PRELIMINARY ASSESSMENT OF STREAMFLOW CHARACTERISTICS FOR SELECTED STREAMS AT FORT GORDON, GEORGIA, 1999–2000

by Timothy C. Stamey

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Cover photograph: Tributary stream to Butler Creek, Fort Gordon, Georgia, January 15, 2000.
Photograph by M. Brian Gregory, U.S. Geological Survey.

For additional information, please write to:

District Chief
U.S. Geological Survey
3039 Amwiler Road, Suite 130
Atlanta, GA 30360-2824
http://ga.water.usgs.gov

Copies of this report can be purchased from:

U.S. Geological Survey
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Denver, CO 80225-0286

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VERTICAL DATUM

Sea level: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)—a geodetic datum derived from a general adjustment of the first order of the United States and Canada, formerly called Sea Level Datum of 1929.

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ABSTRACT

In 1999, the U.S. Geological Survey, in cooperation with the U.S. Army Signal Center and Fort Gordon, began collection of periodic streamflow data at four streams on the military base to assess and estimate streamflow characteristics of those streams for potential water-supply sources.

Simple and reliable methods of determining streamflow characteristics of selected streams on the military base are needed for the initial implementation of the Fort Gordon Integrated Natural Resources Management Plan. Long-term streamflow data from the Butler Creek streamflow gaging station were used along with several concurrent discharge measurements made at three selected partial-record streamflow stations on Fort Gordon to determine selected low-flow streamflow characteristics. Streamflow data were collected and analyzed using standard U.S. Geological Survey methods and computer application programs to verify the use of simple drainage area to discharge ratios, which were used to estimate the low-flow characteristics for the selected streams. Low-flow data computed based on daily mean streamflow include: mean discharges for consecutive 1-, 3-, 7-, 14-, and 30-day period and low-flow estimates of 7Q10, 30Q2, 60Q2, and 90Q2 recurrence intervals. Flow-duration data also were determined for the 10-, 30-, 50-, 70-, and 90-percent exceedence flows.

Preliminary analyses of the streamflow indicate that the flow duration and selected low-flow statistics for the selected streams averages from about 0.15 to 2.27 cubic feet per square mile. The long-term gaged streamflow data indicate that the streamflow conditions for the period analyzed were in the 50- to 90-percent flow range, or in which streamflow would be exceeded about 50 to 90 percent of the time.

INTRODUCTION

Development on Fort Gordon and adjacent areas has prompted concern about the long-term effects on the military base's water supplies. Fort Gordon's Environmental and Natural Resources Management Office has developed and implemented a base-wide Integrated Natural Resources Management Plan to address these concerns.

Fort Gordon water-supply operations withdraws and treats water form Butler Creek Reservoir, and has a production capacity of about 5.2 million gallons per day (Mgal/d). The water-supply system serves about 24,000 people on base. Demands on water-supply sources will increase because on-base population is expected to increase—the population is expected to approach 28,000 by 2010 (Fort Gordon Environmental and Natural Resources Office, written commun., 2001).

Because of widespread and rapid development within certain water-supply basins used by Fort Gordon, a better understanding of hydrologic characteristics of these streams is required to effectively manage the military base's water-supply resources. In March 1999, the U.S. Geological Survey (USGS), in cooperation with the U.S. Army Signal Center and Fort Gordon, began collecting streamflow data at four selected streams on the base to assess flow characteristics of those streams for potential water-supply sources.

Purpose and Scope

This report describes a preliminary assessment of streamflow characteristics of three potential water-supply streams at Fort Gordon. These streamflow characteristics will help determine the suitability of these streams as potential water-supply sources for future base operations.

Periodic streamflow data were collected and analyzed from March 1999 through August 2000. Also, standard USGS streamflow duration statistics were computed using 23 years of historic continuous streamflow data collected at the streamflow-gaging station on Butler Creek (02196820). These statistics were used to estimate and perform a preliminary assessment of the low-flow characteristics for the three other potential water-supply streams on base (Spirit Creek, 02197020; South Prong Creek, 02197025; and Sandy Run Creek, 02197560) (fig. 1). Results are presented for selected flow-durations and low-flow statistics for each stream. Other flow contributions or non-contributions to streamflow—such as: precipitation, ground-water discharge, evapotranspiration, or reservoir outflows—were not considered as part of this study.

Description of Study Area

Fort Gordon is located in east-central Georgia about 8 miles southwest of Augusta in parts of Columbia, McDuffie, and Richmond Counties (fig. 1). The post, established in 1941 as Camp Gordon, became Fort Gordon in 1956 when it was designated a permanent military installation. The study area encompasses about 85 square miles (mi^2) and generally is defined by the boundary of the military reservation.

Past military activities at Fort Gordon have included division training for the Infantry and Armored Divisions, Southeastern Signal School, Military Police, and anti-aircraft Artillery Brigade operations. After the Vietnam War, the Army consolidated the majority of the communications training at Fort Gordon. In 1974, Fort Gordon was designated as the United States Army Signal Center. Today, Fort Gordon is one of the largest communications-electronic facilities in the world.

General land use of the western portion of the base consists of upland areas that are typically cleared and developed; and stream valleys, that are mostly forested and contain wetlands and some small impoundments. The eastern portion of the base is more developed with industrial and military-related operation facilities.

Fort Gordon is in the northern part of the southeastern Coastal Plain Province of Georgia near the Fall Line (fig. 1), which marks the boundary between Coastal Plain sediments and crystalline rocks of the Piedmont Province. Relief in the Coastal Plain Province generally is highest nearest the Fall Line and decreases towards the southeast direction. Rolling hills and well-developed dendritic stream patterns characterize the topography at Fort Gordon. Altitudes range from about 540 feet (ft) along the northern boundary of the military reservation to 250 ft along the southern boundary (Fort Gordon Environmental and Natural Resources Office, written commun., 1998).

Soils generally consist of unconsolidated sands that are highly erodable. Sand-particle sizes are highly variable but generally are medium-grained, and in layers as much as 20 ft thick. Areas of flattened and rounded fine gravel typically are present near the base of the sand. Local areas contain lenses of silty to sandy clay from 1 to 3 ft thick (Fort Gordon Environmental and Natural Resources Office, written commun., 1998).

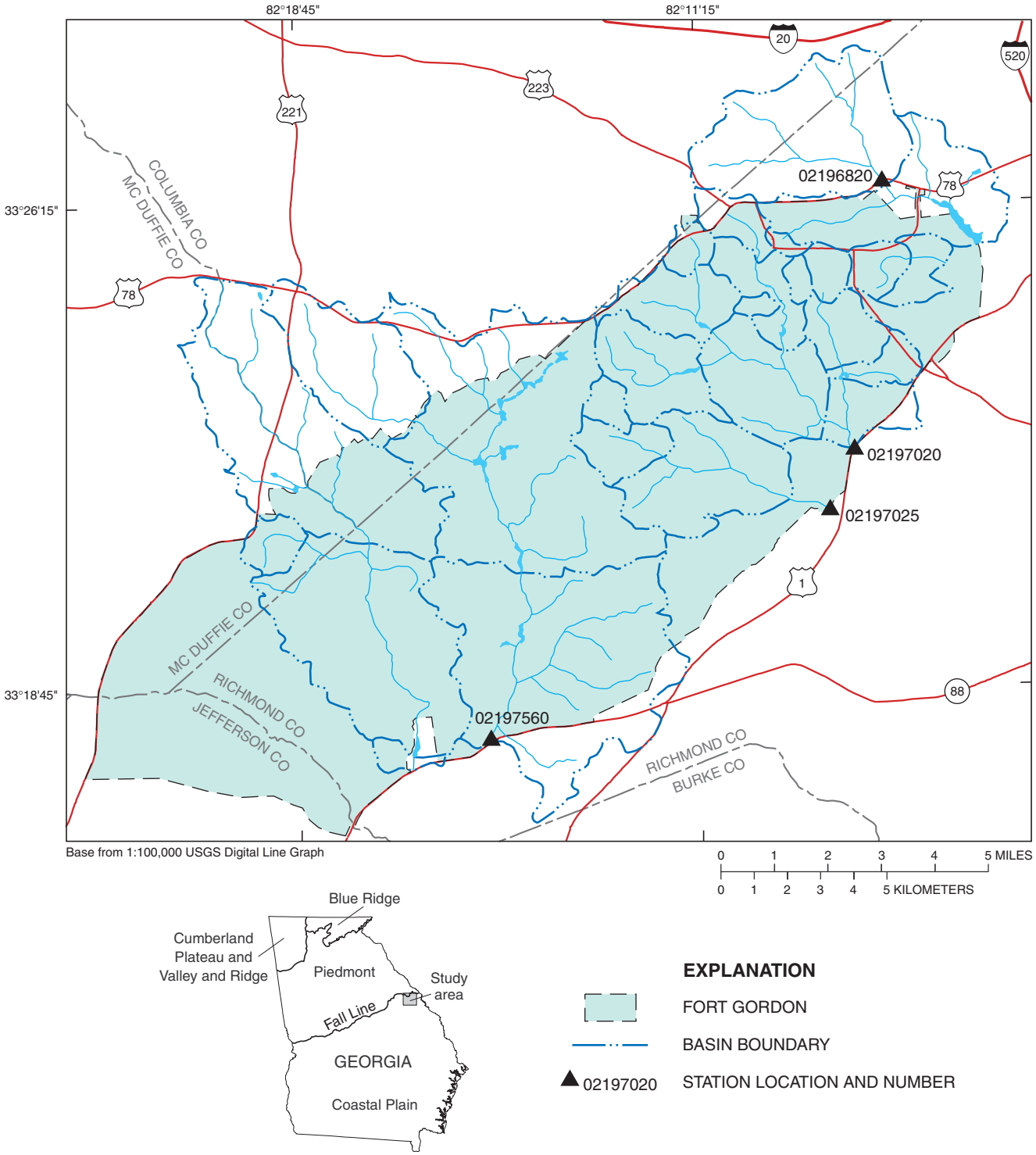

Figure 1. Streamflow stations and study area, Fort Gordon, Georgia.

Method of Study

Long-term streamflow data from the Butler Creek streamflow gaging station (index-correlation station) and several concurrent discharge measurements were made at three potential water-supply streams (partial-record station) on the base. Standard USGS statistical methods and computer application programs (U.S. Geological Survey, 1990) were used in the analysis of these data. Concurrent discharge measurements were made during typical low-flow periods during March 1999–August 2000. Discharge measurements at all locations were used to verify simple drainage-area to discharge ratios. The concurrent streamflow data were correlated with the Butler Creek data and used to estimate the streamflow characteristics for the three other streams. The drainage-area to discharge ratio of each partial-record station was determined by dividing the drainage area for that station by the drainage area of the index station (Butler Creek 02196820). Resulting data were used in the streamflow assessment and computations to assist Fort Gordon in determining whether adequate water supplies are available from the selected streams for base operations and water-resource management decisions.

The accuracy of the computed preliminary streamflow characteristics is strictly a function of the accuracy of index station streamflow and the concurrent discharge measurements, and the degree of hydrologic similarity between the index station and the three partial-record stations. Additional discharge measurements and the installation of continuous streamflow-gaging stations on the selected potential water-supply streams are planned over the next few years. The addition of these streamflow stations will enable a better and more complete understanding of the streamflow characteristics of these streams.

Gaged Sites

The only gaged site used in this study was station Butler Creek at Fort Gordon, Georgia (02196820) (fig. 1). The long-term streamflow station was discontinued in January 1991; however, continuous streamflow data are available beginning in October 1968. These 23 years of continuous streamflow record were used to compute flow-duration, mean consecutive-day values, and selected low-flow frequency values. All computations are derived using are standard USGS programs and applications.

Partial-Record Sites

Three partial-record sites were used in this study: Spirit Creek at U.S. Highway 1 near Augusta, Ga. (02197020); South Prong Creek at U.S. Highway 1 near Augusta, Ga. (02197025); and Sandy Run Creek at U.S. Highway 1 near Blythe, Ga. (02197560). These are potential water-supply streams designated by Fort Gordon Environmental and Natural Resources Management Office. The discharge data collected at these streams were used to verify drainage-area to discharge ratios, and then were used to compute estimates for flow-duration, mean consecutive-day values, and selected low-flow frequency values, based on streamflow data from the Butler Creek streamflow gaging station 02196820.

LOW-FLOW CHARACTERISTICS

Computations of low-flow characteristics include determinations of mean values for consecutive low-flow days, and selected flow-duration and low-flow frequency data. Low-flow data computed from daily mean streamflow include mean discharges for consecutive 1-, 3-, 7-, 14-, and 30-day period (table 1), and estimates of low flows corresponding to selected recurrence intervals, along with selected flow-duration data (tables 2, 3).

Table 1. Mean low-flow characteristics for various consecutive days and drainage areas of selected streamflow stations, Fort Gordon, Georgia, 1999–2000
[square miles, mi^2]

Consecutive low-flow periods (in cubic feet per second)					Drainage area (mi^2)
1-day	3-day	7-day	14-day	30-day	
Butler Creek at Fort Gordon (02196820)					7.5
0.5	0.6	0.7	0.9	1.2	
Spirit Creek at U.S. Highway 1 near Augusta (02197020)					17.5
1.2	1.4	1.6	2.1	2.8	
South Prong Creek at U.S. Highway 1 near Augusta (02197025)					6.0
0.4	0.5	0.5	0.7	1.0	
Sandy Run Creek at U.S. Highway 1 near Blythe (02197560)					32.6
2.3	2.6	2.9	3.9	5.2	

Table 2. Selected low-flow characteristics for selected streamflow stations, Fort Gordon, Georgia, 1999–2000

[Estimates of low-flow characteristics in table 2 are for comparative purposes only, and do not supersede any previous values]

Flow estimates for selected low-flow statistics (in cubic feet per second)			
7Q10	**30Q2**	**60Q2**	**90Q2**
Butler Creek at Fort Gordon (02196820)			
0.3	1.2	1.7	2.3
Spirit Creek at U.S. Highway 1 near Augusta (02197020)			
0.7	2.8	4.0	5.4
South Prong Creek at U.S. Highway 1 near Augusta (02197025)			
0.24	0.96	1.4	1.9
Sandy Run Creek at U.S. Highway 1 near Blythe (02197560)			
1.3	5.2	7.5	10.1

Table 3. Selected flow-duration characteristics for selected streamflow stations, Fort Gordon, Georgia, 1999–2000

Percent time flow equaled or exceeded for selected exceedence values (in cubic feet per second)				
10	**30**	**50**	**70**	**90**
Butler Creek at Fort Gordon (02196820)				
17	8.1	4.8	2.5	1.1
Spirit Creek at U.S. Highway 1 near Augusta (021970200)				
39.7	18.9	11.2	5.8	2.6
South Prong Creek at U.S. Highway 1 near Augusta (02197025)				
13.6	6.5	3.8	2.0	0.9
Sandy Run Creek at U.S. Highway 1 near Blythe (02197560)				
74	35.2	20.9	10.8	4.9

Daily streamflow data shown in table 1 are easily understood. However, the low-flow and flow-duration statistics shown in tables 2 and 3 are less intuitive. The low-flow values shown in table 2 are the minimum streamflows that occur on average over the specified times. For instance, the 7Q10 values are the lowest 7 consecutive-day flows that occur on average once in ten years. The 10-, 30-, 50-, 70-, and 90-percent exceedence values in table 3 are the daily flows that are equaled or exceeded for the specified percent of time for the period of analysis. For example, the 10-percent flow-duration value for a station is the flow that is equaled or exceeded 10 percent of the time during the period of analysis. Low-flow and flow-duration computation methods are explained in greater detail in Riggs (1972) and Stedinger and Thomas (1985).

SUMMARY

Reliable methods of estimating streamflow characteristics for potential water-supply streams are needed for the initial implementation of the Fort Gordon Integrated Natural Resources Management Plan. The streamflow characteristics determined in this study will be used by Fort Gordon for current streamflow management decisions and to determine if adequate water supplies will be available for future base operations.

Concurrent discharge measurements were made during typical base-flow periods during March 1999–August 2000. Discharge measurements at all four locations were used to verify simple drainage-area ratios. The flow data were correlated with the 23 years of continuous streamflow data at Butler Creek and used to estimate the flow characteristics for the three other potential water-supply streams. Standard USGS statistical methods and computer application programs were used in the analysis of the available streamflow data.

Computations of selected streamflow characteristics include the determinations of mean values for consecutive low-flow days, and selected flow-duration and low-flow frequency data. Low-flow data computed based on daily mean streamflow include: mean discharges for consecutive 1-, 3-, 7-, 14-, and 30-day period and low-flow estimates of 7Q10, 30Q2, 60Q2, and 90Q2 recurrence intervals. Flow-duration data for the 10-, 30-, 50-, 70-, and 90-percent time flow is equaled or exceeded were also determined.

REFERENCES CITED

Riggs, H.C., 1972, Low-flow investigations: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 4, Chapter B1, 18 p.

Stedinger, J.R., and Thomas, W.O., Jr., 1985, Low-flow frequency estimations using base-flow measurements: U.S. Geological Survey Open-File Report 85-92, 22 p.

U.S. Geological Survey, 1990, Automated Data Processing System, *compiled by* G.R. Dempster, National Water Information System Users Manual: U.S. Geological Survey Open-File Report 90-116, chap. 11, p. 11-1–11-28.