

A COMPENDIUM OF VIRGINIA HYDROLOGY

by

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INTRODUCTION

Engineers engaged in water supply or power projects are often faced with the problem of dealing with the adequacy of the supply, as well as that of the extremes of flow on which the safety of hydraulic structures depends. For the streams in Virginia three bulletins of the VPI Engineering Experiment Station relating to the solution of these problems have been published. Bulletins 33<sup>(1)</sup> and 92<sup>(2)</sup> published in 1938 and 1954, respectively, were devoted to the solution of the first of these problems, in determining relationships between the annual rainfall data and available stream flow data for various drainage areas. In Bulletin No. 43<sup>(3)</sup> of the Engineering Experiment Station, published in 1940, a study was made of the maximum recorded flood flows of streams in Virginia and the rainfalls producing such floods; the relationship between these rainfalls and the maximum recorded runoff was also determined.

In order to provide greater statistical strength for the relationships established in the above mentioned papers additional data for the 25 years from 1936 to 1960 have been analyzed. The present paper is a report on the results of this analysis.

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1. P. H. McGauhey, "Hydrology of Virginia, Part I, Annual Rainfall and Stream Flow Studies with an Introduction to Statistical Methods of Analysis," Bulletin of VPI Engineering Experiment Station, No. 33, April, 1938.
  2. Linvil G. Rich, and Raymond A. Payne, "Hydrology of Virginia, Part III, Annual Rainfall-Stream Flow Relationships Through 1950," Bulletin of VPI Engineering Experiment Station, No. 92. May, 1954.
  3. P. H. McGauhey and H. B. Snyder, Jr., "Hydrology of Virginia, Part II, Flood Studies; Storms That Have Caused Great Floods; Great Rainfalls," Bulletin of VPI Engineering Experiment Station, No. 44, May, 1940.

## PART I. ANNUAL RAINFALL AND STREAM FLOW STUDIES

The purpose of this part is to study the existing annual rainfall and stream flow records in Virginia and their relationships; and to convert such information into forms more useful to the engineer. The work of this part will provide greater statistical strength for the analysis presented in Bulletin Nos. 33 and 92 of the Engineering Experiment Station in which the same information for the period before 1950 had been analyzed.

### 1. Annual Rainfall:

In the present study rainfall records from 59 stations were used. Forty-two of these are in Virginia, six in West Virginia, six in North Carolina, four in Tennessee, and one in Kentucky. Annual rainfall data collected on a water year (from the first day of October to the thirtieth day of September) basis for the years 1951 through 1960 are listed in Appendix I; the data for the years 1936 through 1950 are listed in Bulletin No. 92. It can be seen that there are only small differences in the means caused by the 10 years of additional data.

### 2. Areal Rainfall:

The "areal rainfall" is the rainfall depth in inches on the drainage area in question. It is obtained by calculating station constants for all rainfall stations pertinent to the drainage area and multiplying such constants by the rainfalls at all stations. The sum of these products for any year is the areal rainfall in the drainage area for that year.

Two methods are used for determining station constants, i.e., the Thiessen's inclined plane method and Horton's method as described in Bulletin No. 33. The station constants employed in the present study were taken from Bulletin No. 33. Annual areal rainfall data for the years 1951 through 1960 are listed in Appendix II.

### 3. Rainfall-Runoff Coefficients:

The rainfall-runoff coefficient for each year is determined by dividing runoff in inches depth on the drainage area by areal rainfall in the same units and for the same period of record. It represents the portion of the rainfall that appeared as stream flow. Annual runoff records collected from the individual gaging stations for the water years 1951 through 1960 are listed in Appendix III. Appendix IV gives the annual coefficients for the same period.

Table 2 shows for each stream the sizes of drainage areas, and the average, maximum and minimum coefficients of the 40 drainage areas located in seven major drainage basins of Virginia. In Table 2 are also listed the mean coefficients through 1935 and the mean coefficients through 1950. In comparing them with the mean coefficients based on the record available up to and including 1960, it should be noted that there are only slight differences between them.

### 4. Rainfall-Runoff Equations:

In the past, the relationship between annual rainfall and runoff has been frequently expressed in a simple ratio, assuming that the relationship is a straight line passing through the origin, with the ratio as the slope of this straight line. Actually the curve of best

fit is usually a straight line intercepting the precipitation axis at some other value instead of the origin. The equation of this line is

$$R = qP - C$$

where R is the runoff in inches, P the areal precipitation in inches, q the slope, and C the intercept of the R axis.

Of the precipitation which reaches the ground, some infiltrates into the ground, some runs off over the surface, and some evaporates or is transpired back into the atmosphere; besides, a certain quantity of precipitation is required to wet the surface and the subsoil, and is intercepted by vegetation. Therefore, the constants q and C can be interpreted hydrologically as follows:

$$q = (\text{Precipitation} - \text{Infiltration} - \text{Evaporation} - \text{Transpiration} - \text{Other Losses}) / \text{Precipitation}.$$

$$C = \text{Precipitation required to wet the surface and the subsoil} / \text{Precipitation intercepted by vegetation}.$$

The equation for rainfall-runoff relationship and the equations for the 50 percent confidence limits with the maximum and minimum deviations of the equation for each drainage area are listed in Table 2. If the annual areal rainfall has been known, then the estimated annual runoff can be obtained by substituting the value of that annual areal rainfall into the corresponding equation for each drainage area.



PART II. FLOOD STUDIES: STORMS THAT HAVE CAUSED GREAT FLOODS:

The work of this part is to continue the work that had been analyzed in Bulletin No. 43 of the Engineering Experiment Station. In Bulletin No. 43, the maximum recorded flood flows of streams in Virginia; the 1-, 2-, 3-, and 5-day rainfalls producing such floods, and the relationship between these rainfalls and the maximum recorded runoff for the period before 1938 had been analyzed. In this part data for the period through 1960 are analyzed in order to increase the statistical strength.

1. Recorded Maximum of Discharge:

Table 3 lists the most important flood records, together with the dates of occurrence, drainage areas, and extent of record studied in the preparation of this part. Some of the records have been revised.

2. Storms That Have Caused Flood Flows:

The data for the floods that occurred in the period after 1938 for most of the Virginia streams for which information is available are listed in Table 4. The data for the floods that occurred before 1938 had been analyzed in Bulletin 43. In Table 4, the maximum discharge as recorded or computed by the United States Geological Survey is given, together with the date on which it occurred. The 1-, 2-, 3-, and 5-day rainfalls responsible for the respective floods are also given, and finally the areal rainfall in inches depth of the drainage area is computed.

Table 1. - Average Annual Rainfall  
Virginia Stations

Station	Average annual rainfall through			Number of years of record	Years of record
	1935	1950	1960		
Speers Ferry-Clinchport	45.82	45.97	46.20	64	1897-1960
Burkes Garden -----	46.69	45.98	45.51	61	1897-1960
Narrows-Glenlyn -----	38.76	37.91	37.68	53	1908-1960
Ivanhoe-Byllesby -----	39.49	39.22	39.32	55	1906-1960
Radford -----	37.75	37.38	37.07	54	1907-1960
Stuart -----	49.83	50.42	50.48	45	1909-1960
Dante -----	48.06	47.95	47.08	41	1918-1960
Mendota -----	47.87	46.87	46.84	55	1906-1960
Demascus -----	44.22	45.05	45.27	50	1910-1960
Saltville-N. Holston --	44.19	44.22	43.77	41	1905-1960
Marion -----	42.40	42.49	42.07	73	1884-1960
Wytheville -----	39.13	38.66	38.50	82	1874-1960
Hot Springs -----	40.91	41.15	41.09	68	1893-1960
Blacksburg -----	42.19	41.72	41.31	68	1892-1960
Catawba Sanatorium ----	42.29	42.88	42.55	48	1912-1960
Salem-Roanoke -----	40.41	41.57	41.47	67	1894-1960
Rocky Mount -----	44.45	44.81	44.64	61	1895-1960
Buchanan -----	41.81	43.32	43.02	58	1895-1960
Lexington -----	39.22	39.47	39.40	88	1870-1960
Mt. Solon-Staunton ----	37.77	37.60	37.73	80	1869-1960
Shenandoah -----	34.22	39.31	39.31	22	1902-1908 1935-1960
Clarksville -----	42.44	43.90	43.90	61	1892-1960
New Canton -----	41.32	42.18	41.88	66	1895-1960
Columbia -----	40.25	40.90	40.53	62	1899-1960
Lassiter-Mineral -----	39.54	40.90	40.90	44	1894-1960
Orange -----	42.23	42.47	42.47	46	1897-1960
Dale Enterprise -----	39.43	38.74	38.41	80	1881-1960
Charlottesville -----	44.31	44.92	44.77	77	1875-1960
Lynchburg -----	40.68	40.96	40.76	89	1872-1960

Table 1. - Average Annual Rainfall (Continued)  
Virginia Stations

Station	Average annual rainfall through			Number of years of record	Years of record#
	1935	1950	1960		
Bedford -----	40.16	44.51	43.69	37	1890-1904 1935-1960
Randolph -----	41.04	43.32	43.58	54	1906-1960
Woodstock -----	34.06	34.48	34.61	71	1890-1960
Stephens City-Winchester	35.89	36.89	37.09	65	1893-1960
Danville -----	41.56	42.15	42.55	62	1892-1960
Chatham -----	41.53	42.77	42.75	48	1890-1960
Richmond -----	41.95	42.16	42.54	88	1873-1960
Hopewell -----	43.21	43.14	43.49	72	1889-1960
Quantico -----	38.24	38.32	38.89	55	1906-1960
Fredericksburg -----	40.18	40.54	40.93	52	1908-1960
Washington, D. C. -----	41.94	41.96	41.82	117	1825-1960
Mt. Weather -----	39.79	40.03	40.23	53	1905-1960
Culpeper -----	--	44.42	42.83	23	1935-1960

# The records at several stations are discontinuous.

Table 1. - Average Annual Rainfall (Continued)

Station	Average annual rainfall through			Number of years of record	Years of record
	1935	1950	1960		
North Carolina Stations					
Mt. Airy -----	45.30	46.34	46.26	68	1890-1960
Benners Elk -----	51.83	52.41	51.74	53	1908-1960
Jefferson -----	47.70	48.23	47.71	52	1904-1960
Reidsville -----	43.41	43.54	43.63	56	1902-1960
Winston-Salem -----	44.32	44.77	44.71	62	1896-1960
Rougemont -----	42.40	43.79	44.25	57	1901-1960
Tennessee Stations					
Mountain City -----	46.93	45.93	45.57	61	1900-1960
Elizabeton -----	44.79	44.47	44.12	61	1900-1960
Bluff City -----	44.65	44.90	44.98	61	1900-1960
Tazewell -----	45.64	45.77	46.23	61	1900-1960
Kentucky Station					
Middlesboro -----	50.78	48.92	49.69	59	1900-1960
West Virginia Stations					
Bluefield -----	40.34	40.68	40.84	66	1893-1960
Brandywine -----	37.04	35.60	35.60	52	1899-1960
Harpers Ferry -----	36.25	37.60	37.72	71	1890-1960
Lewisburg -----	39.63	38.80	38.63	61	1899-1960
Union -----	37.60	37.18	36.71	55	1903-1960
Upper Tract -----	28.60	30.06	30.06	53	1898-1960

Table 2. - Rainfall-Runoff Coefficients, Equations of  
Rainfall-Runoff Relationships and Confidence Limits

James River Basin		
	James River at Cartersville	James River at Buchanan
Drainage area in sq. mile -----	6,242	2,084
Average rainfall- runoff coefficient:		
through 1935 -----	0.384	0.394
through 1950 -----	0.380	0.394
through 1960 -----	0.375	0.396
Max. coef. through 1960 -----	0.507	0.539
Min. coef. through 1960 -----	0.208	0.232
Equation of rainfall- runoff relationship:	$R = 0.56P - 7.39$	$R = 0.57P - 6.95$
50% confidence limits:		
Upper limit -----	$R = 0.56P - 5.30$	$R = 0.57P - 4.60$
Lower limit -----	$R = 0.56P - 9.48$	$R = 0.57P - 9.30$
Max. deviation of the equation -----	4.92	5.72
Min. deviation of the equation -----	-5.90	-6.08
No. of years on which ave. coef. and equa. through 1960 are based	61	49

Table 2.- Rainfall-Runoff Coefficients, Equations of  
Rainfall-Runoff Relationships and Confidence Limits

## James River Basin

	Jackson River at Barber	Hardware River near Scottsville
Drainage area in sq. mile -----	409	104
Average rainfall- runoff coefficient:		
through 1935 -----	0.375	0.357
through 1950 -----	0.383	0.362
through 1960 -----	0.385	0.364
Max. coef. through 1960 -----	0.548	0.638
Min. coef. through 1960 -----	0.208	0.176
Equation of rainfall- runoff relationship:	$R = 0.57P - 7.59$	$R = 0.53P - 7.24$
50% confidence limits:		
Upper limit -----	$R = 0.57P - 4.76$	$R = 0.53P - 3.92$
Lower limit -----	$R = 0.57P - 10.91$	$R = 0.53P - 10.56$
Max. deviation of the equation -----	+6.89	+10.52
Min. deviation of the equation -----	-7.28	-6.67
No. of years on which ave. coef. and equa. thro. 1960 are based	34	31

Table 2.- Rainfall-Runoff Coefficients, Equations of  
Rainfall-Runoff Relationships and Confidence Limits

## James River Basin

	Slate River at Arvonnia	Appomattox River at Farmsville
Drainage area in sq. mile -----	235	306
Average rainfall- runoff coefficient:		
through 1935 -----	0.279	0.281
through 1950 -----	0.303	0.297
through 1960 -----	0.294	0.284
Max. coef. through 1960 -----	0.435	0.491
Min. coef. through 1960 -----	0.156	0.160
Equation of rainfall- runoff relationship:	$R = 0.34P - 1.83$	$R = 0.41P - 5.43$
50% confidence limits:		
Upper limit -----	$R = 0.34P - 0.17$	$R = 0.41P - 3.34$
Lower limit -----	$R = 0.34P - 3.83$	$R = 0.41P - 7.52$
Max. deviation of the equation -----	+5.66	+9.06
Min. deviation of the equation -----	-6.04	-4.91
No. of years on which ave. coef. and equa. thro. 1960 are based	34	32

Table 2.- Rainfall-Runoff Coefficients, Equations of  
Rainfall-Runoff Relationships and Confidence Limits

## James River Basin

	Willis River at Columbia	Cowpasture River near Clifton Forge
Drainage area in sq. mile -----	247	456
Average rainfall- runoff coefficient:		
through 1935 -----	0.272	0.362
through 1950 -----	0.314	0.382
through 1960 -----	0.309	0.386
Max. coef. through 1960 -----	0.408	0.550
Min. coef. through 1960 -----	0.189	0.216
Equation of rainfall- runoff relationship--	$R = 0.37P - 2.39$	$R = 0.76P - 14.55$
50% confidence limits:		
Upper limit -----	$R = 0.37P - 0.60$	$R = 0.76P - 11.91$
Lower limit -----	$R = 0.37P - 4.18$	$R = 0.76P - 17.19$
Max. deviation of the equation -----	+4.04	+6.37
Min. deviation of the equation -----	-5.25	-6.30
No. of years on which ave. coef. and equa. thro. 1960 are based-	29	35



Table 2.- Rainfall-Runoff Coefficients, Equations of  
Rainfall-Runoff Relationships and Confidence Limits

## James River Basin

	Craig Creek at Parr	North River at Lexington
Drainage area in sq. mile -----	337	487
Average rainfall- runoff coefficient:		
through 1935 -----	0.367	0.356
through 1950 -----	0.366	0.363
through 1960 -----	0.366	0.355
Max. coef. through 1960 -----	0.557	0.513
Min. coef. through 1960 -----	0.232	0.211
Equation of rainfall- runoff relationship --	$R = 0.52P - 6.41$	$R = 0.54P - 7.42$
50% confidence limits:		
Upper limit -----	$R = 0.52P - 3.66$	$R = 0.54P - 4.69$
Lower limit -----	$R = 0.52P - 9.13$	$R = 0.54P - 10.15$
Max. deviation of the equation -----	7.84	6.35
Min. deviation of the equation -----	-8.01	-6.88
No. of years on which ave. coef. and equa. thro. 1960 are based -	32	31

Table 2. - Rainfall-Runoff Coefficients, Equations of  
Rainfall-Runoff Relationships and Confidence Limits

## New River Basin

	New River at Eggleston	Big Reed Island Creek at Allisonia
Drainage area in sq. mile -----	2,491	278
Average rainfall- runoff coefficients:		
through 1935 -----	0.410	0.406
through 1950 -----	0.421	0.434
through 1960 -----	0.439	0.410
Max. coef. through 1960 -----	0.581	0.611
Min. coef. through 1960 -----	0.211	0.279
Equation of rainfall- runoff relationship --	$R = 0.55P - 5.18$	$R = 0.29P + 5.69$
50% confidence limits:		
Upper limit -----	$R = 0.55P - 2.69$	$R = 0.29P + 8.70$
Lower limit -----	$R = 0.55P - 7.67$	$R = 0.29P + 2.68$
Max. deviation of the equation -----	+6.53	+7.55
Min. deviation of the equation -----	-7.94	-6.28
No. of years on which ave. coef. and equa. thro. 1960 are based -	45	29

Table 2.- Rainfall-Runoff Coefficients, Equations of  
Rainfall-Runoff Relationships and Confidence Limits

New River Basin

	Wolf Creek at Narrows
Drainage area in sq. mile -----	223
Average rainfall- runoff coefficients:	
through 1935 -----	0.424
through 1950 -----	0.408
through 1960 -----	0.425
Max. coef. through 1960 -----	0.556
Min. coef. through 1960 -----	0.291
Equation of rainfall- runoff relationship--	$R = 0.66P - 4.55$
50% confidence limits:	
Upper limit -----	$R = 0.66P - 1.87$
Lower limit -----	$R = 0.66P - 7.23$
Max. deviation of the equation -----	+2.06
Min. deviation of the equation -----	-10.00
No. of years on which ave. coef. and equa. thro. 1960 are based-	30

Table 2. - Rainfall-Runoff Coefficients, Equations of  
Rainfall-Runoff Relationships and Confidence Limits

Potomac River Basin

	North River at Burketown	Shenandoah River at Millville, W.Va.
Drainage area in sq. mile -----	381	3,040
Average rainfall- runoff coefficients:		
through 1935 -----	0.373	0.318
through 1950 -----	0.382	0.313
through 1960 -----	0.399	0.310
Max. coef. through 1960 -----	0.617	0.553
Min. coef. through 1960 -----	0.197	0.160
Equation of rainfall- runoff relationship	$R = 0.67P - 10.46$	$R = 0.54P - 8.14$
50% confidence limits:		
Upper limit -----	$R = 0.67P - 7.78$	$R = 0.54P - 5.61$
Lower limit -----	$R = 0.67P - 13.14$	$R = 0.54P - 10.67$
Max. deviation of the equation -----	+7.91	+8.61
Min. deviation of the equation -----	-4.89	-5.28
No. of years on which ave. coef. and equa. thro. 1960 are based -	33	42

Table 2. - Rainfall-Runoff Coefficients, Equations of  
Rainfall-Runoff Relationships and Confidence Limits

Potomac River Basin

	South Fork of Shenandoah River near Luray	North Fork of Shenandoah River near Strasburg
Drainage area in sq. mile -----	1,377	772
Average rainfall- runoff coefficients:		
through 1935 -----	0.366	0.255
through 1950 -----	0.317	0.277
through 1960 -----	0.324	0.277
Max. coef. through 1960 -----	0.497	0.482
Min. coef. through 1960 -----	0.222	0.132
Equation of rainfall- runoff relationships	$R = 0.46P - 4.52$	$R = 0.46P - 6.21$
50% confidence limits:		
Upper limit -----	$R = 0.46P - 2.00$	$R = 0.46P - 4.08$
Lower limit -----	$R = 0.46P - 7.04$	$R = 0.46P - 8.34$
Max. deviation of the equation -----	+6.02	+7.01
Min. deviation of the equation -----	-4.56	-3.82
No. of years on which ave. coef. and equa. thro. 1960 are based	18	34

Table 2.- Rainfall-Runoff Coefficients, Equations of  
Rainfall-Runoff Relationships and Confidence Limits

Potomac River Basin

	Occoquan Creek near Occoquan	Middle River at Grottoes
Drainage area in sq. mile -----	645	360
Average rainfall- runoff coefficients:		
through 1935 -----	0.293	0.284
through 1950 -----	0.302	0.313
through 1960 -----	0.305	0.303
Max. coef. through 1960 -----	0.458	0.502
Min. coef. through 1960 -----	0.142	0.178
Equation of rainfall- runoff relationship --	$R = 0.43P - 4.86$	$R = 0.50P - 7.11$
50% confidence limits:		
Upper limit -----	$R = 0.43P - 2.52$	$R = 0.50P - 4.70$
Lower limit -----	$R = 0.43P - 7.20$	$R = 0.50P - 9.52$
Max. deviation of the equation -----	+5.89	+7.17
Min. deviation of the equation -----	-5.75	-3.79
No. of years on which ave. coef. and equa. thro. 1960 are based-	23	33

Table 2. - Rainfall-Runoff Coefficients, Equations of  
Rainfall-Runoff Relationships and Confidence Limits

Potomac River Basin

	South River at Harriston
Drainage area in sq. mile -----	222
Average rainfall- runoff coefficients:	
through 1935 -----	0.332
through 1950 -----	0.349
through 1960 -----	0.353
Max. coef. through 1960 -----	0.583
Min. coef. through 1960 -----	0.195
Equation of rainfall- runoff relationship ----	$R = 0.53P - 7.01$
50% confidence limits:	
Upper limit -----	$R = 0.53P - 4.11$
Lower limit -----	$R = 0.53P - 9.71$
Max. deviation of the equation -----	+9.22
Min. deviation of the equation -----	-5.50
No. of years on which ave. coef. and equa. thro. 1960 are based ---	26

Table 2.- Rainfall-Runoff Coefficients, Equations of  
Rainfall-Runoff Relationships and Confidence Limits

Roanoke River Basin

	Roanoke River at Roanoke	Roanoke River at Altavista
Drainage area in sq. mile -----	388	1,082
Average rainfall- runoff coefficients:		
through 1935 -----	0.334	0.287
through 1950 -----	0.328	0.331
through 1960 -----	0.335	0.334
Max. coef. through 1960 -----	0.549	0.465
Min. coef. through 1960 -----	0.162	0.181
Equation of rainfall- runoff relationship-	$R = 0.64P - 12.64$	$R = 0.59P - 10.65$
50% confidence limits:		
Upper limit -----	$R = 0.64P - 10.73$	$R = 0.59P - 8.26$
Lower limit -----	$R = 0.64P - 14.55$	$R = 0.59P - 13.04$
Max. deviation of the equation -----	+8.70	+5.00
Min. deviation of the equation -----	-8.10	-6.56
No. of years on which ave. coef. and equa. thro. 1960 are based	62	35



Table 2. - Rainfall-Runoff Coefficients, Equations of  
of Rainfall-Runoff Relationships and Confidence Limits

Roanoke River Basin

	Blackwater River near Union Hall	Goose Creek at Huddleston
Drainage area in sq. mile -----	208	187
Average rainfall- runoff coefficients:		
through 1935 -----	0.303	0.223
through 1950 -----	0.346	0.300
through 1960 -----	0.342	0.296
Max. coef. through 1960 -----	0.483	0.423
Min. coef. through 1960 -----	0.177	0.148
Equation of rainfall- runoff relationship--	$R = 0.48P - 6.24$	$R = 0.54P - 10.08$
50% confidence limits:		
Upper limit -----	$R = 0.48P - 3.23$	$R = 0.54P - 8.08$
Lower limit -----	$R = 0.48P - 9.23$	$R = 0.54P - 12.08$
Max. deviation of the equation -----	+6.63	+4.25
Min. deviation of the equation -----	-7.30	-5.87
No. of years on which ave. coef. and equa. thro. 1960 are based-	35	27

Table 2.- Rainfall-Runoff Coefficients, Equations of  
Rainfall-Runoff Relationships and Confidence Limits

Roanoke River Basin

	Dan River at South Boston	Smith River at Martinsville
Drainage area in sq. mile -----	2,730	374
Average rainfall- runoff coefficients:		
through 1935 -----	0.321	0.301
through 1950 -----	0.328	0.362
through 1960 -----	0.327	0.348
Max. coef. through 1960 -----	0.493	0.451
Min. coef. through 1960 -----	0.232	0.216
Equation of rainfall- runoff relationship -	$R = 0.41P - 3.71$	$R = 0.49P - 6.79$
50% confidence limits:		
Upper limit -----	$R = 0.41P - 1.63$	$R = 0.49P - 3.39$
Lower limit -----	$R = 0.41P - 5.79$	$R = 0.49P - 9.59$
Max. deviation of the equation -----	+6.96	+5.00
Min. deviation of the equation -----	-5.79	-5.50
No. of years on which ave. coef. and equa. thro. 1960 are based-	35	27

Table 2. -Rainfall-Runoff Coefficients, Equations of  
Rainfall-Runoff Relationships and Confidence Limits

Roanoke River Basin

	Bannister River near Halifax	Pigg River at Toshes
Drainage area in sq. mile -----	552	394
Average rainfall- runoff coefficients:		
through 1935 -----	0.249	0.244
through 1950 -----	0.304	0.312
through 1960 -----	0.289	0.306
Max. coef. through 1960 -----	0.396	0.407
Min. coef. through 1960 -----	0.177	0.192
Equation of rainfall- runoff relationship---	$R = 0.43P - 6.09$	$R = 0.45P - 6.28$
50% confidence limits:		
Upper limit -----	$R = 0.43P - 4.34$	$R = 0.45P - 4.27$
Lower limit -----	$R = 0.43P - 7.84$	$R = 0.45P - 8.69$
Max. deviation of the equation -----	4.60	4.51
Min. deviation of the equation -----	-4.69	-4.81
No. of years on which ave. coef. and equa. thro. 1960 are based -	31	30

Table 2. - Rainfall-Runoff Coefficients, Equations of  
Rainfall-Runoff Relationships and Confidence Limits

Rappahamock River Basin

	Rappahamock River at Fredericksburg	Rapidan River at Gulpeper
Drainage area in sq. mile -----	1,599	466
Average rainfall- runoff coefficients:		
through 1935 -----	0.352	0.358
through 1950 -----	0.353	0.372
through 1960 -----	0.345	0.364
Max. coef. through 1960 -----	0.534	0.580
Min. coef. through 1960 -----	0.105	0.192
Equation of rainfall- runoff relationship-	$R = 0.47P - 4.98$	$R = 0.47P - 4.23$
50% confidence limits:		
Upper limit -----	$R = 0.47P - 2.22$	$R = 0.47P - 1.16$
Lower limit -----	$R = 0.47P - 7.74$	$R = 0.47P - 7.30$
Max. deviation of the equation -----	7.45	10.80
Min. deviation of the equation -----	-8.05	- 6.03
No. of years on which ave. coef. and equa. thro. 1960 are based	52	32

Table 2. - Rainfall-Runoff Coefficients, Equations of  
Rainfall-Runoff Relationships and Confidence Limits

Tennessee River Basin

	South Fork Holston River at Vestal	South Fork Holston River at Bluff City, Tenn.
Drainage area in sq. mile -----	320	813
Average rainfall- runoff coefficients:		
through 1935 -----	0.477	0.448
through 1950 -----	0.458	0.426
through 1960 -----	0.460	0.424
Max. coef. through 1960 -----	0.601	0.563
Min. coef. through 1960 -----	0.310	0.262
Equation of rainfall- runoff relationship -	$R = 0.45P - 6.48$	$R = 0.58P - 6.94$
50% confidence limits:		
Upper limit -----	$R = 0.45P - 4.27$	$R = 0.58P - 4.55$
Lower limit -----	$R = 0.45P - 8.69$	$R = 0.58P - 9.33$
Max. deviation of the equation -----	4.51	4.98
Min. deviation of the equation -----	-4.81	-6.28
No. of years on which ave. coef. and equa. thro. 1960 are based-	29	41

Table 2.- Rainfall-Runoff Coefficients, Equation of  
Rainfall-Runoff Relationships and Confidence Limits

Tennessee River Basin

	North Fork Holston River at Saltville	North Fork Holston River at Gate City
Drainage area in sq. mile -----	222	672
Average rainfall- runoff coefficients:		
through 1935 -----	0.431	-
through 1950 -----	0.406	0.380
through 1960 -----	0.409	0.420
Max. coef. through 1960 -----	0.565	0.587
Min. coef. through 1960 -----	0.246	0.247
Equation of rainfall- runoff relationship---	$R = 0.50P - 4.21$	$R = 0.60P - 8.97$
50% confidence limits:		
Upper limit -----	$R = 0.50P - 1.52$	$R = 0.60P - 6.56$
Lower limit -----	$R = 0.50P - 6.90$	$R = 0.60P - 11.38$
Max. deviation of the equation -----	46.28	48.43
Min. deviation of the equation -----	-5.60	-6.16
No. of years on which ave. coef. and equa. thro. 1960 are based-	40	29

Table 2.- Rainfall-Runoff Coefficients, Equations of  
Rainfall-Runoff Relationships and Confidence Limits

Tennessee River Basin

	Middle Fork Holston River at Meadowview	Powell River at Jonesville
Drainage area in sq. mile -----	221	319
Average rainfall- runoff coefficients:		
through 1935 -----	-	0.612
through 1950 -----	0.360	0.541
through 1960 -----	0.358	0.516
Max. coef. through 1960 -----	0.499	0.671
Min. coef. through 1960 -----	0.225	0.271
Equation of rainfall- runoff relationship -	$R = 0.71P - 12.83$	$R = 0.39P \neq 5.05$
50% confidence limits:		
Upper limit -----	$R = 0.71P - 10.36$	$R = 0.39P \neq 9.48$
Lower limit -----	$R = 0.71P - 15.30$	$R = 0.39P \neq 1.41$
Max. deviation of the equation -----	$\neq 10.20$	$\neq 11.57$
Min. deviation of the equation -----	-6.74	-9.12
No. of years on which ave. coef. and equa. thro. 1960 are based-	21	40

Table 2.- Rainfall-Runoff Coefficients, Equations of  
Rainfall-Runoff Relationships and Confidence Limits

Tennessee River Basin

	Powell River at Arthur, Tenn.	Clinch River at Cleveland
Drainage area in sq. mile -----	685	528
Average rainfall- runoff coefficients:		
through 1935 -----	0.546	0.386
through 1950 -----	0.500	0.375
through 1960 -----	0.479	0.389
Max. coef. through 1960 -----	0.671	0.532
Min. coef. through 1960 -----	0.276	0.217
Equation of rainfall- runoff relationship:	$R = 0.67P - 8.54$	$R = 0.61P - 9.96$
50% confidence limits:		
Upper limit -----	$R = 0.67P - 4.99$	$R = 0.61P - 7.19$
Lower limit -----	$R = 0.67P - 12.09$	$R = 0.61P - 12.73$
Max. deviation of the equation -----	48.65	46.07
Min. deviation of the equation -----	-8.07	-9.49
No. of years on which ave. coef. and equa. thro. 1960 are based	38	39



Table 2.--Rainfall-Runoff Coefficients, Equations of  
Rainfall-Runoff Relationships and Confidence Limits

Tennessee River Basin

	Clinch River at Speers Ferry
Drainage area in sq. mile -----	1,162
Average rainfall- runoff coefficients:	
through 1935 -----	0.415
through 1950 -----	0.403
through 1960 -----	0.409
Max. coef. through 1960 -----	0.524
Min. coef. through 1960 -----	0.227
Equation of rainfall- runoff relationship ---	$R = 0.58P - 7.69$
50% confidence limits:	
Upper limit -----	$R = 0.58P - 5.43$
Lower limit -----	$R = 0.58P - 9.95$
Max. deviation of the equation -----	+5.53
Min. deviation of the equation -----	-4.48
No. of years on which ave. coef. and equa. thro. 1960 are based --	40

Table 2.- Rainfall-Runoff Coefficients, Equations of  
Rainfall-Runoff Relationships and Confidence Limits

York River Basin

North Anna River at Doswell	
Drainage area in sq. mile -----	4.39
Average rainfall- runoff coefficients:	
through 1935 -----	0.300
through 1950 -----	0.290
through 1960 -----	0.282
Max. coef. through 1960 -----	0.442
Min. coef. through 1960 -----	0.124
Equation of rainfall- runoff relationship:	$R = 0.45P - 6.71$
50% confidence limits:	
Upper limit -----	$R = 0.45P - 4.62$
Lower limit -----	$R = 0.45P - 8.90$
Max. deviation of the equation -----	+6.39
Min. deviation of the equation -----	-5.39
No. of years on which ave. coef. and equa. thro. 1960 are based	29

Table 3.  
Recorded Maximums of Discharge  
James River Basin

River and Station	Drainage area in sq. mi.	Maximum recorded discharge in sec. ft.	Date of maximum discharge	Maximum discharge in sec. ft. per sq. mi.	Extent of record
James River at Cartersville, Va.	6,240	180,000	9/20/44	28.9	1899-1960
James River at Buchanan, Va.	2,080	105,000#	3/27/13	50.5	1895-1960
Jackson River at Barber, Va.	409	24,700#	3/17/36	60.4	1925-1960
Hardware River near Scottsville, Va.	116	23,000	9/19/44	198.2	1925-1957*
Slate River at Arvonix, Va.	235	13,600	9/6/35	57.9	1926-1960
Rivanna River at Charlottesville, Va.	507	13,800	4/17/33	27.2	1925-1934*
Willis River near Columbia, Va.	247	9,580#	4/27/37	38.8	1926-1935 1936-1957*
Appomattox River at Mattoax, Va.	306	21,000	8/15/40	68.6	1900-1905 1926-1960
Cowpasture River near Clifton Forge, Va.	456	34,200#	3/18/36	75.0	1907-1908 1925-1960
Craig Creek at Parr, Va.	331	19,000#	1/23/35	57.4	1925-1957*
North River at Lexington, Va.	487	40,000#	3/18/36	82.1	1925-1957*

\*Station discontinued.

#Figure revised.

Table 3.- (Continued)  
Recorded Maximums of Discharge  
New River Basin

River and Station	Drainage area in sq. mi.	Maximum recorded discharge in sec.ft.	Date of maximum discharge	Maximum discharge in sec. ft. per sq. mi.	Extent of record
New River at Eggleston, Va.	2,941	219,000	8/14/40	74.5	1914-1960 1908-1916
Big Reed Island Creek at Allisonia, Va.	278	14,500	9/30/59	52.2	1940-1960
Walker Creek at Staffordsville, Va.	277	12,100	3/27/13	43.7	1908-1916*
Wolf Creek at Narrows, Va.	223	12,900	1/29/57	57.9	1912-1916 1939-1960

\*Station discontinued.

Table 3.- (Continued)  
Recorded Maximum of Discharge  
Potomac River Basin

River and Station	Drainage area in sq. mi.	Maximum recorded discharge in sec.ft.	Date of maximum discharge	Maximum discharge in sec. ft. per sq. mi.	Extent of record
North River at Burkettown, Va.	375	62,600	6/18/49	167.0	1926-1960
Shenandoah River at Millville, W. Va.	3,040	230,000	10/16/42	75.7	1895-1909 1928-1960
N. Fork Shenandoah R. near Riverton, Va.	1,040	1,040	Not re- corded		1899-1906*
S. Fork Shenandoah R. near Luray, Va.	1,377	100,000	10/16/42	72.7	1925-1930 1939-1951*
N. Fork Shenandoah R. near Strasburg, Va.	772	100,000	10/16/42	129.6	1925-1960
Occoquan Creek near Occoquan, Va.	546	37,000	10/16/42	67.8	1913-1916 1938-1956*
Middle River at Grottoes, Va.	360	24,500#	3/18/36	68.1	1925-1960
South River at Harriston, Va.	222	23,100	10/15/42	104.0	1925-1951*

\*Station discontinued.

#Figure revised.

Table 3.- (Continued)  
 Recorded Maximum of Discharge  
 Rappahannock River Basin

River and Station	Drainage area in sq. mi.	Maximum recorded discharge in sec. ft.	Date of maximum discharge	Maximum discharge in sec. ft. per sq. mi.	Extent of Record
Rappahannock River at Fredericksburg, Va.	1,599	140,000	10/16/42	87.6	1907-1960
Rapidan River at Culpeper, Va.	465	58,100	10/16/42	125.0	1925-1960

Table 3.- (Continued)  
Recorded Maximums of Discharge  
Roanoke River Basin

River and Station	Drainage area in sq. mi.	Maximum recorded discharge in sec. ft.	Date of maximum discharge	Maximum discharge in sec. ft. per sq. mi.	Extent of record
Roanoke River at Altavista, Va.	1,800	105,000	8/15/40	58.3	1931-1960
Roanoke River at Roanoke, Va.	388	26,400	8/14/40	68.1	1896-1960
Blackwater River near Union Hall, Va.	208	19,700	8/14/40	94.7	1925-1960
Goose Creek near Huddleston, Va.	187	20,300#	10/19/37	108.6	1925-1927 1931-1957*
Dan River at South Boston, Va.	2,730	81,000	8/16/40	29.7	1900-1907 1923-1952*
Smith River at Martinsville, Va.	374	39,000	10/19/37	104.2	1929-1930 1932-1957*
Bannister River near Halifax, Va.	374	50,000	9/20/44	133.7	1928-1960
Pigg River at Toshes, Va.	394	34,300	8/15/40	87.1	1929-1960
Otter River near Altavista, Va.	372	7,360	3/17/36	19.8	1929-1930 1932-1936*
Falling River near Naruna, Va.	172	15,800	9/18/44	91.8	1929-1930 1932-1960
Little Falling River at Hat Creek, Va.	43	1,820	3/6/32	42.3	1920-1930 1932-1935*
Leatherwood Creek near Old Liberty, Va.	68	2,790	8/11/28	43.7	1925-1935

\*Station discontinued.

#Figure revised.

Table 3.- (Continued)  
Recorded Maximum of Discharge  
Tennessee River Basin

River and Station	Drainage area in sq. mi.	Maximum recorded discharge in sec. ft.	Date of maximum discharge	Maximum discharge in sec. ft. per sq. mi.	Extent of record
S. Fork Holston River at Riverside, Va.	95	6,000#	6/12/23	63.5	1920-1960
S. Fork Holston River at Vestal, Va.	320	15,100	1/29/57	47.2	1931-1960
S. Fork Holston River at Bluff City, Tenn.	813	30,700#	5/22/01	37.8	1900-1953*
N. Fork Holston River at Saltville, Va.	228	16,500	1/29/57	72.4	1907-1908 1920-1960
N. Fork Holston River at Mendota, Va.	500	19,600	2/3/23	39.2	1920-1931*
N. Fork Holston River at Gate City, Va.	675	28,700	1/30/57	42.5	1931-1960
N. Fork Holston River at Chilhowie, Va.	144	7,170	6/12/23	53.5	1907-1909 1920-1931*
N. Fork Holston River at Meadowview, Va.	211	6,650	2/18/44	31.5	1931-1953*
Powell River at Pennington Gap	304	28,900	3/23/29	95.1	1920-1931*
Powell River at Jonesville, Va.	319	30,000	1/8/46	91.8	1931-1960
Powell River at Arthur, Tenn.	685	33,000	1/9/46	48.2	1919-1960
Clinch River at Cleveland, Va.	536	31,000	1/30/57	57.9	1920-1960
Clinch River at Speers Ferry, Va.	1,140	45,300	1/30/57	39.7	1920-1960

\*Station discontinued.

#Figure revised.



Table 3.- (Continued)  
Recorded Maximums of Discharge  
York River Basin

River and Station	Drainage area in sq. mi.	Maximum recorded discharge in sec. ft.	Date of maximum discharge	Maximum discharge in sec. ft. per sq. mi.	Extent of record
North Anna River at Doswell, Va.	439	18,300	4/27/37	41.7	1925-1930 1932-1957*

\* Station discontinued.

Table 4.  
Storms That Caused Maximums of Discharge  
James River Basin

James River at Cartersville, Va. Drainage area: 6,240 sq. mi.  
Maximum discharge: 180,000 sec. ft., September 20, 1944

Rainfall Station	Station Constant	Rainfall			
		1-day	2-day	3-day	5-day
Blacksburg	0.0151	0.02	0.02	0.02	0.02
Lewisburg, W. Va.	0.0439	0.03	0.03	0.04	0.04
Catawba Sanatorium	0.0813	0.11	0.29	0.30	0.30
Hot Springs	0.1408	0.12	0.30	0.30	0.30
Lexington	0.0629	0.29	0.42	0.43	0.43
Franklin, W. Va.	0.0341	0.03	0.06	0.07	0.07
Staunton	0.1392	0.20	0.69	0.70	0.70
Roanoke-Salem	0.0375	0.23	0.24	0.24	0.24
Lynchburg	0.1851	1.05	1.07	1.07	1.11
Charlottesville	0.1103	0.88	1.16	1.16	1.16
Columbia	0.0970	0.05	0.27	0.29	0.29
Hopewell	0.0156	0.01	0.02	0.02	0.02
Hawfield-Culpeper	0.0317	0.05	0.06	0.06	0.06
Dale Enterprise	0.0034	0.01	0.05	0.05	0.05
Ashland (Richmond)	0.0020	--	--	--	0.07
Areal rainfall in inches depth on drainage area -----		3.08	4.68	4.75	4.79

Hardware River near Scottsville, Va. Drainage area: 116 sq. mi.  
Maximum discharge: 23,000 sec. ft., September 19, 1944

Rainfall Station	Station Constant	Rainfall			
		1-day	2-day	3-day	5-day
Charlottesville	0.259	8.00	10.51	10.51	10.51
New Canton	0.331	1.60	4.81	4.81	4.81
Staunton	0.410	1.41	4.96	4.96	5.09
Areal rainfall in inches depth on drainage area -----		3.18	6.34	6.34	6.40

Table 4.- (Continued)  
 Storms That Caused Maximums of Discharge  
 James River Basin

Appomattox River at Mattoax, Va. Drainage area: 306 sq. mi.  
 Maximum discharge: 21,000 sec. ft., August 15, 1940

Rainfall Station	Station Constant	Rainfall			
		1-day	2-day	3-day	5-day
Lynchburg	0.066	1.51	5.34	5.95	6.09
Randolph	0.434	6.90	7.36	7.82	8.12
New Canton	0.367	2.68	4.36	4.37	4.55
Richmond	0.133	3.44	5.29	5.32	5.32
Areal rainfall in inches depth on drainage area -----		4.54	5.85	6.10	6.31

Table 4.- (Continued)  
Storms That Caused Maximums of Discharge  
New River Basin

New River at Eggleston, Va. Drainage area: 2,941 sq. mi.  
Maximum discharge: 219,000 sec. ft., August 14, 1940

Rainfall Station	Station Constant	Rainfall			
		1-day	2-day	3-day	5-day
Narrows-Glenlyn	0.017	0.03	0.03	0.03	0.03
Blacksburg	0.020	0.09	0.09	0.09	0.10
Banners Elk, N. C.	0.078	0.02	0.68	0.90	0.96
Jefferson, N. C.	0.228	1.34	2.39	2.80	2.93
Mt. Airy, N. C.	0.102	0.31	0.34	0.43	0.43
Wytheville	0.138	0.25	0.38	0.41	0.48
Burkes Garden	0.058	0.12	0.21	0.21	0.22
Ivanhoe	0.248	0.57	0.57	0.61	0.61
Radford	0.177	0.97	0.98	0.99	1.16
Rocky Mount	0.034	0.08	0.09	0.11	0.12
Areal rainfall in inches depth on drainage -----		3.78	5.76	6.58	7.54

Big Reed Island Creek at Allisonia, Va. Drainage area: 278 sq. mi.  
Maximum discharge: 14,500 sec. ft., September 30, 1959

Rainfall Station	Station Constant	Rainfall			
		1-day	2-day	3-day	5-day
Ivanhoe	0.356	No data; Sta. con. added to Radford			
Stuart	0.457	1.70	2.88	2.88	2.88
Radford	0.187	1.37	1.37	1.37	1.37
Areal rainfall in inches depth on drainage area -----		3.07	4.05	4.05	4.05

Wolf Creek at Narrows, Va. Drainage area: 223 sq. mi.  
Maximum discharge: 12,900 sec. ft., January 29, 1957

Rainfall Station	Station Constant	Rainfall			
		1-day	2-day	3-day	5-day
Bluefield, W. Va.	0.148	No data; Sta. con. added to Burkes Garden			
Burkes Garden	0.550	1.75	2.52	2.84	2.87
Narrows	0.302	0.26	0.53	0.53	0.53
Areal rainfall in inches depth on drainage area -----		2.01	3.05	3.37	3.40

Table 4.- (Continued)  
Storms That Caused Maximums of Discharge  
Potomac River Basin

North River at Burkettown, Va. Drainage area: 375 sq. mi.  
Maximum discharge: 62,600 sec. ft., June 18, 1949

Rainfall Station	Station Constant	Rainfall			
		1-day	2-day	3-day	5-day
Staunton	0.205	0.31	0.55	0.69	0.69
Dale Enterprise	0.692	1.59	1.98	2.12	2.15
Upper Tract, W. Va.	0.103	No data; Sta. con. added to Dale Enterprise			
Areal rainfall in inches depth on drainage area -----		1.90	2.53	2.81	2.84

Shenandoah River at Millville, W. Va. Drainage area: 3,040 sq. mi.  
Maximum discharge: 230,000 sec. ft., October 16, 1942

Rainfall Station	Station Constant	Rainfall			
		1-day	2-day	3-day	5-day
Lexington	0.031	--	0.05	0.05	0.10
Staunton	0.177	0.42	0.60	1.02	1.13
Charlottesville	0.043	0.12	0.31	0.31	0.34
Dale Enterprise	0.188	1.69	2.07	2.09	2.10
Shenandoah Upper Tract, W. Va.	0.169 0.037	No data; Sta. con. added to Dale Enterprise			
Woodstock	0.196	1.02	1.47	1.51	1.55
Winchester	0.052	0.18	0.52	0.53	0.71
Mt. Weather	0.094	0.50	0.86	1.12	1.12
Harpers Ferry, W. Va.	0.013	0.03	0.05	0.07	0.07
Areal rainfall in inches on drainage area -----		3.96	5.93	6.70	7.12

Table 4.- (Continued)  
Storms That Caused Maximums of Discharge  
Potomac River Basin

S. Fork Shenandoah River near Luray, Va. Drainage area: 1,377 sq. mi.  
Maximum discharge: 100,000 sec. ft., October 16, 1942

Rainfall Station	Station Constant	Rainfall			
		1-day	2-day	3-day	5-day
Dale Enterprise	0.363	4.28	5.24	5.30	5.33
Staunton	0.359	2.40	3.44	5.80	6.43
Lexington	0.047	0.03	1.68	1.68	3.02
Charlottesville	0.170	2.70	7.15	7.30	8.01
Woodstock	0.061	6.03	8.67	8.89	9.11
Areal rainfall in inches depth on drainage area -----		3.24	4.96	5.87	6.31

N. Fork Shenandoah River near Strasburg, Va. Drainage area: 772 sq. mi.  
Maximum discharge: 100,000 sec. ft., October 16, 1942

Rainfall Station	Station Constant	Rainfall			
		1-day	2-day	3-day	5-day
Dale Enterprise	0.385	2.20	2.69	2.71	2.74
Upper Tract, W. Va.	0.129	No data; Sta. con. added to Dale Enterprise			
Woodstock	0.466	2.81	4.04	4.05	4.15
Winchester	0.020	0.07	0.20	0.27	0.27
Areal rainfall in inches depth on drainage area -----		5.08	6.93	7.12	7.25

Occoquan Creek near Occoquan, Va. Drainage area: 546 sq. mi.  
Maximum discharge: 37,000 sec. ft., October 16, 1942

Rainfall Station	Station Constant	Rainfall			
		1-day	2-day	3-day	5-day
Mt. Weather	0.368	5.30	9.15	11.95	11.95
Washington, D. C.	0.061	2.59	4.10	5.14	5.94
Quantico	0.404	2.65	4.31	5.78	6.53
Culpeper	0.167	3.36	5.76	6.39	6.89
Areal rainfall in inches depth on drainage area -----		3.74	6.32	8.11	8.55

Table 4.- (Continued)  
 Storms That Caused Maximums of Discharge  
 Potomac River Basin

South River at Harriston, Va. Drainage area: 222 sq. mi.  
 Maximum discharge: 23,100 sec. ft., October 15, 1942

Rainfall Station	Station Constant	Rainfall			
		1-day	2-day	3-day	5-day
Lexington	0.242	1.65	1.68	2.82	3.08
Staunton	0.377	1.04	3.44	4.07	4.07
Dale Enterprise	0.032	0.96	5.24	5.27	5.27
Charlottesville	0.349	4.45	7.15	7.78	7.86
Areal rainfall in inches depth on drainage area -----		2.38	4.37	5.10	5.19

Table 4.- (Continued)  
 Storms That Caused Maximums of Discharge  
 Roanoke River Basin

Roanoke River at Altavista, Va. Drainage area: 1,800 sq. mi.  
 Maximum discharge: 105,000 sec. ft., August 15, 1940

Rainfall Station	Station Constant	Rainfall			
		1-day	2-day	3-day	5-day
Rocky Mount	0.321	2.38	4.16	4.44	5.32
Radford	0.045	5.50	7.60	7.63	8.09
Danville	0.111	3.83	5.40	5.43	5.93
Blacksburg	0.122	4.48	5.63	5.81	6.15
Roanoke	0.213	5.36	7.86	8.37	8.99
Buchanan	0.098	1.10	3.85	3.90	4.22
Lynchburg	0.090	3.83	5.34	5.94	6.09
Areal rainfall in inches depth on drainage area -----		3.03	4.95	5.23	5.81

Roanoke River at Roanoke, Va. Drainage area: 388 sq. mi.  
 Maximum discharge: 26,400 sec. ft., August 14, 1940

Rainfall Station	Station Constant	Rainfall			
		1-day	2-day	3-day	5-day
Roanoke-Salem	0.258	5.36	5.87	5.98	6.65
Rocky Mount	0.153	2.38	2.66	3.13	3.54
Radford	0.111	5.50	5.53	5.61	5.99
Blacksburg	0.386	4.48	4.66	4.75	5.00
Gatawba Sanatorium	0.092	3.88	4.20	4.78	4.98
Areal rainfall in inches depth on drainage area -----		4.44	4.72	4.92	5.31

Blackwater River near Union Hall, Va. Drainage area: 208 sq. mi.  
 Maximum discharge: 19,000 sec. ft., August 14, 1940

Rainfall Station	Station Constant	Rainfall			
		1-day	2-day	3-day	5-day
Rocky Mount	0.652	2.38	2.66	3.13	3.54
Roanoke	0.348	5.36	5.87	5.98	6.65
Areal rainfall in inches depth on drainage area -----		3.21	3.54	3.84	4.31



Table 4.- (Continued)  
 Storms That Caused Maximums of Discharge  
 Roanoke River Basin

Dan River at South Boston, Va. Drainage area: 2,730 sq. mi.  
 Maximum discharge: 81,000 sec. ft., August 16, 1940

Rainfall Station	Station Constant	Rainfall			
		1-day	2-day	3-day	5-day
Mt. Airy, N. C.	0.099	0.18	0.19	0.20	0.32
Stuart	0.192	1.01	1.11	1.19	1.42
Rocky Mount	0.128	0.30	0.53	0.89	0.99
Reidsville, N. C.	0.276	0.61	1.20	1.30	1.44
Winston-Salem, N. C.	0.054	0.18	0.26	0.26	0.29
Danville	0.158	0.61	0.86	0.90	0.90
Chatham	0.031	0.09	0.24	0.30	0.31
Clarksville	0.034	0.28	0.44	0.45	0.50
Rougement, N. C.	0.028	0.04	0.09	0.11	0.11
Areal rainfall in inches depth on drainage area -----		3.30	5.01	5.69	6.37

Bannister River near Halifax, Va. Drainage area: 374 sq. mi.  
 Maximum discharge: 50,000 sec. ft., September 20, 1944

Rainfall Station	Station Constant	Rainfall			
		1-day	2-day	3-day	5-day
Danville	0.133	1.83	3.48	3.63	3.63
Randolph	0.330	8.88	0.36	9.49	9.49
Rocky Mount	0.155	2.97	4.57	4.74	4.74
Chatham	0.382	8.45	10.04	10.12	10.12
Areal rainfall in inches depth on drainage area -----		6.86	8.09	8.21	8.21

Pigg River at Toshes, Va. Drainage area: 394 sq. mi.  
 Maximum discharge: 34,300 sec. ft., August 15, 1940

Rainfall Station	Station Constant	Rainfall			
		1-day	2-day	3-day	5-day
Rocky Mount	0.515	2.38	4.16	4.44	5.32
Chatham	0.382	2.85	7.50	7.89	8.06
Stuart	0.103	5.26	5.79	6.39	7.28
Areal rainfall in inches depth on drainage area -----		2.86	5.64	5.96	6.57

Table 4.- (Continued)  
 Storms That Caused Maximums of Discharge  
 Roanoke River Basin

Falling River near Naruna, Va. Drainage area: 172 sq. mi.  
 Maximum discharge: 15,800 sec. ft., September 18, 1944

Rainfall Station	Station Constant	Rainfall			
		1-day	2-day	3-day	5-day
Lynchburg	0.794	5.65	5.89	5.89	5.99
Randolph	0.206	<u>0.48</u>	<u>0.48</u>	<u>0.48</u>	<u>3.35</u>
Areal rainfall in inches depth on drainage area -----		4.01	4.17	4.17	5.15

Table 4.- (Continued)  
 Storms That Caused Maximums of Discharge  
 Rappahannock River Basin

Rappahannock River at Fredericksburg, Va. Drainage area: 1,599 sq. mi.  
 Maximum discharge: 140,000 sec.ft., October 16, 1942

Rainfall Station	Station Constant	Rainfall			
		1-day	2-day	3-day	5-day
Charlottesville	0.117	2.70	7.15	7.30	8.01
Hawfield (Orange)	0.097	4.03	5.53	6.44	6.91
Culpeper	0.463	3.36	5.76	6.39	6.89
Woodstock	0.134	6.03	8.67	8.89	9.11
Mt. Weather	0.082	5.30	9.15	11.95	11.95
Quantico	0.036	2.65	4.31	5.78	6.53
Fredericksburg	0.071	0.42	4.85	11.02	12.20
Areal rainfall in inches depth on drainage area -----		3.63	6.45	7.60	8.10

Rapidan River at Culpeper, Va. Drainage area: 465 sq. mi.  
 Maximum discharge: 58,100 sec. ft., October 16, 1942

Rainfall Station	Station Constant	Rainfall			
		1-day	2-day	3-day	5-day
Charlottesville	0.018	2.70	7.15	7.30	8.01
Hawfield	0.759	4.03	5.53	6.44	6.91
Culpeper	0.223	3.36	5.76	6.39	6.89
Areal rainfall in inches depth on drainage area -----		3.86	5.61	6.44	6.93

Table 4.- (Continued)  
Storms That Caused Maximums of Discharge  
Tennessee River Basin

South Fork Holston River at Vestal, Va. Drainage area: 320 sq. mi.  
Maximum discharge: 15,100 sec. ft., January 29, 1957

Rainfall Station	Station Constant	Rainfall			
		1-day	2-day	3-day	5-day
Damascus	0.578	1.72	2.53	2.79	2.87
Ivanhoe	0.181	No data; Sta. con. added to Saltville			
Elizabethton	0.127	No data; Sta. con. added to Damascus			
Saltville	0.110	0.59	0.88	0.98	1.00
Bluff City	0.004	No data; Sta. con. added to Damascus			
Areal rainfall in inches depth on drainage area -----		2.31	3.41	3.77	3.87

North Fork Holston River at Saltville, Va. Drainage area: 228 sq. mi.  
Maximum discharge: 16,500 sec. ft., January 29, 1957

Rainfall Station	Station Constant	Rainfall			
		1-day	2-day	3-day	5-day
Burkes Garden	0.406	2.50	3.60	4.06	4.10
North Holston-Saltville	0.409	0.48	0.70	1.03	1.67
Marion	0.160	1.70	2.81	3.12	3.22
Wytheville	0.205	0.77	1.77	2.15	2.30
Areal rainfall in inches depth on drainage area -----		1.50	2.24	2.62	2.92

North Fork Holston River at Gate City, Va. Drainage area: 675 sq. mi.  
Maximum discharge: 28,700 sec. ft., January 30, 1957

Rainfall Station	Station Constant	Rainfall			
		1-day	2-day	3-day	5-day
Mendota	0.356	0.74	1.11	1.55	1.76
Speers Ferry (Glinchport)	0.052	0.12	0.19	0.26	0.28
Saltville	0.381	0.77	1.15	1.58	1.74
Burkes Garden	0.183	0.46	0.66	0.69	0.77
Damascus	0.028	0.07	0.10	0.15	0.16
Areal rainfall in inches depth on drainage area -----		2.16	3.21	4.23	4.71

Table 4.- (Continued)  
Storms That Caused Maximums of Discharge  
Tennessee River Basin

Middle Fork Holston River at Meadowview, Va. Drainage area: 211 sq. mi.  
Maximum discharge: 6,650 sec. ft., February 18, 1944

Rainfall Station	Station Constant	Rainfall			
		1-day	2-day	3-day	5-day
Wytheville	0.435	--	0.87	0.87	1.00
Saltville	0.362	0.96	1.07	1.07	1.30
Damascus	0.192	0.36	0.43	0.43	0.46
Burkes Garden	0.011	0.01	0.04	0.04	0.05
Areal rainfall in inches depth on drainage area -----		1.33	2.41	2.41	2.81

Powell River at Jonesville, Va. Drainage area: 319 sq. mi.  
Maximum discharge: 30,000 sec. ft., January 8, 1946

Rainfall Station	Station Constant	Rainfall			
		1-day	2-day	3-day	5-day
Big Stone Gap	0.685	No data; Sta. con. added to Speers Ferry			
Speers Ferry	0.315	2.31	3.12	3.32	3.34
Areal rainfall in inches depth on drainage area -----		2.31	3.12	3.32	3.34

Powell River at Arthur, Tenn. Drainage area: 685 sq. mi.  
Maximum discharge: 33,000 sec. ft., January 9, 1946

Rainfall Station	Station Constant	Rainfall			
		1-day	2-day	3-day	5-day
Speers Ferry	0.270	1.50	2.03	2.16	2.30
Tazewell, Tenn.	0.098	0.30	0.38	0.42	0.42
Middleboro, Ky.	0.252	0.68	1.31	1.46	1.47
Big Stone Gap	0.350	No data; Sta. con. added to Speers Ferry			
Areal rainfall in inches depth on drainage area -----		2.48	3.72	4.04	4.19

Table 4.-- (Continued)  
 Storms That Caused Maximums of Discharge  
 Tennessee River Basin

Clinch River at Cleveland, Va. Drainage area: 536 sq. mi.  
 Maximum discharge: 31,000 sec. ft., January 30, 1957

Rainfall Station	Station Constant	Rainfall			
		1-day	2-day	3-day	5-day
Mendota	0.032	2.07	3.30	4.34	4.94
North Holston-Saltville	0.164	0.48	1.03	1.25	1.64
Burkes Garden	0.277	2.50	2.65	3.75	4.21
Dante	0.427	2.10	3.60	4.35	4.80
Areal rainfall in inches depth on drainage area -----		1.98	2.81	3.61	4.06

Clinch River at Speers Ferry, Va. Drainage area: 1,140 sq. mi.  
 Maximum discharge: 45,300 sec. ft., January 30, 1957

Rainfall Station	Station Constant	Rainfall			
		1-day	2-day	3-day	5-day
Dante	0.466	0.98	1.68	2.03	2.24
Speers Ferry	0.173	0.40	0.63	0.87	0.93
Mendota	0.101	0.21	0.33	0.44	0.50
North Holston-Saltville	0.080	0.04	0.07	0.09	0.12
Burkes Garden	0.180	0.45	0.48	0.68	0.76
Areal rainfall in inches depth on drainage area -----		2.08	3.19	4.11	4.55

## APPENDIX I.

Inches of Rainfall by Water Years (1951-1960)  
Virginia Rainfall Stations

Water Year	Big Stone Gap - Olinger	Blacksburg	Buchanan	Burkes Garden
1951	47.05	37.94#	42.06	41.00
1952	50.34	43.24	48.82	36.96#
1953	46.11	36.36	38.04	45.71
1954	40.60	30.33	36.19	36.24
1955	48.57	38.67	51.06	44.66
1956	59.33	37.28	35.17	43.99
1957	51.46	46.68	43.13	52.44
1958	58.50	38.94	40.97	44.60#
1959	44.60	36.69	34.97	39.70
1960	48.95	39.09	45.29	40.80

Water Year	Oatawba Sanatorium	Charlottesville	Chatham	Clarksville
1951	35.34#	40.64	34.37	37.50#
1952	46.00	53.04	49.42	48.50#
1953	35.19	40.71	41.78	41.46
1954	34.25	33.37	37.57	34.22
1955	46.19	55.59	49.31	52.81
1956	33.34	35.74	34.40	34.48
1957	49.28	41.31	46.43	43.98
1958	41.81	47.86	45.75	54.40
1959	37.25	40.04	38.30	37.68
1960	46.76	49.46	49.25	51.88

# Estimated from surrounding stations or from incomplete data.

## APPENDIX I. (Continued)

Inches of Rainfall by Water Years (1951-1960)  
Virginia Rainfall Stations

Water Year	Olinchport	Columbia	Culpeper	Dale Enterprise
1951	43.75	41.05	40.80#	33.97
1952	52.06	44.15	47.37	42.11
1953	42.71	32.58	37.53	35.64
1954	35.90	32.64	25.21	31.66
1955	44.63	42.72	45.72	47.14
1956	55.26	33.18	34.00#	31.31
1957	51.92	37.34	35.42	29.25
1958	51.47	44.07	48.49	40.16
1959	40.89	36.06	33.49	29.99
1960	52.28	42.35	45.56	39.90

  

Water Year	Damascus	Dante	Danville	Fredericksburg
1951	42.10	39.36#	41.89	32.86#
1952	45.51	48.00	51.97	47.84
1953	42.55	41.59	38.39	40.80
1954	40.04	32.42	36.13	27.96
1955	47.22	38.09	55.67	48.19
1956	49.07	48.91	42.32	37.12
1957	58.28	44.34	44.59	39.77
1958	50.97	53.83	46.77	57.15
1959	37.42	40.86	40.86	33.86
1960	48.50	40.60#	47.58	52.23

#Estimated from surrounding stations or from incomplete data.



## APPENDIX I. (Continued)

Inches of Rainfall by Water Years (1951-1960)  
Virginia Rainfall Stations

Water Year	Hopewell	Hot Springs	Ivanhoe (Byllesby)	Mineral (Louisa)
1951	36.14	43.33	38.00	36.26
1952	49.88	42.58	37.19	52.99
1953	41.07	33.58	39.90	34.02
1954	30.21	41.36	30.33	34.81
1955	52.16	44.20	45.59	46.96
1956	43.79	34.65	36.50	34.85
1957	47.41	43.50	44.41	42.46
1958	59.46	41.64	43.83	51.32
1959	41.72	36.86	39.90	38.91
1960	54.54	45.76	42.22	44.05

Water Year	Lexington	Lynchburg	Marion	Mendota
1951	36.62	36.04	37.95	49.37
1952	41.70	52.41	35.30	52.95
1953	38.03	39.65	39.24	44.87
1954	31.67	32.48	34.10	37.23
1955	45.80	45.95	38.43	42.54
1956	33.74	29.27	41.25	49.06
1957	38.95	40.11	49.00	52.79
1958	40.79	40.64	42.91	53.17
1959	41.43	35.57	38.47	39.06
1960	39.65	39.71	37.82	45.79

## APPENDIX I. (Continued)

Inches of Rainfall by Water Years (1951-1960)  
Virginia Rainfall Stations

Water Year	Rocky Mount	Rosnoke	Saltville- N. Holston	Shenandoah
1951	36.50#	35.55	40.09	36.00#
1952	49.00#	47.86	34.18	42.50#
1953	38.50#	33.98	39.07	36.00#
1954	40.11	34.15	36.58	27.20#
1955	47.10	50.16	44.69	45.80#
1956	30.28	28.07	44.16	30.30#
1957	51.32	53.64	54.50	30.10#
1958	45.04	42.95	48.56	42.60#
1959	39.00#	39.84	38.72	31.00#
1960	48.40#	42.90	43.17	39.00#

Water Year	Winchester	Staunton	Stuart	Washington, D.C.
1951	39.68	36.90	44.03	40.91
1952	42.31	46.63	59.12	51.25
1953	37.65	38.22	47.12	52.56
1954	35.92	30.23	41.83	28.17
1955	44.21	52.99	55.44	41.79
1956	35.13	29.16	36.52	35.06
1957	30.36	39.04	61.67	30.25
1958	44.27	39.59	52.26	50.59
1959	33.10	34.74	38.03	33.48
1960	39.56	38.62	59.00#	38.94

# Estimated from surrounding stations or from incomplete data.

## APPENDIX I. (Continued)

Inches of Rainfall by Water Years (1951-1960)  
Virginia Rainfall Stations

Water Year	Mt. Weather	Narrows- Glenlyn	New Canton	Orange (Rapidan)
1951	40.20#	33.08	39.35	39.75
1952	45.30#	33.75	46.76	39.17
1953	40.50	34.33	35.90	37.05
1954	38.04	35.52	33.74	27.05
1955	43.46	39.41	46.34	46.69
1956	31.15#	38.88	29.49	34.25
1957	38.30	44.79	37.05	31.95
1958	49.12	36.77	46.15	48.75
1959	34.62	35.61	39.56	33.14
1960	46.83	34.94	47.42	48.51

Water Year	Quantico	Radford	Randolph	Richmond
1951	35.92	33.21	36.96#	33.99
1952	42.37	36.11	47.72	49.70
1953	40.22	34.76	41.08	39.62
1954	32.62	31.54	34.80	31.17
1955	43.35	38.78	56.17	52.02
1956	34.95	33.37	36.06	39.41
1957	35.05	42.47	48.20	48.09
1958	55.20	38.06	49.17	59.85
1959	45.53	32.71	38.37	49.42
1960	49.07	36.27	52.24	51.93

# Estimated from surrounding stations or from incomplete data.

## APPENDIX I. (Continued)

Inches of Rainfall by Water Years (1951-1960)  
Virginia Rainfall Stations

Water Year	Woodstock	Wytheville
1951	37.11	38.97#
1952	34.66	35.25
1953	34.67	38.49
1954	29.89	30.95
1955	45.15	34.82
1956	27.14	34.84
1957	27.14	45.81
1958	42.40	40.30
1959	26.03	34.64
1960	40.30	39.57

## North Carolina Rainfall Stations

Water Year	Mt. Airy	Banners Elk	Jefferson	Reidsville
1951	45.57	43.49	37.21	40.34
1952	50.35	42.32	46.07	46.12
1953	37.16	46.50	42.16	34.88
1954	42.62	42.62	38.98	47.64
1955	42.95	52.69	46.54	45.76
1956	41.86	43.86	44.68	42.00
1957	52.74	55.84	56.63	44.78
1958	50.02	53.30	47.84	47.36
1959	48.39	52.54	48.53	50.37
1960	46.21	55.48	46.82	41.45

# Estimated from surrounding stations or from incomplete data.

## APPENDIX I. (Continued)

Inches of Rainfall by Water Years (1951-1960)  
North Carolina Rainfall Stations

Water Year	Winston- Salem	Rougemont
1951	36.92	38.01
1952	44.98	60.23
1953	41.24	42.76
1954	41.17	39.43
1955	43.57	48.58
1956	39.41	40.07
1957	50.94	41.49
1958	45.28	48.70
1959	54.08	51.73
1960	46.40	53.33

## Tennessee Rainfall Stations

Water Year	Mountain City	Elizabethton	Bluff City	Tazewell
1951	41.09	47.99	49.24	62.92
1952	39.35	35.17	37.89	46.15
1953	38.54	38.88	46.39	45.12
1954	42.95	37.94	40.83	38.18
1955	43.27	42.17	41.48	48.09
1956	47.42	46.42	47.71	48.45
1957	52.75	51.75	55.69	56.18
1958	44.71	42.45	46.72	49.92
1959	44.45	37.67	43.39	42.67
1960	43.07	42.85	44.50	48.07

## APPENDIX I. (Continued)

## Inches of Rainfall by Water Years (1951-1960)

## Kentucky Rainfall Station

Water Year	Middleboro
1951	60.18
1952	55.32
1953	49.02
1954	42.38
1955	53.36
1956	59.31
1957	60.31
1958	54.99
1959	42.67
1960	53.60

## West Virginia Rainfall Stations

Water Year	Bluefield	Brandywine (Franklin)	Harpers Ferry	Lewisburg
1951	42.46	34.40#	34.16	36.51#
1952	38.64	35.00#	47.85	38.37
1953	40.15	32.49	38.82	31.03
1954	39.14	35.46	37.50	46.53
1955	44.90	33.00	39.66	36.40
1956	46.50	29.32	44.64	38.71
1957	47.94	29.99	29.85	36.98
1958	46.29	31.76	43.64	40.16
1959	37.80	25.98	30.44	36.81
1960	33.55	35.00	38.11	34.00

#Estimated from surrounding stations or from incomplete data.

## APPENDIX I. (Continued)

## Inches of Rainfall by Water Years (1951-1960)

## West Virginia Rainfall Stations

Water Year	Union	Upper Tract
1951	34.47	30.99
1952	33.49#	32.65
1953	30.53	34.02
1954	32.28	30.12
1955	32.65	34.47
1956	37.92	33.14
1957	37.61	25.85
1958	36.05	31.77
1959	33.55	28.25
1960	33.42	32.65

# Estimated from surrounding stations or from incomplete data.

## APPENDIX II

## Inches of Areal Rainfall by Water Years

(1951-1960)

Year ending Sept. 30	James River at Cartersville	James River at Buchanan	Jackson River at Barber
1951	38.25	38.77	43.33
1952	46.51	41.42	42.58
1953	36.61	34.23	33.58
1954	33.68	35.79	42.26
1955	46.69	42.26	44.20
1956	32.61	35.15	34.65
1957	41.05	41.46	43.50
1958	42.18	39.40	41.64
1959	36.65	35.23	36.97
1960	42.44	41.47	45.76

Year ending Sept. 30	Hardware River near Scottsville	Slate River at Arvonnia	Appomattox River at Farmsville
1951	38.68	39.35	37.38
1952	48.34	46.76	47.94
1953	38.02	35.90	38.91
1954	32.20	33.74	33.77
1955	51.08	46.34	51.34
1956	30.98	29.49	33.64
1957	38.97	37.05	43.57
1958	43.52	46.15	48.92
1959	37.70	39.56	40.09
1960	44.34	47.42	49.60



## APPENDIX II (Continued)

## Inches of Areal Rainfall by Water Years

(1951-1960)

Year ending Sept. 30	Willis River at Columbia	Cowpasture River near Clifton Forge	Craig Creek at Parr
1951	39.35	40.18	36.42
1952	46.76	41.40	45.54
1953	35.90	34.17	35.69
1954	33.74	38.28	33.46
1955	46.34	43.08	44.76
1956	29.49	33.34	34.40
1957	57.05	39.27	48.24
1958	46.15	39.82	41.09
1959	39.56	34.67	39.96
1960	47.42	42.79	44.84

Year ending Sept. 30	North River at Lexington	New River at Eggleston	Big Reed Island Creek at Allisonia
1951	38.62	38.34	39.86
1952	43.27	40.93	56.76
1953	36.22	39.67	51.62
1954	34.87	35.07	44.33
1955	46.98	43.13	59.25
1956	32.61	38.99	44.93
1957	39.32	49.53	63.40
1958	40.70	44.49	56.87
1959	36.88	41.54	55.67
1960	41.49	43.18	58.57

## APPENDIX II (Continued)

## Inches of Areal Rainfall by Water Years

(1951-1960)

Year ending Sept. 30	Wolf Creek at Narrows	North River at Burketown	Shenandoah River at Millville, W. Va.
1951	38.81	34.26	35.60
1952	36.23	42.06	42.59
1953	41.43	36.00	35.87
1954	36.45	31.21	30.41
1955	43.10	47.03	45.60
1956	42.81	31.06	29.92
1957	49.45	30.90	31.65
1958	42.48	39.18	40.92
1959	38.17	30.78	30.85
1960	37.54	38.89	39.22

Year ending Sept. 30	South Fork of Shenandoah River near Luray	North Fork of Shenandoah River near Strasburg	Occoquan Creek near Occoquan
1951	36.47	35.16	38.61
1952	45.67	41.62	44.83
1953	37.33	35.02	40.63
1954	31.32	30.73	33.11
1955	50.15	44.52	43.69
1956	31.17	29.68	33.40
1957	35.16	27.98	36.02
1958	41.45	40.21	51.57
1959	33.71	27.99	38.76
1960	41.07	39.14	47.04

## APPENDIX II (Continued)

## Inches of Areal Rainfall by Water Years

(1951-1960)

Year ending Sept. 30	Middle River at Grottoes	South River at Harriston	Roanoke River at Roanoke
1951	36.49	38.04	36.33
1952	45.65	47.53	44.78
1953	37.70	38.88	35.79
1954	30.53	31.72	33.27
1955	50.92	51.62	39.50
1956	29.80	32.63	33.00
1957	37.74	39.51	48.95
1958	39.77	42.79	41.07
1959	34.63	38.06	37.47
1960	38.87	42.70	41.90

  

Year ending Sept. 30	Roanoke River at Altavista	Blackwater River near Union Hall	Goose Creek at Huddleston
1951	37.32	36.17	36.80
1952	46.93	48.61	50.14
1953	37.91	36.93	38.09
1954	35.75	38.03	35.27
1955	47.59	48.17	47.55
1956	32.54	29.51	30.07
1957	48.29	52.13	45.75
1958	42.94	44.32	42.19
1959	38.13	39.29	37.07
1960	43.77	46.49	43.27

## APPENDIX II (Continued)

## Inches of Areal Rainfall by Water Years

(1951-1960)

Year ending Sept. 30	Dan River at South Boston	Smith River at Martinsville	Bannister River near Halifax
1951	39.71	40.29	36.56
1952	50.84	54.10	49.14
1953	39.50	42.85	40.60
1954	41.87	40.97	36.86
1955	49.39	51.30	52.08
1956	38.79	33.43	35.36
1957	49.89	56.53	47.53
1958	48.40	48.68	46.91
1959	48.11	48.59	38.77
1960	48.45	53.75	49.88

  

Year ending Sept. 30	Pigg River at Toshes	Rappahannock River at Fredericksburg	Rapidan River at Gulpeper
1951	36.47	39.39	40.00
1952	50.21	46.43	41.24
1953	39.03	38.05	37.22
1954	43.81	28.49	26.75
1955	48.81	46.79	46.64
1956	32.49	33.33	34.22
1957	50.52	35.22	32.89
1958	46.06	48.54	48.67
1959	40.70	33.77	33.34
1960	49.82	46.31	47.87

## APPENDIX II (Continued)

## Inches of Areal Rainfall by Water Years

(1951-1960)

Year ending Sept. 30	South Fork Holston River at Vestal	South Fork Holston River at Bluff City, Tenn.	North Fork Holston River at Saltville
1951	41.91	42.00	40.09
1952	41.41	38.80	35.52
1953	41.24	41.81	41.78
1954	37.62	38.14	35.90
1955	45.96	42.37	43.43
1956	45.70	45.24	43.39
1957	54.51	53.57	52.57
1958	48.28	46.40	45.85
1959	38.06	30.29	38.99
1960	46.03	43.91	40.97

Year ending Sept. 30	North Fork Holston River at Gate City	Middle Fork Holston River at Meadowview	Powell River at Jonesville
1951	43.90	39.99	46.01
1952	42.60	36.85	50.88
1953	42.62	39.54	45.04
1954	36.80	34.80	39.12
1955	43.97	40.87	47.33
1956	46.57	41.05	58.05
1957	53.49	51.41	51.60
1958	49.70	45.47	56.28
1959	39.08	36.70	43.43
1960	44.15	42.13	50.00

## APPENDIX II (Continued)

## Inches of Areal Rainfall by Water Years

(1951-1960)

Year ending Sept. 30	Powell River at Arthur, Tenn.	Clinch River at Cleveland	Clinch River at Speers Ferry
1951	51.02	40.42	41.49
1952	51.64	41.75	46.11
1953	45.82	42.84	42.66
1954	39.54	34.69	34.53
1955	48.67	41.79	41.39
1956	62.16	46.27	48.76
1957	54.28	49.33	48.77
1958	54.87	49.46	51.26
1959	43.87	40.00	40.31
1960	50.93	40.74	43.24

Year ending Sept. 30	North Anna River at Doswell
1951	36.79
1952	48.35
1953	36.31
1954	31.44
1955	47.63
1956	35.26
1957	39.47
1958	51.73
1959	37.24
1960	46.98

## APPENDIX III

## Inches of Runoff by Water Years

(1951-1960)

Year ending Sept. 30	James River at Cartersville	James River at Buchanan	Jackson River at Barber
1951	16.84	20.87	22.45
1952	18.14	17.49	---
1953	15.00	14.93	15.76
1954	8.83	10.28	11.73
1955	16.73	18.61	19.24
1956	6.77	8.61	10.30
1957	13.60	16.35	16.34
1958	17.79	20.15	18.85
1959	9.46	9.86	11.15
1960	18.35	19.52	19.73

  

Year ending Sept. 30	Hardware River near Scottsville	Slate River at Arvonnia	Appomattox River at Farmville
1951	16.85	11.22	10.48
1952	25.48	16.74	15.94
1953	15.64	11.58	11.35
1954	6.38	8.94	8.70
1955	13.69	13.34	11.82
1956	5.46	5.50	6.68
1957	10.06	10.22	8.91
1958	(Discontinued)	12.09	14.71
1959	---	8.25	7.34
1960	---	13.20	12.61

## APPENDIX III (Continued)

## Inches of Runoff by Water Years

(1951-1960)

Year ending Sept. 30	Willis River at Columbia	Cowpasture River near Clifton Forge	Craig Creek at Parr
1951	10.66	21.74	17.96
1952	15.26	18.40	16.52
1953	12.46	15.01	15.52
1954	9.61	11.04	8.85
1955	16.47	17.14	17.20
1956	6.19	8.43	8.43
1957	9.67	14.41	17.97
1958	(Discontinued)	18.41	(Discontinued)
1959	---	10.59	---
1960	---	19.29	---

  

Year ending Sept. 30	North River at Lexington	New River at Eggleston	Big Reed Island Creek at Allisonia
1951	19.49	17.78	18.54
1952	16.72	15.83	19.00
1953	13.71	16.39	18.43
1954	10.80	11.70	13.27
1955	11.07	16.63	18.02
1956	6.16	11.85	12.61
1957	10.90	22.69	22.76
1958	(Discontinued)	25.21	26.52
1959	---	9.73	15.54
1960	---	25.10	26.52



## APPENDIX III (Continued)

## Inches of Runoff by Water Years

(1951-1960)

Year ending Sept. 30	Wolf Creek at Narrows	North River at Burketown	Shenandoah River at Millville, W. Va.
1951	17.98	16.96	14.68
1952	17.81	14.88	14.03
1953	19.12	14.38	13.49
1954	11.63	8.08	6.78
1955	22.58	16.16	14.76
1956	15.68	6.11	6.40
1957	25.10	10.96	8.91
1958	25.55	14.77	13.33
1959	12.96	6.84	6.03
1960	18.65	(No data)	(No data)

Year ending Sept. 30	South Fork of Shenandoah River near Luray	North Fork of Shenandoah River near Strasburg	Occoquan Creek near Occoquan
1951	15.49	13.09	16.50
1952	---	13.05	14.94
1953	---	13.05	15.81
1954	---	5.81	4.69
1955	---	14.13	12.53
1956	---	5.71	---
1957	---	6.42	(Discontinued)
1958	---	11.90	---
1959	---	5.12	---
1960	---	(No data)	---

## APPENDIX III (Continued)

Inches of Runoff by Water Years  
(1951-1960)

Year ending Sept. 30	Middle River at Grottoes	South River at Harriston	Roanoke River at Roanoke
1951	13.45	17.76	13.80
1952	14.08	(Discontinued)	12.47
1953	10.92	---	11.15
1954	6.77	---	6.18
1955	14.56	---	13.16
1956	5.35	---	6.20
1957	9.61	---	15.54
1958	14.18	---	16.31
1959	7.14	---	8.18
1960	(No data)	---	17.24

  

Year ending Sept. 30	Roanoke River at Altavista	Blackwater River near Union Hall	Goose Creek at Huddleston
1951	15.36	16.42	13.69
1952	17.38	16.75	16.98
1953	13.04	13.43	11.33
1954	8.42	8.46	6.98
1955	15.82	14.39	14.32
1956	6.89	7.28	5.87
1957	16.20	16.72	13.48
1958	19.68	17.90	(Discontinued)
1959	10.64	10.26	---
1960	18.50	17.46	---

## APPENDIX III (Continued)

## Inches of Runoff by Water Years

(1951-1960)

Year ending Sept. 30	Dan River at South Boston	Smith River at Martinsville	Bannister River near Halifax
1951	12.24	16.39	9.65
1952	15.31	18.50	11.80
1953	(Discontinued)	14.18	9.83
1954	---	10.31	7.92
1955	---	13.25	13.56
1956	---	8.86	7.20
1957	---	16.77	11.43
1958	---	(Discontinued)	17.12
1959	---	---	9.96
1960	---	---	14.46

  

Year ending Sept. 30	Pigg River at Toshas	Rappahannock River at Fredericksburg	Rapidan River at Culpeper
1951	13.46	17.26	19.41
1952	14.77	16.42	18.73
1953	10.73	16.04	17.21
1954	8.42	5.69	7.01
1955	13.68	13.41	13.93
1956	7.26	6.80	6.56
1957	13.22	11.28	11.57
1958	18.44	16.62	16.94
1959	12.12	7.29	8.25
1960	16.87	(No data)	(No data)

## APPENDIX III (Continued)

## Inches of Runoff by Water Years

(1951-1960)

Year ending Sept. 30	South Fork Holston River at Vestal	South Fork Holston River at Bluff City, Tenn.	North Fork Holston River at Saltville
1951	18.78	16.36	16.88
1952	17.50	14.63	15.10
1953	18.10	---	16.58
1954	16.22	(Discontinued)	10.81
1955	21.83	---	20.66
1956	19.32	---	16.43
1957	27.25	---	26.59
1958	27.04	---	24.44
1959	15.82	---	12.21
1960	23.26	---	18.24

Year ending Sept. 30	North Fork Holston River at Gate City	Middle Fork Holston River at Meadowview	Powell River at Jonesville
1951	16.55	14.85	23.49
1952	15.47	11.39	26.39
1953	16.97	13.83	18.65
1954	9.86	(Discontinued)	11.74
1955	19.33	---	21.29
1956	17.09	---	25.24
1957	24.99	---	22.61
1958	26.59	---	26.30
1959	12.59	---	15.75
1960	18.03	---	24.20

## APPENDIX III (Continued)

## Inches of Runoff by Water Years

(1951-1960)

Year ending Sept. 30	Powell River at Arthur, Tenn.	Olinch River at Cleveland	Olinch River at Speers Ferry
1951	22.63	17.27	18.47
1952	27.42	17.38	19.54
1953	18.24	18.34	17.80
1954	11.90	11.44	11.26
1955	21.07	22.12	20.44
1956	25.04	18.30	19.89
1957	22.61	23.11	21.61
1958	26.66	26.28	26.37
1959	14.98	12.72	13.79
1960	22.83	18.46	19.33

Year ending Sept. 30	North Anna River at Doswell
1951	10.64
1952	15.64
1953	13.51
1954	5.24
1955	11.42
1956	5.86
1957	9.78
1958	(Discontinued)
1959	---
1960	---

## APPENDIX IV

## Rainfall-Runoff Coefficients by Water Years

(1951-1960)

Year ending Sept. 30	James River at Cartersville	James River at Buchanan	Jackson River at Barber
1951	0.440	0.539	0.518
1952	0.390	0.422	--
1953	0.410	0.437	0.410
1954	0.262	0.287	0.278
1955	0.359	0.441	0.435
1956	0.208	0.245	0.297
1957	0.332	0.395	0.376
1958	0.422	0.512	0.453
1959	0.258	0.280	0.302
1960	0.432	0.471	0.431

Year ending Sept. 30	Hardware River near Scottsville	Slate River at Arvonnia	Appomattox River at Farmville
1951	0.436	0.285	0.280
1952	0.527	0.358	0.332
1953	0.411	0.323	0.292
1954	0.198	0.265	0.258
1955	0.268	0.288	0.230
1956	0.176	0.187	0.205
1957	0.258	0.276	0.205
1958	0.427	0.262	0.301
1959	(Discontinued)	0.209	0.183
1960	--	0.278	0.254

## APPENDIX IV (Continued)

## Rainfall-Runoff Coefficients by Water Years

(1951-1960)

Year ending Sept. 30	Willis River at Columbia	Cowpasture River near Clifton Forge	Craig Creek at Parr
1951	0.271	0.541	0.493
1952	0.326	0.445	0.363
1953	0.347	0.440	0.435
1954	0.285	0.289	0.264
1955	0.355	0.398	0.384
1956	0.210	0.253	0.245
1957	0.261	0.367	0.373
1958	(Discontinued)	0.462	(Discontinued)
1959	--	0.305	--
1960	--	0.451	--

Year ending Sept. 30	North River at Lexington	New River at Eggleston	Big Reed Island Creek at Allisonia
1951	0.505	0.464	0.465
1952	0.386	0.387	0.335
1953	0.379	0.413	0.357
1954	0.310	0.334	0.299
1955	0.236	0.386	0.304
1956	0.189	0.304	0.281
1957	0.277	0.459	0.359
1958	(Discontinued)	0.567	0.466
1959	--	0.234	0.279
1960	--	0.581	0.453

## APPENDIX IV (Continued)

## Rainfall-Runoff Coefficients by Water Years

(1951-1960)

Year ending Sept. 30	Wolf Creek at Narrows	North River at Burketown	Shenandoah River at Millville, W. Va.
1951	0.463	0.495	0.413
1952	0.492	0.354	0.330
1953	0.462	0.400	0.376
1954	0.320	0.259	0.223
1955	0.524	0.344	0.324
1956	0.367	0.197	0.214
1957	0.509	0.355	0.282
1958	0.601	0.377	0.326
1959	0.340	0.222	0.196
1960	0.497	(No data)	(No data)

Year ending Sept. 30	South Fork of Shenandoah River near Luray	North Fork of Shenandoah River near Strasburg	Cocoquan Creek near Cocoquan
1951	0.437	0.372	0.427
1952	(Discontinued)	0.314	0.333
1953	---	0.373	0.390
1954	---	0.189	0.142
1955	---	0.318	0.287
1956	---	0.193	(Discontinued)
1957	---	0.230	---
1958	---	0.321	---
1959	---	0.183	---
1960	---	(No data)	---



## APPENDIX IV (Continued)

## Rainfall-Runoff Coefficients by Water Years

(1951-1960)

Year ending Sept. 30	Middle River at Grottoes	South River at Harriston	Roanoke River at Roanoke
1951	0.369	0.467	0.380
1952	0.308	(Discontinued)	0.279
1953	0.290	--	0.312
1954	0.222	--	0.186
1955	0.286	--	0.353
1956	0.180	--	0.188
1957	0.255	--	0.318
1958	0.357	--	0.397
1959	0.206	--	0.218
1960	(No data)	--	0.412

Year ending Sept. 30	Roanoke River at Altaviata	Blackwater River near Union Hall	Goose Creek at Huddleston
1951	0.412	0.454	0.372
1952	0.370	0.345	0.339
1953	0.344	0.389	0.297
1954	0.235	0.222	0.198
1955	0.333	0.299	0.301
1956	0.212	0.246	0.195
1957	0.336	0.321	0.295
1958	0.459	0.404	(Discontinued)
1959	0.279	0.261	--
1960	0.423	0.276	--

## APPENDIX IV (Continued)

## Rainfall-Runoff Coefficients by Water Years

(1951-1960)

Year ending Sept. 30	Dan River at South Boston	Smith River at Martinsville	Bannister River near Halifax
1951	0.309	0.404	0.265
1952	0.301	0.342	0.240
1953	(Discontinued)	0.331	0.242
1954	--	0.252	0.215
1955	--	0.258	0.260
1956	--	0.265	0.204
1957	--	0.297	0.241
1958	--	(Discontinued)	0.365
1959	--	--	0.257
1960	--	--	0.290

Year ending Sept. 30	Figg River at Toshes	Rappahannock River at Fredericksburg	Rapidan River at Culpeper
1951	0.369	0.439	0.485
1952	0.294	0.354	0.454
1953	0.275	0.422	0.462
1954	0.192	0.200	0.262
1955	0.280	0.287	0.299
1956	0.224	0.204	0.192
1957	0.262	0.320	0.351
1958	0.400	0.340	0.348
1959	0.298	0.216	0.247
1960	0.339	(No data)	(No data)

## APPENDIX IV (Continued)

## Rainfall-Runoff Coefficients by Water Years

(1951-1960)

Year ending Sept. 30	South Fork Holston River at Vestal	South Fork Holston River at Bluff City, Tenn.	North Fork Holston River at Saltville
1951	0.449	0.390	0.421
1952	0.423	0.377	0.425
1953	0.439	(Discontinued)	0.397
1954	0.431	--	0.301
1955	0.475	--	0.476
1956	0.423	--	0.379
1957	0.500	--	0.505
1958	0.560	--	0.533
1959	0.416	--	0.313
1960	0.508	--	0.446

  

Year ending Sept. 30	North Fork Holston River at Gate City	Middle Fork Holston River at Meadowview	Powell River at Jonesville
1951	0.377	0.372	0.511
1952	0.363	0.309	0.519
1953	0.398	0.350	0.414
1954	0.268	(Discontinued)	0.300
1955	0.440	--	0.450
1956	0.367	--	0.435
1957	0.467	--	0.438
1958	0.535	--	0.467
1959	0.322	--	0.363
1960	0.409	--	0.484

## APPENDIX IV (Continued)

## Rainfall-Runoff Coefficients by Water Years

(1951-1960)

Year ending Sept. 30	Powell River at Arthur, Tenn.	Clinch River at Cleveland	Clinch River at Speers Ferry
1951	0.443	0.427	0.445
1952	0.531	0.417	0.424
1953	0.398	0.428	0.417
1954	0.301	0.330	0.326
1955	0.433	0.529	0.494
1956	0.403	0.396	0.408
1957	0.417	0.469	0.443
1958	0.487	0.532	0.514
1959	0.342	0.318	0.342
1960	0.448	0.453	0.447

Year ending Sept. 30	North Anna River at Doswell
1951	0.289
1952	0.324
1953	0.372
1954	0.167
1955	0.240
1956	0.166
1957	0.248
1958	(Discontinued)
1959	--
1960	--

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*Yung-Chi Yang*

# A COMPENDIUM OF VIRGINIA HYDROLOGY

by

Yung Chi Yang

## ABSTRACT

Engineers engaged in water supply or power projects are often faced with the problem of dealing with the adequacy of the supply, as well as that of the extremes of flow on which the safety of hydraulic structures depends. For the streams in Virginia three bulletins (Bulletin Nos. 33, 43, and 92 published in 1938, 1940, and 1954, respectively) of the V.P.I. Engineering Experiment Station relating to the solution of these problems have been published. In order to provide greater statistical strength for the relationships established in the above mentioned papers additional data for the 25 years from 1936 to 1960 have been analyzed. The present paper is a report on the results of this analysis.

This paper is divided into two parts. Part I is to study the existing annual rainfall and stream flow records in Virginia and their relationships; and to convert such information into forms more useful to the engineer. In Part II, the maximum recorded flood flows of streams in Virginia and the relationship between these rainfalls and the maximum recorded runoff for the period through 1960 had been analyzed.