.

A percentage equivalent is a value obtained by dividing the equivalents per million of the particular anion or cation by the summation of the equivalents per million of all of the anions or cations.

Hydrogen-ion concentration.—The degree of acidity or alkalinity of water is indicated by the hydrogen-ion concentration, expressed as pH. pH values range from 0 to 14 and are the negative logarithm of the hydrogen-ion concentration in moles per liter of solution. pH is necessary for evaluation of the usefulness of the water for various industrial uses, treatment necessary for clarification of the water, and evaluating the corrosiveness of the water. A pH value of 7.0 indicates that the water is at its neutral point, being neither acidic nor alkaline. Values progressively lower than 7.0 denote increasing acidity, whereas values progressively higher than 7.0 denote increasing alkalinity.

Instantaneous loads—The quantity, in tons, of dissolved material carried by a stream at the point and time indicated. Instantaneous load, in tons per day, is calculated by the formula: Discharge (Q), in cubic feet per second, times 0.0027 (conversion factor), times the sum of dissolved minerals (C), in parts per million.

Parts per million (ppm).—The dissolved chemical constituents are reported in parts per million. A part per million is a unit weight of a constituent in a million unit weights of water plus constituents.

Specific conductance.—Specific conductance is the measure of the capacity of water to conduct an electric current. It varies with the concentration and degree of ionization of the different constituents in solution. It may be used to estimate the mineral content but does not indicate the nature of or the relative amounts of the various mineral constituents.

Sum—mineral content.—A calculated value obtained by summation of the quantities, in parts per million, of the individual constituents dissolved in the water. In this report the value usually includes silica, iron, calcium, magnesium, sodium, potassium, bicarbonate (as carbonate), sulfate, chloride, fluoride, and nitrate.

APPENDIX B

Table 1.—LOADS OF DISSOLVED SOLIDS—

Savannah River basin

Location	Date	Drainage area (sq mi)	Discharge (cfs)	Dissolved solids: Sum (ppm)	Dissolved solids: Tons per day	Dissolved solids: Tons per day per sq mi of drainage area
Chattooga River near Clayton	Sept. 16, 1957	203	624	15	25	.12
Do	May 1, 1958	do	1,380	13	48	.24
Do	June 2, 1958	do	744	17	34	.17
Savannah River near Iva, S. C.	May 1, 1958	2,231	9,050	26	635	.28
South Beaverdam Creek at Dewey Rose	June 2, 1958	36.6	46	30	4	.10
Savannah River near Calhoun Falls	Sept. 16, 1957	2,876	1,240	38	127	.04
Do	June 3, 1958	do	8,750	30	709	.25
Broad River near Bell	Sept. 15, 1957	1,420	274	45	33	.02
Do	June 3, 1958	do	1,460	39	154	.11
Little River near Washington	Feb. 12, 1958	292	360	58	56	.19
Do	June 3, 1958	do	222	70	42	.14
Savannah River at Augusta	June 3, 1958	7,508	7,700	40	832	.11
Savannah River at Burton Ferry	Aug. 7, 1957	8,650	5,500	39	579	.07
Do	May 1, 1958	do	15,900	36	1,550	.18
Brier Creek at Millhaven	Jan. 23, 1958	656	795	33	71	.11
Do	June 3, 1958	do	396	40	43	.07
Savannah River near Clyo	Feb. 25, 1958	9,850	20,000	34	1,840	.19
Do	June 3, 1958	do	7,490	43	870	.09

Table 1.—LOADS OF DISSOLVED SOLIDS—

Ogeechee River basin

Location	Date	Drainage area (sq mi)	Discharge (cfs)	Dissolved solids: Sum (ppm)	Dissolved solids: Tons per day	Dissolved solids: Tons per day per sq mi of drainage area
Ogeechee River near Louisville	Mar. 6, 1958	801	822	24	53	.07
Ogeechee River at Scarboro	Jan. 2, 1958	1,940	2,770	43	322	.17
Do	May 31, 1958	do	880	55	131	.07
Ogeechee River at Eden	Jan. 2, 1958	2,650	3,600	45	437	.17
Do	May 31, 1958	do	1,500	51	207	.08
Canoochee River near Claxton	Mar. 13, 1958	555	3,100	18	151	.27
Do	May 31, 1958	do	123	26	9	.02

Table 1.—LOADS OF DISSOLVED SOLIDS—

Ocmulgee and Altamaha River basins

Location	Date	Drainage area (sq mi)	Discharge (cfs)	Dissolved solids: Sum (ppm)	Dissolved solids: Tons per day	Dissolved solids: Tons per day per sq mi of drainage area
South River near McDonough	Dec. 3, 1957	436	580	95	149	.34
Do	May 27, 1958	do	379	61	62	.14
Yellow River near Covington	May 27, 1958	396	258	41	28	.07
Ocmulgee River near Jackson	May 28, 1958	1,420	3,140	39	331	.23
Ocmulgee River at Macon	Apr. 7, 1958	2,240	6,320	38	648	.29
Do	May 28, 1958	do	1,600	44	190	.08
Tobesofkee Creek near Macon	Feb. 26, 1958	182	986	36	96	.53
Do	May 27, 1958	do	135	44	16	.09
Ocmulgee River at Hawkinsville	Dec. 6, 1957	3,800	8,010	42	908	.24
Do	May 28, 1958	do	2,250	47	286	.08
Ocmulgee River at Lumber City	Dec. 6, 1957	5,180	15,000	39	1,580	.30
Do	May 28, 1958	do	5,900	52	828	.16
Ohoopee River near Reidsville	Mar. 12, 1958	1,110	8,010	21	454	.41
Do	May 29, 1958	do	402	32	35	.03
Altamaha River at Doctortown	Aug. 8, 1957	13,600	9,260	52	1,300	.10
Do	May 29, 1958	do	12,100	48	1,570	.12

Table 1.—LOADS OF DISSOLVED SOLIDS—

Oconee River basins

Location	Date	Drainage area (sq mi)	Discharge (cfs)	Dissolved solids: Sum (ppm)	Dissolved solids: Tons per day	Dissolved solids: Tons per day per sq mi of drainage area
Middle Fork Oconee River near Athens	May 28, 1958	398	340	43	40	.10
Oconee River near Greensboro	Apr. 1, 1958	1,090	2,180	40	235	.22
Do	May 28, 1958	do	885	45	108	.10
Apalachee River near Buckhead	Dec. 2, 1957	436	876	33	78	.18
Do	May 28, 1958	do	356	40	38	.09
Oconee River at Milledgeville	Dec. 11, 1957	2,950	7,150	45	869	.29
Do	May 28, 1958	do	570	41	63	.02
Oconee River at Dublin	Dec. 5, 1957	4,400	12,000	39	1,260	.29
Do	May 28, 1958	do	2,620	43	304	.07
Oconee River near Mt. Vernon	Dec. 6, 1957	5,110	13,500	42	1,530	.30
Do	May 29, 1958	do	3,400	51	468	.09

Table 1.—LOADS OF DISSOLVED SOLIDS—

Lower Coastal Plain rivers

Location	Date	Drainage area (sq mi)	Discharge (cfs)	Dissolved solids: Sum (ppm)	Dissolved solids: Tons per day	Dissolved solids: Tons per day per sq mi of drainage area
Satilla River near Waycross	Dec. 9, 1957	1,300	2,940	26	206	.16
Do	May 19, 1958	do	1,500	20	81	.06
Little Satilla River near Offerman	Mar. 14, 1958	646	2,300	21	130	.20
Do	May 19, 1958	do	105	25	7	.01
Satilla River at Atkinson	Dec. 10, 1957	2,880	4,760	29	373	.13
Do	May 19, 1958	do	1,300	22	77	.03
Suwanee River at Fargo	Dec. 10, 1957	1,260	2,120	22	126	.10
Do	May 28, 1958	do	785	17	36	.03
Alapaha River near Alapaha	May 21, 1958	644	1,090	21	62	.10
Alapaha River near Statenville	May 28, 1958	1,400	2,470	20	133	.10
Little River near Adel	Jan. 31, 1958	547	1,180	24	76	.14
Do	May 15, 1958	do	348	32	30	.06
Ochlockonee River near Thomasville	Nov. 25, 1957	550	1,600	32	138	.25
Do	May 21, 1958	do	610	34	56	.10
Tired Creek near Cairo	Nov. 25, 1957	55	215	36	21	.38
Do	May 14, 1958	do	80	27	6	.11

Chattahoochee River (Apalachicola River basin)

Location	Date	Drainage area (sq mi)	Discharge (cfs)	Dissolved solids: Sum (ppm)	Dissolved solids: Tons per day	Dissolved solids: Tons per day per sq mi of drainage area
Chattahoochee River near Leaf	Sept. 16, 1957	150	234	20	13	.08
Do	May 24, 1958	do	438	20	24	.16
Chestatee River near Dahlonega	Dec. 23, 1957	153	471	19	24	.16
Chattahoochee River near Roswell	May 25, 1958	1,230	644	29	50	.04
Chattahoochee River at Atlanta	Nov. 25, 1957	1,450	3,680	39	388	.27
Do	May 25, 1958	do	894	28	68	.05
Sweetwater Creek near Austell	Feb. 17, 1958	246	285	44	34	.14
Do	May 25, 1958	do	160	47	20	.08
Yellowjacket Creek near LaGrange	Feb. 17, 1958	182	256	36	25	.14
Do	May 26, 1958	do	98	47	12	.07
Chattahoochee River at West Point	Feb. 7, 1958	3,550	33,600	21	1,910	.54
Do	May 26, 1958	do	3,280	49	434	.12
Chattahoochee River at Columbus	Feb. 27, 1958	4,670	12,100	35	1,140	.24
Do	May 26, 1958	do	4,450	45	541	.12
Chattahoochee River at Ft. Gaines	May 26, 1958	7,600	c5,652	48	732	.10
Chattahoochee River at Columbia, Ala.	Feb. 28, 1958	8,040	c27,500	41	3,040	.38
Do	May 27, 1958	do	c5,500	46	683	.08

Table 1.—LOADS OF DISSOLVED SOLIDS—

Flint River

(Apalachicola River basin)

Location	Date	Drainage area (sq mi)	Discharge (cfs)	Dissolved solids: Sum (ppm)	Dissolved solids: Tons per day	Dissolved solids: Tons per day per sq mi of drainage area
Flint River near Griffin	Feb. 11, 1958	272	935	32	81	.30
Do	May 25, 1958	do	146	51	20	.07
Line Creek near Digbey	Feb. 26, 1958	----	320	29	25	----
Do	May 25, 1958	----	130	41	14	----
Whiteoak Creek near Alvaton	Oct. 11, 1957	146	35	44	4	.03
Flint River near Molena	Feb. 27, 1958	----	3,780	29	296	----
Do	May 25, 1958	----	599	43	70	----
Potato Creek near Thomaston	Feb. 27, 1958	186	986	23	61	.33
Do	May 25, 1958	do	141	38	14	.08
Flint River near Culloden	Oct. 11, 1957	1,890	790	51	109	.06
Do	May 25, 1958	do	1,120	43	130	.07
Whiteoak Creek near Butler	May 25, 1958	93.4	158	10	4	.05
Flint River at Montezuma	Feb. 13, 1958	2,900	13,500	24	875	.30
Do	May 25, 1958	do	2,350	35	222	.08
Muckalee Creek near Leesburg	Feb. 28, 1958	406	d1,600	31	134	.33
Kinchaponee Creek near Leesburg	Dec. 5, 1957	590	d170	29	13	.02
Do	Mar. 10, 1958	do	d2,300	22	137	.23
Flint River at Albany	Feb. 28, 1958	5,230	14,900	34	1,370	.26
Do	May 26, 1958	do	4,240	54	618	.12
Flint River at Newton	Feb. 28, 1958	5,740	14,300	38	1,470	.26
Do	May 26, 1958	do	4,980	61	820	.14
Ichawaynochaway Creek near Milford	Mar. 4, 1958	620	2,250	32	194	.31
Do	May 26, 1958	do	596	53	85	.14
Chickasawhatchee Creek at Elmodel	Jan. 18, 1958	322	c341	82	76	.23
Do	Mar. 4, 1958	do	c1,365	49	181	.56
Flint River at Bainbridge	Aug. 6, 1957	7,350	19,400	67	3,150	.48
Do	May 26, 1958	do	c45,500	70	8,600	1.17
Spring Creek near Iron City	Aug. 6, 1957	520	c176	64	30	.06
Do	May 26, 1958	do	950	86	221	.42

Table 1.—LOADS OF DISSOLVED SOLIDS—

Coosa River

(Mobile River basin)

Location	Date	Drainage area (sq mi)	Discharge (cfs)	Dissolved solids: Sum (ppm)	Dissolved solids: Tons per day	Dissolved solids: Tons per day per sq mi of drainage area
Cartecay River near Ellijay	May 23, 1958	135	330	18	16	.12
Coosawatee River at Pine Chapel	May 24, 1958	856	1,460	32	126	.15
Mill Creek at Dalton	May 24, 1958	37	40	115	12	.34
Conasauga River at Tilton	Feb. 14, 1958	682	1,400	63	238	.35
Do	May 24, 1958	do	614	78	129	.19
Oostanaula River at Rome	Sept. 19, 1957	2,120	6,100	34	560	.26
Do	May 24, 1958	do	2,610	64	451	.21
Etowah River near Dawsonville	Feb. 13, 1958	108	236	18	12	.11
Etowah River at Canton	Jan. 14, 1958	605	1,340	52	188	.31
Do	May 23, 1958	do	1,130	31	95	.16
Etowah River at Rome	Sept. 19, 1957	1,180	832	81	182	.10
Do	May 24, 1958	do	3,390	42	384	.21
Coosa River near Rome	Dec. 1, 1957	4,040	13,400	52	1,880	.47
Do	Jan. 8, 1958	do	4,450	71	853	.21
Chattooga River near Summerville	Apr. 1, 1958	193	417	116	131	.68
Do	May 24, 1958	do	205	121	67	.35

a Estimated discharge.
b Mean discharge, estimated.
c Daily mean discharge.
d Estimated daily mean discharge.

APPENDIX C

Table 2.—LOADS OF DISSOLVED SOLIDS PREVIOUS PERIODS

Location	Date	Drainage area (sq mi)	Discharge (cfs)	Dissolved solids: Sum (ppm)	Dissolved solids: Tons per day	Dissolved solids: Tons per day per sq mi of drainage area
Altamaha River at Doctortown	1937-38	13,600	10,330	54	1,510	.11
Chattahoochee River at Columbus	1940-41	4,670	3,704	44	440	.09
Chattahoochee River near Hilton	1940-41	8,040	5,700	47	723	.09
Chattahoochee River near Vinings	1937-38	1,450	2,220	33	198	.14
Chattooga River at Trion	1946-47	193	385	101	105	.54
Conasauga River at Tilton	1942-43	682	1,231	69	229	.34
Etowah River near Cartersville	1938-39	1,110	1,389	36	135	.12
Flint River at Bainbridge	1941-42	7,350	9,547	68	1,750	.24
Flint River at Montezuma	1943-44	2,900	4,463	34	410	.14
Ichawaynochaway Creek near Newton	1944-45		856	67	155	
Ocmulgee River at Lumber City	1945-46	5,180	7,395	55	1,100	.21
Ocmulgee River at Macon	1937-38	2,240	2,573	44	306	.14
Oconee River at Milledgeville	1937-38	2,950	2,863	51	394	.13
Ogeechee River near Eden	1937-38	2,650	1,844	59	294	.11
Oostanaula River at Rome	1941-42	2,120	2,734	56	413	.20
Satilla River near Waycross	1937-38	1,300	457	49	60	.05
Savannah River near Clyo	1938-39	9,850	11,240	41	1,240	.13

APPENDIX D

TABLE 3.—CHEMICAL ANALYSES OF SELECTED SURFACE WATERS

Chemical constituents in parts per million

STATION	Date of collection	Discharge	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (Sum)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Non-carbonate	Specific conductance (micromhos at 25° C)	pH	Color
SAVANNAH RIVER BASIN																			
Chattooga River near Clayton	1- 1-58	787	5.7	.....	0.8	0.7	1.1	0.2	5	0.2	0.5	0.1	0.0	12	5	1	12.0	6.6	5
	6- 2-58	736	7.5	0.12	1.2	.1	1.0	.5	8	.8	1.5	.0	.1	17	4	0	13.1	6.5	3
Tallulah River at Tallulah Falls	6- 2-58		6.8	.08	.8	.5	.8	.5	8	.8	1.5	.0	.0	16	4	0	14.4	6.4	3
Savannah River near Iva, S. C.	5- 1-58	9,450	9.2	.21	1.4	.7	2.5	.8	13	2.0	2.0	.1	.4	26	6	0	25.7	6.7	12
South Beaverdam Creek at Dewey Rose	2-12-58	51	7.1	.....	2.2	.6	2.6	1.2	13	1.5	2.5	.1	1.4	26	8	0	32.3	6.5	7
	6- 2-58	42	12	.49	1.8	.7	2.6	1.4	15	.8	2.8	.1	.0	30	8	0	32.6	6.3	3
Savannah River near Calhoun Falls	6- 3-58	7,450	13	.....	2.2	.6	2.6	1.1	15	.8	1.2	.0	.8	30	8	0	31.3	6.7	.....
S. F. Broad River near Carlton	6- 3-58		14	.10	2.4	1.1	2.8	1.7	18	2.0	3.0	.1	.1	36	10	0	37.8	6.4	13
Broad River near Royston	6- 2-58		11	.54	2.0	.9	2.6	1.6	13	2.2	3.0	.1	.9	31	8	0	33.8	6.6	.....
Broad River near Bell	1-21-58	1,140	19	.....	4.0	1.6	4.7	1.3	27	2.8	3.2	.0	.3	50	16	0	57.4	6.6	25
	6- 3-58	1,460	17	.40	2.8	1.1	3.4	1.3	20	1.0	2.0	.0	.6	39	12	0	41.2	6.8	7
Little River near Washington	2-12-58	365	21	.....	4.8	1.9	5.4	1.0	32	4.0	3.5	.1	.4	58	20	0	64.6	6.7	50
	6- 3-58	220	24	.56	6.8	2.4	6.4	1.6	44	1.5	4.8	.2	.5	70	27	0	84.9	6.9	13
Savannah River near Evans	5- 1-58	23,000	12	.25	2.0	1.3	3.2	1.1	16	1.8	3.0	.2	.4	33	10	0	38.0	6.8	15
Savannah River near Augusta	6- 3-58	7,700	11	.21	2.8	1.3	4.5	1.4	21	3.5	4.5	.1	.6	40	12	0	47.2	6.9	17
Savannah River at Burton Ferry	5- 1-58	16,100	11	.50	3.0	1.2	3.8	1.2	20	2.5	3.0	.1	.5	36	12	0	46.5	6.6	12
Brier Creek near Waynesboro	6- 3-58		10	.46	5.4	1.0	2.3	.7	21	.0	4.0	.2	.6	34	18	0	45.6	6.7	23
Brier Creek near Millhaven	6- 3-58	395	10	1.8	7.0	1.3	2.4	.5	27	.8	4.0	.1	.5	40	23	1	55.6	6.7	47
		1,101	1.1	.....	4.8	.5	2.7	.8	18	1.5	3.5	.1	.1	24	14	0	42.4	6.4	22
Savannah River at Clyo	6- 3-58	7,600	11	.61	5.2	1.2	4.0	1.0	26	4.0	3.2	.1	.3	43	18	0	56.6	6.7	8
Savannah River at Port Wentworth	5- 2-58	32,000	10	.....	3.8	1.2	3.9	1.5	21	3.2	3.2	.1	.6	38	14	0	48.8	6.6	28
	6- 3-58	8,500	11	.67	4.4	1.3	5.3	1.2	26	5.0	3.5	.1	.4	45	16	0	62.6	6.7	.....
OGEECHEE RIVER BASIN																			
Ogeechee River at Jewell	5-30-58		26	1.0	4.8	1.8	7.8	1.4	37	2.5	6.0	.1	.1	68	20	0	77.0	6.7	7
Rocky Comfort Creek at Louisville	8- 7-57		9.9	.....	3.0	.7	2.2	.6	15	1.0	3.0	.0	.4	28	10	0	45.2	6.6	22
	1-22-58		10	.....	5.6	.9	3.3	.4	20	2.0	4.2	.0	.4	37	18	1	53.8	6.2	30
	5-30-58		10	2.2	3.2	.9	2.4	.6	16	.8	4.2	.1	.6	31	12	0	36.2	6.5	35
Ogeechee River near Louisville	3- 6-58		5.8	.....	2.8	.6	3.6	.5	15	.0	3.2	.1	.2	24	10	0	38.0	6.4	17
	5-30-58		14	1.9	4.6	1.1	3.6	.7	23	.5	4.5	.1	.3	40	16	0	48.7	6.5	20

TABLE 3.—CHEMICAL ANALYSES OF SELECTED SURFACE WATERS—CONTINUED

STATION	Date of collection	Discharge	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (Sum)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Non-carbonate	Specific conductance (micromhos at 25° C)	pH	Color
OGEECHEE RIVER BASIN—Continued																			
Williamson Swamp Creek at Bartow	2-25-58		1.6	......	5.0	.7	2.4	.4	20	.0	3.5	.2	.0	24	16	0	43.7	6.9	3
	5-30-58		11	1.7	9.2	.7	2.4	.4	33	1.5	4.5	.1	.2	46	26	0	61.9	6.7	8
Ogeechee River at Midville	1- 2-58		13	......	3.6	1.0	3.2	.7	18	1.0	4.0	.1	.0	36	13	0	42.3	6.8	55
	5-30-58		14	1.7	6.4	.9	3.5	.5	27	.0	4.5	.4	.5	44	20	0	55.5	6.7	45
Buckhead Creek at Millen	2- 4-58		6.2	......	10	.7	3.0	.4	36	1.5	4.5	.2	.4	45	28	0	72.0	7.0	8
	5-30-58		11	1.1	24	.5	3.2	.5	76	2.8	4.5	.1	.6	84	62	0	135	7.0	12
Ogeechee River at Scarboro	1- 2-58	2,770	12	......	7.2	.4	3.5	.8	24	1.8	5.0	.1	.0	43	20	0	54.5	6.7	42
	5-31-58	905	13	.26	10	1.3	3.2	.6	40	2.2	4.2	.1	.5	55	30	0	77.0	6.7	38
Ogeechee River at Eden	1- 2-58	3,600	12	......	7.6	.9	3.6	.7	27	1.8	5.0	.2	.0	45	22	0	59.4	6.9	65
	5-31-58	1,500	12	1.5	9.2	1.0	3.5	.7	35	2.2	4.8	.1	.2	51	27	0	69.8	6.6	35
Canoochee River near Claxton	1- 2-58	805	12	......	1.6	.2	4.0	.9	5	.5	6.2	.1	.2	29	5	1	31.6	5.6	100
	2-28-58	1,120	2.7	......	1.2	.4	3.2	.5	6	.2	6.2	.0	.0	17	4	0	29.9	5.5	37
	5-31-58	119	10	1.3	1.6	.5	3.6	.6	6	1.2	6.5	.2	.6	28	6	1	32.4	5.8	85
Canoochee River near Fort Stewart	5-31-58		7.4	.97	1.8	.4	3.5	.6	6	1.8	6.5	.1	.4	26	6	1	31.3	6.7	110
ALTAMAHA RIVER BASIN																			
South River near McDonough	12- 3-57	580	16	......	8.4	2.2	14	3.6	32	14	10	0.4	10	95	30	4	151	6.7	4
	5-27-58	379	14	0.53	5.4	1.7	7.1	2.3	24	5.8	6.8	.4	5.5	61	20	1	84.4	6.6	3
Yellow River near Covington	12- 4-57	458	15	......	3.2	.6	3.6	1.2	19	2.0	2.5	.1	.1	38	10	0	39.1	6.7	21
	5-27-58	253	15	.07	3.2	1.1	3.7	1.1	22	2.2	2.8	.1	.6	41	12	0	45.5	6.8	3
Alcovy River near Covington	5-27-58		14	.04	3.2	1.1	3.7	1.2	23	.2	2.8	.2	.6	38	12	0	46.8	6.8	3
Ocmulgee River near Jackson	12- 4-57	3,120	11	......	6.0	.7	3.4	2.4	26	3.5	3.0	.1	.4	44	18	0	58.3	6.6	.....
	5-28-58	1,210	11	.44	3.6	1.0	4.2	1.5	23	2.8	3.5	.2	.5	39	13	0	52.8	6.5	3
Ocmulgee River at Dames Ferry	12- 4-57		12	......	4.8	.5	3.8	2.2	21	4.2	2.8	.1	.4	41	14	0	49.9	6.5	.....
	5-28-58		11	.04	3.6	1.6	4.4	1.5	23	2.2	3.2	.2	.9	40	16	0	53.4	6.7	3
Ocmulgee River at Macon	12- 5-57	4,120	12	......	2.0	1.9	3.9	2.3	18	3.5	3.0	.1	.7	38	13	0	47.3	6.6	.....
	2-12-58	4,840	8.8	......	2.6	1.0	3.5	2.0	14	3.5	2.5	.1	1.6	32	10	0	42.3	6.0	.....
	5-28-58	1,650	13	.33	3.8	1.3	4.8	1.4	24	3.5	2.8	.3	1.1	44	15	0	57.2	6.8	3
Tobesofkee Creek near Macon	2-26-58		12	......	2.2	1.2	3.7	1.6	18	2.5	3.0	.2	1.0	36	10	0	41.8	6.6	.....
	5-27-58	123	17	.80	2.4	2.2	5.0	1.7	23	1.2	3.2	.2	.5	44	15	0	51.2	6.9	3
Echeconnee Creek near Roberta	12-17-57		17	......	3.6	1.5	4.3	1.2	25	2.0	3.5	.1	.2	46	15	0	53.9	6.8	.....
Echeconnee Creek near W. Robins AFB	2-26-58		6.5	......	2.0	.7	2.5	.6	12	1.2	2.0	.0	.3	22	8	0	29.6	6.5	16
Ocmulgee River at Hawkinsville	12- 6-57	7,920	12	......	4.8	1.0	4.5	1.7	21	3.8	3.5	.1	.0	42	16	0	52.4	6.5	.....
	5-28-58	2,250	13	.40	5.2	1.9	4.7	1.2	27	3.2	3.0	.3	1.3	47	21	0	66.3	6.9	7
Ocmulgee River at Abbeville	5-28-58		11	.97	9.2	1.5	4.8	1.4	41	4.5	3.5	.1	.1	56	29	0	83.8	6.7	3

TABLE 3.—CHEMICAL ANALYSES OF SELECTED SURFACE WATERS—CONTINUED

STATION	Date of collection	Discharge	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (Sum)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Non-carbonate	Specific conductance (micromhos at 25° C)	pH	Color
ALTAMAHA RIVER BASIN—Continued																			
Ocmulgee River near Lumber City	8- 8-57	3,400	12	......	11	1.5	4.5	1.2	46	3.5	3.8	.0	.4	61	34	0	93.3	6.9	7
	12- 6-57	15,000	11	......	4.4	.9	3.7	1.7	20	3.8	3.0	.1	.1	39	14	0	49.8	6.5	.....
	5-28-58	5,900	12	.69	9.2	1.3	4.5	1.1	37	2.0	2.8	.3	1.1	52	28	0	78.1	7.1	12
Little Ocmulgee River at Towns	8- 8-57		12	......	4.2	.7	2.7	.7	15	2.5	4.2	.0	.5	35	14	1	44.0	6.3	50
	3-19-58		8.0	......	2.2	.4	2.6	.9	7	.0	3.2	.1	.3	21	7	2	27.9	5.8	37
	5-28-58		10	1.4	3.2	1.0	2.3	.5	14	.5	3.2	.3	.4	28	12	0	38.2	6.6	45
Oconee River at Athens	1-29-58		15	......	2.8	1.3	3.6	1.3	20	2.2	2.5	.1	1.0	42	12	0	40.5	6.8	2
	5-28-58		17	.62	3.6	1.9	3.8	1.0	25	1.5	2.0	.2	.8	44	17	0	52.1	6.5	7
Middle Oconee River near Athens	1-29-58	473	14	......	2.6	1.0	3.6	1.2	18	2.0	2.2	.1	1.4	37	10	0	42.2	6.8	2
	5-28-58	316	16	.49	3.2	1.5	4.5	1.3	22	1.5	2.5	.1	1.3	43	14	0	48.8	6.9	7
Barber-Mangus Creek near Athens	12- 5-57		15	......	1.4	1.2	3.6	1.7	17	.8	2.5	.1	.2	35	8	0	37.0	6.7	24
Oconee River near Greensboro	12- 5-57	1,310	16	......	3.2	1.5	4.0	1.5	21	3.0	2.5	.3	.5	43	14	0	47.2	6.5	7
	5-28-58	885	17	.69	4.0	1.1	4.0	1.0	24	.8	3.0	.3	1.8	45	14	0	49.5	7.0	5
Apalachee River near Buckhead	12- 2-57	876	12	......	2.4	.9	3.1	1.9	17	1.8	2.2	.1	.4	33	10	0	39.0	6.8	.....
	12- 5-57	580	14	......	2.8	.9	3.4	1.5	17	2.0	2.5	.1	.3	36	10	0	39.2	6.4	.....
	1- 2-58	525	13	......	2.4	1.1	3.9	1.5	18	.8	2.8	.1	1.0	36	10	0	42.2	7.0	.....
	2- 3-58	676	12	......	3.2	.7	3.7	1.5	16	.0	3.2	.1	1.2	34	11	0	39.4	6.7	22
	5- 3-58	604	11	......	2.8	.5	3.3	1.6	15	.0	2.5	.1	.8	30	9	0	38.4	6.5	7
	5-28-58	374	15	.66	3.2	1.2	3.7	1.6	22	.8	2.5	.0	.9	40	13	0	45.5	6.9	8
Little River near Eatonton	12- 5-57		17	......	4.8	1.2	4.0	1.5	27	2.8	2.5	.1	.0	47	17	0	52.9	6.8	11
	2-24-58		16	......	3.2	1.8	3.8	1.3	24	2.0	2.2	.2	.4	43	16	0	50.3	7.0	0
	5-28-58		19	.42	4.6	1.8	4.3	1.5	32	2.5	2.8	.1	.2	53	19	0	61.4	6.8	3
Oconee River at Milledgeville	12- 5-57	7,170	13	......	3.2	1.5	3.3	1.8	21	2.8	2.2	.2	.1	38	13	0	44.7	6.5	.....
	5-28-58	976	13	.35	3.6	1.5	3.4	1.4	24	2.8	3.0	.1	.6	41	15	0	48.5	6.7	22
Richland Creek near Greensboro	5-28-58		26	0.68	9.6	3.3	7.9	1.4	56	4.0	6.8	0.1	0.1	87	38	0	113	6.8	3
Commissioner Creek at McIntyre	12- 5-57	-	14	......	3.2	1.3	4.1	.8	9	11	3.2	.1	.1	43	14	6	55.5	6.2	.....
	5-28-58		14	.82	5.4	1.8	6.4	.7	10	24	3.8	.2	.1	61	21	13	83.4	6.2	4
Oconee River at Dublin	12- 5-57	12,000	13	......	4.0	1.0	3.3	1.8	20	2.5	2.5	.1	.2	39	14	0	45.3	6.6	.....
	5-28-58	2,620	13	.62	4.6	1.1	3.4	1.1	24	4.2	3.0	.1	.1	43	16	0	51.7	6.6	17
Oconee River near Mt. Vernon	12- 6-57	13,500	14	......	4.0	1.2	3.4	1.7	21	3.5	3.5	.2	.3	42	15	0	47.7	6.6	.....
	5-29-58	3,400	13	.66	7.4	1.3	3.7	1.1	34	3.2	3.8	.2	.6	51	24	0	69.6	6.8	3
Ohoopee River near Oak Park	5-29-58		13	.15	8.0	.9	2.9	.4	29	.2	4.0	.3	.2	44	24	0	62.7	7.0	37
Ohoopee River near Reidsville	3-12-58	8,140	7.3	......	1.8	.5	2.8	.8	6	1.2	3.2	.1	.3	21	6	2	25.7	5.7	47
	5-29-58	392	11	.83	3.4	.5	2.7	.6	13	1.0	5.5	.1	.3	32	10	0	36.0	6.5	45

TABLE 3.—CHEMICAL ANALYSES OF SELECTED SURFACE WATERS—CONTINUED

STATION	Date of collection	Discharge	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (Sum)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Non-carbonate	Specific conductance (micromhos at 25° C)	pH	Color
ALTAMAHA RIVER BASIN—Continued																			
Altamaha River near Baxley	12- 6-57		13	......	3.6	1.1	3.6	1.6	19	3.2	3.5	.1	.1	39	14	0	45.8	6.6	....
	5-29-58		12	.66	7.8	1.6	3.9	1.0	35	.5	3.8	.3	.6	48	26	0	71.9	7.0	18
Altamaha River near Surrency	12- 6-57		12	......	3.6	1.0	4.2	1.7	18	2.8	3.5	.1	.1	38	13	0	44.1	6.5	....
	5-29-58		12	.65	7.4	1.2	3.8	.8	31	1.8	3.0	.3	.4	46	24	0	67.1	7.1	17
Altamaha River at Doctortown	12- 6-57	32,700	13	......	3.8	1.2	6.0	1.6	18	5.5	5.5	.2	.1	46	14	0	56.3	6.6	....
	3-14-58	51,700	7.5	......	3.6	.4	3.1	1.2	14	1.8	3.0	.1	1.3	29	10	0	37.9	6.4	40
	5-29-58	12,600	12	.70	7.6	1.5	4.2	.9	35	.5	3.8	.2	.3	48	25	0	69.7	6.9	27
SATILLA RIVER BASIN																			
Seventeen Mile Creek near Douglas	5-21-58		4.8	1.1	1.4	.7	2.3	.6	6	1.0	4.2	.4	.5	19	6	2	33.5	5.9	150
Alabaha River at Blackshear	5-19-58		7.1	.14	.8	.5	3.6	.3	5	2.8	5.0	.4	.5	24	4	0	32.8	5.3	150
Little Satilla River near Offerman	5-19-58	105	7.9	1.2	.6	.7	4.0	.4	5	1.2	7.0	.4	.4	25	4	0	39.2	5.3	250
Satilla River at Atkinson	1- 9-58	1,830	12	......	1.4	1.7	4.9	.6	5	.0	8.0	.2	.3	32	10	6	41.9	5.3	55
	5-19-58	1,260	7.3	.95	1.6	.4	3.6	.4	0	.8	6.8	.4	.5	22	6	6	34.0	4.5	150
ST. MARYS RIVER BASIN																			
St. Marys River near Moniac	5-19-58	44	2.9	1.2	1.2	.7	5.2	.2	0	1.2	9.2	.6	.9	22	6	6	69.7	4.3	550
St. Marys River near Macclenny, Fla.	5-19-58	231	5.4	......	1.8	1.6	4.2	.5	2	1.5	12	.3	.3	29	11	10	51.2	4.8	380
St. Marys River at Boulogne, Fla.	5-19-58		7.5	.71	4.8	1.0	4.8	.2	12	3.2	9.5	.5	.7	38	16	6	52.3	6.0	350
SUWANNEE RIVER BASIN																			
Suwannee River at Fargo	1-14-58	905	4.3	......	1.2	.9	4.3	.7	0	2.8	9.8	.1	.3	25	6	6	58.8	4.4	180
	5-28-58	785	1.8	.02	1.4	.5	4.0	.2	0	.5	7.2	.6	.4	17	6	6	59.7	4.3	400
Alapaha River near Alapaha	5-21-58	1,090	9.1	1.5	1.2	.6	2.6	.4	2	1.5	4.0	.5	.3	21	6	4	24.8	5.5	100
Alapaha River at Statenville	11- 7-57	165	10	......	1.6	1.0	3.4	.6	6	2.5	6.5	.1	.4	29	8	3	35.8	6.1	55
	5-28-58	2,500	5.8	1.1	1.2	.6	2.8	.4	4	1.8	3.8	.6	.8	20	6	2	27.3	5.4	150
New River near Nashville	5-20-58		4.5	......	1.6	.6	4.4	.8	6	1.2	7.5	.3	.3	24	6	2	41.3	5.7	60
Withlacoochee River near Adel	11- 7-57		10	......	2.0	1.5	12	1.6	10	2.2	20	.6	.4	56	11	3	85.4	6.1	90
Little River near Adel	5-15-58	380	7.3	......	2.4	1.0	4.5	1.3	10	.0	9.2	.2	.8	32	10	2	42.8	6.1	48
	5-20-58		7.1	1.2	2.0	.7	3.2	.6	10	.2	5.8	.4	.6	26	8	0	33.2	6.3	150
Little Indian Creek near Moultrie	5-21-58		6.0	.88	2.0	.4	4.2	.8	8	.2	7.5	.4	.3	26	6	0	36.8	5.9	50
Withlacoochee River near Quitman	12-11-57		8.1	......	1.2	1.0	4.1	.7	6	1.8	7.0	.3	.0	28	7	2	39.7	5.6	130
	5-20-58		7.6	1.1	1.6	1.1	4.3	.6	6	2.2	6.0	.5	.8	28	8	4	39.2	6.0	150
Okapilco Creek at Moultrie	11- 8-57		18	......	8.0	4.4	175	9.0	62	3.0	260	0.3	8.2	524	38	0	983	6.8	55
	12-31-57		11	......	4.2	1.6	31	2.5	8	10	45	2.7	2.7	115	17	10	211	5.9	65
Okapilco Creek near Moultrie	12-31-57		12	......	2.4	1.1	13	1.8	6	5.0	21	1.7	.2	62	10	6	102	5.1	85

TABLE 3.—CHEMICAL ANALYSES OF SELECTED SURFACE WATERS—CONTINUED

STATION	Date of collection	Discharge	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (Sum)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Non-carbonate	Specific conductance (micromhos at 25° C)	pH	Color
OCHLOCKONEE RIVER BASIN																			
Ochlockonee River at Moultrie	2–28–58		8.4	......	1.0	.7	3.5	.7	7	1.0	5.5	.2	.5	25	6	0	31.4	6.1	22
Ochlockonee River near Thomasville	11– 9–57	98	13	......	4.0	1.9	11	1.4	20	2.8	15	.0	.3	60	18	2	94.9	6.1	90
	11–25–57	1,630	8.7	......	1.8	1.3	4.2	1.0	8	2.0	7.8	.2	.1	32	10	4	46.0	5.9	150
	5–21–58	640	7.7	1.2	2.6	1.5	4.6	.6	14	2.5	6.8	.4	.9	34	12	1	47.6	6.5	100
Tired Creek near Cairo	5–14–58	80	8.5	......	2.4	1.2	3.1	.8	10	.8	4.5	.4	.4	27	11	3	35.5	6.1	47
	11–25–57	222	11	......	3.0	1.1	3.4	1.7	12	1.8	7.0	.2	.1	36	12	2	42.8	6.2	100
Little Tired Creek near Cairo	11– 8–57		13	......	8.0	2.9	272	4.8	24	1.0	430	.0	3.6	752	32	12	1,410	5.1	45
	1– 1–58		11	......	1.6	.7	4.4	.6	10	.5	6.2	.2	.0	31	7	0	37.4	6.4	95
Little Tired Creek South of Cairo	1– 1–58		10	......	2.4	1.5	41	1.2	10	3.5	64	.1	.0	129	12	4	242	6.2	50
	6– 4–58		9.9	5.5	16	5.2	335	6.0	52	22	575	.1	1.1	996	62	10	1,780	6.4	150
Ochlockonee River near Cairo	11– 8–57		13	......	3.6	1.5	8.4	1.2	16	5.2	12	.0	1.7	55	15	2	76.2	6.3	90
Little Attapulgus Cr. near Attapulgus	12–29–58		8.7	......	2.2	1.1	2.2	.3	0	25	3.8	.1	.5	45	10	10	219	3.6	15
Big Attapulgus Cr. near Havana, Fla.	12–29–58		10	......	2.4	.7	2.0	.3	0	7.0	4.5	.1	.3	28	9	9	41.0	4.9	45
APALACHICOLA RIVER BASIN																			
Chattahoochee River near Leaf	4– 8–58	586	8.7	......	1.0	.5	1.2	.7	13	.0	.8	.1	.1	20	4	0	16.5	7.0	5
	5–24–58	428	9.9	.09	1.2	.4	1.5	.7	10	.5	1.0	.1	.0	20	4	0	17.3	6.6	4
Soque River near Clarkesville	5–24–58		9.6	.16	1.2	.5	1.6	.7	9	.5	2.0	.1	.0	21	5	0	19.2	6.7	9
Chattahoochee River near Gainesville	4– 8–58		7.9	......	2.0	.6	1.8	1.2	19	.2	1.3	.0	.5	25	8	0	28.5	7.4	12
	5–24–58		6.6	.11	1.4	.9	1.6	1.0	12	.2	.8	.1	.0	19	7	0	23.8	6.6	7
Chestatee River near Dahlonega	9–18–57	112	11	......	1.6	.6	1.8	.5	12	1.0	1.0	.1	.5	24	6	0	23.7	6.4	9
	5–24–58	324	9.6	.41	1.0	.5	1.5	.6	10	.0	.5	.2	.0	19	4	0	18.6	6.6	6
Suwannee Creek near Duluth	4– 8–58		12	......	10	1.2	8.2	1.2	45	5.2	9.5	.0	.7	70	30	0	106	7.4	45
Chattahoochee River near Duluth	4– 8–58		7.5	......	5.2	1.2	6.0	1.5	29	3.5	7.5	.2	1.2	48	18	0	73.7	7.2	12
Chattahoochee River near Norcross	5–25–58		7.1	1.0	2.8	1.3	2.6	1.6	20	1.2	1.2	.1	.1	28	12	0	39.4	6.7	8
Chattahoochee River near Roswell	5–25–58	567	8.0	.28	3.4	1.2	2.5	1.5	18	1.0	1.5	.0	.9	29	14	0	39.9	6.8	3
Nancy Creek at West Paces Ferry	5–25–58		18	.69	5.6	1.8	5.1	1.8	31	2.8	3.2	.2	.6	54	22	0	69.5	6.9	3
Chattahoochee River at Atlanta	4– 8–58	1,380	8.4	......	2.6	1.5	2.8	1.3	23	1.5	2.0	.1	.4	33	12	0	42.2	7.3	25
	5–25–58	750	7.1	.04	3.2	1.1	2.6	1.4	18	1.2	1.5	.0	.9	28	12	0	40.7	6.8	3
	5–25–58		12	.38	10	2.4	15	3.9	79	10	17	.1	.1	110	35	0	210	6.7	12
	5–25–58		9.6	.42	5.6	1.2	5.5	2.1	21	5.2	4.8	.1	4.9	49	19	2	72.1	6.9	3
Chattahoochee River near Douglasville	4– 8–58		11	......	4.4	1.7	5.0	1.6	26	5.8	4.5	.1	2.2	49	18	0	66.5	7.1	10
	5–25–58		11	.48	5.6	1.1	5.9	2.0	22	4.5	5.0	.1	3.6	50	18	0	72.4	6.5	3
Sweetwater Creek near Austell	2–17–58	318	15	......	3.8	1.1	3.6	.8	24	3.5	2.8	.1	.8	44	14	0	47.3	7.1	3
	5–25–58	162	17	.68	4.6	1.6	4.3	.8	26	2.8	2.5	.0	.8	47	18	0	56.2	6.7	3

TABLE 3.—CHEMICAL ANALYSES OF SELECTED SURFACE WATERS—CONTINUED

STATION	Date of collection	Discharge	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (Sum)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Non-carbonate	Specific conductance (micromhos at 25° C)	pH	Color
APALACHICOLA RIVER BASIN—Continued																			
Chattahoochee River near Whitesburg	5-26-58		12	.43	4.4	1.1	5.3	1.8	21	3.5	3.8	.1	3.2	45	16	0	62.1	6.6	3
Wahoo Creek at Arnco Mills	5-26-58		18	2.0	6.0	1.8	7.2	2.0	32	3.5	5.0	.1	4.5	64	22	0	81.0	6.5	3
Chattahoochee River at Franklin	4- 9-58		12	......	3.0	1.5	4.1	1.4	22	4.0	3.5	.1	1.0	43	14	0	53.8	7.1	32
	5-26-58		11	.88	3.8	1.2	4.4	1.1	20	2.5	3.5	.3	2.2	40	14	0	54.4	6.5	3
Yellowjacket Creek near LaGrange	2-17-58	263	14	......	3.0	1.1	3.4	0.9	20	1.2	2.0	0.0	0.4	36	12	0	41.6	6.8	0
	5-26-58	98	19	0.34	4.2	1.8	4.0	1.0	28	.0	1.8	.2	.8	47	18	0	55.2	7.2	3
Chattahoochee River at West Point	4-10-58	6,640	13	......	3.0	1.6	3.3	1.2	24	2.2	3.0	.1	.5	40	14	0	46.9	7.3	7
	5-26-58	3,360	13	.23	4.2	1.6	5.9	1.2	24	5.0	4.2	.3	1.4	49	17	0	66.4	6.7	3
Chattahoochee River at Columbus	4-10-58	9,150	12	......	2.4	1.5	4.0	1.3	22	2.8	.8	.1	.7	37	12	0	46.8	7.1	14
	5-26-58	3,370	12	.06	3.8	1.6	5.9	1.1	25	3.5	3.8	.2	1.1	45	16	0	59.7	7.1	3
Upatoi Creek near Fort Benning	12-20-57		10	......	2.6	1.0	2.0	.9	12	3.0	2.8	.1	.0	29	10	0	35.8	6.2	.....
	4- 8-58		7.3	......	1.6	.7	2.1	.3	7	2.5	2.0	.1	.3	20	7	2	24.3	6.3	45
	5-26-58		10	.86	1.2	1.2	1.4	.3	8	.0	2.2	.2	.3	21	8	2	25.6	6.9	8
Chattahoochee River at Georgetown	4-10-58		9.5	......	7.2	.7	3.0	1.3	24	5.2	2.5	.1	.6	42	21	2	61.0	6.5	12
	5-26-58		12	.08	4.4	1.5	5.4	1.1	24	4.5	3.2	.3	.9	45	17	0	60.6	6.8	3
Pataula Creek near Hatcher	2-27-58		11	......	4.0	.7	1.3	.6	16	2.2	2.0	.2	.9	31	13	0	33.2	7.2	8
	5-26-58		11	.91	7.6	1.3	1.5	.5	29	.0	2.0	.2	.8	39	24	0	56.4	7.0	8
Chattahoochee River near Fort Gaines	5-26-58	5,652	11	.20	5.8	1.1	5.5	1.0	29	4.8	3.5	.3	.7	48	19	0	67.8	6.9	3
Chattahoochee River near Hilton	4-10-58	20,500	8.4	......	4.4	.9	2.9	.8	18	3.5	2.2	.0	.7	33	14	0	45.8	6.6	17
	5-27-58	5,500	11	.15	5.8	1.3	5.2	.9	28	4.0	3.0	.2	.3	46	20	0	66.2	6.9	3
Chattahoochee River near Saffold	5-27-58		10	.15	6.4	1.7	5.0	.9	30	4.0	3.5	.3	.6	47	23	0	69.2	6.7	3
Chattahoochee River near Steam Mill	4-10-58		7.9	......	5.0	.5	2.5	1.0	19	2.5	3.0	.1	.5	32	14	0	45.4	6.5	18
	5-27-58		9.7	.15	8.0	1.0	4.6	.9	33	3.8	3.0	.2	.7	48	24	0	72.2	6.8	3
Flint River near Atlanta	5-25-58		13	1.2	15	3.2	9.0	2.6	28	26	12	1.3	3.3	99	50	28	164	6.6	3
Flint River near Griffin	10-11-57	76	17	......	4.6	1.3	6.1	2.2	29	3.0	5.8	.2	.3	55	17	0	69.0	6.7	8
	2-11-58	920	10	......	3.0	1.0	3.2	1.6	11	2.8	2.8	.1	1.6	32	12	2	37.9	6.1	8
	5-25-58	150	15	1.7	5.2	1.5	5.6	1.3	32	.2	4.5	.5	.8	51	19	0	75.8	6.9	20
Line Creek near Digbey	10-11-57		18	......	3.0	1.5	3.8	1.4	22	2.0	3.5	.0	.4	45	14	0	47.2	6.6	23
	2-26-58		11	......	2.4	.6	2.6	.9	17	1.5	1.2	.2	.4	29	8	0	32.3	6.8	7
	5-25-58		15	1.0	3.8	1.6	3.7	.7	25	1.2	1.8	.3	.5	41	16	0	49.9	6.5	7
Flint River near Concord	10-11-57		16	......	3.6	1.1	4.7	1.8	23	2.8	4.5	.0	.3	46	14	0	52.9	6.8	.....
Flint River near Molena	10-11-57		16	......	3.6	1.0	4.4	1.8	22	1.8	3.5	.0	.4	44	13	0	51.3	6.7	16
	5-25-58		15	1.0	4.0	1.7	4.2	1.1	26	.8	2.5	.5	.6	43	17	0	53.7	6.5	13
Potato Creek near Thomaston	5-25-58	146	12	......	2.8	1.0	5.5	1.7	22	.2	2.5	.2	.8	38	11	0	51.6	6.4	8
Flint River near Thomaston	10-11-57		16	......	3.4	1.1	3.9	1.6	22	2.0	3.2	.0	.4	43	13	0	48.6	6.8	16

TABLE 3.—CHEMICAL ANALYSES OF SELECTED SURFACE WATERS—CONTINUED

STATION	Date of collection	Discharge	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (Sum)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Non-carbonate	Specific conductance (micromhos at 25° C)	pH	Color
APALACHICOLA RIVER BASIN—Continued																			
Flint River near Culloden	10-11-57	850	15	......	4.0	.5	7.2	2.1	30	3.0	3.5	.0	.5	51	12	0	61.9	6.8	7
	2-27-58	6,960	8.0	......	2.0	.9	3.6	1.3	18	.0	2.8	.0	.1	28	8	0	37.3	6.8	17
	5-25-58	1,120	14	.91	4.2	1.1	4.9	1.2	26	1.5	2.2	.3	.3	43	15	0	54.7	6.5	3
Whitewater Creek near Butler	12-17-57	158	6.3	......	.4	.2	.6	.2	4	.8	1.0	.0	.6	12	2	0	10.1	5.7	7
	2-13-58	166	2.3	......	1.4	.1	1.1	.1	3	.5	1.8	.1	.5	9	4	2	13.8	6.4	3
	5-25-58	158	5.8	.35	.4	.4	.6	.1	2	.0	1.5	.2	.4	10	2	1	9.3	5.6	3
Flint River at Montezuma	10-11-57	2,110	13	......	2.2	1.0	4.3	1.2	18	1.8	2.8	.0	.4	36	10	0	41.1	6.5	13
	5-25-58	2,290	12	.96	2.8	1.2	4.3	.8	20	.5	2.5	.3	.5	35	12	0	45.2	6.4	7
Flint River at Cobb	10-12-57		12	......	3.0	.7	3.2	1.3	16	2.2	3.2	.0	.4	34	10	0	40.1	6.6.	45
	5-25-58		11	.95	5.8	1.5	3.5	.7	26	.5	2.0	.3	.7	39	20	0	56.9	6.4	27
Kinchafoonee Creek near Leesburg	3-10-58		5.4	......	3.8	.4	1.9	.7	10	1.5	3.2	.1	.2	22	11	3	31.3	6.3	23
	5-27-58		8.2	.28	8.4	.1	1.7	.5	23	1.8	3.0	.0	.2	35	22	2	45.8	6.7	15
Muckalee Creek near Leesburg	2-28-58		3.3	......	6.0	0.9	1.7	1.0	26	0.0	2.8	0.2	0.1	31	18	0	47.1	7.1	45
	5-27-58		7.9	1.7	13	1.1	2.1	.4	43	.5	3.5	.1	.3	50	37	2	78.8	6.8	28
Flint River at Albany	10-12-57	4,240	11	......	6.4	.4	3.4	1.1	23	2.5	3.5	.4	.3	40	18	0	55.6	6.6	17
	5-26-58	4,090	10	.07	13	.4	3.1	.7	38	2.0	3.0	2.9	.0	54	34	3	86.7	6.8	3
Flint River at Newton	10-12-57	5,350	11	......	12	1.6	3.4	1.0	44	3.0	3.8	.2	.3	58	36	0	85.3	6.9	12
	5-26-58	5,100	8.3	.07	16	.9	3.0	.6	56	1.0	3.2	.1	.1	61	44	0	99.0	6.9	8
Ichawaynochaway Creek at Milford	5-26-58	620	8.3	.28	13	.7	2.0	.4	44	2.2	3.5	.1	.6	53	36	0	79.7	7.0	28
Chickasawhatchee Creek near Herod	2-27-58		3.9	......	3.6	.2	1.6	.9	14	.0	1.8	.2	.4	20	10	0	32.0	6.5	8
Chickasawhatchee Creek at Elmodel	8- 6-57		9.3	......	26	2.1	2.4	.4	87	2.2	4.0	.1	.7	90	74	2	153	7.2	18
	11-26-57		7.7	......	26	.9	2.6	.8	80	2.2	5.0	.1	.3	85	68	3	141	7.4	70
	5-26-58		6.9	1.1	27	.6	2.3	.4	85	2.5	4.0	.2	.5	86	70	0	146	7.2	32
Ichawaynochaway Creek near Newton	2-28-58		3.8	......	14	.5	1.8	.6	50	2.0	3.5	.2	.2	52	36	0	83.1	7.4	32
	5-26-58		6.7	1.1	21	.6	1.9	.5	68	2.2	3.5	.1	.3	70	55	0	117	7.1	22
Flint River at Bainbridge	10-12-57	22,000	9.8	......	21	3.8	2.8	.9	84	2.2	3.8	.0	.5	86	68	0	142	7.4	16
	11-25-57	23,600	11	......	7.6	1.0	3.9	1.1	32	1.8	3.5	.2	.2	47	23	0	62.4	7.7	.....
	5-26-58	45,500	7.7	.62	20	.8	2.7	.5	69	1.5	3.0	.1	.1	70	54	0	118	6.9	8
Tributary to Jim Woodruff Reservoir	10-12-57		7.0	......	11	1.1	2.7	1.0	40	2.0	3.5	.0	.5	49	32	0	76.1	6.8	6
Spring Creek near Iron City	8- 6-57	176	5.1	......	20	.4	1.0	.6	60	4.0	2.5	.0	.8	64	52	2	108	7.0	14
	5-14-58	419	7.1	......	38	.4	2.7	.5	119	.0	2.5	.1	1.3	112	96	0	194	7.4	8
	5-26-58	950	5.7	.06	28	.5	1.9	.4	87	3.0	3.0	.1	.2	86	72	0	147	7.2	45
From Reservoir at Jim Woodruff Dam	10-12-57		8.1	......	11	.9	4.1	1.3	41	3.5	4.5	.0	.3	54	31	0	83.6	6.8	8
MOBILE RIVER BASIN																			
Cartecay River near Ellijay	5-23-58	322	9.2	.02	1.2	.2	1.6	.7	9	.0	.8	.1	.0	18	4	0	17.1	6.6	3

TABLE 3.—CHEMICAL ANALYSES OF SELECTED SURFACE WATERS—CONTINUED

STATION	Date of collection	Discharge	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (Sum)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Non-carbonate	Specific conductance (micromhos at 25° C)	pH	Color
MOBILE RIVER BASIN—Continued																			
Coosawattee River at Pine Chapel	5-24-58	1,430	8.9	.01	4.8	1.3	1.7	.8	24	1.5	1.0	.1	.2	32	18	0	43.9	7.0	1
Conasauga River near Crandall	9-18-57		6.4	......	2.4	.6	.7	.2	10	.2	.2	.0	.1	16	8	0	24.3	6.6	3
	12-5-57		9.5	......	3.0	.5	1.2	.3	13	1.5	1.0	.0	.0	23	10	0	27.3	6.7	0
Coahulla Creek at Prater Mill	2-14-58		6.1	......	27	5.6	1.4	.8	112	3.0	2.0	.1	1.5	102	90	0	180	8.0	3
	5-24-58		7.3	.01	32	6.8	1.4	.8	133	1.8	1.2	.1	1.2	119	108	0	211	7.7	2
Mill Creek at Dalton	2-14-58	61	7.2	......	22	4.7	1.2	.2	90	2.0	1.2	.1	.6	83	74	0	148	7.3	3
	5-24-58	38	8.3	.01	30	7.3	1.5	.7	130	1.5	1.2	.2	.4	115	105	0	205	7.6	2
Conasauga River at Tilton	5-24-58	636	7.7	.02	15	4.0	6.2	.9	68	3.0	8.0	.1	.6	78	54	0	135	7.3	3
Oostanaula River at Rome	5-24-58	2,560	8.4	.01	11	2.6	5.4	.9	45	9.0	3.8	.1	.5	64	38	1	104	7.0	4
Etowah River near Dougherty	5-23-58		9.7	.03	1.0	.5	1.6	1.2	10	.2	1.0	.1	.0	20	4	0	17.9	6.7	7
Etowah River near Dahlonega	5-23-58		8.2	.02	1.0	.2	1.2	.7	8	.0	1.0	.1	.0	16	4	0	15.0	6.6	4
Amicolola River near Dawsonville	2-13-58		8.1	......	.8	.2	.8	.3	7	.2	.8	.1	.1	15	3	0	12.9	6.6	3
	5-23-58		7.9	.13	1.2	.2	1.6	.8	8	.0	1.0	.1	.0	17	4	0	16.3	5.9	7
Long Swamp Creek near Tate	5-24-58		10	.13	14	1.0	1.7	.8	50	1.2	1.3	.1	.0	55	39	0	83.9	8.0	3
Pettit Creek near Cartersville	5-24-58		7.4	.01	28	12	1.8	1.5	143	4.5	2.5	.2	1.5	123	120	2	233	7.7	2
Coosa River near Coosa	5-24-58		9.4	.02	9.8	3.0	3.4	2.1	46	4.2	3.0	.1	.4	58	37	0	90.0	6.9	4
Chattooga River near Trion	5-24-58		6.5	.01	31	4.0	7.1	.8	115	3.2	9.2	.2	.7	120	94	0	213	7.4	3
Chattooga River near Summerville	9-19-57	158	8.2	......	24	4.6	40	1.5	a173	11	11	.0	1.1	186	79	0	314	8.5	7
	5-24-58	200	7.0	.01	30	5.8	5.9	.8	117	4.5	5.2	.1	3.4	121	99	3	214	7.2	3
Walkers Creek near Tallapoosa	2-14-58		8.9	......	1.6	1.0	1.5	0.2	12	0.0	1.2	0.1	0.1	21	8	0	22.9	6.6	7
Little Tallapoosa River near Bowden	2-17-58		9.7	......	2.2	.9	2.5	.8	14	1.8	2.0	.2	.5	28	9	0	33.7	6.7	4
	5-25-58		12	.82	3.0	1.6	3.8	.7	20	2.2	2.8	.5	1.1	38	14	0	45.9	6.6	15
TENNESSEE RIVER BASIN																			
Hiwassee River at Presley	2-13-58	195	10	......	1.2	.0	.8	.2	7	.2	1.5	.1	.0	17	3	0	11.7	6.4	2
	5-23-58	156	7.5	.05	1.0	.2	.9	.5	8	.2	.8	.1	.0	15	4	0	13.0	6.6	3
Nottley River near Ivy Log	9-18-57	9	11	......	2.4	.7	1.8	.8	14	2.2	1.2	.0	1.0	28	9	0	33.7	6.3	3
	5-23-58	358	7.7	.04	1.2	.5	1.3	.8	10	.5	.8	.1	.0	18	5	0	19.1	6.5	3
Toccoa River near Blue Ridge	9-18-57	249	8.9	......	2.0	1.0	1.0	.6	12	.5	.5	.0	.1	21	9	0	26.3	6.4	3
	1-15-58	707	6.9	......	.8	.6	1.0	.5	8	.0	1.0	.1	.2	15	4	0	16.8	6.3	7
	5-23-58	684	7.7	.02	.6	.7	1.1	.6	8	1.0	.8	.1	.0	17	4	0	14.7	6.7	3
Fightingtown Creek near Maccaysville	5-23-58		7.4	.08	1.0	.4	.9	.5	8	.2	.5	.0	.1	15	4	0	13.7	7.1	3
Tiger Creek near Ringgold	5-23-58		8.6	.06	36	8.3	1.6	.8	119	32	2.0	.2	.5	149	124	26	257	7.6	3
S. Chickamauga Creek near Ringgold	5-23-58		7.8	.12	32	7.3	3.3	.8	118	14	5.0	.2	.3	129	110	14	223	7.3	5
S. Chickamauga Creek near	12-11-57	1,030	6.6	......	26	3.2	3.0	1.0	92	5.5	3.0	.0	2.2	96	78	2	164	7.3	3
Chickamauga, Tenn.	5-23-58	352	5.7	.05	32	7.5	5.2	.9	134	6.5	4.0	.2	.1	128	111	1	229	7.3	3

a Includes equivalent of 6 parts per million carbonate (CO_3)

APPENDIX E

TABLE 4.—CHEMICAL ANALYSES OF SURFACE WATERS—PREVIOUS PERIODS [1]

Source and Location	Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Non-carbonate	Specific conductance (micromhos at 25° C)	pH	Color
Altamaha River at Doctortown	1937–38	10,330	12	0.10	7.2	1.6	4.1	1.2	31	3.2	3.2	0.0	0.5	54	25				19
Chattahoochee River at Columbus	1940–41	3,704	11	.05	3.9	1.3	5.2	1.5	21	4.7	3.5	.1	1.1	44	15				9
Chattahoochee River near Hilton........	1940–41	5,700	10	.03	5.6	1.3	4.8	1.4	23	5.4	4.1	.1	1.0	47	19				7
Chattahoochee River near Vinings	1937–38	2,220	11	.04	2.4	1.1	3.3	1.1	16	2.7	1.9	.0	.4	33	11				9
Chattooga River at Trion	1946–47	385	7.1	.04	26	6.5	1.9		109	3.0	2.2	.1	1.1	101	92			7.5	9
Conasauga River at Tilton	1942–43	1,231	7.1	.04	15	4.3	2.6	1.0	63	4.2	2.6	.0	.6	69	55				9
Etowah River near Cartersville	1938–39	1,389	11	.03	4.0	1.3	2.8	1.0	22	3.2	1.5	.0	.2	36	15				6
Flint River at Bainbridge	1941–42	9,547	8.7	.05	17	1.0	2.7	.8	54	3.2	2.7	.1	.6	68	46				14
Flint River at Montezuma	1943–44	4,463	9.8	.07	2.4	1.0	3.6		14	2.5	2.2	.0	.6	34	10				13
Ichawaynochaway Cr. near Newton	1944–45	856	7.4	0.12	16	0.9	2.4		53	1.4	3.0	0.0	0.6	67	44				23

TABLE 4.—CHEMICAL ANALYSES OF SURFACE WATERS—PREVIOUS PERIODS [1]—CONTINUED

Source and Location	Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Non-carbonate	Specific conductance (micromhos at 25° C)	pH	Color
Ocmulgee River at Lumber City	1945–46	7,395	11	.07	8.2	1.4	4.2		32	3.2	3.5	.2	0.6	55	26			7.0	15
Ocmulgee River at Macon	1937–38	2,573	12	.06	3.6	1.6	4.6	1.6	22	3.9	2.9	.0	1.0	44	16				9
Oconee River at Milledgeville	1937–38	2,863	16	.05	4.1	1.8	5.1	1.7	27	2.9	3.2	.0	1.2	51	18				8
Ogeechee River near Eden	1937–38	1,844	11	.27	7.5	1.2	3.7	.8	27	2.5	4.3	.0	.2	59	24				50
Oostanaula River at Rome	1941–42	2,734	7.5	.03	12	2.8	2.3	1.1	47	4.4	1.9	.1	.7	56	41				7
Satilla River near Waycross	1937–38	457	5.8	.08	1.6	1.0	3.8	.7	6	2.0	6.1	.0	.1	49	8			6.1	90
Savannah River near Clyo	1938–39	11,240	11	.05	4.3	1.3	3.4	1.2	22	3.0	2.4	.0	.3	41	16		50		13

[1]Average for water year

INDEX

INDEX

INDEX