DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
NATIONAL PARK SERVICE

WATER RESOURCES INVESTIGATIONS
OPEN-FILE REPORT 80-964
SHEET 2 OF 2

SURFACE WATER RESOURCES

Quantico Creek, which has a drainage area of 25 mi^2, is the major stream. It flows through the Park in a southeastward direction and empties into the Potomac River estuary at Quantico, Va. (fig. 1). Streamflow data have been collected at the Geological Survey gaging station on South Fork Quantico Creek near Independent Hill (station no. 01658500) since May 1951. As part of this study, measurements were made at several additional sites throughout the park (fig. 7). These data were correlated with flows at the gaging station to determine the annual maximum flows.

The hydrograph for the gaging station on South Fork Quantico Creek (fig. 8) shows that mean monthly discharge is highest in March and lowest in September. The highest and lowest monthly mean discharges for each month during the period are also shown. A flow-duration curve (fig. 9) shows the distribution of different magnitudes of daily flow at the gaging station. The mean daily flow at the gaging station on South Fork Quantico Creek exceeds 0.9 ft^3/s (cubic feet per second) 70 percent of the time and 0.1 ft^3/s 95 percent of the time. The flow-duration curve also shows that there have been periods of no flow.

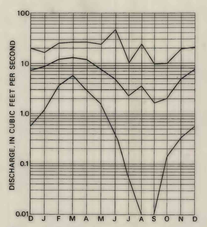


Figure 8. Graph showing mean monthly discharge and highest and lowest monthly mean discharge for South Fork Quantico Creek near Independent Hill, Va. 1952-73.

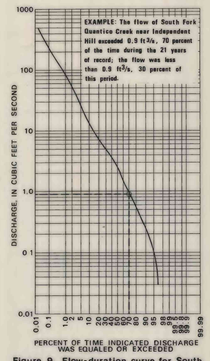


Figure 9. Flow-duration curve for South Fork Quantico Creek near Independent Hill, Va.

Low Flow

Planning for the possible use of streamflow as a public water supply requires knowledge of the low-flow characteristics of the stream. For example, demands on the water supply are greatest during late summer and early fall, when streamflow is generally lowest. Low flows of streams are derived largely from ground-water sources. Base flow, or ground-water runoff, is that part of streamflow consisting of water discharged into a stream channel by seepage from the ground-water reservoir. Periods of no flow may occur when the water table falls below the level of the streambed and there is no ground-water discharge to the stream.

Low-flow data are available for the gaging station on South Fork Quantico Creek for the period 1951-74. Periods of no flow were recorded at times in 1954, 1957, and 1962-66. A low-flow frequency curve (fig. 10) indicates how often the average discharge for an indicated period of consecutive days (3, 7, or 14 days) may be expected to be equal to or less than a specified value.

Low-flow characteristics at other sites may be estimated by correlation between the particular site and the gaging station on South Fork Quantico Creek. Figure 11 shows correlations between concurrent base flows at the gaging station and at three miscellaneous measuring sites. In figure 7, the last of the three streamflow characteristics shown on the flag for each site is the unit discharge (discharge in cubic feet per second from a 1-square-mile area) computed from baseflow measurements made on Oct. 15, 1974. These unit discharges indicate larger yields per unit area below the gaging station than from the area above it. This is assumed to be caused by the addition of flow from small springs downstream from the gage. Based on this assumption, the (M 7,2) values (the average minimum flow for a 7-day period that would be expected to occur on the average of once every 2 years) at miscellaneous sites in the lower reaches of both South Fork Quantico Creek and Quantico Creek basins can be expected to be about 0.1 ft^3/sec.

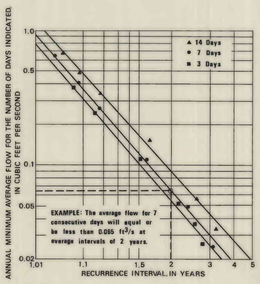


Figure 10. Low-flow frequency curves for South Fork Quantico Creek near Independent Hill, Va.

Mean Flow

Mean annual discharge is a limiting factor in the design of a surface-water supply. This average flow is the maximum constant rate at which water from a stream could be used if it were possible to store all the streamflow and if seepage and evapotranspiration were eliminated.

A regression analysis that considered the factors that might affect streamflow in Atlantic slope basins in Virginia showed that drainage area and mean annual precipitation were the most significant basin characteristics (Nuckels, 1970). The regression equation derived by Nuckels can be used to determine mean annual discharge at any point in the park with about the same accuracy as that obtained from 10 years of flow records. In figure 7, the second of the three streamflow characteristics shown on the flag for each site is the value of mean flow computed from the regression equation.

Values of mean annual flow at the miscellaneous measuring sites can be determined from figure 11 by entering the diagram along the abscissa at the mean flow for South Fork Quantico Creek, going vertically to the curve for the desired site, and then reading the mean flow for that site from the ordinate. Estimates of mean daily flow at each of the miscellaneous sites can also be obtained from figure 11 by the same technique.

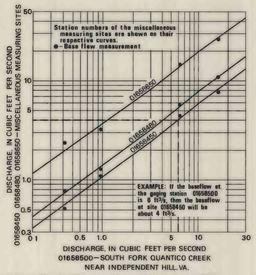


Figure 11. Graph showing relation of baseflow measurements of South Fork Quantico Creek near Independent Hill, Va. to baseflow measurements at miscellaneous measuring sites in Prince William Forest Park.

Peak Flow

Damages from high streamflows are related to the height, duration, frequency, and season of flooding. High flows are influenced by basin characteristics, such as size, shape, and topography. The frequency of high flows at the gaging station on South Fork Quantico Creek is shown in figure 12 as a plot of discharge versus recurrence interval of time within which a given discharge will be equalled or exceeded once. It is emphasized that recurrence intervals are average figures--the average number of years that will elapse between floods that equal or exceed a given magnitude. Thus, the occurrence of a major flood does not reduce the probability that a flood of as great or greater magnitude will occur in the next year or even in the next week.

Approximate boundaries of flood-prone areas in Prince William Forest Park are shown in figure 7. These are the areas subject to inundation in a 100-year flood. There is, on the average, about 1 chance in 100 that the designated areas will be inundated in any year. The flood-prone areas have been delineated by the use of information on past floods. The delineated areas are for conditions unaffected by structures; effects of present or proposed flood-control structures are not considered.

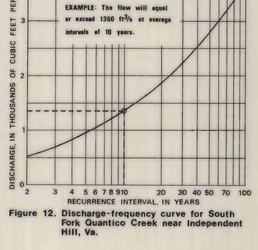


Figure 12. Discharge-frequency curve for South Fork Quantico Creek near Independent Hill, Va.

Quality of Surface Water

Four sites on streams were sampled for mineral content. Analyses of samples taken at these sites on Oct. 25, 1973, during low flow are shown in figure 7 as bar diagrams. Stream waters in the park are generally dilute and of good mineral quality. Dissolved-solids concentrations range from 37 to 74 mg/L. The concentrations are generally greatest during late summer and early fall when precipitation and runoff are at a minimum and more highly mineralized ground-water discharge constitutes a significant part of the streamflow. Values of pH ranged from 6.3 to 7.5.

On Oct. 15, 1974, streams were sampled at three sites for trace elements. The results of the analyses are as follows:

(Values in micrograms per liter)

	Station Number		
	01658450	01658480	01658650
Cobalt, total	3	3	0
Copper, total	8	110	6
Iron, total	600	1600	420
Manganese, total	14	240	10
Zinc, total	90	670	80

These analyses show that at a point just below the abandoned Cabin Branch pyrite mine (station 01658480), Quantico Creek is anomalously high in concentrations of copper, iron, manganese and zinc compared with other streams sampled. Mine tailings at the abandoned mine site are probably the source of these higher metal concentrations.

From February to October 1973, temperature and conductance were monitored continuously on South Fork Quantico Creek below the pond at Camp 3 (station 01658620). The stream temperature has a seasonal variation that responds to changes in the ambient air temperature. Shorter-term fluctuations in stream temperature also occur (fig. 13); these fluctuations correlate with increases in discharge caused by precipitation whose temperature differs from that of the stream.

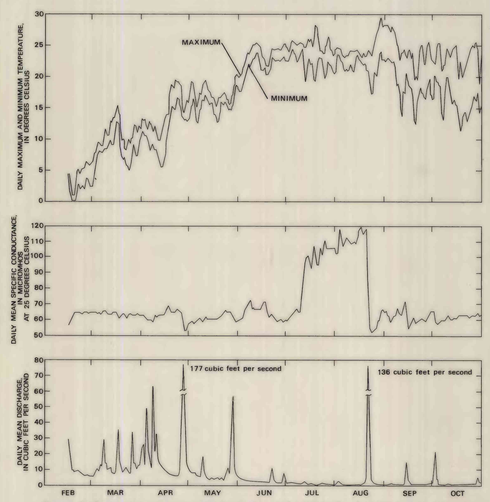
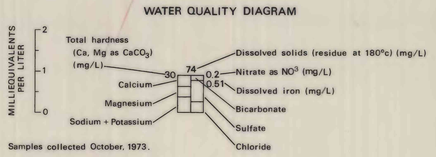


Figure 13. Graph showing daily mean discharge at the Geological Survey gaging station on South Fork Quantico Creek near Independent Hill (01658500), and daily mean specific conductance and daily maximum and minimum temperature in South Fork Quantico Creek at Camp 3 (01658620) for the period Feb. 15 to Oct. 31, 1973.

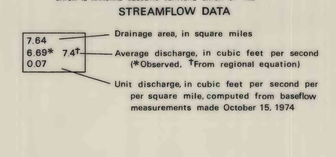
EXPLANATION

WATER QUALITY DIAGRAM



Samples collected October, 1973.

STREAMFLOW DATA



STREAMFLOW-MEASURING AND QUALITY-OF-WATER SITES

- Continuous-record gaging station
- Miscellaneous measuring site
- Low-flow measuring site
- Quality-of-water sampling site
- Flood-prone area delineated only when wider than 400 ft.
- 01658480 Station number

Figure 7. Map of Prince William Forest Park showing chemical analyses of surface-water, location of measuring sites for surface-water discharge, sampling sites for water quality, and flood prone areas.

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CONVERSION FACTORS

Factors for converting Inch-Pound Units to International System (SI) Units, and abbreviations.

Multiply Inch-Pound Units	by	To obtain SI Units
inch (in)	.54	centimeter (cm)
feet (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
square mile (mi^2)	2.59	square kilometer (km^2)
acre	4047	square meter (m^2)
gallon (gal)	3.7854	liter (l)
cubic feet per second (ft^3/s)	28.32	liter per second (l/s)
gallons per minute (gal/min)	0.06309	liter per second (l/s)
cubic feet per second per square mile ($ft^3/s/mi^2$)	10.39	liter per second per square kilometer ($(l/s)/km^2$)

WATER RESOURCES OF PRINCE WILLIAM FOREST PARK, VIRGINIA

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