flood plain information
MEADOW CREEK
albemarle county and charlottesville, virginia

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U.S. ARMY CORPS OF ENGINEERS
NORFOLK DISTRICT

JANUARY 1972

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INTRODUCTION

GENERAL

This report covers the flood situation along Meadow Creek in the city of Charlottesville and in a portion of Albemarle County, Virginia. The report was prepared at the request of the governing bodies of Charlottesville and Albemarle County through application to the Commissioner of the Division of Water Resources, Department of Conservation and Economic Development of the Commonwealth of Virginia. Its purpose is to aid in defining local flood problems and in the best utilization of land subject to overflow. The report is based on information on rainfall, runoff, historical and current flood heights, and other technical data bearing upon the occurrence and size of floods along Meadow Creek in the study area.

The report covers two significant phases of the flood problem. It first brings together a record of the largest known floods of the past on Meadow Creek. Second, it treats of probable future floods: specifically, the Intermediate Regional Flood and the Standard Project Flood. The Intermediate Regional Flood is one having an average frequency of occurrence in the order of once in 100 years. It is determined from an analysis of known floods on Meadow Creek, and on other streams which have similar physical characteristics and are in the same general geographical region. The Standard Project Flood is one of rare occurrence and, on most streams, is considerably larger than any flood of past occurrence. However, it should be considered in planning for use of a flood plain.

In problems concerned with the control of developments on the flood plains of Meadow Creek, and in reaching decisions on the size of floods to consider for this purpose, appropriate consideration should be given to the possible future occurrence of floods of the size of those experienced in the past, the Intermediate Regional Flood, and the Standard Project Flood.

The report contains maps, profiles, cross sections, and photographs which indicate the extent of flooding that has been experienced and that which might occur in the future along Meadow Creek. These should prove helpful in planning the best use of flood plains. From these data, the depth of probable flooding may be determined from the recurrence of the largest known floods or by occurrence of the Intermediate Regional or Standard Project Floods at any location. With this information, floor levels and other critical features of structures may be planned high enough to avoid flood damage, or at lower elevations with recognition of the chance and hazard of flooding.

The report does not include plans for the solution of flood problems. Rather, it is intended to provide the basis for further study and planning on the part of Charlottesville and Albemarle County in arriving at solutions to minimize vulnerability to flood damages. This might involve local planning programs to guide developments by controlling the type of use made of the flood plain through zoning and subdivision regulations, the construction of flood protection works, or a combination of the two approaches.

INTERPRETATION OF DATA

The Norfolk District of the Corps of Engineers will, upon request, provide technical assistance to Federal, State, and local agencies in the interpretation and use of the information contained herein, and will provide other available flood data for flood plain management.

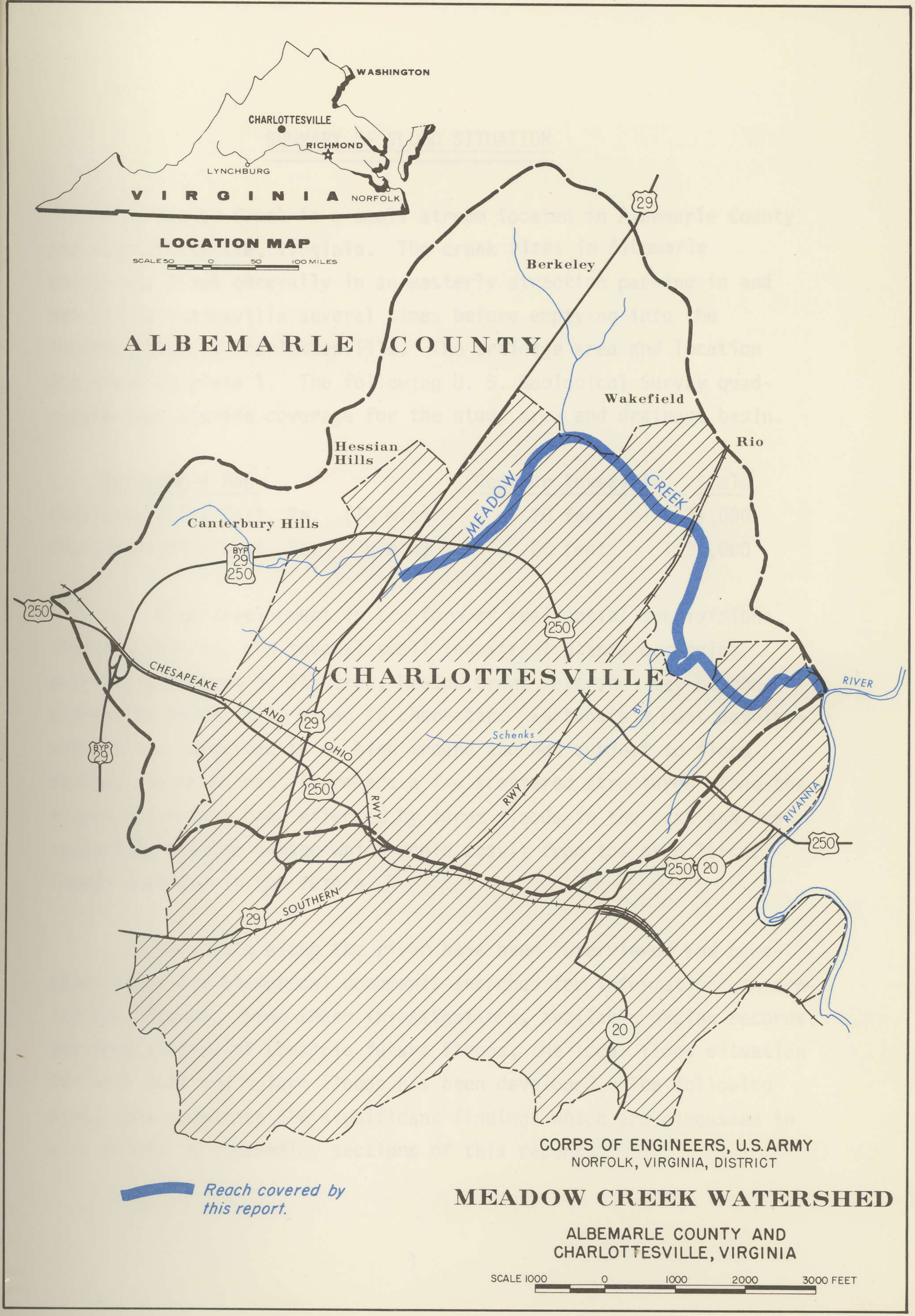

WASHINGTON
CHARLOTTESVILLE
RICHMOND
LYNCHBURG
VIRGINIA
NORFOLK
LOCATION MAP
SCALE 50 0 50 100 MILES
ALBEMARLE COUNTY
Berkeley
Wakefield
Rio
Hessian Hills
Canterbury Hills
MEADOW CREEK
CHARLOTTESVILLE
CHESAPEAKE AND OHIO RWY
SOUTHERN RWY
Schenks Br
RIVANNA RIVER
29
BYP 29 250
250
20
Reach covered by this report.
CORPS OF ENGINEERS, U.S. ARMY
NORFOLK, VIRGINIA, DISTRICT
MEADOW CREEK WATERSHED
ALBEMARLE COUNTY AND
CHARLOTTESVILLE, VIRGINIA
SCALE 1000 0 1000 2000 3000 FEET

PLATE 1

SUMMARY OF FLOOD SITUATION

Meadow Creek is a small stream located in Albemarle County and Charlottesville, Virginia. The creek rises in Albemarle County and flows generally in an easterly direction passing in and out of Charlottesville several times before emptying into the Rivanna River at Charlottesville. The drainage area and location are shown on plate 1. The following U. S. Geological Survey quadrangle maps provide coverage for the study area and drainage basin.

Quadrangle Map		Contour Inverval	Scale
Charlottesville East, Va.	(7½ min)	20 feet	1:24,000
Charlottesville West, Va.	(7½ min)	20 feet	1:24,000

With development in the form of residential subdivisions, shopping centers, and several small industrial plants occupying over fifty percent of its area, Meadow Creek watershed may be considered as essentially urban in character. Fortunately, most development in the watershed is on high ground and not subject to flood damage. Nevertheless, there are a few scattered structures along the stream which have been effected by large floods in the past and are subject to greater damage which could result from the even larger floods expected in the future.

Residents along the river have been interviewed and newspaper files and historical documents searched for information concerning past floods. From these investigations, available gaging records, and from studies of possible future floods, the local flood situation for both past and future floods has been developed. The following paragraphs summarize the significant findings which are discussed in more detail in succeeding sections of this report.

THE GREATEST FLOOD on Meadow Creek in the study area in recent history was probably that of October 1942.

OTHER LARGE FLOODS. Rainfall records, records of floods in other streams in the vicinity, and other available information indicate that large floods probably occurred on Meadow Creek in May 1924, April 1937, September 1944, August 1955, and August 1969.

INTERMEDIATE REGIONAL FLOOD has an average return interval of once in 100 years. Such a flood for Meadow Creek was determined by empirical methods and checked for reasonableness by comparison with frequency estimates determined for nearby streams of similar size and drainage characteristics for which a number of years of streamflow records are available.

STANDARD PROJECT FLOOD determinations indicate that floods could occur on Meadow Creek as much as 1 to 7 feet higher than the Intermediate Regional Flood crest.

FLOOD DAMAGES that would result from recurrences of major known floods would be substantial. Extensive damage would be caused by the Standard Project Flood because of its wider extent, greater depth, and higher velocities.

MAIN FLOOD SEASON. While minor to moderate flooding is more prevalent in the spring, the larger and more infrequent floods may occur at any time of the year. Most of the higher floods have resulted from heavy general rains or from intense rainfall produced by hurricanes or other storms of tropical origin which moved into the area from the Atlantic or Gulf Coasts. The storms of tropical origin almost always occur during the period from May through Novenber.

VELOCITIES OF WATER during major floods would be dangerously high in the main channel. Velocities on the flood plain would be considerably lower and would vary widely depending on the location. During a Standard Project Flood, velocities would be extremely dangerous to life and property. In the channel they would range up to 14 feet per second and on the flood plain as high as 6 feet per second. Velocities greater than three feet per second combined with depths of three feet or greater are generally considered dangerous.

DURATION OF FLOODS depend to some extent on the duration of runoff producing rainfall over the drainage basin upstream from the study area. Stages can rise from normal low to extreme flood peaks in less than 3 hours following the beginning of intense rainfall. During an Intermediate Regional Flood, the stream could have a maximum rate of rise of 4.5 feet per hour, and remain above bankfull stage for over 4 hours. During a Standard Project Flood, the stream could rise almost 12 feet in about 4 hours and would remain above bankfull stage for over 6 hours.

HAZARDOUS CONDITIONS would occur during large floods as a result of rapidly rising floodwaters, high velocities, and deep flows.

FLOOD DAMAGE PREVENTION MEASURES. As far as known there are no existing, authorized or proposed flood control or related measures in the study area or upstream in the watershed which will provide significant protection to the study area. There are no flood plain regulations presently in effect in Albemarle County or Charlottesville.

FUTURE FLOOD HEIGHTS that would be reached if the Intermediate Regional or Standard Project Floods were to occur are shown on table 1.

TABLE 1

RELATIVE FLOOD HEIGHTS

Flood	Distance Above Mouth of Stream feet	Estimated Peak Discharge c.f.s.	Water Surface Elevation feet, m.s.l.
HOLMES AVENUE			
Intermediate Regional	3,580	6,400	346.3
Standard Project		10,200	350.1
BRANDYWINE DRIVE			
Intermediate Regional	15,030	4,300	390.7
Standard Project		6,900	393.5
U. S. ROUTE 250 BYPASS			
Intermediate Regional	21,110	3,600	426.1
Standard Project		5,800	430.3

GENERAL CONDITIONS AND PAST FLOODS

This section of the report includes a history of floods on Meadow Creek and a discussion of general conditions as they apply to the flood situation.

Area Covered

The area investigated extends for about 4.5 miles along both the north and south sides of Meadow Creek beginning at its confluence with Rivanna River. The greater part of the study area and drainage basin is in Charlottesville with the remainder in Albemarle County. The limits of the study area are shown on plate 1.

Extent of Flooding

For a stream of its relatively small size, the flood plain along Meadow Creek is exceptionally wide. It ranges in width from a minimum of about 75 feet up to a maximum of about 700 feet with the average width being about 350 to 400 feet. Generally speaking, the topography rises abruptly at the outer edge of the flood plain. Percentagewise, therefore, the large and infrequent floods do not inundate substantially more area than is covered in the smaller and more frequent floods.

At the present time the flood plain along Meadow Creek is not extensively developed and the flood problem is not serious. Damage during past floods in the study area has been limited to the few scattered buildings and other structures such as roads and bridges. However, as available sites in the general area are exhausted, pressure to use the flood plain for building purposes will increase. The timely enactment of proper regulations to control further development will prevent the areas from adding to the flood problem. Moreover, as the watershed becomes more urbanized and rooftops, parking areas, streets and other impervious surfaces are substituted for the existing natural absorbent areas, there will be more runoff produced from a storm of given size. Flooding to greater depths and at more frequent intervals than before can be expected.

Flooding along the entire study area generally occurs as a result of prolonged intense rainfall over Meadow Creek watershed. But, serious flooding of the downstream portion of the study area may occur as a result of backwater from the Rivanna River whenever that stream is experiencing high water. Of course, both Meadow Creek and the Rivanna River may experience high water simultaneously which adds to the problem on either stream. However, because of the time difference required for floodwaters to concentrate on the two watersheds, there is only a remote possibility that flood crests originating from the fairly large Rivanna River basin and, by comparison, the much smaller Meadow Creek watershed would ever coincide exactly at their confluence. Usually, the flood crest from Meadow Creek, precedes that from the Rivanna River by several hours.

Settlement

Data on settlement of Charlottesville City and Albemarle County have been extracted from "Economic Data Summary," Albemarle County, dated June 1966. This report is available from the Governor's Office, Office of Administration, Division of Planning, 1010 James Madison Building, Richmond, Virginia 23219.

Albemarle County was formed from Goochland County in 1744. Settlement here began about 1734. Charlottesville was established in 1762 and incorporated as a city in 1888.

Albemarle County and the city of Charlottesville are separate governmental units.

The County Board of Supervisors, consisting of representatives elected by the qualified voters, is the governing body of Albemarle County. One representative is chosen from each of six magisterial districts into which the county is divided. The administrative and business affairs of the county are carried out by a county executive who is appointed by, and serves at the pleasure of, the Board of Supervisors.

Charlottesville, a city of the first class, operates under the council-manager form of government. The council consists of five members who are elected at large by the qualified voters of the city. The council elects one of its members to serve as mayor. Administrative and executive powers of the government are placed in the hands of the city manager who is appointed by, and serves at the pleasure, of the city council. The council retains all legislative functions and powers.

Both Charlottesville and Albemarle County have active planning commissions. The county has enacted subdivision regulations. Charlottesville has adopted a zoning ordinance, subdivision regulations and a comprehensive plan for future growth.

Albemarle County has a total area of 745 square miles of which rivers, lakes, and streams make up about 6 square miles. Over half of the county is forested. Lumbering, millwork, and other wood industries are important to the economy of the area. However, in recent years, more emphasis has been placed on livestock raising and dairying. In Charlottesville, manufacturing has grown in recent years. Products include machinery, electronic devices, fabrics, apparel, stock feeds, flour, scientific instruments and many others. The University of Virginia, with its many related enterprises, is the largest single business in Albemarle County.

Table 2 gives population statistics pertinent to the study area.

TABLE 2

POPULATION

Community	1940	1950	1960	1965	1970
Albemarle County	24,652	26,662	30,969	32,882	37,107
Charlottesville City	19,400	25,969	29,427	37,717	38,047

Flood Damage Prevention Measures

The Norfolk District Corps of Engineers is currently studying the flood situation in the entire James River Basin and ways by which flood problems may be solved. The Rivanna River Basin, of which Meadow Creek Watershed is a part, is included in the study. Findings and recommendations with respect to flood problems, will be included in a comprehensive river basin report.

When completed, studies underway in the Rivanna River Basin could show that it may be feasible to provide flood protection at some locations in the form of dams, levees, channel improvements, or similar devices. In this connection, it should be kept in mind that such measures are normally undertaken only when it can be clearly illustrated that the benefits to be derived from the provision of these structures, exceed the cost of constructing and maintaining them. At the present time, studies are not far enough advanced to permit this type of an evaluation for projects being considered in the Rivanna River Basin.

In the large number of cases whereby an economical solution to the flood problem cannot be obtained through structural measures, the most effective means of dealing with the problem is through sound flood plain management practices. These usually involve the adoption of some form of land use control, such as a flood plain ordinance, which can be used to effectively guide and regulate development on the flood plain.

Charlottesville City and Albemarle County have not adopted any form of regulatory ordinance pertaining to the use or or development on the flood plains. However, officials of both communities have expressed an interest in the formulation and adoption of such a measure. The data contained in this report provide the basis for sound land use planning and control in the area studied.

Flood Warning Forecasts

The National Weather Service maintains a flood warning plan for the study area. Whenever floods threaten, the Service issues warnings and forecasts for Rivanna River Basin and its tributaries through the normal news media.

The Stream and its Valley

Meadow Creek Watershed covers an area of 9.2 square miles. It is located in the larger Rivanna River Basin near Charlottesville, Virginia as shown on plate 1. The watershed is irregularly shaped, has a length of about 3.8 miles and a maximum width of about 3.8 miles near its center.

Meadow Creek and its watershed area lie altogether within Albemarle County and the city of Charlottesville. The stream flows generally in an easterly direction for about 6 miles to its confluence with the main stem of the Rivanna River in Charlottesville. The principal tributary is Schenks Branch which merges with Meadow Creek about 1.3 miles upstream from the confluence of Meadow Creek with the Rivanna River.

Meadow Creek Watershed lies wholly within the physiographic region known as the Piedmont Plateau. The Piedmont Plateau is located east of the Blue Ridge Mountains. The land slopes gradually eastward from the base of the mountains and is characterized by rolling terrain with elevations ranging from 1000 feet above mean sea level in the foothills to 300 feet near the eastern limits of the plateau. It is traversed by highlands which are cut by numerous small valleys.

Table 3 gives drainage area at selected points along Meadow Creek.

TABLE 3
DRAINAGE AREAS
MEADOW CREEK

Location	Distance Above Mouth Meadow Creek feet	Drainage Area sq. mi.
Mouth	0	9.2
Va. Route 631	6,460	8.4
Southern Railway	11,770	5.2
U. S. Route 250 Bypass	21,110	2.7

Developments on the Flood Plain

Plates 5, 6, 7, 8, and 9 show areas that are subject to flooding. Development includes residential, commercial and industrial buildings. Some structures on the flood plain have been damaged by floods in the past.

Highway and Railway Crossings in the Study Area

Seven highway bridges and one railway bridge cross Meadow Creek in the study area. Table 4 lists pertinent elevations for these structures and shows their relation to the crests of the Intermediate Regional and Standard Project Floods.

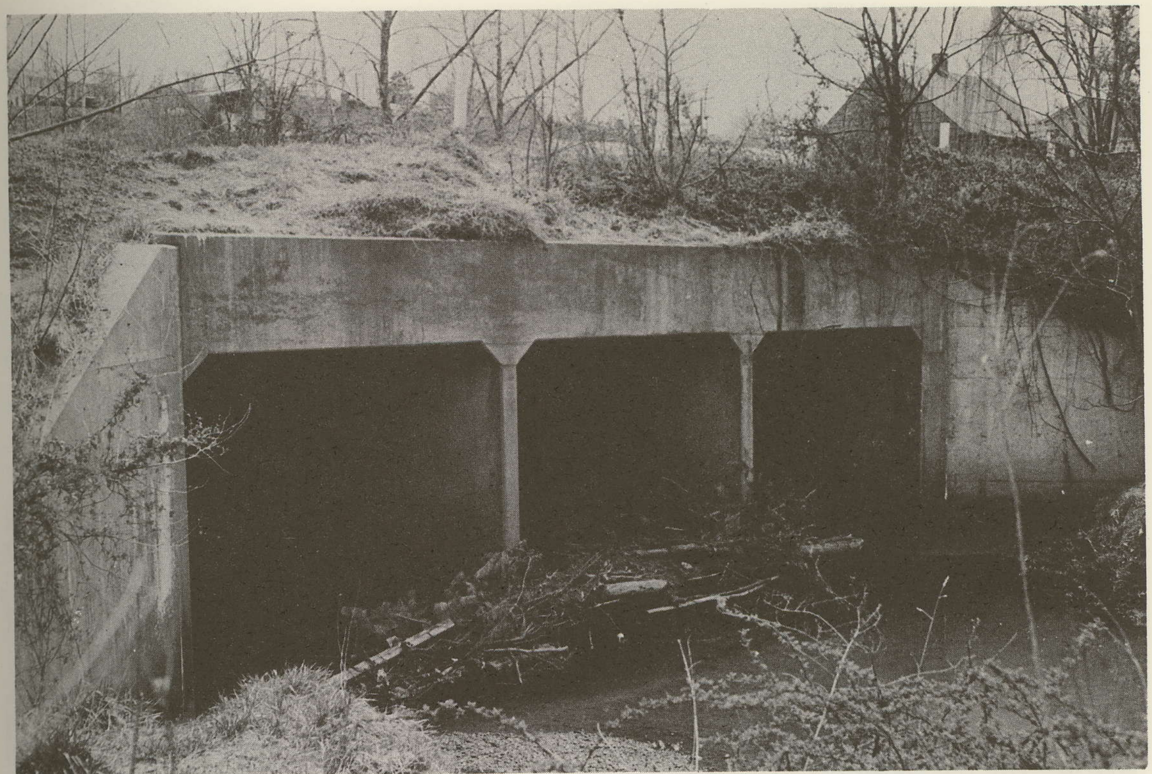
Table 4 shows that on Meadow Creek in the study area, only the Park Street crossing (Va. Rte 631) is completely above the level of expected flooding. The Holmes Avenue crossing would be inundated to a depth of about two feet during the Intermediate Regional Flood and to about six feet in the Standard Project Flood. The Southern Railway crossing would not be effected by the Intermediate Regional Flood but during the higher Standard Project Flood, water would rise to about six feet above the top of the culvert at this location. The Brandywine Drive crossing would remain open during the Intermediate Regional Flood but would be impassible during the Standard Project Flood. Hydraulic Road would be closed to traffic during both the Intermediate Regional Flood and Standard Project Flood. The U. S. 250 By-Pass culverts can accommodate the Intermediate Regional Flood but the carrying capacity of the two concrete culverts at this location would be exceeded during the Standard Project Flood, causing the roadway to be inundated to about one foot of depth. The roadways at two recently constructed culvert-type crossings near the upstream limits of the study area would be flooded during the Standard Project Flood. The roadway level of downstream structure would be above the level of the Intermediate Regional Flood but the upstream crossing would be flooded in this event.

Figures 1, 2, 3, and 4 are photographs of the bridges and culverts which carry highways and the railway across the study area.

Obstructions to Flood Flow

Table 4 and the profiles on plates 9, 10, and 11 show that the bridges and culverts which cross Meadow Creek produce significant backwater effects. For example, at Holmes Avenue, Park Street, Southern Railway, Brandywine Drive, Hydraulic Road, U. S. 250 By-Pass, and the two culverts near the upstream limits of the study area, the increase in flood heights attributed to the stream crossings would be 3.0, 5.1, 1.4, 3.5, 3.8, 3.9, 3.4 and 1.4 feet, respectively, during the Intermediate Regional Flood and 0.6, 6.5, 6.6, 3.8, 3.9, 5.4, 3.7 and 3.4, respectively, for the Standard Project Flood. Fortunately, however, the average stream slope in the study area is rather steep which, in most cases, tends to diminish the backwater effects produced by the stream crossings quite rapidly in an upstream direction.

Plans for the construction of new stream crossings or replacement of existing ones should consider the possible adverse effects on flood stages which may be caused by restricting the available waterway area.



Holmes Avenue

Va. Route 631 (Park Street)

Figure 1 Bridges Across Meadow Creek

Southern Railway

Brandywine Drive

Figure 2 Bridges Across Meadow Creek

Hydraulic Road

Pedestrian crosswalk and U.S. Route 250 Bypass

Figure 3 Bridge Across Meadow Creek

Earhart Street

Entrance to O'Neill Building's Parking Lot

Figure 4 Bridges Across Meadow Creek

TABLE 4

BRIDGES ACROSS MEADOW CREEK

Distance Above Mouth of Stream	Identification	Elevations in Feet Referred to Mean Sea Level — Water Surface — Intermediate Regional Flood — Downstream Side of Bridge	Intermediate Regional Flood — Upstream Side of Bridge	Standard Project Flood — Downstream Side of Bridge	Standard Project Flood — Upstream Side of Bridge	Stream Bed	Low Steel	Bridge Floor	Height of Low Steel above Intermediate Regional Flood (Upstream Water Surface) feet
3,580	Holmes Avenue	343.3	346.3	349.5	350.1	328.0	338.0	344.2	-8.3
6,460	Va. Route 631 (Park Street)	353.2	358.3	355.7	362.2	341.7	363.6	366.9	+5.3
11,770	Southern Railway	377.3	378.7	379.2	385.8	367.8	379.8	416.9	+1.1
15,030	Brandywine Drive	387.2	390.7	389.7	393.5	379.7	389.7	391.7	-1.0
20,380	Hydraulic Road	416.0	419.8	417.2	421.1	406.0	415.3	417.3	-4.5
21,110	U. S. Route 250 Bypass	422.2	426.1	424.9	430.3	413.9	423.9	429.0	-2.2
22,670	Earhart Street	427.7	431.1	431.5	435.2	419.8	426.0	431.3	-5.1
22,950	Entrance to O'Neill Building's Parking Lot	430.9	432.3	432.9	436.3	420.9	427.0	432.0	-5.3

FLOOD SITUATION

Flood Records

There are no records of stream stages or discharges for Meadow Creek. Several highwater marks were located along the stream and their elevations determined following the moderate flooding of 19 August 1969. Information on other floods is meager. Interviews with local residents have established only that a number of large floods have occurred on Meadow Creek within recent history. Those interviewed were uncertain as to the exact dates of these events. Streamflow records are available for nearby streams, including the Rivanna River, Schenks Branch (a small tributary of Meadow Creek), Mechum River, North Fork Moormans River, and the South Fork of Rivanna River. These records together with area precipitation records provide the best means of estimating the probable dates of significant flooding on Meadow Creek. For example, the largest flood known to have happened on the Rivanna River at Charlottesville was that of 16 October 1942. Rainfall associated with this flood was heaviest in the immediate Charlottesville area. Therefore, despite the fact that none of the available accounts of this flood make specific mention of heavy runoff over the Meadow Creek watershed, flooding on this stream was also undoubtedly severe during the October 1942 flood.

Flood Stages and Discharges

Peak stages and discharges recorded by the U. S. Geological Survey are available for several streams located in the vicinity of Meadow Creek. These records reflect the flood history of the general area and are reasonably indicative of the frequency of occurrence of floods to be expected on Meadow Creek.

Available peak stages and discharges for gaging stations at Palmyra and Charlottesville on the Rivanna River are shown on tables 5 and 6, respectively. Tables 7, 8, 9, and 10 show flood crest stages and discharges for Mechum River near Ivy, North Fork, Moormans River near Whitehall, South Fork Rivanna River near Earlysville, and Schenks Branch at Charlottesville, respectively.

Table 5 includes all recorded floods above bankfull stage of 17 feet at the Palmyra U. S. Geological Survey gaging station located at river mile 15.56. The drainage area at this point is 675 square miles.

TABLE 5

FLOOD CREST ELEVATIONS OF FLOODS

RIVANNA RIVER AT PALMYRA, VA.

Date of Crest	Gage Height feet	Elevation feet m.s.l.	Discharge c.f.s. (a)
September 17, 1934	24.75	235.14	24,000
December 1, 1934	20.60	230.99	13,200
January 23, 1935	20.17	230.56	12,800
September 6, 1935	26.27	236.66	29,000
January 3, 1936	20.54	230.93	13,900
January 19, 1936	19.53	229.92	12,400
March 18, 1936	29.26	239.65	39,900
October 18, 1936	18.19	228.58	10,600
January 21, 1937	19.65	230.04	12,500
February 22, 1937	17.05	227.44	9,330
April 26, 1937	33.35	243.74	56,700
October 20, 1937	23.45	233.84	20,000
August 17, 1940	21.78	232.17	16,300
August 9, 1942	18.59	228.98	11,400
October 16, 1942	36.5	246.89	78,000
September 19, 1944	30.5	240.89	39,600
April 1, 1948	21.54	231.93	16,800
August 4, 1948	22.9	233.29	19,800
December 4, 1948	26.78	237.17	28,800
December 31, 1948	18.27	228.66	10,700
March 23, 1949	19.25	229.64	11,900
August 15, 1949	21.70	232.09	17,200
December 5, 1950	21.55	231.94	17,000
June 10, 1951	21.13	231.52	15,900
February 4, 1952	17.38	227.77	11,000

TABLE 5 (Cont'd)

FLOOD CREST ELEVATIONS OF FLOODS

RIVANNA RIVER AT PALMYRA, VA.

Date of Crest	Gage Height feet	Elevation feet, m.s.l.	Discharge c.f.s. (a)
March 12, 1952	17.80	228.19	11,400
August 19, 1955	29.00	239.39	34,800
October 1, 1959	20.41	230.80	15,700
February 19, 1960	18.27	228.66	12,700
April 13, 1961	17.83	228.22	12,100
October 21, 1961	24.27	234.66	22,900
March 13, 1962	17.90	228.29	12,200
March 12, 1963	18.63	229.02	13,100
February 8, 1965	21.77	232.16	18,000
March 8, 1967	18.41	228.80	12,800
August 20, 1969	39.85	250.24	98,700

(a) Minor inconsistencies in data due to periodic changes in stage-discharge relationship.

Table 6 shows annual peak stages and discharges between February 1925 and May 1934 for the U. S. Geological Survey gaging station at Charlottesville. The drainage area at this gage (Rivanna River Mile 36.1) is 507 square miles.

TABLE 6

FLOOD CREST ELEVATIONS OF FLOODS

RIVANNA RIVER BELOW MOORES CREEK, NEAR CHARLOTTESVILLE, VA.

Date of Crest	Gage Height feet	Elevation feet, m.s.l.	Discharge c.f.s.
November 16, 1926	11.96	304.86	8,790
October 4, 1927	11.83	304.73	8,570
April 28, 1928	10.80	303.70	7,490
April 16, 1929	14.15	307.05	11,200
March 8, 1930	9.30	302.20	5,990
July 25, 1931	11.00	303.90	7,690
October 17, 1932	15.00	307.90	12,100
April 17, 1933	16.50	309.40	13,800
September 17, 1934	19	311.90	18,000

Table 7 includes all recorded floods above bankfull stage of 9 feet at the U. S. Geological Survey gaging station on the Mechum River near Ivy, Virginia. The drainage area at the gage is 97 square miles and the altitude is 440 feet mean sea level.

TABLE 7

FLOOD CREST ELEVATIONS OF FLOODS

MECHUM RIVER NEAR IVY, VA.

Date of Crest	Gage Height feet	Discharge c.f.s.
October 15, 1942	30.3	20,000
December 30, 1942	10.8	3,030
September 18, 1944	21.9	10,600
September 18, 1945	9.32	2,360
April 1, 1948	9.58	2,740
August 4, 1948	10.9	3,490
December 4, 1948	14.7	5,340
September 13, 1950	16.8	6,330
December 4, 1950	16.28	5,980
September 30, 1959	18.05	7,200

Table 8 includes the annual peak discharges at the U. S. Geological Survey gaging station on the North Fork Moormans River near Whitehall, Virginia. The drainage area is 11.4 square miles and the altitude of the gage is 999 feet mean sea level.

TABLE 8

ANNUAL PEAK DISCHARGES

NORTH FORK MOORMANS RIVER NEAR WHITEHALL, VA.

Date of Crest	Gage Height feet	Discharge c.f.s.
October 15, 1942	11.7	7,620
February 4, 1952	4.40	437
March 24, 1953	4.61	492
March 1, 1954	4.93	603
August 18, 1955	7.94	2,400
October 31, 1956	4.59	490
February 26, 1957	4.70	520
December 29, 1958	4.65	592
September 30, 1959	5.97	1,180
May 8, 1960	5.72	1,050
October 21, 1961	4.41	505
November 10, 1962	4.17	424
March 12, 1963	3.91	334
- 1964	3.62	241
February 7, 1965	3.94	344
September 21, 1966	4.84	662
August 24, 1967	5.02	720
May 27, 1968	5.16	780
July 7, 1969	4.12	407

Table 9 includes all recorded floods above bankfull stage of 10 feet at the U. S. Geological Survey gaging station on the South Fork Rivanna River near Earlysville, Va. The drainage area at the gage is 216 square miles and the altitude is 369 feet mean sea level.

TABLE 9

FLOOD CREST ELEVATIONS OF FLOODS

SOUTH FORK RIVANNA RIVER NEAR EARLYSVILLE, VA.

Date of Crest	Gage Height feet	Discharge c.f.s.
October 1942	33 (a)	-
February 4, 1952	12.18	6,190
March 11, 1952	13.55	7,480
March 25, 1953	11.71	5,750
March 1, 1954	15.55	9,560
August 8, 1955	26.1	30,200
June 2, 1959	12.22	6,190
September 30, 1959	24.35	25,500
February 18, 1960	11.97	6,010
April 13, 1961	11.84	5,340
October 21, 1961	14.00	7,200
November 10, 1962	11.47	5,570
February 7, 1965	14.05	7,200
February 13, 1966	11.10	4,780
February 28, 1966	10.78	4,560
September 22, 1966	10.68	4,490

(a) From information by local residents

Table 10 includes all recorded floods above bankfull stage of 7 feet at the U. S. Geological Survey gaging station on Schenks Branch, a small tributary of Meadow Creek. The drainage area at the gage is 1.34 square miles and the altitude is 380 feet mean sea level.

TABLE 10

FLOOD CREST ELEVATIONS OF FLOODS

SCHENKS BRANCH AT CHARLOTTESVILLE, VA.

Date of Crest	Gage Height feet	Discharge c.f.s.
July 20, 1956	8.60	650
September 30, 1959	7.99	580
May 1, 1962	9.41	900
July 11, 1968	7.74	504
August 20, 1969	7.15	(a)

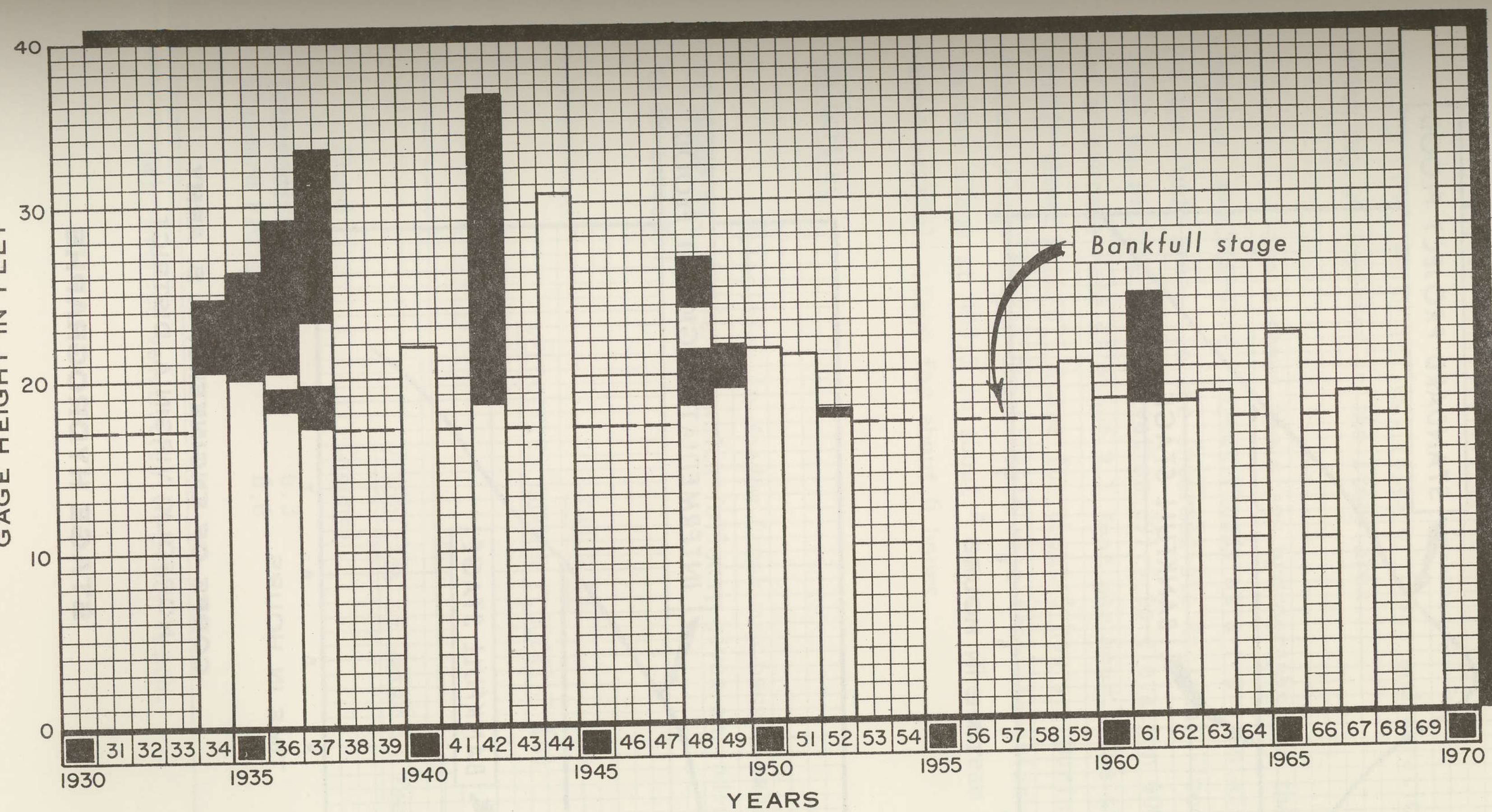
(a) Discharge not determined.

Flood Occurrences

Plate 2 shows the dates and heights of floods since 1933 which have exceeded bankfull stage on Rivanna River at Palmyra.

Duration and Rate of Rise

A stage-discharge relationship was developed for Meadow Creek to include a range of stages and discharges up to the size of the Standard Project Flood. Using this relationship, stage hydrographs were computed for the Intermediate Regional Flood and Standard



U.S. Geological Survey gaging station at Palmyra, Virginia. Datum of gage is 210.39 feet above mean sea level.

Variation in shading on the bar graph indicates more than one flood during the year. For example in 1934 there were 2 floods; gage heights were 20.60 and 24.75 feet.

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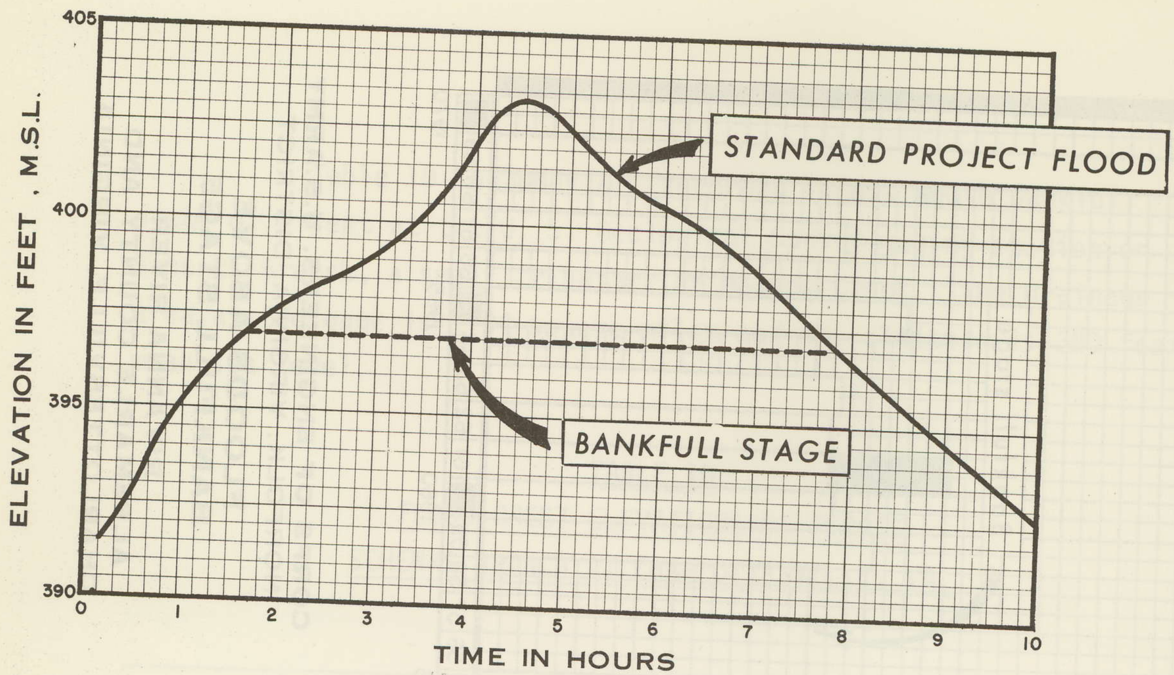
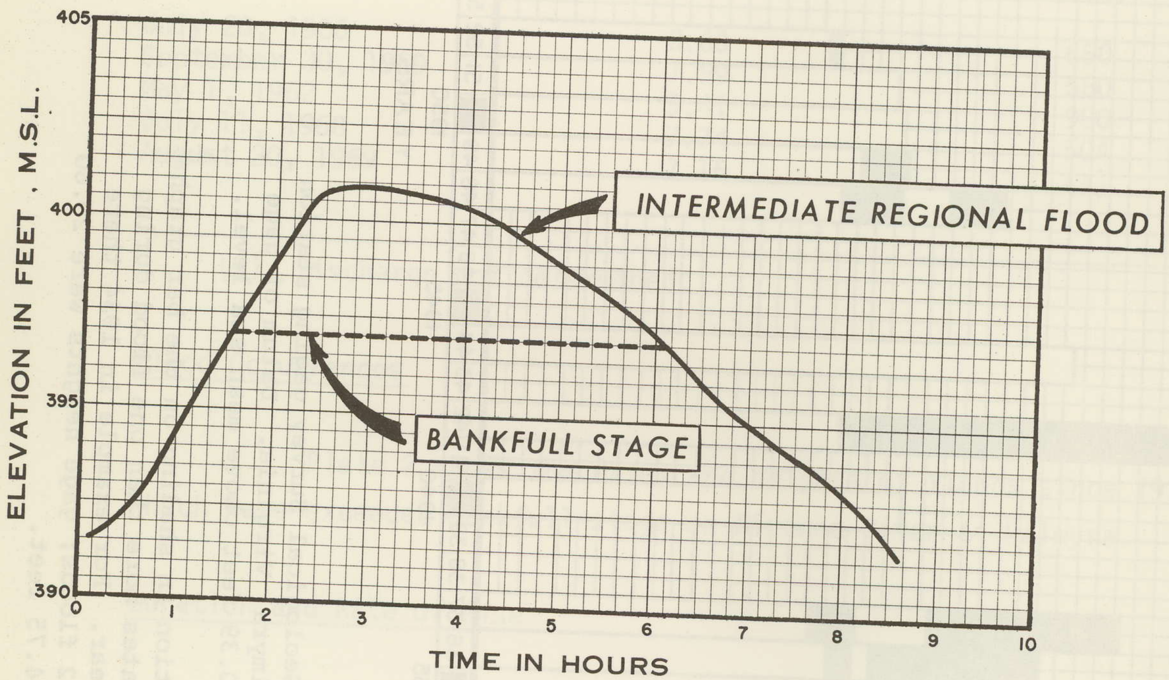
FLOODS ABOVE BANKFULL STAGE

RIVANNA RIVER
ALBEMARLE COUNTY AND CHARLOTTESVILLE, VIRGINIA





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NORFOLK, VIRGINIA, DISTRICT

STAGE HYDROGRAPHS

MEADOW CREEK
ALBEMARLE COUNTY AND
CHARLOTTESVILLE, VIRGINIA

Project Flood which reflect rates of rises and duration of flooding which may be expected in the study area.

Plate 3 shows the stage hydrographs for the Intermediate Regional and Standard Project floods at a representative location in the study area. In the Intermediate Regional Flood, Meadow Creek would rise from elevation 391.5 to elevation 400.8 in 3 hours at an average rate of about 3.1 feet per hour. The stream would remain above bankfull stage for about 5 hours. During the Standard Project Flood Meadow Creek would rise from elevation 391.5 to its maximum stage at 403.3 in about 4 hours. The stream would remain above bankfull stage for about 6 hours.

Velocities

Velocities in Meadow Creek may become hazardous in time of flooding. Table 11, which follows, gives an indication of velocities to be expected.

TABLE 11

VELOCITIES DURING FLOODTIME (a)

Flood	Velocities of Water in feet per second: Channel	Overbank
Intermediate Regional	6.3	3.1
Standard Project	6.6	3.3

(a) Average velocities in study reach.

FLOOD DESCRIPTIONS

The following are descriptions of four large floods that have occurred in the Rivanna River Basin and which probably caused noteworthy flooding in the study area. These are based on newspaper accounts, historical records, and field investigations.

Flood of May 1924

From THE DAILY PROGRESS, Charlottesville, Virginia

May 13, 1924:

"This section was visited Saturday night and Sunday by the heaviest rainfall that has occurred in many years, the records kept at University Observatory showing a rainfall of 5.57 inches during the two days.

"The rain commenced to fall about 2 o'clock Saturday afternoon and grew in intensity until at 9 o'clock it began to threaten serious consequences. The downpour continued throughout the night, and with a slight diminution during the early forenoon Sunday, but showed no signs of cessation. From noon until an early hour Monday the precipitation increased, and the danger of the flood situation was realized.

"By noon the streams from the mountains had reached flood height, and the water was overflowing the low lands of the territory through which they pass and in the face of the continuing downpour of rain residents along the course of these streams became apprehensive of the worst flood in many years.

"The rain continued without cessation, and as night approached some fear was felt as to the safety of certain bridges, but no one especially the county officials entertained any uneasiness about the new steel bridges which had been erected within recent years at such flood levels "as were considered absolutely safe. However, their calculation proved not well founded in the face of a downpour of rain which raised the normal water level at least 30 feet, as was recorded by measurement on the steel bridge at Hydraulic which withstood the strain of the high tide, although the approach to it from the west was washed away. At this bridge the water was five feet higher than the level of the flood in 1870.

" . . . Havoc was played by the flood waters at the Woolen Mills where the swollen river overflowed and backed the waters of Moore's Creek to a height of 25-feet above the normal reading the highest level since 1877, and three feet higher than the last serious flood, which occurred on May 3rd, 1901.

"Public utilities in the city soon felt the effects of high water as the Rivanna River reached a height which flooded the power plant of the Virginia-Western Power Co., and before 8'o'clock the arc lights on the streets went out. . . .

"In addition to the damage sustained by the Virginia-Western Power Co. at the power plant two of their new steel towers, erected for supporting heavy cables on their line westward, caught the strain of the flood tide in the Rivanna River, and one of the towers was badly twisted.

May 14, 1924

"Following the Account Yesterday That Many Bridges Had Been Swept Away and Large Damage Done at the Woolen Mills, Later Information Tells of Heavy Losses Sustained by Farmers - Scottsville Suffered When James River Rose to Greater Height - Travel and Delivery of Mail Badly Interrupted in the county."

May 15, 1924

"After suspension of service at 9 o'clock Sunday night on account of lack of current occasioned by the flooded condition of the power plant, street cars began to run today and resumed the regular schedule."

"Following an interruption for a period of one hour, from 5 to 6 yesterday afternoon, electric current for power and light was supplied, but the interruption occurred before The Progress was able to complete the press run for the day and many readers were deprived of the paper last night."

Flood of April 1937

From THE DAILY PROGRESS, Charlottesville, Virginia

April 26, 1937

"The swollen water of the Rivanna River were receding rapidly here today after a heavy week-end rainfall which set an all-time record, temporarily paralyzed transportation for several hours late yesterday afternoon and last night.

"For forty-eight hours, ending at 9 o'clock today, a steady downpour raised streams in this area far above the flood stage, setting a record precipitation of 7:60 inches, according to the University of Virginia Observatory. 'Cloudy weather' will continue through tonight.

"An unofficial reading at the Charlottesville Woolen Mills at noon showed the Rivanna had reached a flood stage of thirty-two feet, two feet less than the record mark of 1924. The entire basement floor of the old building of the plant was entirely submerged and approximately two-thirds of the floor of the new division was under water."

April 27, 1937

"The unrully water of the Rivanna River had subsided today and danger of serious flood damage to Charlottesville had passed.

April 28, 1937

"Red Cross begins relief activities as flood recedes.

Flood of October 1942

The largest and most damaging flood known to have occurred on the Rivanna River in the study area was that of October 1942. Intense rainfall associated with the remnants of a tropical hurricane fell over the Rivanna River watershed for about three days. Amounts totalling almost 10 inches were measured in the Rivanna watershed while a short distance to the northeast, in the Rappahannock River Basin, up to 18.9 inches at Big Meadows were recorded. This storm also produced record flooding on the Rappahannock River.

Rainfall depths measured during the October 1942 storm indicate that the largest amounts and most intense rainfall occurred over the upper portion of the Rivanna River watershed. The adjacent Rappahannock Basin experienced even heavier and more intense rainfall.

Following are excerpts from the Charlottesville newspaper which relate to the October 1942 flood.

From THE DAILY PROGRESS, Charlottesville, Virginia

October 16, 1942

"Fire Department Saves Residents in Flooded Areas.

"Charlottesville was almost isolated today when slides blocked traffic by rail, and water cut off all service. The City Fire squad was kept busy last night rescuing citizens stranded by the rising water.

"A number of bridges in the county have been reported washed out or partially damaged, and many of the secondary road bridges have been affected.

"There was a severe threat last night when the water rose to 61 inches in the engine room, 52 inches higher than the nine inches of 1924 when the city was thrown into darkness.

"Only the third and fourth floor workers were at their regular jobs at the woolen mills today, after a flood affecting the first and second stories with water five feet deeper 'than any known before.' Workers have been diverted to cleaning up the damage."

Flood of August 1969

Torrential rains associated with the remnants of "Hurricane Camille" which passed across the state on the night of August 19-20, 1969 were responsible for the worst natural disaster known in Virginia. Over 150 lives, mostly in the mountainous portion of the state, were lost as a result of flash flooding and mud slides.

In one respect, those on the flood plain at Charlottesville and the remainder of the area studied in this report were fortunate during the "Camille" flood. The main storm center passed some distance to the south of the study area. Consequently, in the Charlottesville area, occupants of the flood plain were not nearly as seriously affected as were those on other streams in the storm's path. Flood stages on Moores Creek, Meadow Creek, and the Rivanna River at Charlottesville were much lower in August 1969 than those experienced in some of the earlier recorded floods. However, downstream on the Rivanna River at Palmyra, the 1969 flood established an all-time record.

FUTURE FLOODS

This section of the report discusses the Standard Project Flood and the Intermediate Regional Flood on Meadow Creek and some of the hazards of great floods. Floods of the size of the Standard Project Flood represent reasonable upper limits of expected flooding. Those of the size of the Intermediate Regional Flood represent floods that may reasonably be expected to occur more frequently, although they will not be as high or severe as the infrequent Standard Project Flood.

Extremely large floods have been experienced in the past on streams in the general geographical and physiographical region. Heavy storms similar to those causing these floods could occur over the watershed of Meadow Creek. In this event, floods would result comparable in size with those experienced on neighboring streams. It is therefore desirable, in connection with any determination of future floods which may occur on Meadow Creek, to consider storms and floods that have occurred in the region on watersheds whose topography, watershed cover, and physical characteristics are similar.

DETERMINATION OF INTERMEDIATE REGIONAL FLOOD

The Intermediate Regional Flood is defined as one having an average frequency of occurrence of once in 100 years at a designated location, although the flood may occur in any year. Ideally, probability estimates are based on statistical analysis of streamflow records available for the watershed under study. However, on numerous streams, as on Meadow Creek, lack of adequate record requires that frequency estimates be determined by indirect methods. A commonly used method involves the application of rainfall runoff amounts to a synthetic graph (unit-hydrograph). Results are generally checked for reasonableness by appropriate comparison with more reliable values determined for watersheds in the "general region" of the area under study. The above described technique was used to determine the Intermediate Regional Flood for Meadow Creek.

Results of the studies indicate that the Intermediate Regional Flood on Meadow Creek would have a peak discharge of 7,000 cubic feet per second at the mouth of the stream and 3,600 cubic feet per second at the upstream limits of the study area. Table 12 shows flood stages and discharges at various points along the stream which would result from the occurrence of the Intermediate Regional Flood. Figures 5, 6 and 7 show heights that the Intermediate Regional Flood would reach at selected locations along Meadow Creek.

TABLE 12

FLOOD STAGES AND DISCHARGES - INTERMEDIATE REGIONAL FLOOD

Location	Distance Above Mouth feet	Stage feet, m.s.l.	Discharge c.f.s.
Mouth	0	342.6	7,000
Va. Route 631	6,460	358.3	5,900
Southern Railway	11,770	378.7	4,800
U. S. Route 250 Bypass	21,110	426.1	3,600

DETERMINATION OF STANDARD PROJECT FLOODS

Only in rare instances has a specific stream experienced the largest flood that is likely to occur. Severe as the maximum known flood may have been on any given stream, it is a commonly accepted fact, that in practically all cases, sooner or later a larger flood can and probably will occur. The Corps of Engineers in cooperation with the National Weather Service has made comprehensive studies based on the vast records of experienced storms and floods, and had evolved generalized procedures for estimating the flood potential of streams. These procedures have been used in determining the Standard Project Flood for the study area. It is defined as the largest flood that can be expected from the most severe combination of meteorological and hydrological conditions that are considered reasonably characteristic of the geographical region involved. Table 13 which follows, is a tabulation of the maximum heights of water and discharges which would occur during the Standard Project Flood. Figures 5, 6, and 7 show heights which the Standard Project Flood would reach at selected locations in the study area.

TABLE 13

FLOOD STAGES AND DISCHARGES - STANDARD PROJECT FLOOD

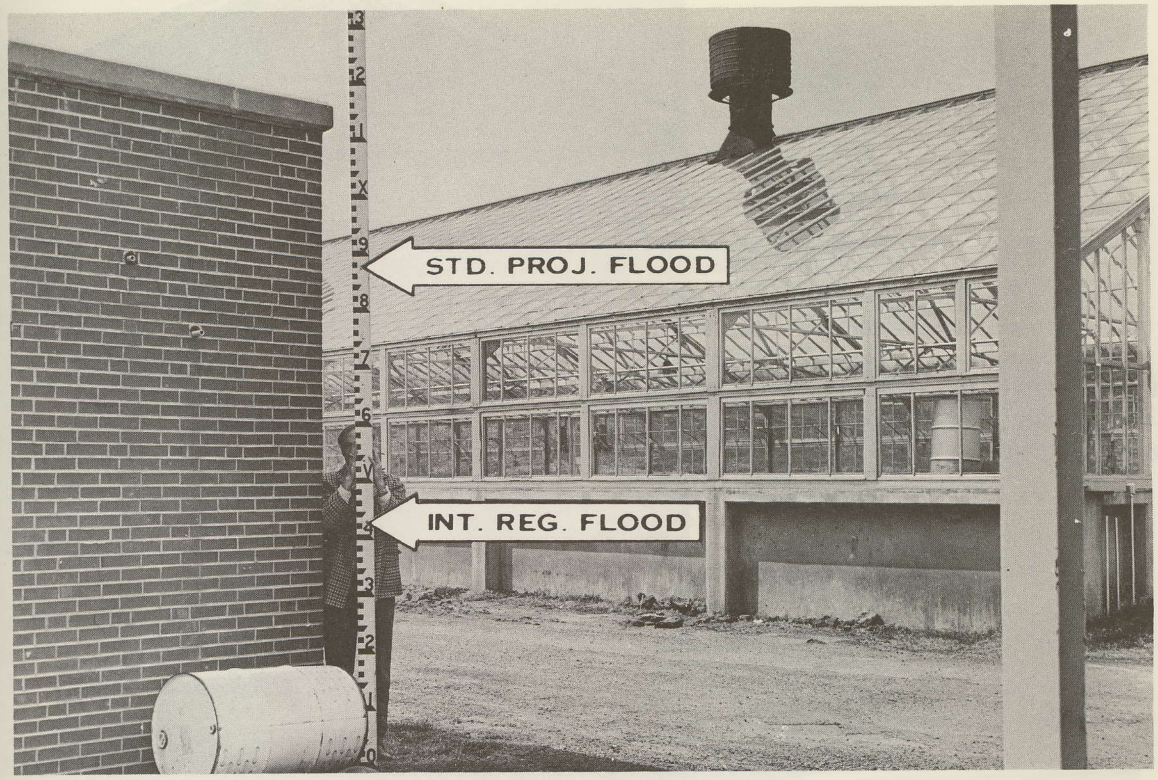
Location	Distance Above Mouth feet	Stage feet, m.s.l.	Discharge c.f.s.
Mouth	0	349.1	11,100
Va. Route 631	6,460	362.2	9,400
Southern Railway	11,770	385.8	7,600
U. S. Route 250 Bypass	21,110	430.3	5,800

Frequency

It is not practical to assign a frequency to the Standard Project Flood. The occurrence of such a flood would be a rare event; however, it could occur in any year.

Possible Larger Floods

Floods larger than the Standard Project Flood are possible; however, the combination of factors that would be necessary to produce such floods would rarely occur. Consideration of floods of this magnitude is important in cases where the consequences of flooding would be disastrous, or, otherwise, not acceptable under any circumstances.



Sewage Disposal Plant

Holmes Avenue Bridge

Figure - 5 Flood Heights

Radio Tower near intersection of Milbourne Road and Park Street (Va. Route 631)

Hydraulic Road Bridge

Figure 6 Flood Heights

State Property on Brookway Drive

O'Neill Building's Parking Lot

Figure 7 Flood Heights

HAZARDS OF GREAT FLOODS

The amount and extent of damage caused by any flood depends in general upon the size of the area flooded, the height of flooding, the velocity of flow, the rate of rise, and the duration of flooding.

Areas Flooded and Heights of Flooding

The area along Meadow Creek that would be flooded by the Standard Project Flood and the Intermediate Regional Flood is shown on plates 5, 6, 7, 8 and 9. The actual limits of these overflow areas on the ground may vary somewhat from those shown on the maps because the large contour interval and scale of the maps do not permit precise plotting of the flooded areas. More exact determination can be made by using the profiles, plates 10, 11 and 12 in conjunction with field surveys or more detailed maps.

Profiles for the Intermediate Regional Flood and Standard Project Flood for the study area were computed using stream characteristics determined from topographic maps, valley cross sections, and field inspections. Typical valley cross sections used in the study are shown for selected locations on plates 13 and 14.

The profiles of the Standard Project Flood and the Intermediate Regional Flood depend in part upon the degree of destruction or clogging of various bridges during the flood. Because it is impossible to forecast these events, it was assumed that all bridge structures would stand, and that no clogging would occur. The Standard Project Flood profile for Meadow Creek would vary from 1 to 7 feet higher than the Intermediate Regional Flood in the study area.

Velocities, Rates of Rise, and Duration

Water velocities during floods depend largely upon the size and shape of the cross section, the condition of the stream, and the bed slope, all of which vary on different streams and at different locations on the same stream.

Table 14 lists the maximum velocities that would occur in the main channel and overbank area of Meadow Creek during the Intermediate Regional and Standard Project Floods.

TABLE 14

INTERMEDIATE REGIONAL AND STANDARD PROJECT FLOODS

MAXIMUM VELOCITIES, MEADOW CREEK

Flood	Distance Above Mouth feet	Maximum Velocities Channel ft. per sec.	Overbank ft. per sec.
Intermediate Regional	6,400	12	5
Standard Project	6,400	14	6

The rate of rise and duration of flooding depend largely on the time required for floodwaters to concentrate in the area and on the duration of flood-producing rainfall.

Table 15 indicates for the Intermediate Regional and Standard Project Floods the time required for the floods to rise to maximum height and the duration above bankfull stage.

TABLE 15

INTERMEDIATE REGIONAL AND STANDARD PROJECT FLOODS, RATES OF RISE, AND DURATION OF FLOODING, MEADOW CREEK (a)

Flood	Height of Rise feet	Time of Rise hour	Maximum Rate of Rise feet, per hr	Duration Above Bankfull hours
Intermediate Regional	9.3	3	4.5	5
Standard Project	11.8	4	4.8	6

(a) As determined 16,720 feet above the mouth of Meadow Creek.

The rapid rates of rise and high stream velocities, shown in tables 14 and 15 in combination with deep, fairly long-duration flooding, would create a hazardous situation in developed areas. Velocities greater than three feet per second combined with depths of three feet or greater are generally considered hazardous.

GLOSSARY OF TERMS

BANKFULL STAGE. The stage or elevation above which extensive overflow of the natural banks of a stream or body of water begins in the reach or area in which the elevation is measured.

* * *

ELEVATION. As used herein refers to height in feet above mean sea level datum (USGS Supplemental Adjustment 1936).

* * *

FLOOD. An overflow of lands not normally covered by water and that are used or usable by man. Floods have two essential characteristics: The inundation of land is temporary; and the land is adjacent to and inundated by overflow from a river or stream or an ocean, lake, or other body of standing water.

Normally a "flood" is considered as any temporary rise in stream flow or stage but not the ponding of surface water that results in significant adverse effects in the vicinity. Adverse effects may include damages from overflow of land areas, temporary backwater effects in sewers and local drainage channels, creation of unsanitary conditions or other unfavorable situations by deposition of materials in stream channels during flood recessions, rise of ground water coincident with increased stream flow and other problems.

* * *

FLOOD CREST. The maximum stage or elevation reached by the waters of a flood at a given location.

FLOOD PEAK. The maximum instantaneous discharge of a flood at a given location. It usually occurs at or near the time of the flood crest.

* * *

FLOOD PLAIN. The relatively flat area or low lands adjoining the channel of a river, stream or watercourse or ocean, lake, or other body of standing water which has been or may be covered by flood water.

* * *

FLOOD PROFILE. A graph showing the relationship of water surface elevation to location, the latter generally expressed as distance above mouth for a stream of water flowing in an open channel. It is generally drawn to show surface elevation for the crest of a specific flood, but may be prepared for conditions at a given time or stage.

* * *

FLOOD STAGE. The stage or elevation at which overflow of the natural banks of a stream or body of water begins in the reach or area in which the elevation is measured.

* * *

HEAD LOSS. The effect of obstructions, such as narrow bridge openings or buildings that limit the area through which water must flow, raising the surface of the water upstream from the obstruction.

INTERMEDIATE REGIONAL FLOOD. A flood having an average frequency of occurrence in the order of once in 100 years although the flood may occur in any year. It is based on statistical analyses of streamflow records available for the watershed and analyses of rainfall and runoff characteristics in the "general region of the watershed."

* * *

LEFT BANK. The bank on the left side of a river, stream, or watercourse, looking downstream.

* * *

LOW STEEL (OR UNDERCLEARANCE). See "underclearance."

* * *

NORMAL WATER SURFACE. The elevation of the water surface on a stream at times other than during drought or flooding. In this report, it is the elevation obtained by field surveys.

* * *

RIGHT BANK. The bank on the right side of a river, stream, or watercourse, looking downstream.

* * *

STANDARD PROJECT FLOOD. The flood that may be expected from the most severe combination of meteorological and hydrological conditions that are considered reasonably characteristic of the geographical area in which the drainage basin is located, excluding extremely rare combinations. Such floods as used by the Corps of Engineers are intended as practicable expressions of the degree of protection that should be sought in the design of flood control works, the failure of which might be disastrous.

* * *

TIME OF CONCENTRATION. The flow time from the most remote point in the drainage area to the point in question.

* * *

UNDERCLEARANCE. The lowest point of a bridge or other structure over or across a river, a stream, or watercourse that limits the opening through which water flows. This is referred to as "low steel" in some regions.

AUTHORITY

PUBLIC LAW. This report has been prepared in accordance with the authority granted by Section 206 of the Flood Control Act of 1960 (PL 86-645), as amended.

ACKNOWLEDGEMENT

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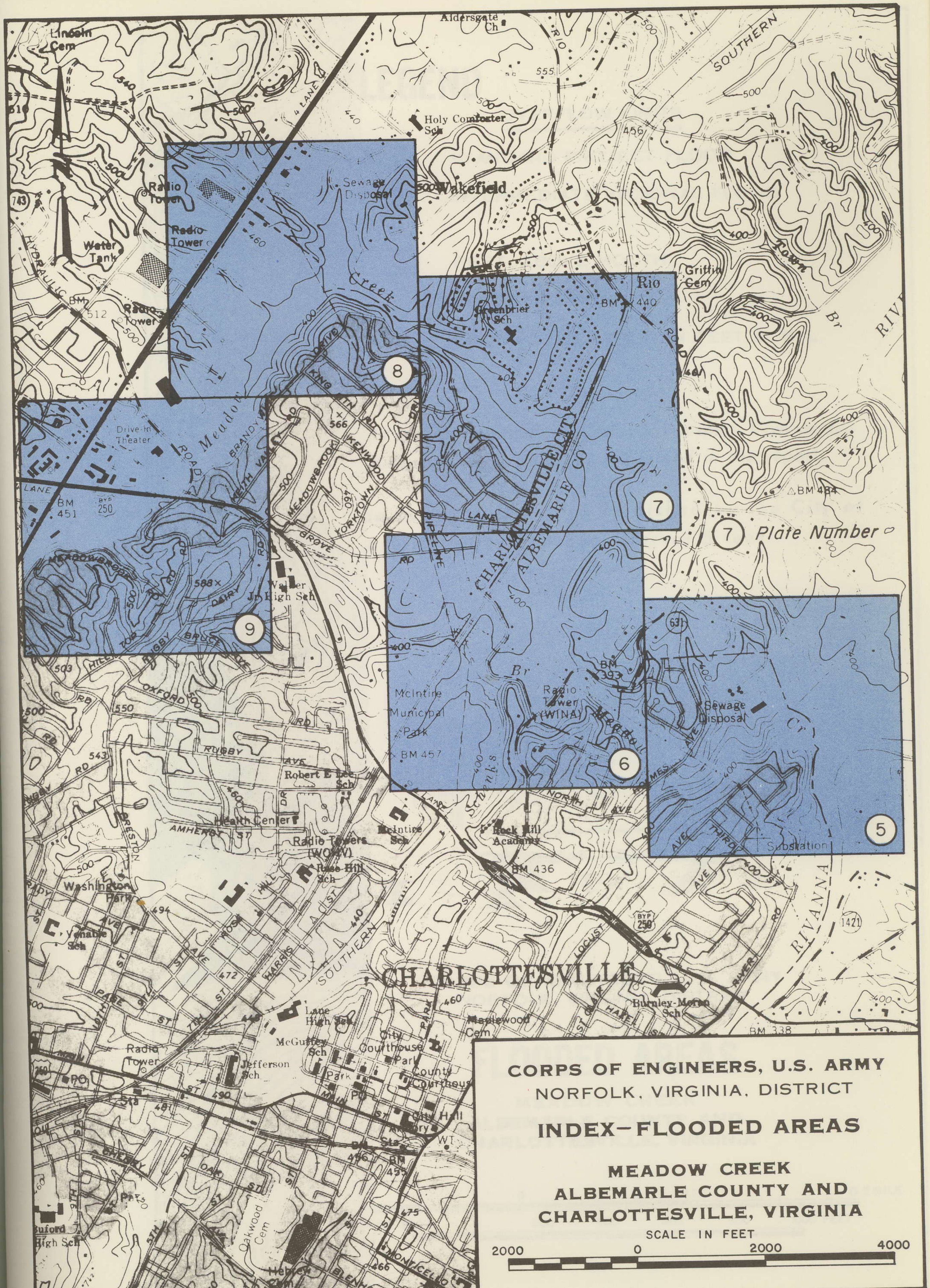
OTHER AGENCIES. Assistance and cooperation of the United States Weather Bureau, United States Geological Survey, Virginia Department of Highways, The Daily Progress, the City of Charlottesville, Albemarle County and private citizens in supplying useful data are appreciated.


CORPS OF ENGINEERS, U.S. ARMY
NORFOLK, VIRGINIA, DISTRICT
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ALBEMARLE COUNTY AND
CHARLOTTESVILLE, VIRGINIA
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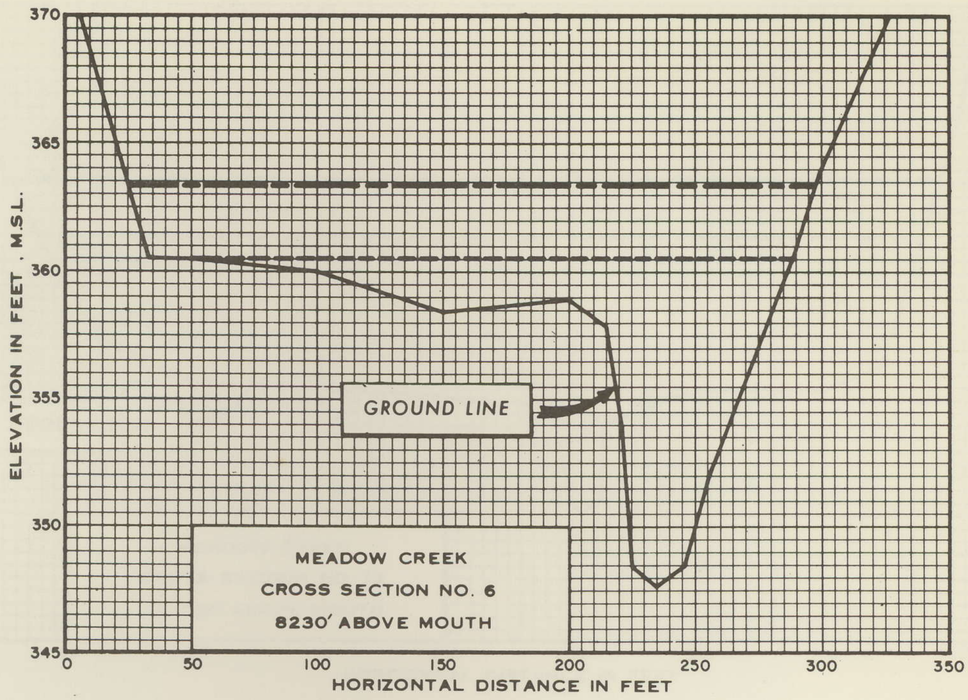
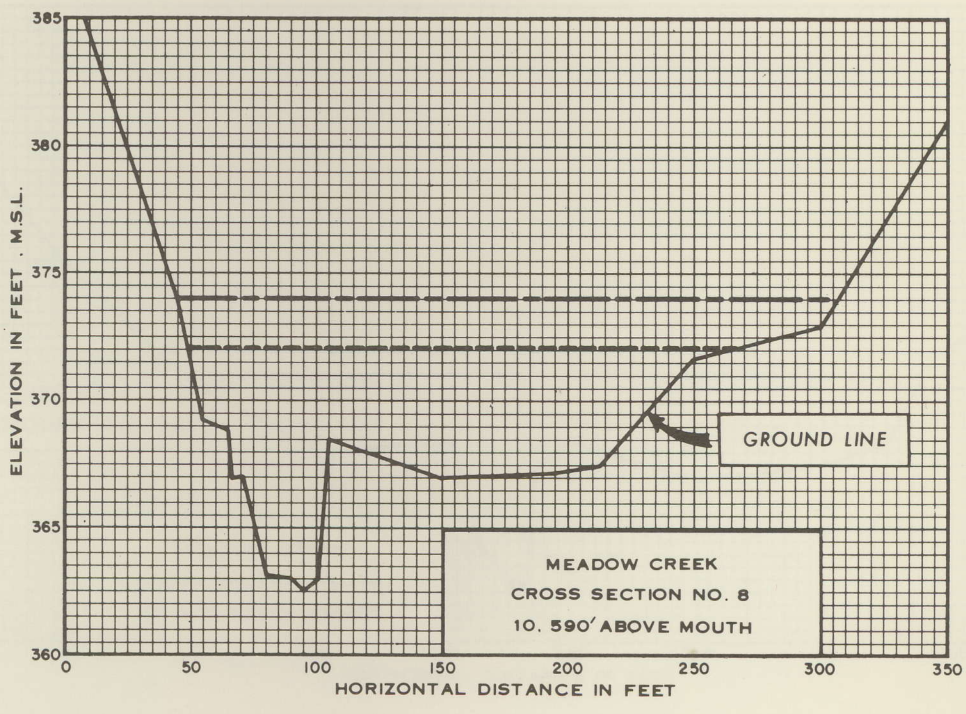
CHARLOTTESVILLE
Wakefield
Rio
Meadow Creek
McIntire Municipal Park
RIVANNA





LEGEND

— — — STANDARD PROJECT FLOOD

- - - - - - INTERMEDIATE REGIONAL FLOOD

SECTIONS TAKEN LOOKING DOWNSTREAM

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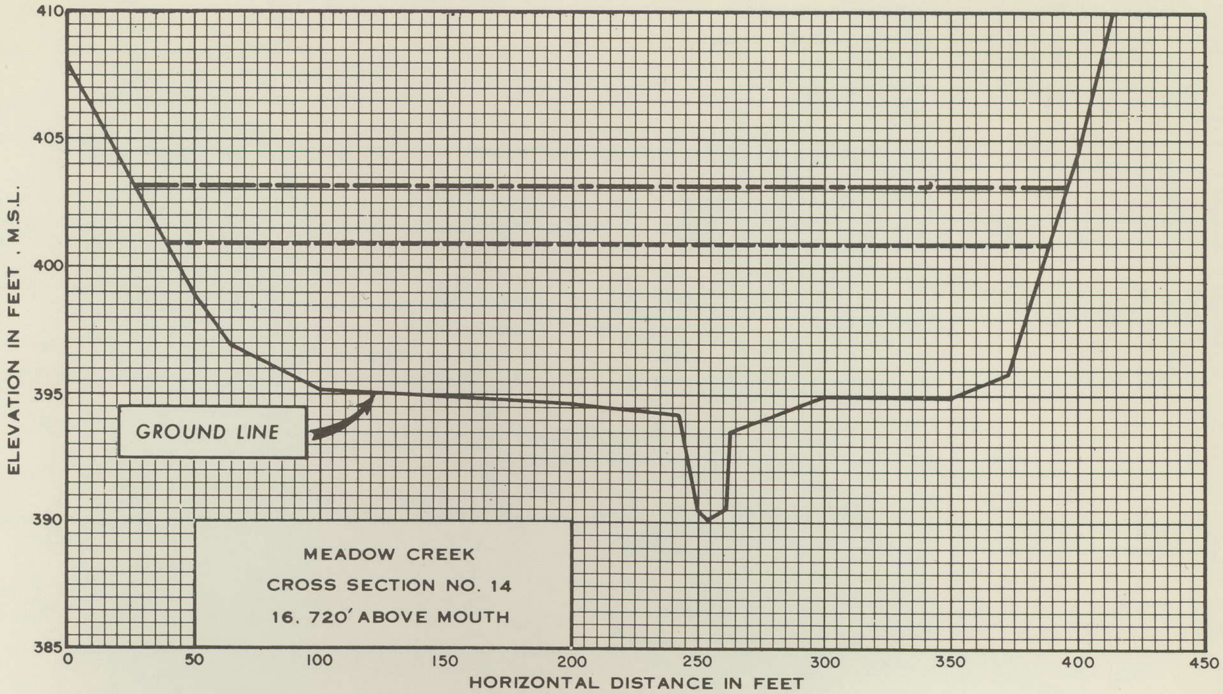
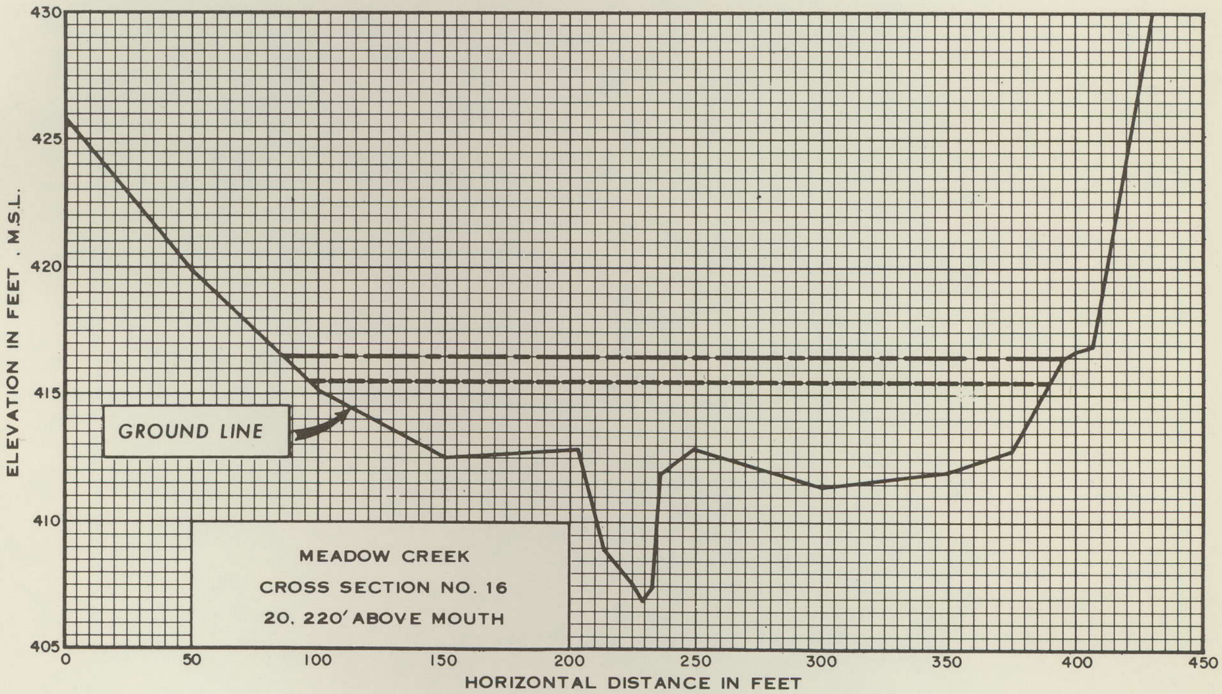
NORFOLK, VIRGINIA, DISTRICT

CROSS SECTIONS

MEADOW CREEK
ALBEMARLE COUNTY AND
CHARLOTTESVILLE, VIRGINIA





LEGEND

——— – ——— STANDARD PROJECT FLOOD

– – – – – – – INTERMEDIATE REGIONAL FLOOD

SECTIONS TAKEN LOOKING DOWNSTREAM

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CROSS SECTIONS

MEADOW CREEK
ALBEMARLE COUNTY AND
CHARLOTTESVILLE, VIRGINIA

U.S. ARMY CORPS OF ENGINEERS
NORFOLK DISTRICT

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