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**VA650.290 Purpose of Virginia Supplement**

The purpose of this supplement is to assist Area and Field staff in utilizing the most current rainfall data available, National Oceanic and Atmospheric Administration Atlas 14 (NOAA 14), for the design of conservation practices. This supplement updates the rainfall depths, rainfall distribution types, and soils to be used in estimating runoff and peak discharges as described in NEH Part 650, Engineering Field Handbook Chapter 2 (EFH-2). This supplement updates rainfall and soils databases that are used by the computer program, EFH-2. This supplement releases the statewide GIS shapefile for design rainfall data (depths and types).

This supplement describes the implementation process, the technical background, and gives an example application of the rainfall data in the computer program, EFH-2.

**VA650.291 Implementation of Virginia Supplement**

Effective upon receipt, NRCS Area and Field staff are to use the updated rainfall depths, rainfall distribution types, and soils when estimating runoff and peak discharges described in NEH 650, Chapter 2. The implementation is in three parts, (1) updating NEH 650, Chapter 2 for Virginia; (2) updating the databases for the EFH-2 computer program; and (3) providing a statewide GIS shapefile for design rainfall data on the Geodatabase server (F drive).

- (1) The methods and data described in this supplement supersede any applicable methods and data from NEH 650, Chapter 2 for Virginia. The design rainfall table in Appendix VA650.29-1 and rainfall maps in Appendix VA650.29-5 supersedes all rainfall data in NEH 650, Chapter 2 for Virginia. The design rainfall data in Appendix VA650.29- 1 will replace rainfall depths from Weather Bureau Technical Paper 40 (TP-40) and the 2008 Virginia Supplement to NEH 650, Chapter 2. The new rainfall distribution types (NOAA A, NOAA B, NOAA C, NOAA D, and DMV C) in Appendix VA650.29- 1 will replace the standard NRCS rainfall types Type II and Type III.
- (2) This supplement will be implemented by replacing the rainfall database (**COUNTY.VA**), rainfall distribution types (**type.rf**), and hydrologic soil group database (**SOILS. HG**) used with the EFH-2 computer program. An example application of the EFH-2 Computer Program in Virginia specific example is included in Appendix VA650.29- 2. The procedure for loading the updated rainfall and soils databases is presented in Appendix VA650.29- 2.
- (3) This supplement releases the statewide GIS shapefiles for design rainfall data (depths and types). The statewide GIS shapefiles are located on the Geodatabase server (F drive).

**VA650.292 Technical Background**

NOAA completed Volume 2 of Atlas 14 (NOAA 14) precipitation-frequency analysis in 2004. This is the first comprehensive precipitation-frequency analysis for the Ohio Valley and neighboring states since TP-

40 was completed in 1961. NOAA used periods of record for rainfall stations up through December 2000 to compute precipitation-duration-frequency values. The period of record for TP-40 ended in 1958. This additional 42 years of data gives different frequency-duration rainfall values than TP-40. These values were updated in 2008 and again in 2012 for Virginia.

### (a) Rainfall Depth

Representative county values for the 24-hour rainfall depths are presented in Appendix VA650.29- 1 of this Supplement. The rainfall depths are incorporated into the rainfall database for use with the EFH-2 computer program (**COUNTY.VA**).

The representative county values were determined from the NOAA 14 GIS grid. The location of the representative county value is near the mean of the 100-year 24-hour rainfall for the county or rainfall zone (explained below). If a more precise rainfall estimate is desired, site specific data may be downloaded from the NOAA 14 website. Data are available for specific locations from an interactive web site (<http://hdsc.nws.noaa.gov/hdsc/pfds/>).

### (b) Rainfall Zones

Rainfall in NOAA Atlas 14 can be highly variable even on a county basis, particularly in the Appalachian Mountains and Blue Ridge regions where orographic effects are present. For example, the Rockingham County 100-year 24-hour storm ranges from 6.07 inches to 10.48 inches. When the 100-year 24 hour rainfalls ranged more than 1.5 inches within a county, the county was split into rainfall zones. Fifteen counties are split into zones where two or more rainfall values are designated. Federal land, such as National Forests and National Parks, were excluded from the analysis. Appendix VA650.29- 5 of this Supplement contains county maps that designate the boundaries of the zones.

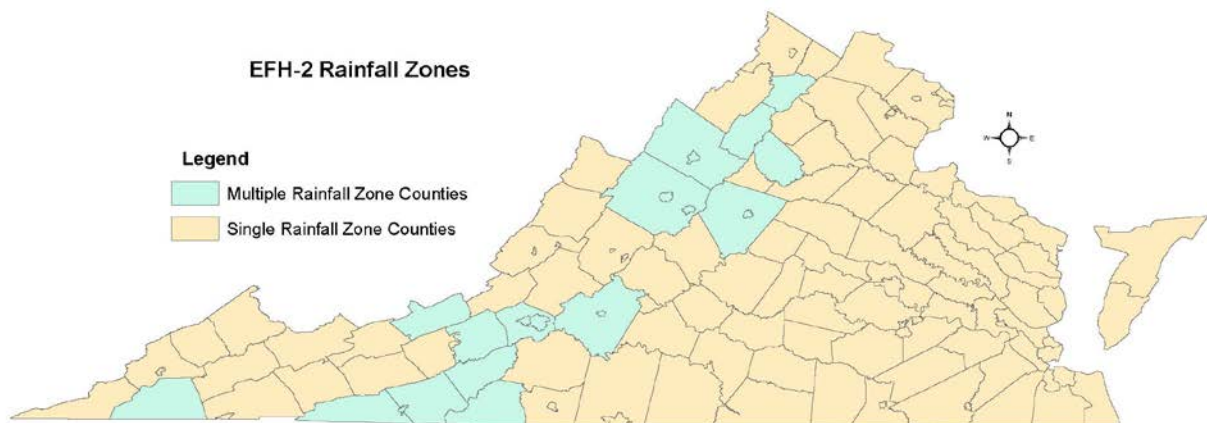


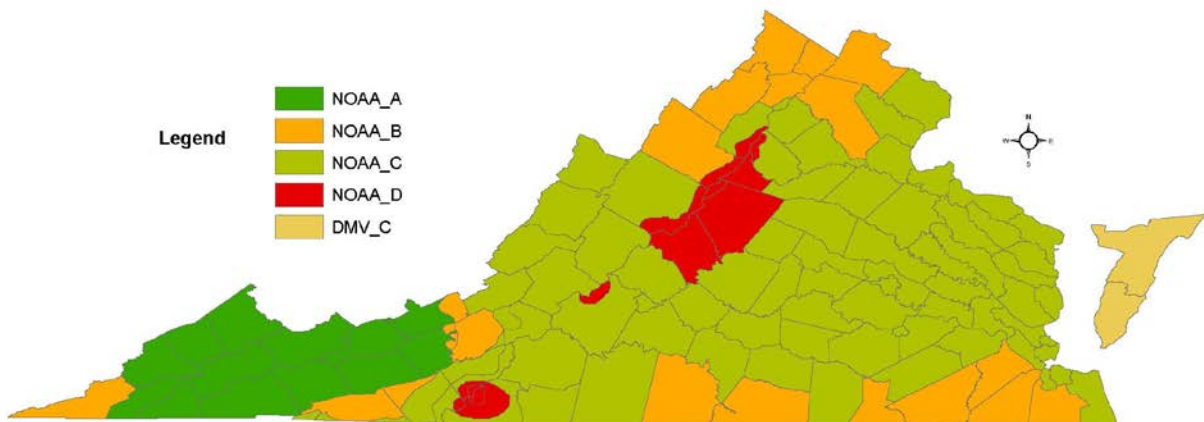
Figure VA2-1: EFH-2 Rainfall Zones for Virginia

**(c) Rainfall Distribution Types**

Four new rainfall distribution types (NOAA A, NOAA B, NOAA C, and NOAA D) were developed from the NOAA 14 data for the standard SCS unit hydrograph (dimensionless unit hydrograph peak factor of 484). Also the new rainfall type (DMV C) was developed for the Eastern Shore, part of the Delmarva Peninsula. Rainfall-runoff events on the Eastern Shore are better described by the DelMarVa unit hydrograph (dimensionless unit hydrograph peak factor of 284).

These new rainfall types replace the NRCS Type II and III in EFH-2 for Virginia. The Type II and III should no longer be used unless an old model needs to be recreated. Figure 2 displays appropriate rainfall distribution types to use per county and rainfall zone. The rainfall distribution type for each county and rainfall zone is presented in the table in Appendix VA650.29- 1 and the maps in Appendix VA650.29- 5 of this Supplement. The rainfall distribution type is developed for use with the EFH-2 computer program (**type.rf**).

The EFH-2 computer program is unable to use site specific rainfall types. Instead, EFH-2 uses equations to produce the unit peak discharge (cubic feet per second per inch of runoff per square mile of drainage area) from the time of concentration and excess runoff volume. The coefficients for these equations were developed for the five new rainfall types (NOAA A, NOAA B, NOAA C, NOAA D, and DMV C) from the NOAA 14 data. The equations, coefficients and plots for the five NOAA 14 rainfall distribution types are included in the **type.RF** file and described in this Supplement, Appendix VA650.29- 4.



**Figure VA2-2: EFH-2 Rainfall Distribution Types for Virginia**

**Appendix VA650.29-1. Rainfall Values and Distribution Types for each County and Rainfall Zone**

Notes: Rainfall distribution type for each county and rainfall zone is shown with the county name (NOAA A, NOAA B, NOAA C, NOAA D, and DMV C). The 24-hour rainfall duration values are in units of inches.

County / Rainfall Zone	Rainfall Type	1-year	2-year	5-year	10-year	25-year	50-year	100-year
Accomack	DMV C	2.7	3.3	4.2	5.1	6.4	7.5	8.8
Albemarle ZONE-1	NOAA D	3.4	4.1	5.2	6.2	7.6	8.7	10.1
Albemarle ZONE-2	NOAA D	3	3.6	4.6	5.5	6.7	7.8	9
Alleghany	NOAA C	2.4	2.8	3.6	4.2	5	5.8	6.5
Amelia	NOAA C	2.7	3.3	4.2	5	6.1	7.1	8.2
Amherst	NOAA C	2.8	3.4	4.4	5.1	6.3	7.2	8.3
Appomattox	NOAA C	2.8	3.4	4.4	5.2	6.4	7.4	8.5
Augusta ZONE-1	NOAA C	2.4	3	3.7	4.4	5.3	6.1	6.9
Augusta ZONE-2	NOAA D	2.8	3.4	4.3	5.1	6.2	7.1	8.1
Bath NOAA-C	NOAA C	2.5	3	3.7	4.4	5.3	6	6.8
Bedford ZONE-1	NOAA D	3.1	3.8	4.8	5.7	7	8.1	9.3
Bedford ZONE-2	NOAA C	2.8	3.3	4.3	5	6.2	7.1	8.2
Bland	NOAA A	2.2	2.6	3.2	3.6	4.2	4.7	5.2
Botetourt	NOAA C	2.6	3.2	4.1	4.8	5.8	6.7	7.6
Brunswick	NOAA C	2.8	3.4	4.4	5.2	6.3	7.3	8.3
Buchanan	NOAA A	2.2	2.6	3.2	3.7	4.3	4.9	5.5
Buckingham	NOAA C	2.8	3.4	4.3	5.1	6.3	7.3	8.4
Campbell	NOAA C	2.7	3.3	4.3	5	6.2	7.2	8.3
Caroline	NOAA C	2.7	3.3	4.2	5	6.3	7.3	8.6
Carroll ZONE-1	NOAA B	2.3	2.7	3.4	4	4.8	5.5	6.1
Carroll ZONE-2	NOAA C	2.6	3.2	4	4.7	5.6	6.4	7.2
Carroll ZONE-3	NOAA C	3	3.6	4.6	5.3	6.5	7.5	8.5
Carroll ZONE-4	NOAA D	3.4	4.1	5.2	6.1	7.5	8.6	9.9
Charles City	NOAA C	2.8	3.4	4.4	5.2	6.5	7.6	8.8
Charlotte	NOAA C	2.7	3.3	4.2	5	6.1	7.1	8.1
Chesapeake City	NOAA B	3	3.7	4.8	5.7	7	8.2	9.4
Chesterfield	NOAA C	2.8	3.4	4.3	5.1	6.3	7.3	8.4
Clarke	NOAA B	2.4	2.9	3.6	4.3	5.2	5.9	6.8
Craig	NOAA C	2.4	2.9	3.6	4.2	5.1	5.9	6.6
Culpeper	NOAA C	2.7	3.3	4.2	5	6.2	7.2	8.4
Cumberland	NOAA C	2.7	3.3	4.2	5	6.1	7.1	8.1
Dickenson	NOAA A	2.2	2.6	3.2	3.7	4.4	5	5.7
Dinwiddie	NOAA C	2.8	3.4	4.4	5.2	6.3	7.3	8.4
Essex	NOAA C	2.7	3.2	4.2	5	6.3	7.4	8.6
Fairfax	NOAA C	2.6	3.1	4	4.8	6	7	8.2
Fauquier	NOAA B	2.6	3.2	4	4.8	5.9	6.9	8
Floyd ZONE-1	NOAA C	2.5	3.1	3.9	4.6	5.6	6.4	7.3
Floyd ZONE-2	NOAA C	2.9	3.5	4.4	5.2	6.4	7.4	8.4
Floyd ZONE-3	NOAA D	3.4	4.1	5.3	6.2	7.6	8.8	10.2
Floyd ZONE-4	NOAA D	3.8	4.6	5.9	7	8.6	10	11.5
Fluvanna	NOAA C	2.7	3.3	4.2	4.9	6	7	8.1
Franklin	NOAA C	2.8	3.4	4.4	5.2	6.3	7.3	8.4
Frederick	NOAA B	2.4	2.8	3.5	4.1	5	5.7	6.5
Giles ZONE- 1	NOAA A	2.1	2.5	3.1	3.6	4.3	4.9	5.5
Giles ZONE- 2	NOAA B	2.3	2.8	3.5	4.1	4.9	5.6	6.4
Gloucester	NOAA C	2.9	3.5	4.5	5.4	6.7	7.9	9.2
Goochland	NOAA C	2.7	3.3	4.2	5	6.1	7.1	8.2
Grayson ZONE-1	NOAA C	3.3	3.9	4.9	5.7	6.8	7.7	8.7

County / Rainfall Zone	Rainfall Type	1-year	2-year	5-year	10-year	25-year	50-year	100-year
Grayson ZONE-2	NOAA B	2.4	2.9	3.6	4.1	4.9	5.6	6.2
Grayson ZONE-3	NOAA C	2.7	3.2	4.1	4.7	5.7	6.5	7.3
Greene	NOAA D	3	3.7	4.7	5.5	6.7	7.8	8.9
Greensville	NOAA B	2.7	3.3	4.2	5	6.2	7.2	8.3
Halifax	NOAA B	2.7	3.3	4.1	4.9	6	6.9	7.9
Hampton City	NOAA C	2.9	3.6	4.6	5.5	6.9	8.1	9.3
Hanover	NOAA C	2.7	3.3	4.2	5	6.2	7.3	8.4
Henrico	NOAA C	2.7	3.3	4.3	5.1	6.3	7.3	8.4
Henry	NOAA C	2.9	3.5	4.5	5.3	6.5	7.5	8.7
Highland	NOAA C	2.4	2.9	3.6	4.2	5	5.7	6.4
Isle of Wight	NOAA B	3	3.6	4.7	5.5	6.8	8	9.2
James City	NOAA C	2.9	3.5	4.6	5.5	6.8	7.9	9.2
King and Queen	NOAA C	2.7	3.3	4.3	5.1	6.4	7.5	8.7
King George	NOAA C	2.6	3.2	4.1	5	6.2	7.3	8.5
King William	NOAA C	2.7	3.3	4.2	5.1	6.3	7.4	8.6
Lancaster	NOAA C	2.7	3.3	4.3	5.2	6.5	7.6	8.9
Lee	NOAA B	2.5	3	3.7	4.2	5	5.7	6.3
Loudon	NOAA B	2.6	3.1	4	4.7	5.7	6.7	7.7
Louisa	NOAA C	2.7	3.3	4.2	5	6.2	7.2	8.3
Lunenburg	NOAA C	2.7	3.3	4.2	5	6.1	7.1	8.2
Lynchburg City	NOAA C	2.8	3.3	4.3	5	6.2	7.2	8.2
Madison ZONE-1	NOAA D	3.4	4.1	5.2	6.1	7.5	8.7	9.9
Madison ZONE-2	NOAA C	2.9	3.5	4.4	5.3	6.5	7.5	8.6
Mathews	NOAA C	2.8	3.4	4.5	5.4	6.7	7.9	9.2
Mecklenburg	NOAA B	2.7	3.2	4.1	4.9	5.9	6.8	7.8
Middlesex	NOAA C	2.8	3.4	4.4	5.3	6.6	7.7	9
Montgomery ZONE-1	NOAA B	2	2.4	3.1	3.6	4.3	5	5.6
Montgomery ZONE-2	NOAA B	2.3	2.7	3.5	4.1	5	5.7	6.5
Montgomery ZONE-3	NOAA C	2.6	3.2	4	4.7	5.8	6.6	7.6
Nelson	NOAA D	3	3.6	4.6	5.5	6.7	7.7	8.8
New Kent	NOAA C	2.8	3.4	4.4	5.2	6.4	7.5	8.7
Newport News City	NOAA C	2.9	3.6	4.6	5.5	6.9	8	9.3
Norfolk City	NOAA C	2.9	3.6	4.6	5.5	6.8	8	9.2
Northampton	DMV C	2.7	3.3	4.3	5.2	6.5	7.6	8.9
Northumberland	NOAA C	2.7	3.3	4.3	5.1	6.4	7.5	8.8
Nottoway	NOAA C	2.7	3.3	4.2	5	6.2	7.1	8.2
Orange	NOAA C	2.8	3.3	4.3	5.1	6.3	7.3	8.5
Page ZONE-1	NOAA C	2.4	2.9	3.7	4.4	5.3	6.1	6.9
Page ZONE-2	NOAA D	3	3.6	4.6	5.4	6.6	7.6	8.7
Patrick ZONE-1	NOAA D	3.8	4.6	5.9	7	8.6	9.9	11.5
Patrick ZONE-2	NOAA D	3.3	4	5.2	6.1	7.5	8.7	10
Patrick ZONE-3	NOAA C	3	3.7	4.7	5.6	6.8	7.9	9.1
Petersburg City	NOAA C	2.8	3.4	4.4	5.2	6.3	7.4	8.5
Pittsylvania	NOAA C	2.8	3.4	4.3	5.1	6.2	7.2	8.2
Poquoson City	NOAA C	2.9	3.6	4.6	5.5	6.9	8	9.4
Portsmouth City	NOAA C	3	3.6	4.7	5.6	6.9	8	9.3
Powhatan	NOAA C	2.7	3.3	4.2	5	6.1	7.1	8.2
Prince Edward	NOAA C	2.7	3.3	4.3	5	6.2	7.2	8.3

County / Rainfall Zone	Rainfall Type	1-year	2-year	5-year	10-year	25-year	50-year	100-year
Prince George	NOAA C	2.8	3.4	4.4	5.2	6.4	7.5	8.6
Prince William	NOAA C	2.5	3	3.9	4.7	5.8	6.9	8
Pulaski	NOAA A	2	2.4	3.1	3.6	4.3	5	5.6
Rappahannock	NOAA C	2.8	3.4	4.3	5	6.2	7.1	8.2
Richmond City	NOAA C	2.8	3.4	4.3	5.1	6.3	7.3	8.4
Richmond	NOAA C	2.7	3.3	4.3	5.1	6.4	7.5	8.8
Roanoke ZONE-1	NOAA C	2.4	2.9	3.6	4.2	5.2	5.9	6.7
Roanoke ZONE-2	NOAA C	2.6	3.2	4	4.7	5.7	6.6	7.5
Rockbridge	NOAA C	2.5	3	3.9	4.5	5.5	6.3	7.2
Rockingham ZONE-1	NOAA B	2.3	2.8	3.5	4.1	4.9	5.6	6.4
Rockingham ZONE-2	NOAA D	2.9	3.4	4.4	5.1	6.2	7.1	8.1
Russell	NOAA A	2.2	2.6	3.2	3.6	4.3	4.8	5.4
Scott ZONE-1	NOAA A	2.4	2.8	3.4	3.9	4.6	5.2	5.8
Scott ZONE-2	NOAA A	2.3	2.7	3.2	3.6	4.2	4.6	5
Shenandoah	NOAA B	2.3	2.8	3.5	4.1	5	5.7	6.5
Smyth	NOAA A	2.3	2.7	3.2	3.7	4.2	4.7	5.1
Southampton	NOAA B	2.9	3.5	4.5	5.4	6.6	7.7	8.8
Spotsylvania	NOAA C	2.7	3.2	4.2	4.9	6.1	7.2	8.4
Stafford	NOAA C	2.6	3.1	4	4.8	6	7	8.2
Suffolk City	NOAA B	3	3.6	4.7	5.6	6.9	8	9.3
Surry	NOAA C	2.9	3.5	4.6	5.4	6.7	7.8	9
Sussex	NOAA C	2.9	3.5	4.5	5.3	6.5	7.5	8.6
Tazewell	NOAA A	2.1	2.5	3	3.5	4.1	4.6	5.1
Virginia Beach City	NOAA C	3	3.7	4.7	5.7	7	8.2	9.4
Warren ZONE-1	NOAA B	2.5	3	3.8	4.4	5.4	6.2	7.1
Warren ZONE-2	NOAA C	2.8	3.4	4.3	5.1	6.2	7.2	8.3
Washington	NOAA A	2.2	2.6	3.1	3.5	4	4.4	4.8
Westmoreland	NOAA C	2.7	3.2	4.2	5	6.3	7.4	8.7
Wise	NOAA A	2.3	2.7	3.3	3.8	4.6	5.2	5.9
Wythe	NOAA A	2.1	2.5	3.1	3.6	4.2	4.7	5.3
York	NOAA C	2.9	3.6	4.6	5.5	6.8	8	9.3

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**Appendix VA650.29-2. Instructions for Incorporating Updated Rainfall and Soils Databases into EFH-2 Computer Program in Virginia**

EFH-2 Runoff and Peak Discharge software requires a rainfall database (**COUNTY.VA**), rainfall distribution types (**type.rf**), and hydrologic soil group database (**SOILS. HG**). These databases are available on the Virginia NRCS Sharepoint Engineering site and will replace the TP40 based databases. The following describes the steps to use the current databases with the EFH-2 computer program.

1. Navigate to the EFH-2 Software Updates section of the Virginia NRCS Sharepoint Engineering site. <https://nrcs.sc.egov.usda.gov/east/va/default.aspx>. (Virginia > Engineering > Design Aids > Hydrology > EFH2 Software Updates)
2. Individually, save "**COUNTY.VA**", "**type.rf**", and "**SOILS. HG**" into C:\Program Files\USDA\EFH2 on your computer. This will replace the existing TP40 based data file. The EFH-2 software now has the NOAA 14 rainfall depths, rainfall distribution types, and Hydrologic Soil Group database for Virginia.
3. Within the EFH-2 computer program, type "VA" for the state under the Basic Data tab to see every county, city and rainfall zone in Virginia. Appendix VA650.29- 3 provides an example application of the Virginia rainfall data in EFH-2 software.
4. Within the EFH-2 computer program, click on the HSG button while within the RCN tab of the software, and a window will pop up with "Soil Name" "Surface Texture" and "Hydrologic Group". This database can be used in lieu of Table 2.1 Hydrologic soil groups for U.S. soil in the Engineering Field Handbook, Chapter 2.

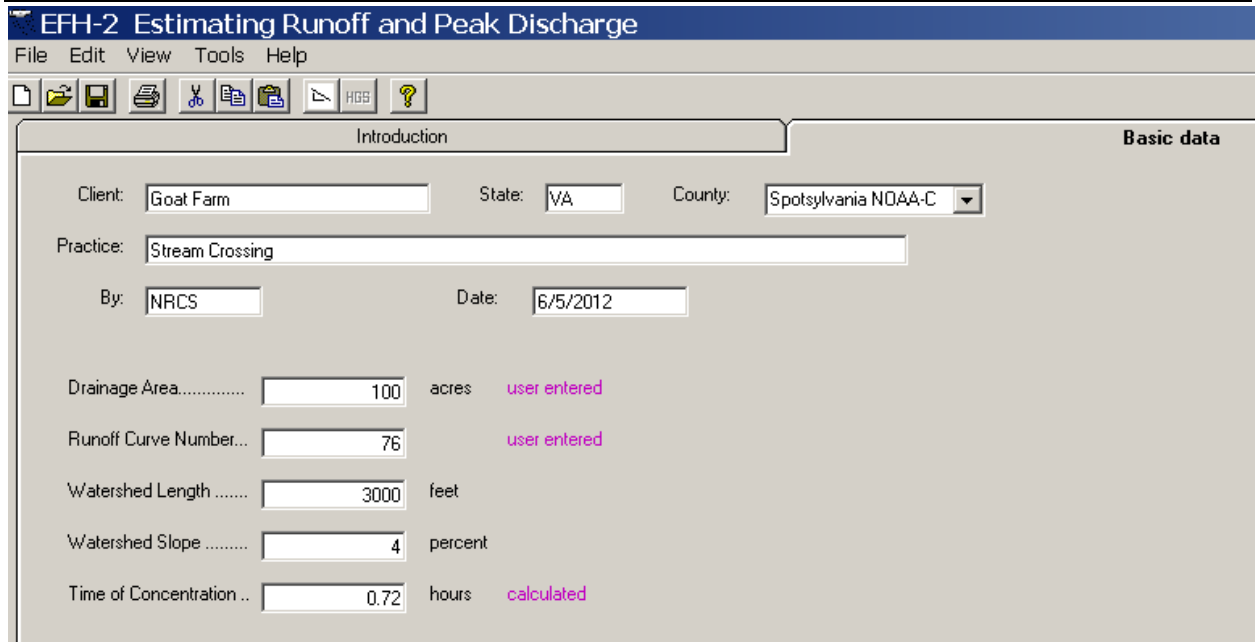
**Appendix VA650.29 -3. Example Application of the EFH-2 Computer Program in Virginia**

For this example, a small watershed in Spotsylvania County is selected. The drainage area is 100 acres, the curve number is 76, watershed length is 3000 feet, and average watershed slope is 4 percent. From the rainfall distribution map above, the rainfall distribution region is “C”.

1. Open the EFH-2 computer program and open the Basic Data tab. Enter State: VA and use the pull-down menu to select Spotsylvania County. The name “NOAA C” next to the county name designates this county is in NOAA Rainfall Distribution Type C region.

2. Enter the remaining data on this window (curve number, watershed length and watershed slope). The Drainage Area and Runoff Curve Number could alternatively be entered by opening the RCN tab (far right side of Basic data window).





**EFH-2 Estimating Runoff and Peak Discharge**  
File Edit View Tools Help

Introduction Basic data

Client:  State:  County:

Practice:

By:  Date:

Drainage Area.....  acres user entered

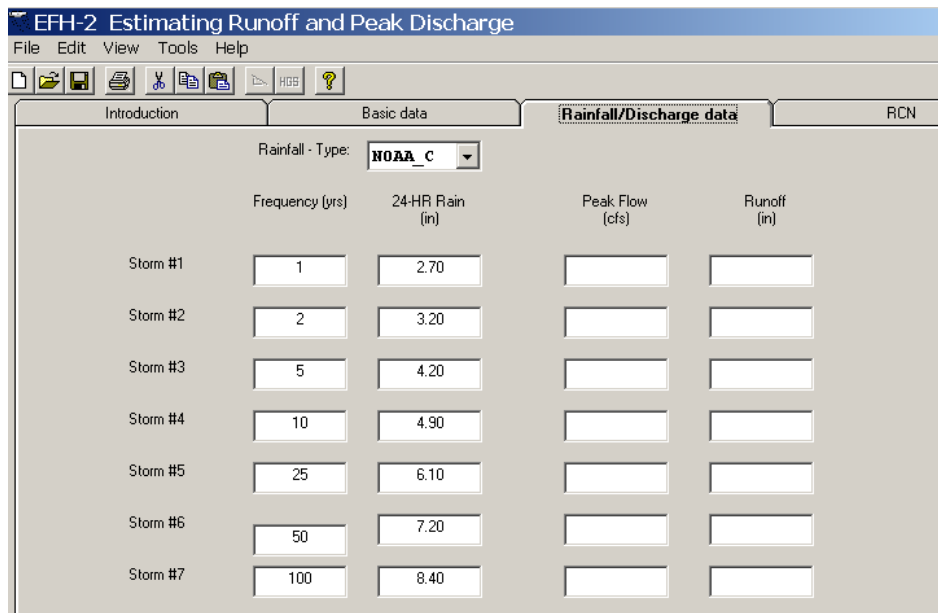
Runoff Curve Number...  user entered

Watershed Length .....  feet

Watershed Slope .....  percent

Time of Concentration ..  hours calculated

- Open the Rainfall/Discharge data tab. The 24-hour rainfall data for Spotsylvania County has automatically been entered. At this point you may replace these county values with site specific data from <http://hdsc.nws.noaa.gov/hdsc/pfds/> if desired. Use the Rainfall Type pull-down menu to select NOAA\_C.



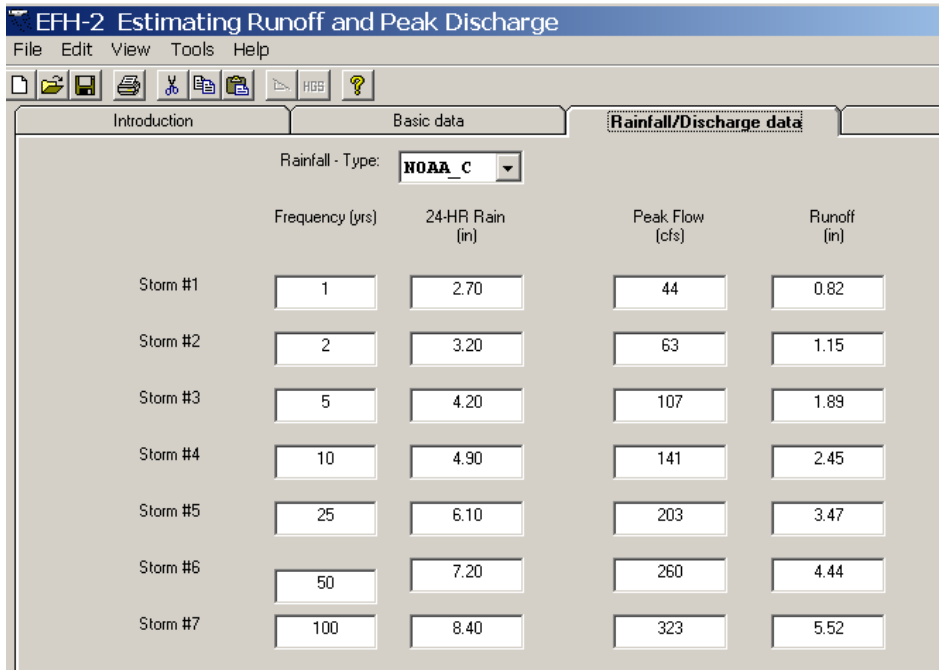
**EFH-2 Estimating Runoff and Peak Discharge**  
File Edit View Tools Help

Introduction Basic data **Rainfall/Discharge data** RCN

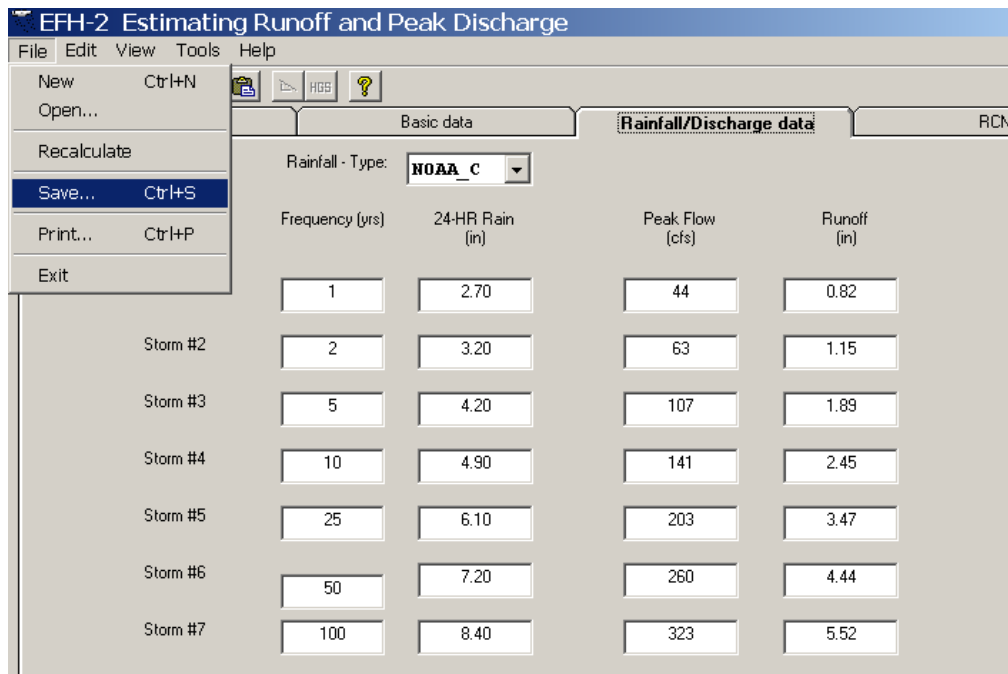
Rainfall - Type:

	Frequency (yrs)	24-HR Rain (in)	Peak Flow (cfs)	Runoff (in)
Storm #1	<input type="text" value="1"/>	<input type="text" value="2.70"/>	<input type="text"/>	<input type="text"/>
Storm #2	<input type="text" value="2"/>	<input type="text" value="3.20"/>	<input type="text"/>	<input type="text"/>
Storm #3	<input type="text" value="5"/>	<input type="text" value="4.20"/>	<input type="text"/>	<input type="text"/>
Storm #4	<input type="text" value="10"/>	<input type="text" value="4.90"/>	<input type="text"/>	<input type="text"/>
Storm #5	<input type="text" value="25"/>	<input type="text" value="6.10"/>	<input type="text"/>	<input type="text"/>
Storm #6	<input type="text" value="50"/>	<input type="text" value="7.20"/>	<input type="text"/>	<input type="text"/>
Storm #7	<input type="text" value="100"/>	<input type="text" value="8.40"/>	<input type="text"/>	<input type="text"/>

- Upon choosing the rainfall type, the peak discharges and runoff depths are calculated.



- To complete the project, click File and Save. Print output if desired. Close EFH-2.



**Appendix VA650.29-4. Rainfall Distribution Type Equations, Peak Discharge Curves and Peak Discharge Equation Coefficients**

Since the EFH-2 computer program cannot use actual rainfall distribution types, alternative methods of estimating peak discharges are needed as described below. Also, since NRCS Type II does not match the NOAA 14 data, new distribution types and peak flow coefficients were also created.

Extents of Rainfall Distribution Types

Five rainfall distribution types (NOAA A, NOAA B, NOAA C, NOAA D, and DMV C) were developed from the NOAA 14 data to replace the NRCS Type-II rainfall distribution and EFH-2 coefficients. The four rainfall distribution types were developed for the NOAA Atlas 14 Volume 2 region which includes 13 states from New Jersey west to Illinois and southeast to South Carolina. The extent of each region was based on the 60-minute/24-hour ratio of the 25-year NOAA 14 data. The thresholds for the 5 regions are as follows.

- A > 0.48
- B 0.43 to 0.48
- C 0.38 to 0.43
- D < 0.38

Peak Equation Coefficients

Rainfall distributions were created for each region and used in WinTR20 models to develop peak flow equation coefficients for use in EFH-2 computer program. To simplify the estimation of peak discharge, WinTR-20 was run for times of concentration of 0.1 to 10.0 hours and  $I_a/P$  ratios of 0.1, 0.25, 0.3, 0.4 and 0.5.  $I_a$  is initial abstraction in units of inches. Initial abstraction includes all losses before runoff begins (interception, depression storage, early storm infiltration, etc).  $P$  is the storm rainfall with units of inches and CN = NRCS runoff curve number.

$$I_a = 0.2 * ((1000 / CN) - 10) \quad \text{Eq. VA2-1}$$

Equations to relate time of concentration to unit peak discharge were then developed. The equation used to compute the unit peak discharge ( $q$ ) for the EFH-2 computer program is:

$$q = 10 ^ { (\text{Coeff}_1 + \text{Coeff}_2 * \text{LOG}(T_c) + \text{Coeff}_3 * (\text{LOG}(T_c))^2) } \quad \text{Eq. VA2-2}$$

The coefficients to be used with each rainfall distribution are tabulated below. For example, the equation applicable to the Region C rainfall distribution region of Virginia and  $I_a/P$  ratio of 0.1 is:

$$q = 10 ^ { (2.4928 - 0.585 * \text{LOG}(T_c) - 0.137 * (\text{LOG}(T_c))^2) } \quad \text{Eq. VA2-3}$$

For a time of concentration of 0.5 hours and  $I_a/P$  ratio of 0.1, the unit peak discharge is  $q = 453.41$  cfs / inch / sq mile. If the drainage area is 200 acres (0.31 square miles) and there is 1.5 inches of runoff, the peak discharge,  $Q$ , is:

$$Q = 453.41 * 0.31 * 1.5 = 210 \text{ cfs}$$

Eq. VA2-4

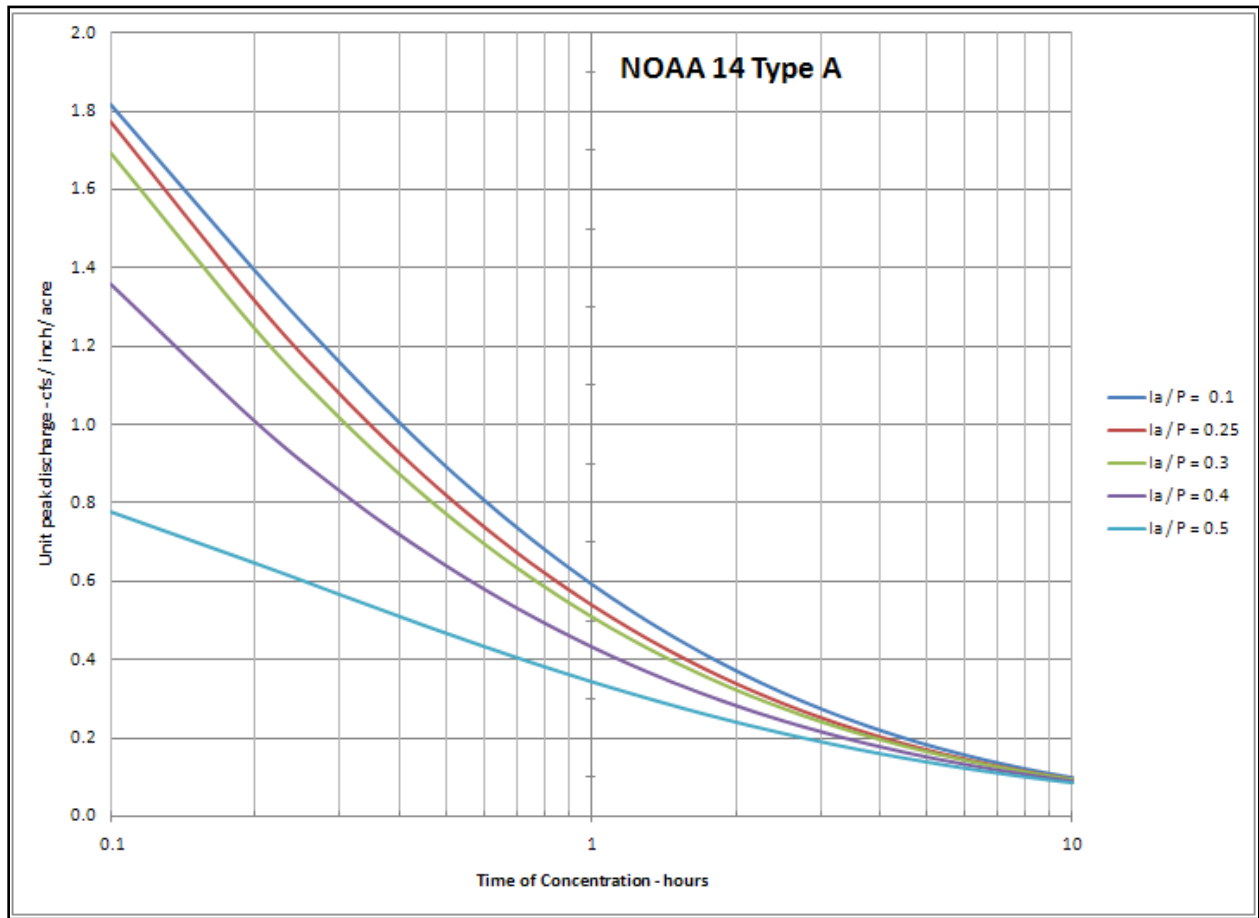


Figure A4-1, EFH-2 Peak Discharge Curves for NOAA-A

Table A4-1, EFH-2 Peak Discharge Equation Coefficients for NOAA-A

$I_a/P$	Coeff_1	Coeff_2	Coeff_3
0.1	2.5796	-0.6312	-0.1451
0.25	2.539	-0.6368	-0.1203
0.3	2.5126	-0.6315	-0.1087
0.4	2.4423	-0.5887	-0.0921
0.5	2.3435	-0.4789	-0.1246

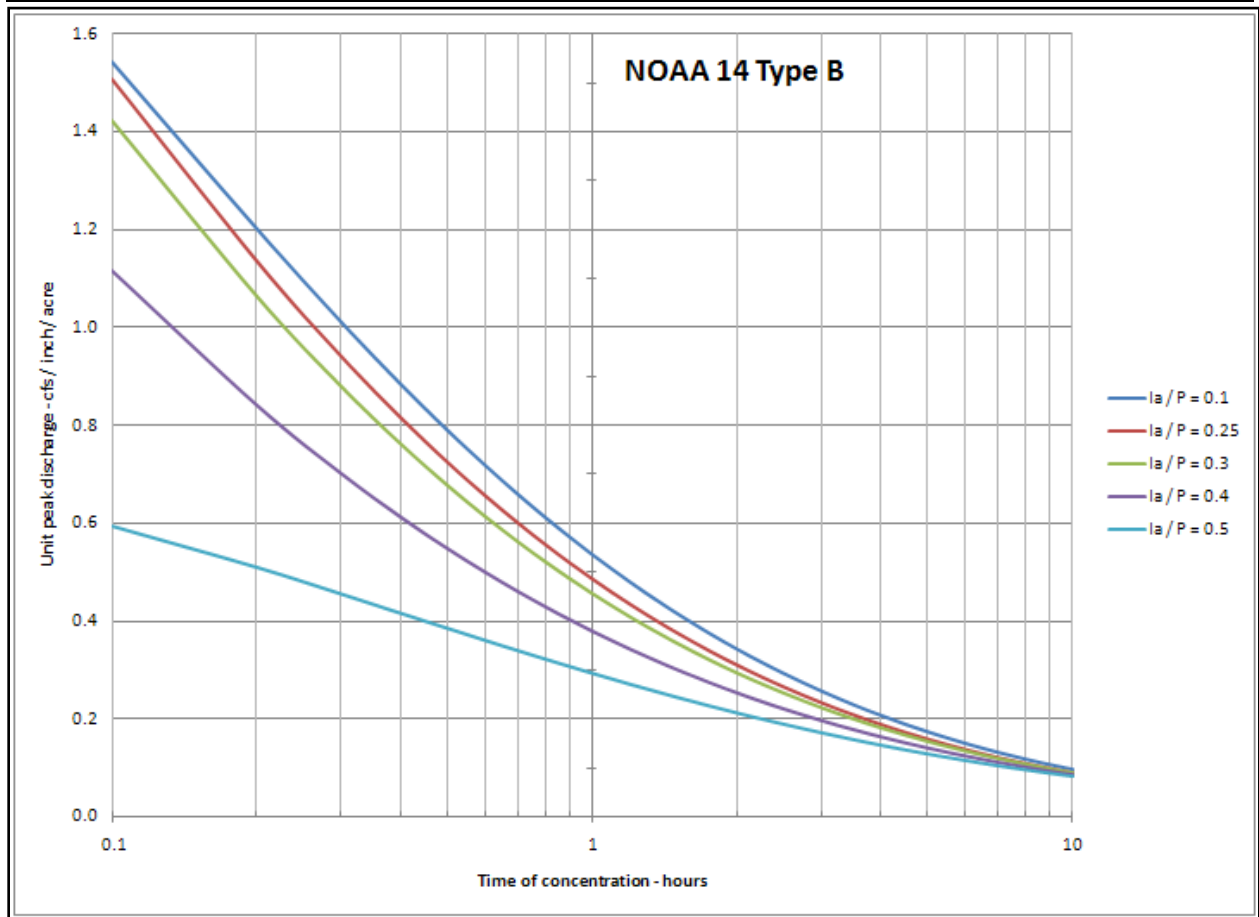


Figure A4-2, EFH-2 Peak Discharge Curves for NOAA-B

Table A4-2, EFH-2 Peak Discharge Equation Coefficients for NOAA-B

$I_a/P$	Coeff_1	Coeff_2	Coeff_3
0.1	2.5352	-0.603	-0.1433
0.25	2.4928	-0.6109	-0.1197
0.3	2.4646	-0.6035	-0.1085
0.4	2.3852	-0.5578	-0.0886
0.5	2.2713	-0.4318	-0.124

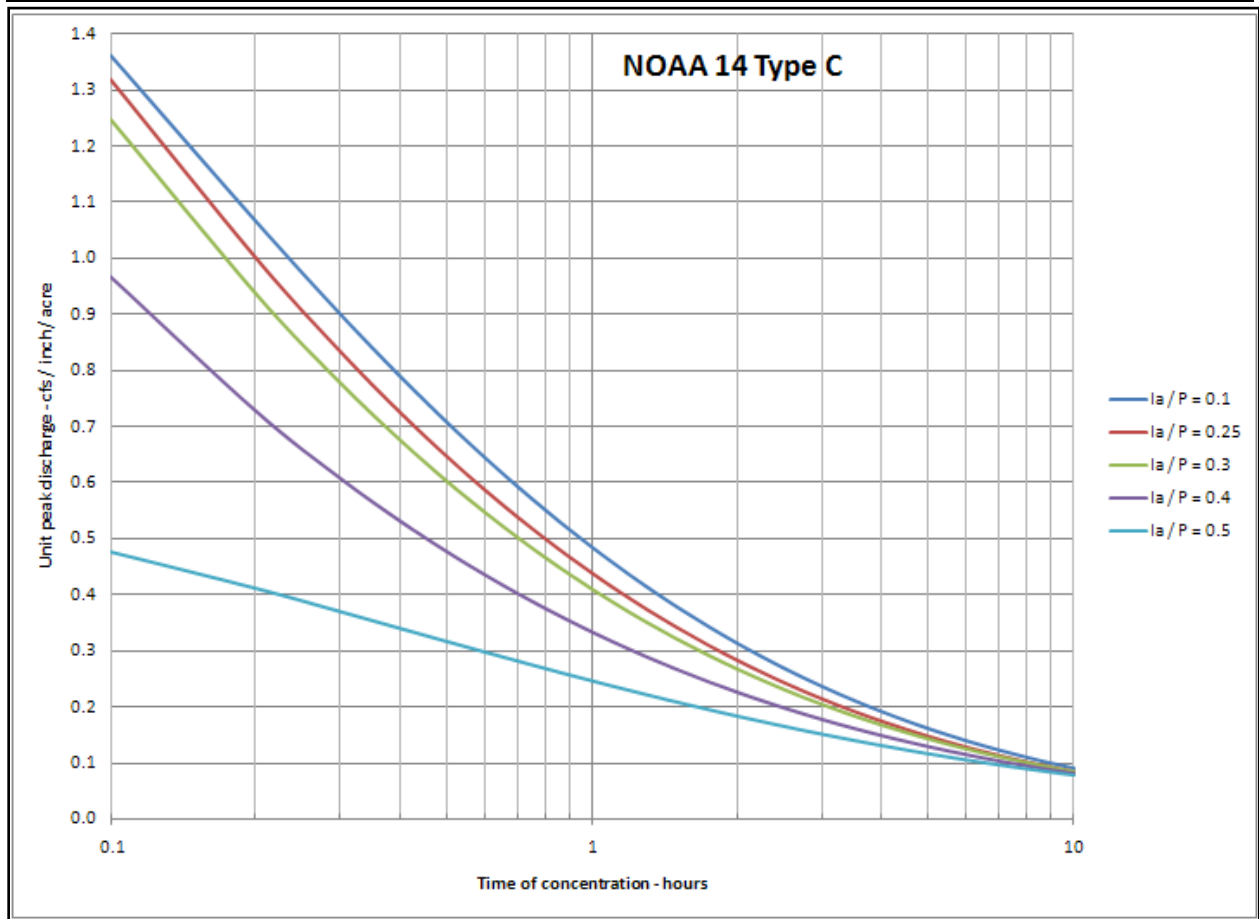


Figure A4-3, EFH-2 Peak Discharge Curves for NOAA-C

Table A4-3, EFH-2 Peak Discharge Equation Coefficients for NOAA-C

$I_a/P$	Coeff_1	Coeff_2	Coeff_3
0.1	2.4928	-0.585	-0.137
0.25	2.4494	-0.5928	-0.1154
0.3	2.4182	-0.5857	-0.1018
0.4	2.3289	-0.5381	-0.0754
0.5	2.1955	-0.3952	-0.1077

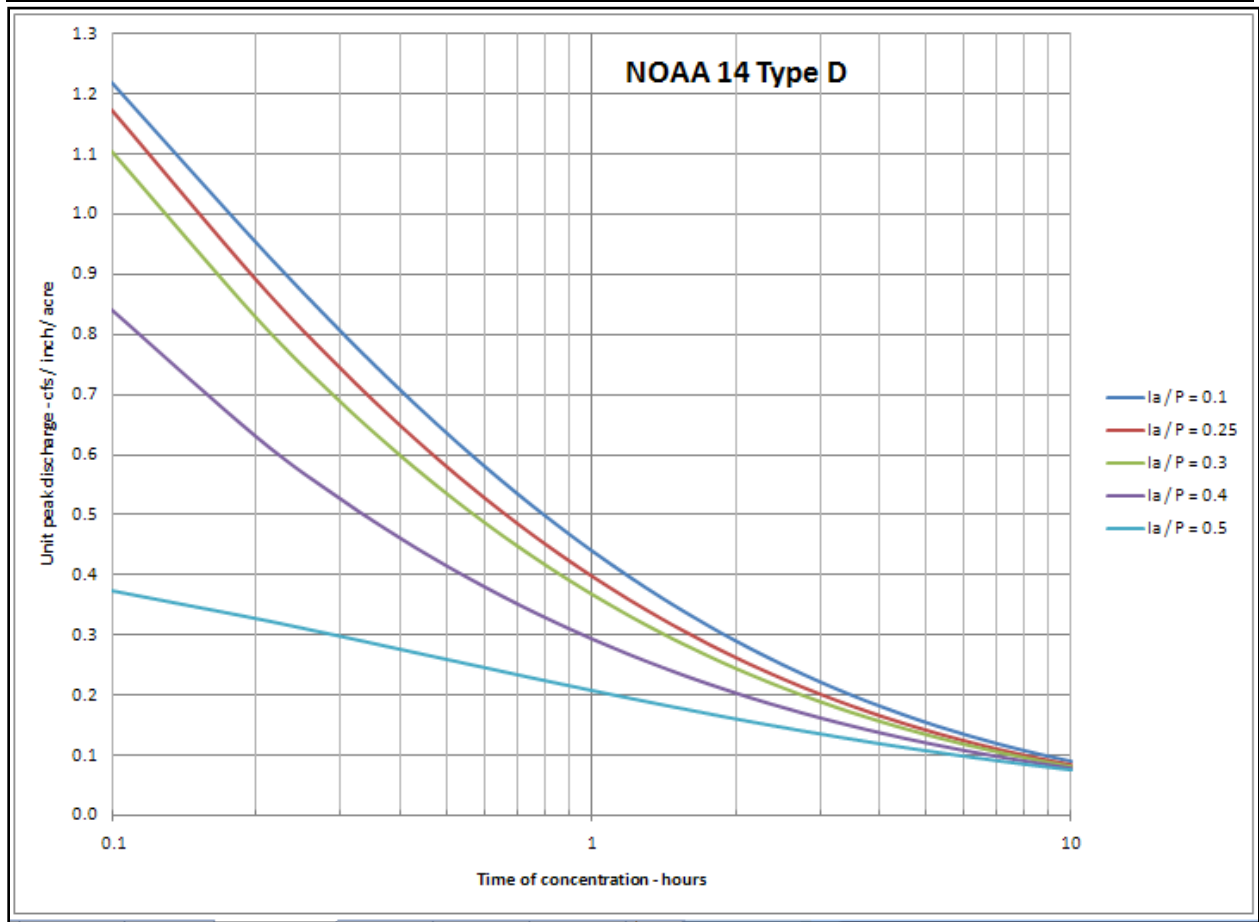


Figure A4-4, EFH-2 Peak Discharge Curves for NOAA-D

Table A4-4, EFH-2 Peak Discharge Equation Coefficients for NOAA-D

$I_a/P$	Coeff_1	Coeff_2	Coeff_3
0.1	2.4504	-0.5651	-0.1233
0.25	2.4067	-0.5713	-0.1024
0.3	2.3736	-0.5624	-0.0866
0.4	2.2763	-0.5109	-0.056
0.5	2.1265	-0.3442	-0.0908

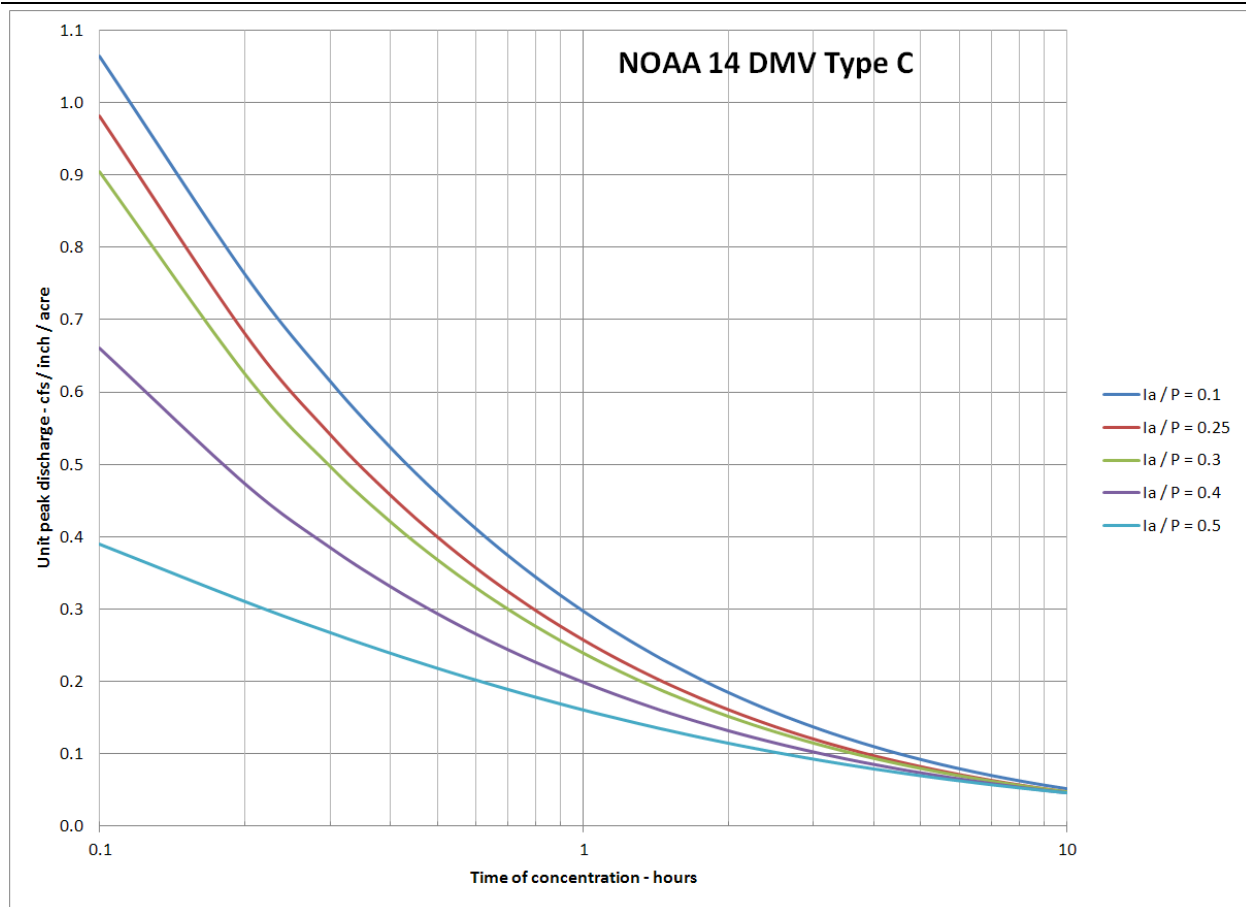


Figure A4-4, EFH-2 Peak Discharge Curves for DMV-C

Table A4-5, EFH-2 Peak Discharge Equation Coefficients for DMV-C

$I_a/P$	Coeff_1	Coeff_2	Coeff_3
0.1	2.2789	-0.6589	-0.1045
0.25	2.2181	-0.6548	-0.0745
0.3	2.1852	-0.64	-0.0625
0.4	2.1058	-0.5758	-0.0556
0.5	2.0114	-0.4671	-0.0811



The following plots are for use with 24-hour design storms. They represent the accumulated rainfall during the 24-hour storm duration on a non-dimensional basis. The maximum accumulated rainfall in the plot is 1.0 which represents the total storm 24-hour rainfall. These rainfall distributions are represented in WinTR-20 in tabular format at a time interval of 0.1 hour.

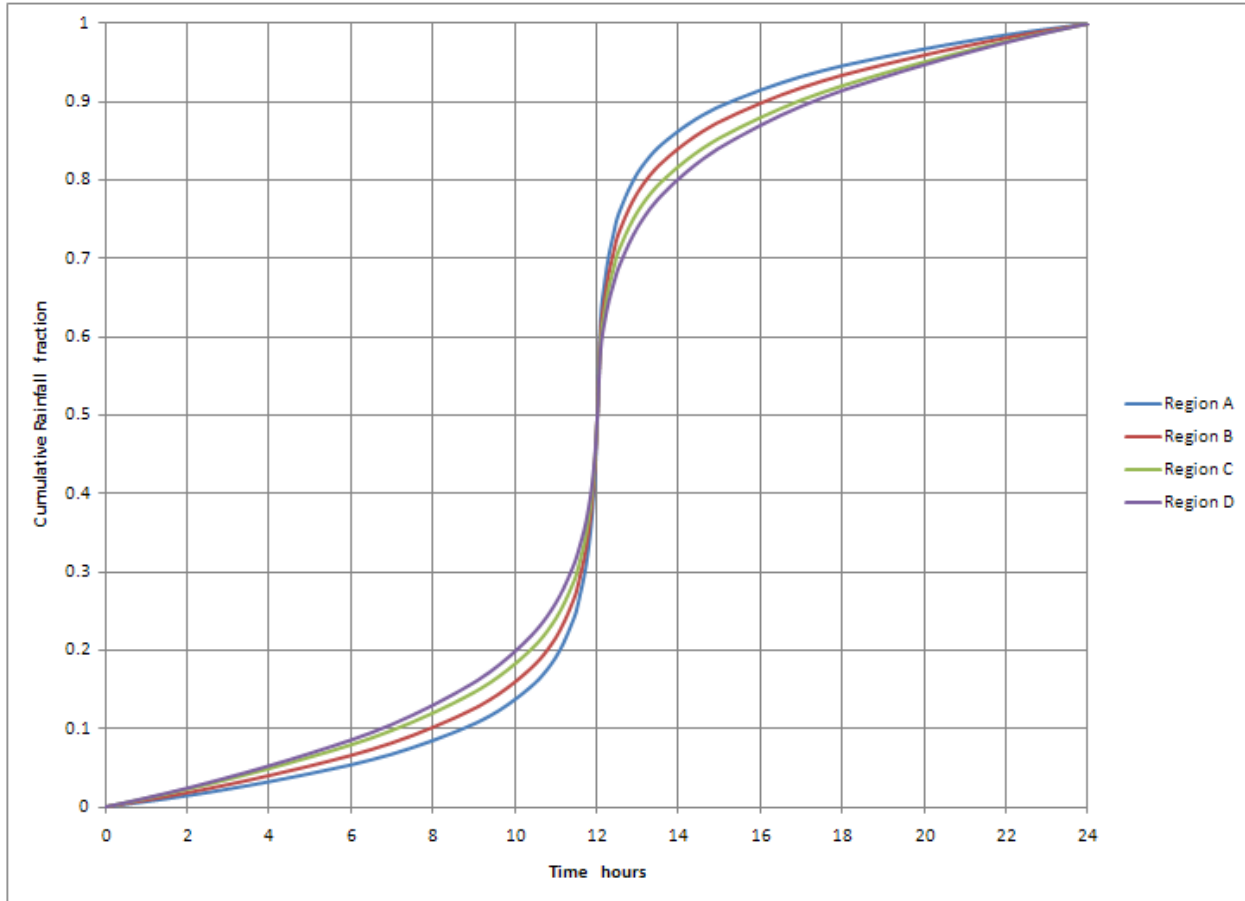


Figure A4-5, Plots of the Ohio Valley and neighboring states rainfall distributions.

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**Appendix VA650.29-5. Maps of Rainfall Zones in Virginia.**

The rainfall maps are located on eDirectives or on the Virginia NRCS Sharepoint Engineering site.

Navigate to <https://nrsc.sc.egov.usda.gov/east/va/default.aspx>. (Virginia > Engineering > Design Aids > Hydrology > Maps of Rainfall Zones in Virginia ). There are 19 rainfall maps.

**Area 1 Rainfall Maps:**

[Area 1 Rainfall Map](#)

[Augusta Co](#)

[Madison Co](#)

[Page Co](#)

[Rockingham Co](#)

[Warren Co](#)

**Area 2 Rainfall Maps:**

[Area 2 Rainfall Map](#)

[Carroll Co](#)

[Floyd Co](#)

[Giles Co](#)

[Grayson Co](#)

[Montgomery Co](#)

[Patrick Co](#)

[Roanoke Co](#)

[Scott Co](#)

**Area 3 Rainfall Maps:**

[Area 3 Rainfall Map](#)

[Albemarle Co](#)

[Bedford Co](#)

**Area 4 Rainfall Maps:**

[Area 4 Rainfall Map](#)